GROWING ELITE MARIJUANA

THE COMPLETE GUIDE

RYAN RILEY

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Thank you to all the people who have posted quality, detailed, and helpful information on the internet. Your knowledge has led many aspiring growers to bountiful crops of some of the best cannabis. Without your DIY threads and grow journals many growers today would be lost in a sea of confusion. Your efforts have helped many people realize the joys of having their own marijuana home garden to grow their own medicine in the privacy of their very own homes. I hope that this book will serve to aid in the preservation of cannabis knowledge and source for many new growers to rely on.

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Thanks so much, I know you'll do the right thing. :)

DEDICATION

I would like to thank all the talented medicinal marijuana growers who helped contribute to the creation of this wealth of knowledge. This book is dedicated to all those who support green, and the message in between. Without our established wonderful cannabis growing community of incredibly talented individuals we would surely all be in the dark and be doomed to settle for crappy buds. This book is dedicated to growers everywhere in the worldwide cannabis community who get better and better on an ongoing basis.

To my dad, Jim E. Riley. Without you dad, I wouldn't be able to spread this healing knowledge to so many people in need. You were the best father a punk kid could ever ask for. Thanks for putting up with my bullshit all those years.

I love you dad.

And to especially all of you - my fellow friends, fans, stoners, growers, and cannabis aficionados.

And of course, our loving Mother Earth. For without her, none of this would even be possible... ;)!

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"Make the most of the Indian Hemp Seed and sow it everywhere."
-George Washington

WELCOME!!!

Ryan Riley – Marijuana Extraordinaire

Introduction

Welcome. I'm so stoked for you! You now have access to the sum total of over 18 plus years of intense research and practice involving attempts at figuring out the most effective way to cultivate the best cannabis on Earth. I have taught, learned from, and helped many medicinal marijuana growers discover the absolute best way biologically possible to grow the most elite, top-caliber sparkling THC rich potent sticky dank buds as fast as possible - And now I'm passing all of this incredible information on to you so that you, too, can grow your own incredible bud. In only a short time after finishing reading this book, you will be smoking a seemingly *bottomless* supply of some of the most sensational, best tasting, highly potent aromatic euphoric-inducing bud you have ever experienced.

If you are an absolute beginner, then I suggest you use this guide as an A to Z complete walk-through encompassing virtually everything you need to know to learn how to grow some killer weed. No worries, I have specifically designed this book in a way that is clear, concise, and easy to follow along. Feel free to grab a notebook and a pen, you're going to learn a lot!! I hope you're excited!!!

I want to congratulate you on taking this massive step for your own personal cannabis cultivation career. You now have access to one of the most newest up-to-date detailed guides that will shave literally years off of your learning curve; in other words – you're starting off on a *very* good foot. If you apply half of the information I will be presenting to you here, I am confident you will be ecstatic with the results you will achieve with your treasured buds. If you're intermediate or advanced feel free to skip ahead to any chapter that you need to study up on and use the book as an encyclopedia reference manual in order to suit your individual growing needs, as I'm certain you will learn a lot of really cool tricks, tips & other marijuana grower gems along the way!!!!

Over the last few years I've have seen a sharp increase in the cost of street cannabis, and a rapid decline in its already sketchy quality. My father used to always say, "The greatest problem mankind faces today is the classic conflict between the artist and the producer. It's a basic Tug-O-War between quality vs. distribution. Just look at movies, they're literally developed on an assembly line nowadays. Rushed processing. Cinemas are not an art form anymore, it's a dirty business! Market value mass appeal butchers the authentic message the creators want to get across." As you will soon discover, one of the greatest benefits to growing your own cannabis is the unbeatable quality of your very own grown herb. Never again will you have to worry about dodgy sources or wasting cash on toxic, overpriced, impotent buds. The days of unknown bud (that may or may not be packed full with chemicals and other health hazards that disrupt the taste, potency, and aroma in order to increase profit) are <u>over</u>. Growing *your own* green means you get to ditch the dealer.

Marijuana growing is a lot of fun! The more you know, the more tricks you will invent by yourself to get the most out of your yields. Some of the best cannabis growers are very exotic with their grow methods. A number of people have invented so many amazing methods to grow bigger and better cannabis plants. I sincerely hope with the help of this guide you will learn a lot of awesome growing methods and strategies and hopefully develop some of your very own.

Word Of Caution: Don't become discouraged if your first growing attempts are a total disaster. One of the cool things about this book is that I'm going to be outlining the most common growing mistakes. I can't promise you that you wont make errors, as you most likely will when first learning, but I have clearly described many of them here so you'll have a game plan and know exactly what to avoid. The chances of you messing up your precious plants will be greatly reduced by following this guide properly. No worries, you're in good hands.

This book is massive. It contains virtually everything you need to know to grow elite bud successfully. At first glance you may become overwhelmed at all the wealth of information. Relax, I recommend you use this book like a walkthrough. It's like my dad always used to say; "How do you eat an elephant? One bite at a time of course!" Reference back to sections as your grow progresses, as needed. Feel free to skip ahead to research any particular section that interests you. If you are a first time grower just follow along, I'm going to take you by the hand and show you step-by-step how to grow your very own awesome bud supply. So without further a due... let's grow!

And remember, *always* keep it GREEN, LOVING and full of LIGHT.

1

MARIJUANA BASICS

Growing Marijuana

Growing your own marijuana is exciting and fun! Homegrown cannabis is not only ideal for the small-time closet enthusiast, but also serves as a lucrative career in the realm of industrial weed farmers. It is great for those looking to generate an income ranging from part-time extra pocket cash to a full booming business, and even better for those looking to ditch dealers with ridiculous top-shelf prices so they can grow their own amazing bud in the comfort and privacy of their very own homes. Marijuana growers can grow their own unlimited supply of medical-grade marijuana practically for free!

Whether cultivated indoors or outdoors, with hydroponics or with soil, in order for marijuana to grow well it needs six essential foundational elements:

1. Light. (Must be the proper spectrum, intensity, and duration.)
2. Water. (Must be abundant but NOT excessive.)
3. Air. (Must be ideal temperature, flowing great, and rich in CO_2.)
4. Nutrients. (Must contain the right amounts.)
5. A Growing Medium. (Has to have the right texture and ingredients.)
6. Optimal environmental conditions. (Temperature, Humidity, etc.)

Growing marijuana is exploding exponentially in popularity nowadays. Many authorities are referring to this sudden spike of interest as the “green rush”. We're on a rising wave of green that's sweeping the globe. Now more than ever is an exciting time to jump right in and learn how to grow your own crops.

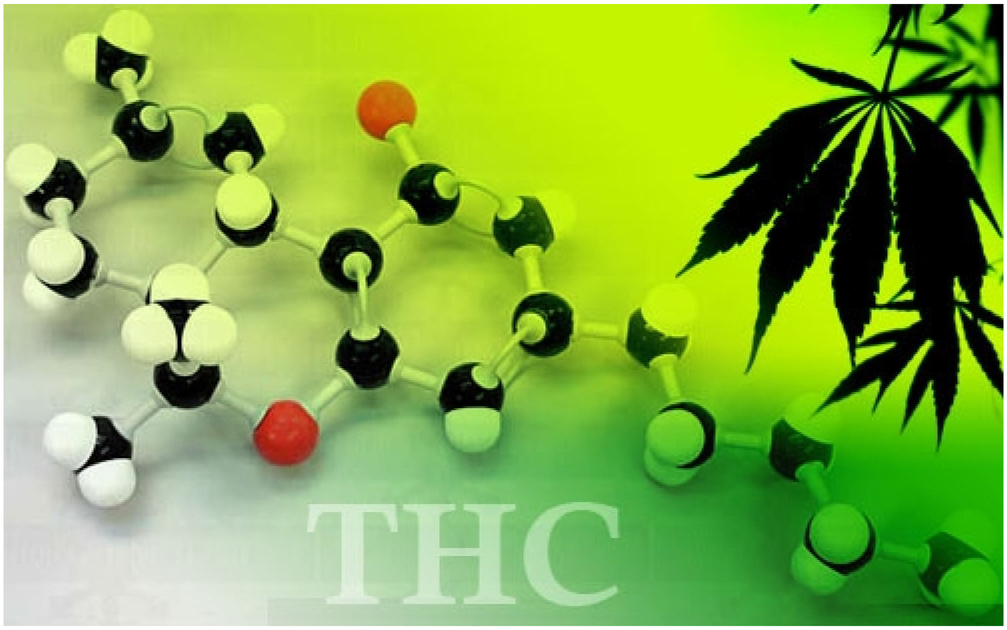
A great benefit of growing your own cannabis is that most of the stuff out there that is commercially grown is grown based on factors of the buds overall look, and the plant's yield amount. Often the quality of the high is entirely neglected as it tends not to be a selling point. Commercial growers tend to do unnatural things to their buds to force huge growth, at the cost of yield and potency. Like many mass-produced commercial food products, it's more about the look and weight of the product, rather than the underlying quality or health benefits. Lots of toxic chemicals go into the production of flowering marijuana to make them flower faster, and produce larger, unnatural buds that lack in resin. The highs you can experience when growing your own plants is phenomenal!!!

Many agree the best reason for growing your own potent herb is the enjoyment you will get out of watching those tiny little seeds you picked out of your stash sprout and become some of the most lovely and lush of all house plants, and not to mention the incredible dank buds you will produce for a lifetime supply of delicious greens to enjoy for you and your friends.

Marijuana

Marijuana, the Indian hemp plant, Cannabis Sativa (Cannabis), is a drug composed of leaves and flowers. It is usually dried and crushed and put into pipes or formed into cigarettes ("joints" or "blunts") for smoking. The drug, known by a variety of other names, including pot, trees, grass, bud, and weed, can also be added to foods and beverages. Marijuana varies in potency, depending on where and how it is grown, prepared for use, or stored.

Cannabis is the only plant that produces chemicals known as Cannabinoids. These cannabinoids are psychoactive and are responsible for the various effects of marijuana. Not all, but many cannabinoids get you high.



The most important cannabinoid and active ingredient, tetrahydrocannabinol (THC), is present in all parts of both the male and female plants but is most concentrated in the resin (cannabin) in the flowering tops of the female. Hashish, a more powerful form of the drug, is made by collecting and drying this resin and is about eight times as strong as the marijuana typically smoked in the United States. Dried flower tops (buds) of potent marijuana can contain up to 25% THC.

Mentioned in a Chinese herbal documents dating from 2700 BC, marijuana long has been considered valuable as an analgesic, an anesthetic, an antidepressant, an antibiotic, and a sedative. Although it was usually used externally (e.g., as a balm or smoked), in the 19th century its tips were sometimes administered internally to treat gonorrhea and angina pectoris.

The effect that cannabis has on the user depends on the strength, how often it's smoked, how recently it was smoked and how the body naturally reacts to the "drug."

Positive Effects of Marijuana:

- Mood lift.
- Relaxation, stress reduction, calming.
- Creative, philosophical or deep thinking...ideas flow more easily and tends to be more creative when under the influence.
- Increased appreciation of music.
- Increased awareness of senses (tasting, feeling, smell.)
- Change in experience of muscle fatigue. Pleasant body feel. Increase in body/mind connection.
- Pain relief (headaches, cramps, and various others.)
- Reduced nausea (also used medicinally for this purpose.)
- Much more... :)

Neutral Effects of Marijuana:

- Increased appetite; “munchies”.
- General change in consciousness (as with many psychoactives.)
- Sleepiness.
- Blood shot red eyes (more common with certain varieties of cannabis and inexperienced users.)
- Mouth dryness aka “Cotton mouth”.
- Temporarily interrupts linear memory.
- Difficulty following a train of thought, can become slightly A.D.D.
- Cheek, jaw, facial tension (less commonly reported.)

Negative Effects of Marijuana:

- Nausea.
- Coughing, asthma, upper respiratory problems.
- Difficulty with short-term memory during effects and during periods of heavy frequent use.
- Slowness and delayed reactions, especially dangerous when driving or operating machinery.
- Racing heart, agitation, and tenseness.
- Mild to severe anxiety.
- Panic attacks at very high doses (usually oral) or in sensitive users.
- Headaches.
- Dizziness, confusion, vomiting.
- Possible psychological dependence development on cannabis.
- "Mild" withdrawal symptoms occur after daily use in some users. These may last for 1-6 weeks after cessation of use and can include anxiety, anhedonia (reduced experience of pleasure), headaches, general unease/discomfort, difficulty sleeping, and a strong desire to smoke pot.

Using Marijuana

There are various ways to make use of marijuana...

Smoking/Inhaling: Burning or vaporizing cannabis and inhaling the smoke into the lungs is the fastest route to the blood stream. Conventional wisdom is that holding in the smoke increases the effects felt. Recent research shows the opposite; it causes more harm to the lungs without increasing the amount of THC absorbed. Studies done in Australia indicate that 95% of the THC in cannabis is absorbed in the first few seconds of inhaling. Holding in the smoke longer just allows more tar and other noxious chemicals to be absorbed. Many ganja professionals recommend you to take small, shallow puffs rather than deep inhalations. Irritation of the throat and lungs is one of the most obvious adverse effects to the marijuana smoker as is the inevitable cough upon inhaling. The cough is the body's reaction to the irritation of the numerous constituents of the smoke. Prolonged and repeated exposure to these irritants can lower resistance to, and aggravate infections from viruses, bacteria, or fungi. The lesser coughing, the safer the smoke. The fewer puffs the better; the more potent the cannabis used is the fewer puff s required. For these reasons, it is preferable to use only the more potent flower tops, or high grade hash for smoking use.

Despite the obvious minor dangers of inhaling hot smoke, there is evidence that in some cases (ie. asthma) smoking could be a beneficial medical use of cannabis. Another advantage of smoking is that it allows the user to control their dosage better as the effects are almost immediate, unlike when eating, or using THC in pill or spray form.

In general however, smoking is not the best way to take cannabis, especially for pain, being a less efficient use of the herb than eating. However, many medical users find they appreciate the immediate and pleasurable effects of smoking cannabis and the harm of smoking can be reduced in various ways. One alternative to inhaling smoke is to release the THC through Vaporization; inhaling vapor rather than smoke, see vaporization.

Pipes and Bongs: Many ingeniously designed products are on the market that claim to offer a cooler smoke but they are not all safe or efficient to use. Avoid wood, aluminum or plastic materials. Use glass, stainless steel or brass pipes and bongs.

Joints: Smoking cannabis in ‘joints’ is one of the least harmful ways of smoking. A loose, fat joint is preferable to a thin one because the temperature of the smoke is lower in a thick joint. Mixing cannabis with tobacco counteracts the positive effects of THC. Some research suggests that Cannabis may actually off set some of the harmful effects of tobacco but there is also evidence that the relaxing effects of cannabis on the lungs allows the toxins in tobacco to get in deeper. There is evidence that a thin joint gives a more stimulating “high”, while a fat joint has a more sedative effect (due to the different burn temperature in "fat" vs "thin" joints). If you're concerned about your long-term health, avoid rolling papers with "strawberry" tasting chemicals and the like, "rainbow colors" and any use of colored artificial inks & dyes.

Water Pipes: Recent research suggests that water pipes aren't the most efficient methods of smoking cannabis, but they are a healthier option. The problem with efficiency is because water absorbs a great deal of the THC in the smoke (up to 50%!), increasing the amount of tar the smoker must ingest to get the desired result. Using a water pipe with a mouthpiece less than 20cm from the water level can allow water vapor and water drops to enter the lungs, which isn't a problem as long as you regularly clean out your bong water.

Vaporization: Using a vaporizer which heats but does not burn the cannabis, is an alternative to smoking. The process involves releasing the THC as vapor which is inhaled rather than smoke. The effect is "clearer" and it is far more economical and reduces the exposure of the throat and lungs to products of burning. Vaporization works because THC, the active ingredient of cannabis, is a resin that vaporizes at a lower combustion (burning) point than cellulose.

You can make your own vaporizer very cheaply or buy various types starting at around $25 up to $300+ for the "hospital standard" and "Volcano". High heat destroys some of the THC molecules in smoked cannabis (estimates may vary.) Vaporizers heat them more gently; the THC molecules decarboxylate and evaporate in a whitish vapor. The main problem with vaporizers is with correct use. Many users tend to overheat and consequently burn the stuff. They are now "smoking" not "vaporizing" the cannabis, often without realizing - and just as many toxic tars are released as smoking in a pipe which defeats the point.

Vaporizers sometimes fail to satisfy longtime recreational smokers who associate burning lungs with getting high. They distrust the incredibly smooth taste of the vapors, and they don't like waiting 20 seconds to 1 minute for each hit. However they always like the fact that their supply seems to last up to four times as long because vaporization wastes so little of the active ingredients lost through smoking. Some regular users of vaporizers have complained that they produce a fine dust along with the vapor. This can't be good and they should maybe be fitted with a filter system but vaporizers are still the safest way to consume cannabis using heat.

Eating or Drinking: Simply sucking a small piece of hashish or eating cannabis baked into a cake, mixed in with a drink or any other delicious food you can think of is a very effective and economical method of using cannabis. The effects take up to an hour and last around 4-12 hours. A minor "Overdose" is possible by eating too much. This could result in an unpleasant nauseous feeling but no lasting physical damage will result. If in doubt slowly sample the dose; experiment with just a little, and then add a little more. More worrying are the dangers of adulteration and infection encouraged by the unregulated trade in cannabis. These include smuggling methods and profiteering practices which can make eating the resulting product totally undesirable, with questionable effects. In general avoid eating most hash especially "Soap Bar" and "Manali" or "Squiggie" black. Eating Hemp seeds or their oil (which have no THC content) is a very valuable and rich source of nutrition; a quality which can have considerable medical value and contribute to general well being.

Tinctures: The active ingredients of the plant are extracted as oil and can then be used either as drops taken orally, or the ingredient for creams and lotions to be rubbed on the skin to relieve pain and other symptoms, as well as used inside of extremely rare & ultra-dank recipes.

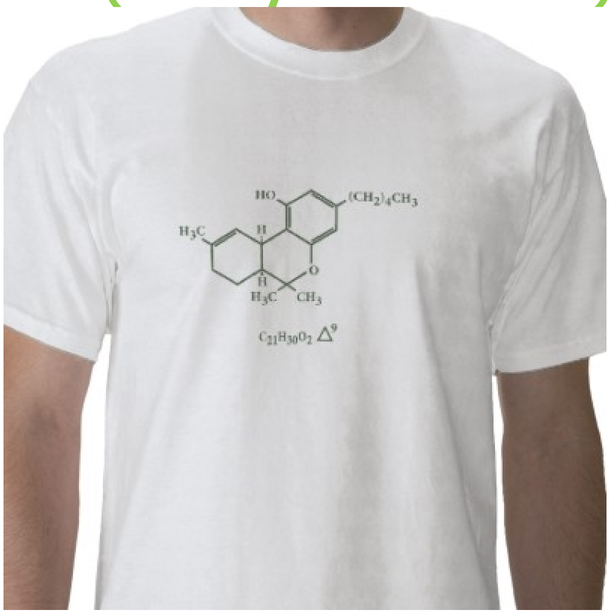
Creams and Lotions: Applied on the skin to treat complaints ranging from muscle pain and/or tremors to aching. You can make these yourself. The simplest way to do this it to put leaves and buds of cannabis into a bottle filled with surgical alcohol available from any chemist, or online. Leave in a dark place for 1-3 weeks, shaking every day or as often as possible, and then use it to rub on any area suffering from pain.

What Gets You High

The main factors in determining the quality and intensity of the high are the amount, and the ratio of cannabinoids present in your bud. Cannabinoids are what are responsible for getting that sensational soaring high out of your buds. Currently there are more than 40 known cannabinoids, but most of these occur in very tiny amounts and aren't important to the quality of the high. The cannabinoids that are found in the greatest quantity and have the most influence on your bud's high are THC, CBN THCV, and CBC.

THC (TetraHydroCannabinol) is the main psychoactive ingredient In marijuana. It accounts for most of the high. THC occurs in all varieties of cannabis. CBD (Cannabidiol) occurs in almost all cannabis varieties in quantities that range from trace amounts to 95 percent of all cannabinoids present. In its pure form CBD is not psychoactive, but it does have sedative, antibiotic, and analgesic qualities. CBD contributes to the high by interacting with THC to potentiate or antagonize certain qualities of the high. In general, it potentiates the depressant effects and antagonizes the euphoric effects. CBD is also known for delaying the onset of the high, but makes it last much longer. So THC-CBD ratios are very important when considering the effects of your high. Keep in mind that the ratios of cannabinoids found in different varieties of cannabis plants also tend to vary greatly.

THC (Tetrahydrocannabinol)

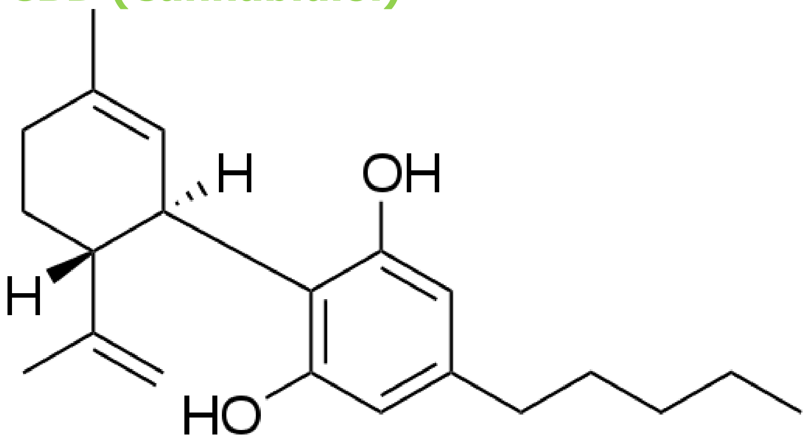


THC is the active psychoactive ingredient in marijuana that gets a user high. Without it, or in extremely low amounts – you don't get high. All plant's THC levels vary greatly. Some plants can have THC levels of 100%, yet the quantity of the THC isn't high so it's less potent. On the other hand, some plants may only have 50% THC, but the levels will be very high. A good potent plant (one I intend to teach you how to grow using this book) will have both high levels and quantities of THC cannabinoids present.

The key difference between THC levels and THC quantities is that THC levels are genetically predetermined. This means that they are not under the influence of the grower. THC *quantities* though are in fact controllable by the grower. When growing weed, the THC quantities are basically bud mass and how much resin can be generated.

To determine how potent a plant is when examining strains check for the THC levels to determine the potential potency of the plant. Nowadays many seedbanks clearly and accurately state their strains' legitimate THC levels, but there are also a lot of shady seed dealers out there too who over-exaggerate their THC levels (read on to find out about some recommended reputable seed suppliers).

CBD (Cannabidiol)



CBD is what amplifies certain effects of THC and depresses others. CBD is an isomer of THC, which means they share the same molecular formula, but have different structural formulas. Basically they are made up of the exact same molecules, except that the molecules are connected in different orders.

CBD by itself has no psychoactive properties (CBD by itself does not get you high), however it does regulate the euphoric effect of THC and gives it more of a sedative effect (more of a "chill" high). Cannabis often has a high CBD content

(as much or more than 40% CBD in most Cannabis extracts.)

High THC and low CBD produce a strong clear headed, more energetic high. Low THC and high CBD produces a stoned lethargic feeling, a heavy sluggish tired body and a dull feeling mind. High levels of both THC and CBD produces a strong, almost dreamlike high. It's ineffable.

To sum things up, if you want a more energetic high, you want more THC and less CBD. Usually Sativa and Sativa-dominant hybrids have more THC and less CBD. If you want a more relaxed high, then of course your want more CBD, usually found in Indica and Indica-dominant hybrids. But remember CBD on its own does nothing; it only regulates effects of the THC high. So regardless if you want a high THC content, the difference is the ratio of CBD to THC.

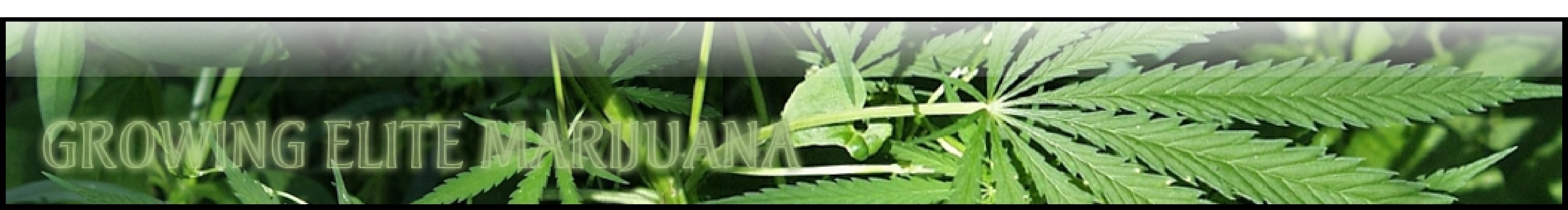
Marijuana is just like any other plant that is grown. It needs a combination of proper abundant light, warm CO2 rich air, pure water, and sufficient nutrients in the grow medium to ensure vigorous growth. When these conditions are optimum, your harvest is optimum. Of course there are more factors to take into consideration, but for right now, these are the basics you need to understand.

The end goal is to grow a non-pollinated female plant (known as "Sinsemilla"), that is flowering and producing lots and lots of buds with sticky resin glands (that contain high levels and amounts of THC) aka "dank potent big frosty buds" that will provide a sensational smoke. Weed is always grown from the female plant, because the male does not produce flowers (buds). Another crucial part of growing is to properly clean, cure, and process the plants so that enables you to enjoy the full flavor, aromatic smell, potency, and taste of the plant.

First you must decide whether or not you want to grow indoors or outdoors.

Why Grow Indoors?

Growing indoors is very popular. The benefits of growing marijuana indoors is that you have 100% full control of the environment that you simply cannot regulate outdoors - that means you are guaranteed to get a good quality plant virtually every time and will be able to keep your plants safe during their



delicate growth cycles. Growing indoors can make way for some seriously wicked bud. Indoor growing means you have complete control over the grow elements: humidity, optimal temperature, nutrients, lighting, and so many other crucial factors that are essential for the plants thriving growth. In addition you also have full control over when and how to flower your plants by illuminating them, as you do not when growing outdoors.

Certain key chemical processes undergo change when exposed to lighting, and that can radically alter your buds production & timing, an element impossible to regulate when growing in sunshine. Another key benefit is the avoiding of various pests & diseases. Setting up an isolated, sterile growth environment means your plants can spend less time fighting off mould spores and insects, and more time producing heavy sparkling rich buds. It is also much safer to grow indoors and nearly impossible to get caught by those who do not understand your art form.

It is of the opinion of many established growers in the ganja community today that the quality of marijuana grown indoors is far superior to marijuana grown outdoors, which is essential if you are going to be selling to picky clientele.

But, others disagree. They take a more spiritual standpoint and argue that the sun contains living energy that nourishes, heals, and supplies life to the planet and the plant. Many feel that scientists are at their infancy in determining the chemical-biological processes undergoing from plant photosynthesis and light acquisition.

That is why, there are of course disadvantages to growing marijuana indoors. Natural sunlight is the best source of lighting for any Earthly crop. Indoor lighting is powerful, but nothing comes close to the solar orb. Also, ventilation issues are often a big concern for indoor growers. An enclosed area often generates heat and lacks sufficient fresh air. Both of these problems can be easily remedied with a proper ventilation system though (discussed in detail later). Failure to ventilate and regulate humidity & temperature in your grow room is failure to grow satisfying buds. Also before deciding, keep in mind growing indoors, depending on the space you choose, will generally tend to produce smaller crops. This is actually desirable for many indoor cultivars. Depending on the space you decide to grow in, the crops usually will not reach the height they normally would outdoors.

Why Grow Outdoors?

Growing outdoors can save you lots of money when it comes to lighting. Outdoor cannabis plants will use the greatest source of light, the sun, which is free!!!!! But keep in mind when growing outdoors the photoperiod tends to be much more gradual so it takes longer for the plants to fully bloom out during flowering. Some say this “longer harvest” is made up for in yield.

Another great benefit of growing outdoors is that you do not have to worry about changing your air supply regularly and constantly (unless greenhouse growing), as outdoors this occurs naturally with an abundance of fresh air being supplied to your plants all the time, again, for free!

Now let's talk numbers. If you grow 10 plants indoors with a 400 watt metal halide grow light, each plant will yield about ½ to 1 ounce of marijuana. (Don't worry, we have some tips later that will show you how to increase yield, but for now these are the average guidelines.) A single plant grown outdoors will yield around a pound (16 ounces) of marijuana, or sometimes even more!

But be warned, there are also many downsides to growing outdoors. You have no control over light cycles and must grow on the natural annual harvest cycle, you have absolutely no privacy and some areas require you to take privacy precautions in order to grow for medical use. Your plants are more susceptible to pests, both small and large. Trade winds outdoors means you have constant open ventilation which means your plants could be pollinated by wild pollen messing up your attempts to breed seed of a certain strain or to avoid seeding instead of budding & flowering. (This is where the female devotes all her energy into producing seeds, rather than large healthy buds!) You are also mostly limited to soil grows outdoors unless you have a greenhouse which is sort of a hybrid of indoor and outdoor growing "room".

So remember that generally outdoors = massive yields, lower quality and limited strain selection due to lack of environmental control.

Indoors = lower yields, but much higher quality and choice.

What is better - Hydroponics or Soil?

Indoor growers are initially faced with a very important choice. Do they go with an expensive hydroponic grow system, or soil? On one hand you have soil, the traditional growth medium that has been used for thousands of years to grow plants, and on the other you've got hydroponics, a more recent practice of growing plants with water and nutrients but with no soil.

For a first time grower it is popular opinion that the "better" more convenient setup is soil. Hydroponics makes plants grow faster, but when first starting out, unless you learn extremely quickly it generally won't make your buds more potent than soil (at first). Hydroponics should be attempted after you have a few successful foundational soil crops under your belt, or if you feel you will be able to jump right in successfully without becoming overwhelmed. If you are starting from seed and growing for personal use, soil is the practical growing medium. If the crop is started with clones and is commercial, a hydroponics setup is then definitely more practical.

It is of popular opinion that soil is far superior in terms of quality factors such as bud taste and flavor. People pay fortunes for the best quality, so soil is ideal for this reason. The problem is, soil is harder to mas-produce, so it is not ideal for commercial varieties, unless used outdoors. Which as we;ve discussed, sacrifices overall quality (in some cases) depending on the growth environment and strain (genetics) chosen. It is also much cheaper on your wallet. Many growers also find that soil is more forgiving. If you make a mistake with hydroponics the damage can be drastic and irreversible. Plants "burn" and get severely injured due to the heavy chemical concentrations. Soil is easier to fix damage, you just repot the plant! Hydroponics tends to be a bit more tricky.

A hydroponics garden's nutrient and root setup typically aids in faster plant development, but it takes a lot of monitoring. Hydroponic gardens benefit the overall growth of the plant in terms of size - root systems are spread throughout soil in order to increase surface area and the chance that the plant will absorb minerals and water that permeate through the grow medium, as well as vastly increasing oxygenation of the roots, which aids in yield and growing time.

With hydroponically grown plants, the nutrients are present all throughout the liquid mixture. That way, the root system does not have to be as extensive as with soil-based plants. This means that the plant can devote more nutrients and energy to growth above the root system, which is the kind of foliage vegetative matter growth that leads to big potent exotic buds.

As plants grown in soil begin to grow larger their root systems begin to cramp. They must then be placed in a larger container, or *transplanted*. (Please note that hydroponically grown cannabis does not need to be transplanted.) This saves time and increases growing efficiency greatly. Hydroponically grown plants do not have to deal with problems such as "transplant shock". It is very easy to move them around, depending on the setup of your system.

Hydroponic grow mediums are definitely an improvement over traditional soil when it comes to speed of production and overall yield, but it is much easier to grow marijuana in soil.

It is not that difficult to set up and operate a hydroponic system, but one detail like a faulty irrigation timer can cause devastation if not immediately corrected.

The hydroponic solution must be monitored closely and kept balanced, while a well prepared soil solution may not need any additional fertilizers for the entire life of the plant. As long as you water the soil when it gets dry the plant will thrive and be happy.

Soil-grown pot is considered by many to have a more palatable taste than hydroponically grown herb, but there are always exceptions to such rules. Some growers get the best of both worlds by experimenting with organic hydroponics, but most use basic stock solutions that contain fertilizer salts and plant nutrients chemicals in a readily available form.

These salts are easy to administer in tried-and-true formulas, but the problem is that these stock solutions tend to leave a metallic taste in the precious produce. Experienced growers know to leach their plants before harvest to remove residual salts from the buds, but it appears that few bother to leach sufficiently for a truly clean, pure taste.

A milder feed solution will prevent the build-up of excess fertilizer salts in the bud. Leaching time varies from grower to grower, from two days to two weeks. Some use plain or distilled water, others simply use a very diluted feed solution.

For the newbie grower, soil is definitely a great choice. A Hydroponics setup takes up more room, is less stealthy (along with the noise), plus the care and monitoring of the system, and high costs are often too much for a newbie first starting out. But, as cannabis cultivation gains widespread popularity, easy to use inexpensive all-in-one hydroponic grow systems are becoming increasingly available for purchasing.

(For tips on choosing the right hydroponic system for you, please refer to the hydroponic chapter in this guide.)

Strains

The first step to growing your own wicked buds is to choose the best marijuana seed strains. This is your first crucial step to reaping the highest quality and quantity yields by starting off on the right foot with with the best possible cannabis strain seeds you can get. A "strain" is a fancy way of saying what variety of cannabis it is. Genetics determine the quality of the maturing plants, so what you want to look for are strains with favorable genetics. Potency, aroma, fast growth, early maturation, potential yield amounts and resistance to fungus and pests are a good start.

Each variety is either a "pure" species type (taking two plants in the same species and crossing them) or a "crossbreed" of two or more species (taking two totally different plants from different species and crossing them). The most common examples include Pure Sativa, Sativa (mostly sativa species with indica), Pure Indica, Indica (mostly Indica with some Sativa), and Indica/Sativa Hybrid(this is a 50/50 cross between a Sativa and Indica species).

If you are serious about producing marijuana, don't settle for any available seed you can get, go for the best and know before you grow.

(Later I will show you my top recommended seed banks who offer quality seed strains at low prices with stealth & discrete shipping near the end of this section, so *slow your wheels* Turbo.)

So first things first, what exactly does the term "strain" mean?

Well, a marijuana strain is simply what sets the marijuana apart from other plants due to it's genetics. It offers unique characteristics. Veteran growers can recognize specific genetics of on-the-market strains just by mere observation.

Most strains of marijuana are derived from two species of cannabis, they are Cannabis Indica and Cannabis Sativa. Both species have very unique characteristics that affect the user differently. If you are a complete beginner than I highly suggest you start your first batch off with a pure Indica in order to learn how to grow properly. As you gain more experience you can craft an Indica/Sativa "hybrid" mix, and then eventually a complete Sativa strain.

An Indica/Sativa mix will yield a larger crop that is not as tall as a pure Sativa, but THC level will be lower and CBD levels will be higher. If you are growing indoors this Inidca/Sativa hybrid is strongly recommended due to it having the best high and best indoor growth characteristics. Sativas are hard to grow indoors due to specific height requirements and late flowering tendencies, so a hybrid can be bred that will have the energetic cerebral high of the Sativa and the early maturation and "easy-to-grow" characteristics of the Indica plant.

Cannabis Indica

Physical Characteristics:

Height – Squat and dense with heavy, compact buds.
Nodes – Has long internodes between branches, averaging 3-6 inches.
Leaf – Broad pointy leaves with no markings or patterns, rounded on the sides. Indica leaves are wide with short fingers.

Indica's originally come from the hash producing countries of the world like Afghanistan, Tibet, and Morocco. They are short dense plants, with broad leaves and often grow a darker green. After flowering starts they will be mature in 6 to 8 weeks. The buds will be thick and dense, with flavors and aromas ranging from pungent skunk to sweet and fruity.

Indica has higher CBD and lower THC levels than Sativa. In laymens terms this means marijuana from a pure Cannabis Indica strain will produce a heavy, stony, tiresome sleepy type of high in the user. As far as the yield of Cannabis Indica plants goes, it is usually greater than Cannabis Sativa plants, and they take a bit less time to mature. Indica buds generally tend to be smelly - they smell like a pungent bad body odor. Their smoke is thick, palpable, even a small toke will often induce fits of coughing! A Pure Indica high has the properties of a body stone / couch potato feel. The smoke from an Indica is generally a body type stone, relaxing and laid back. The best Indicas have a relaxing social high, which allows the person to sense and feel the environment, but does not lead to thinking or over-analyzing the experience with "mind trips". Poor quality Indica marijuana and processed hashish contain high quantities of CBD. This is where the toker becomes lead-headed and sleepy.

Note: For desirable medical marijuana you should grow a plant low in THC and rich in CBD. Let the plant vegetate for a longer period of time and harvest when all pistils have attained their color, i.e. as late as possible. (More on this later.)

Cannabis Indica strains are easier to grow and don't get as tall as Cannabis Sativa strains, but they tend to be bushier and have to be grown further apart. They tend to be thick and strong, they can take more cold than the sativa - overall they are just a tougher plant. This is why the Indica strain is best for newbies and when growing in an area where height is a consideration, like a small closet or cabinet. (If you have your heart set on growing sativa as a beginner, then we recommend a Northern Lights cross, as this is a very easy to grow Sativa strain indoors.)

The prized things about growing an Indica strain is that they produce a higher yield, are much much easier to grow, are shorter in height, and they grow and matures faster. At maturity, the leaves start to turn a dark purple. It has short branches laden with thick, dense buds, which ripen early. Indica plants tend to be short, bushy, mature early, have more chlorophyll and less accessory pigments (accessory pigments protect the plant from excessive sunlight). Because Indica strains have more chlorophyll than Sativa, they grow and mature faster.

Hint: Can you see why professionals create "hybrid" strains? They take the high THC content of the Sativa and blend it with the fast-growing properties of the Indica. (This is an extremely simplified version of cross-breeding, but it's all you need to know for now.)

The only downside is that Indica tends to be less potent, and usually doesn't taste as good. Under artificial light an Indica plant will mature faster than a Sativa. Approximately four weeks of extra light is required to bring a Sativa plant into full maturity, and even then it's weight is often much lower. Therefore, Indica tends to be a favorite among industrial weed farmers. More Indica strains are grown for sales-specific goals, making the dealer/grower richer, but the experience of the user leaves much to be desired.

Cannabis Sativa

Physical Characteristics:

Height – Tall and hardy with fluffy buds.
Nodes – Has short internodes between branches, averaging 3 inches or less.
Leaf – Narrow finger-like rounded leaves with marble-like patterns.
Slender, with long fingers.

Sativa has higher THC content and lower CBD levels than Indica. This means that marijuana from a pure Sativa strain produces a more cognitive (in the mind), "floating" type of high that tends to be more energetic when compared with pure Indica. Sativa buds smell sweet, fruity and perfumed, and their smoke is usually smooth and easily inhaled. Once flowering has begun, they can take anywhere from 10 to 16 weeks to fully mature. Flavors range from earthy to sweet and fruity.

They grow very quickly and can reach heights of 20 feet in a single season. They originally come from Colombia, Mexico, Thailand and Southeast Asia. The buds are long and thin (makes for much fluffier lighter bud), far less densely populated than the Indica, although longer in length (sometimes stretching 3ft. in or more along the branch). The stomas of the flowering bud may be tinged slightly purple in a cool climate but in a warmer environment will turn dark orange or even red. Maturation time varies considerably.

Sativa plants are taller, take longer to mature, have less chlorophyll and more accessory pigments (accessory pigments protect the plant from harsh sunlight). As pure Sativa strains have less chlorophyll than Indica and they take longer to grow, mature, and require more light. Sativas have a huge root system. They are much more drought tolerant than the Indica plant. The yield generally tends to be lower than an Indica, but the plants are much more potent. Since the Sativa plants tend to grow taller, and take longer to mature, they are best suited for outdoor growing.

But don't worry, there are certain Sativa strains you can get specifically bred for growing indoors.

The good thing about growing Cannabis Sativa buds is that they are more potent and taste really really good. Typically, pure Sativas have a high THC/CBD ratio (that is to say, not much CBD), and so they tend to provide clear, buzzy, “uppity” highs. When smoking a Sativa the high is very Cerebral, you have a rush of energy, a buzz in the body and a great way of getting the housework done without vegging out on the couch all day. On the other hand, pure Indicas tend to have much more CBD present. Commercial hash is usually manufactured using the resin of Indicas, explaining its stoney, drowsy high.

The downside? Lower yield, takes longer to mature, and generally harder to grow.

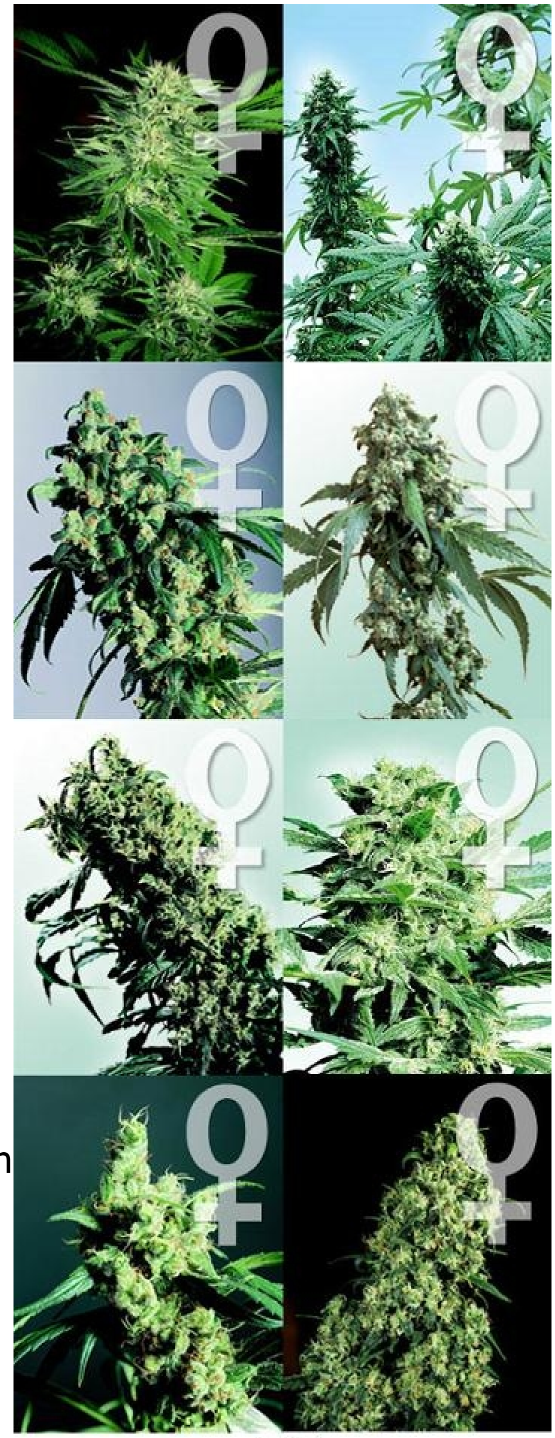
Note: If your seed has a ratio such as 40% Sativa, 60% Indica then you can imagine what the high will be like. It has 40% of the “head high”, and 60% of the “body stone”.

So remember, Indica plants grow faster, have a heavy, stony high that is relaxing and can help different medical problems.

Sativa plants take longer to mature, have an energetic, cerebral high which can stimulate brain activity and may produce hallucinations.

Hybrid strains have a combination of both Indica and Sativa highs which are relative to strain ratio. The leaves of a hybrid tend to be thinner than an Indica, but much broader than a Sativa. Once you get good it is possible to recognize a good hybrid solely by the leaves when you know exactly what to look for.

Choosing Your Variety



Choosing your cannabis variety is extremely important. It largely depends on your growing goals. There are several key factors to consider when deciding what varieties of cannabis you want to grow - the type of high, the maturation time, and the shape of the plant all are very important. Once you have chosen your quality seedbank supplier and have a good idea of which type of plant you want to grow, it is now time to choose your seeds wisely.

Many newer growers make the mistake of choosing cannabis varieties that favor a high potency thinking this is what they want. The *quality* of high is just as, if not more of an important selection factor.

Note: Be sure to choose the BEST possible seed you can get your hands on because later you can produce your own seeds and clones from that strain!

Make sure your seed strains have good genetics. This is CRUCIAL. Bad genetics can lead to mutations, warping, flowering problems, poor germination success rates, ad nauseum. Sometimes even problematic nutrient symptoms will appear even though your nutrients are fine and you know for a fact that a nutrient problem does not exist. It is very important to find a reputable supplier for top-shelf quality strains that are bred with great genetics.

If you are a first time medicinal grower I would recommend Big Bud, Top 44, Northern Lights, or Skunk #1. All of these are great – they are the easiest, most durable, with great yields for the beginner grower.

SENSI SEEDS
FEMINIZED

Another important factor to take into consideration when choosing a cannabis variety is the plant's yield. Some plants will bud heavily and produce very very thick top colas and others simply wont. A heavy-yielding plant can be worth easily twice as much as a lesser-yielding one. (Remember Indica varieties are great for commercial growing as they produce heavy yields and mature early.)

If you're commercially growing, in general the type of high does not seem to be an important marketing factor at all. The yield, taste, aroma, and the overall bud appearance are important in determining the final price amount.

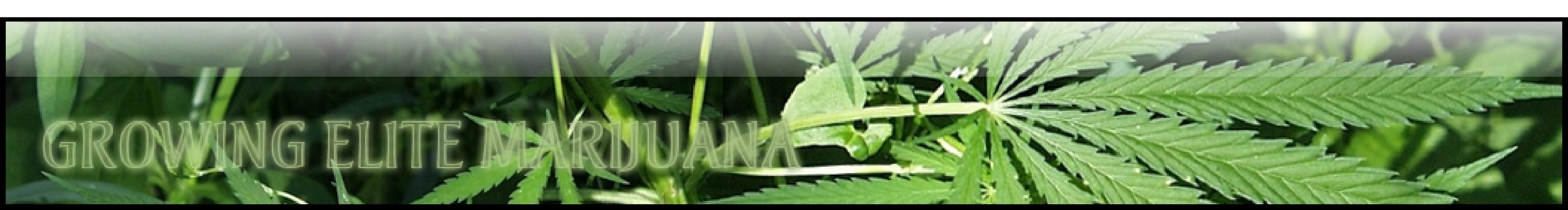
For some, the type of high may be more important to them than their yield amount, and that's both OK and very common.

Note: Feminized seeds produce a higher % of female seeds, but 100% female is never guaranteed, no matter what marketing says.

So again, it all really depends on your individual goals as a grower...

Don't feel frustrated when at first trying to decide. Because there is large selection of strains across the internet, this can sometimes get overwhelming when trying to decide which one to order. Choosing is not as difficult as you may think. There are really only two sides of the marijuana family - Indica's and Sativas, and both have their foundational growth characteristics as discussed earlier.

Combining different Indicas, different Sativas or a combination thereof creates hybrids. The resulting hybrid strains will grow, mature and smoke in relationship to the Indica/Sativa percentages they end up containing, and the unique genetics of plant. You can modify smells, potency, even the plant's COLOR to suit your unique needs! Cannabis growing can be extremely fun and rewarding when you get into it!



Indoor vs Outdoor Cannabis Seed Varieties

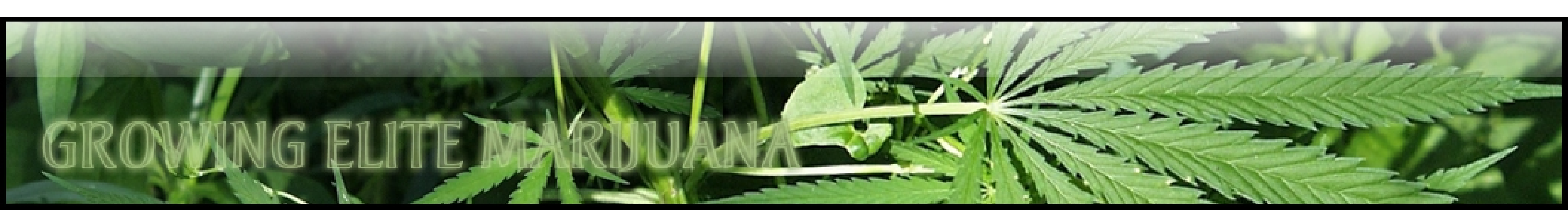
The next thing to check for is if they are meant for indoor or outdoor growing. A lot of new growers argue saying you can use indoor-bred seeds outdoors and vice versa but they will find that trying the opposite does not produce satisfactory results. Outdoor growers want plants that mature early before the arrival of frost, thieves, or pests. Indoor growers generally are looking for compact plants that ripen quickly and uniformly (so that light and space are used in the most efficient predictable manner possible).

So for outdoor marijuana cultivation choose among outdoor intended cannabis seed strains. Modern marijuana seeds varieties are bred with high level of specialization, so you don't have to reinvent the wheel. Take advantage of that and use an outdoor genetics of marijuana seeds for best acclimatization, pest resistance and high natural sunlight absorption.

Whether or not a strain can be grown outdoors also depends on the length of season you have. Take note of listed approximate flowering time. This is most important feature to consider and is completely influenced by the Indica/Sativa ratio. There is nothing worse than seeing an outdoor strain fail to mature early enough, enter into winter dormancy, and yield the second year.

Typically you will want plants that will mature before the danger of frost or bad weather comes along. The more Sativa that is in the mix, the longer it takes to finish up. If you have a very long growing season, most strains can be grown outdoors. These flowering periods are approximate and will vary depending on grow conditions. From this foundational starting point you can then go back to what you like and the descriptions of the plants.

Plan to grow indoors? Pick a good seedbank and you can browse through a broad range of indoor cannabis seeds strains. Since modern marijuana seeds varieties are bred with high level of specialization, you can get a customized indoor marijuana strain that has genetics favoring shorter plants, higher yields, and quicker growing and flowering.



Height

When growing cannabis indoors, you have complete control over how tall your plants get. You control this by how long you decide to grow them before initiating flowering. Artificial lights do not efficiently penetrate more than 3 feet down into the garden, so it makes little sense to grow them any bigger than that. You also are able to "train" by cutting & pruning your crop to keep it thick & bushy! An ideal shape for any indoor gardener.

After the light schedule is changed to 12 hours on and 12 hours off, flowering will begin in about 7 to 14 days. During this time the plants will continue to grow another 6 to 14 inches and then stop. How much they grow depends on the Indica-Sativa ratio of the strain. Sativas will stretch the most. Depending on this ratio, indoor flowering crops should be initiated at around 18 to 24 inches to achieve the end height of 36 inches. How long it will take to get this tall depends on the strain and the conditions in the garden.

Potency

Nearly all of the strains available today are pretty potent. The success of the eventual potency outcome will depend on your personal tastes and the conditions in which they are grown. Most seedbanks do not test the THC percentages of strains and no one is really sure what the numbers mean when they do. Not to worry, by following the conditions this guide will outline for you and supplying your plants with an optimal growth environment, you are guaranteed to get an incredibly potent high-yielding marijuana plant.

Yields

As aforementioned, yield is primarily determined by the conditions in which the cannabis is grown. But in regards to your potential end yield amount, genetics does come into play. All of the yields listed in your seedbank for the strains are approximate and depends a lot on how they are grown and the quality of the growth environment. Think of it like an average. You can probably get more. In fact, I'm confident you will get MUCH MORE if you follow the powerful techniques correctly contained inside this eBook!

Please note that indoor lights don't penetrate down very far so it is much better to grow a larger number of smaller plants to achieve the highest yield of top quality bud. Maximum yields indoors are primarily coming from Indicas and mostly Indica hybrids - the more Sativa in the mix, the lower the yields tend to be. (Remember the rushed processing tidbit from earlier? Many people don't realize they're buying bunk, rushed harvested Indica schwag strains that look big and juicy but don't provide a powerful punch!!!)

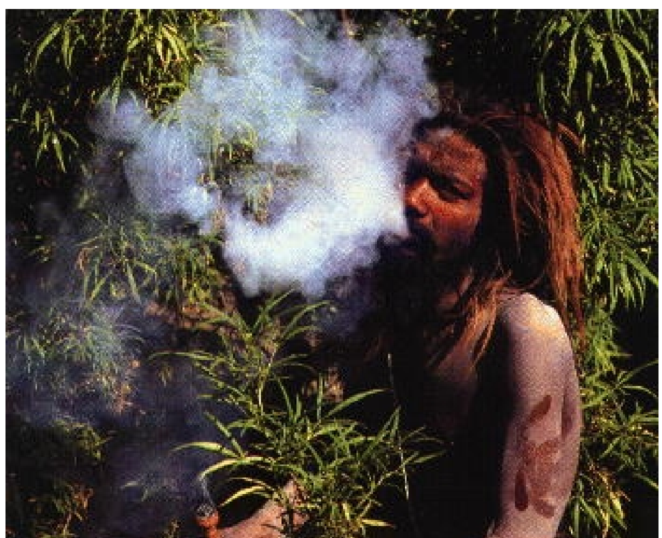
Typically, your indoor yield is really limited only by the amount of light you use, not the strain you choose. It's rare to find a newbie grower who is limited by his particular strain selections' genetics.

It is up to you as a grower to maximize your plant's potential inside your grow space. Experiment to find out how each strain will respond best.

Flowering Times

Flowering times are an indication of how long it will take the plant to mature indoor after flowering has been induced by changing the lights to a 12/12 on off light cycle. This will also be affected by the environment to a certain degree, but is pretty much fixed in the plant.

Indicas are faster flowering than Sativas, and hybrids are in relationship to the percentage which of each they contain. Sativas grow very quickly and if you wait too long to flower them they will outgrow the limits of the space and will not fill out. On the other hand, if an Indica is not grown for long enough, the yield can be *severely* reduced.



Growing Near The Equator

If you live near the Equator the South Indian varieties from Tamil and Madya Pradish would do very well. These plants are very vigorous and flower abundantly in India's hot, dry summers.

Great Choices for Growing Near The Equator:

- Master Kush
- Master Kush x Northern Light
- Shiva
- Northern Light x Shiva
- Hindu Kush

These varieties are adapted to flower in November and December in equator-locations such as India, but with the slightly shorter days in other regions, they will flower a little earlier, maturing in November. Other varieties that you also might grow are landraces from Thailand, Cambodia, Jamaica and Brazil and some of the central African countries.

- Afghani
- 4 Way (Four way)
- Swazi x Skunk
- Thai x Skunk
- Maroc x Skunk

You could try some of the mostly Sativa commercial varieties. These are adapted for higher latitudes so they will flower several months earlier where you are, ripening in September and October. The Haze varieties may also be of some use. However, your best program might be to use well-adapted Sativas and to make your own crosses with Indicas or Indica-Sativa hybrids.

- Purple Power
- Durban Poison
- Haze
- Haze 19 x Skunk
- Silver Haze

Backcrossing tropical hybrids with Indicas or Sativa-Indica hybrids produce shorter, more controlled plants than the two to three-meter Sativa giants. With 25% Indica heritage, these plants will begin flowering and will mature in October, one to one and a half months earlier than the purebreds.

Example Strain List According to High

Starting with the clearest highs at the top and the stoniest last. Skunk#1 is the zero standard since most smokers have experienced it, and it is a very stable variety that leaves a memorable experience.

+3 "Super Sativas" - Very low in CBD – Edgy, trippy:

- Thai
- Haze
- Neville's Haze

+2 "Party Weed" - Lots of laughter:

- Silver Haze
- Haze x skunk
- Thai skunk
- Bubblegum
- Cinderella 99
- Bubblegum x Cinderella 99

+1 "Daytime Smoke" – Makes all TV/housework interesting:

- Silver Pearl x Thai Skunk
- Jack Herer
- Eclipse
- California Orange Bud (Dutch Passion)
- Silver Pearl (Sensi)
- Big Bud
- Blueberry
- Durban skunk

0 - "Zero Standard" - Think about doing stuff, but later:

- Skunk#1

-1 - "Couch-Lock Indicas" - Relaxing, drooping eyelids:

- Hindu Kush
- Shiva Skunk
- Northern Lights#5
- Misty

- Sweet Tooth
- Most commercial hash

-2 - "Party Killers" - Lots of CBD – Time for bed:

- White Widow
- Chronic
- Afghani
- Black Domina

Seeds

Seeds are the result of sexual propagation of marijuana plants. They contain the genes of both the male and female parent plants. Some plants known as hermaphrodites can produce both male and female flowers on the same plant. The genetic code contained within the tiny seed will determine the plant's size, pest resistance, root, stem, leaf and flower production, cannabinoid level and many other vital variety factors. Strong seeds produce healthy plants, and heavy harvest. Remember, you only get strong seeds from a strong healthy parent.

Selecting Viable Seeds

One of The most important decisions a grower makes when growing marijuana is choosing a starting Grade-A Quality seed. Seeds vary in size and coloring according to their individual cannabis variety. Bunk seeds = dirt weed. A good seed will not be cracked or deformed, shriveled or rotting. The seed should not be green - a green seed is not fully mature and was picked early. When selecting your seeds make sure they are not shiny, or excessively dark. These seeds will most likely not germinate. You want your seeds to be hard, not brittle, medium-dark brown, not blackish.

Indica seeds tend to be larger than Sativa seeds. Indica seeds often have what appears to be "zebra" stripes. This helps you determine the origin and strain of the seeds. For example, if a seed vendor says a particular seed will grow out as Sativa, but the seed is very large, you can bet that the seed is an Indica and that the vendor isn't giving you accurate information. Growers select seeds that are plump, oily and healthy-looking. Whitish, light tan, weak, pale, green immature or cracked seeds are usually not viable. A seeds viability is determined by pressing it against your fingers or against a hard surface. Bad seeds will crumble in your fingertips.

Mature seeds that are hard, beige, dark brown and spotted or mottled have the highest germination rate. Soft, pale, or green seeds are usually immature and should be avoided. Keep in mind depending on the area in which it was grown, seed color and pattern are also affected naturally by the need for camouflage.

WARNING: It is very important you choose seeds from plants that are suited to the growing conditions in your garden. You do not want to buy a plant that will grow 10 ft tall when growing inside a cabinet! Following these proper guidelines you can ensure a successful, potent, and very satisfying grow.

Weak permeable seeds can allow disease and pests to come in. Stay away from soft, pale, immature, white, fragile grainy seeds that crush easily in between your finger and thumb.

You want to look for mature seeds that are strong, hard, and beige to a dark-brown. If it's spotted or mottled you can bet it has the highest germination rate.

Selecting The Proper Genetics

Since time immemorial human beings have been cultivating cannabis for thousands of years, resulting in virtually thousands of varieties that are now easily available to the modern day grower. There are many commercial seedbanks that sell an assortment of unbelievable award winning time-tested strains. Be sure to select a plant that will survive in the climate it is to be grown in. (This doesn't matter if you are growing Indoors or in a Greenhouse.)

For example, a plant native to Jamaica, where the growing season is longer, will not be able to complete flowering in Canada. Know the date of the first expected frost and choose a variety that will be ready for harvest before then. If you are growing commercially then the yield per plant is also important. Different varieties have different yields. The biggest yielding plants are grown near the equator where the sun is much more intense and the growing season is longer. If these plants are chosen they may have to be finished in a greenhouse or brought indoors in the northern US and Canada.

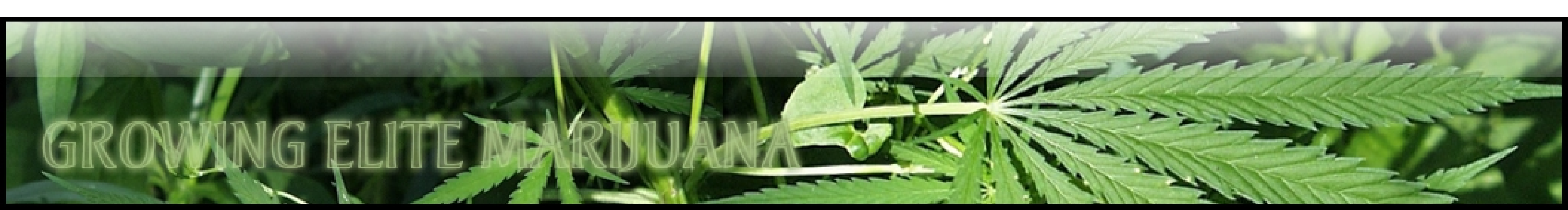
Where To Get Seeds?

Buying seeds is tricky. If you can't find a friend willing to hook you up with some high quality seeds then your next best bet is grabbing your seeds online. There are a lot of sketchy companies out there nowadays. We've heard countless horror stories about online seedbank companies where lots people have payed top dollar for their seeds and never received them. Then the company mysteriously disappeared, with a disconnected phone line and complete with a missing website. What a way to blow $250! You need to be extremely careful when buying seeds nowadays. Do not risk it - get them only from a reputable company on the internet, from magazines, or any local coffee shops around your town (if available). Stick with a reputable & reliable company. You may wish to buy more than you think you will need due to germination failures.

Note: Marijuana seeds are still illegal in many parts of the world, including the United States. Please check local laws before ordering and always use a safe address. Never order the marijuana seeds directly to your grow site.

Please be careful! Over the years, I have tried various companies out and after speaking with hundreds of growers as well as investing in countless of hours of personal research and money to seek them out & test them; I have determined the following list to be the current best seed banks in the world. If you are going to purchase your seeds from a different vendor, please be safe - google them first in order to make sure they are reliable and no one has been ripped off in the past, as this happens a lot. Make sure they are reputable and carry the most important foundational aspect of your entire grow – a quality seed.

As promised, here is my highly recommended list of seed banks with reviews. The following list of seedbanks are the most reliable today with the greatest quality and outstanding selection. They take every precaution to ensure that your package is delivered in a stealthy, timely, secure manner. These vendors have been in the seed business for many years now and have successfully shipped countless packages to many satisfied customers worldwide. You can find them recommended on many review sites, and for good reason. Discreet packaging and efficient customer service guarantees these companies will continue to thrive for many years to come.



World's Greatest Seedbanks

#1. AMSTERDAM MARIJUANA SEEDS

Top choice - I dare to say these are the best in the world. Incredible strains, scarily low prices. They hold the reputation as one of the most reliable seed banks in the world. They carry a huge selection of awesome high THC/Feminized quality seeds. You also get 20 free seeds with every order!
Shipping: Worldwide

#2. BUY DUTCH SEEDS

High quality dutch cannabis seeds. Award winning strains that are shipped in super discrete stealth packaging. They only select their seeds from the best breeders. Customer satisfaction is their number one priority, so they've got great customer support and package tracking options.
Shipping: Worldwide

#3. THE ATTITUDE SEEDBANK

The Attitude Seedbank are exporters of some of the finest Cannabis seeds available in the world today. They offer hundreds of Marijuana seeds strains to choose from, expertly grown by the pioneers of the legendary Amsterdam

cannabis seeds banks. A lot of awesome breeders come together to make some badass strains for these guys and they only buy from the best breeders in the world. The genetics of these seeds are breathtaking! A huge selection of the finest Cannabis Cup winners fills their stock. They carry some of the biggest and most up-to-date, impressive line of feminized marijuana seeds from some of the world's top breeders & suppliers. All of their seeds are purchased fresh, then kept in a refrigerated room to maintain and ensure their viability.
The Attitude always buys the freshest marijuana seeds stock to ensure buyers get an exceptional harvest.
Shipping: Worldwide

#4. NIRVANA SHOP

These guys ROCK. They have sweet deals going all the time and kickass strains. The Nirvana Shop is a seed bank and online seed supplier with many years in the business under their belt. They have supplied thousands of growers with quality seeds over the years. They've emerged as the top supplier of medical marijuana seeds worldwide.
Shipping: Worldwide(except for Australia)

#5. THE SENSI SEEDBANK

They are the backbone of many coffee shops. Sensi Seeds carry original cannabis strains that have won many international prizes. Multiple Cannabis Cup-winners such as Jack Herer, Northern Lights, Big Bud are all strains bred by the Sensi Seeds Laboratories. They've also been in the seed biz for 20+ years!!!
Shipping: Mostly EU only, and a few outside countries; but attitude carries em'!

#5. HEMP DEPOT

These cats take a longggg time to get you your seeds but they stock some great seeds from some rare and unique talented breeders. If you do decide to go with them, then be sure to check out Blueberry by DJ Short... it's EPIC.
Shipping: Worldwide

#6. SKUNK SEEDS

Skunk seeds rule. Now known as "Seedsman" their seeds are in constant high demand and they even filter out who they ship their seeds to – :(they've turned away a lot of people in the past. If you get ahold of some of these strains, you wont be disappointed. Like any other high-quality seedbank, they also specialize in discrete stealth shipping methods.
Shipping: Everywhere except the USA. (I know..)

Storing Seeds

Typically, marijuana seeds produced by a female plant will be good for about two years. If kept in a cool, dark place (the ideal storing location) the seeds may be good for even up to 5 years!

Many growers favor storing seeds in a cold environment for optimal germination rates. Since a seed is a living thing, when it is placed in a cold environment its' life cycle slows down. This slows the seeds natural degradation significantly, meaning seeds stored in cold environments last longer. The favored seed storing method among many commercial growers is to get a black film canister (blocks out the light) and place a small amount of either uncooked rice or loose/bagged silica crystals in the bottom. These desiccants soak up any surrounding moisture and humidity. Put them in either your fridge or freezer.

Note: You can also use specifically designed seed envelopes sold at most grow shops or online.

Make sure to label the container/envelopes with strain, quantity and date received to make sorting easier.

Also remember when storing seeds that incorrect moisture (humidity), temperature, and light levels are your number one enemies...

Temperature and humidity are the most important factors affecting seed quality during storage (humidity being the more important of these). Marijuana seeds absorb moisture from wet atmospheres and dry out when placed in dry atmospheres. Seed storage life is doubled for each 1% decrease in moisture content. The problems of maintaining seed germination increase with seed moisture content.

Seed moisture above:

- 80-100% - seeds drown and become wilted after any more than 12 hours.
- 40-60% - germination occurs.
- 18-20% - heating may occur.
- 12-14% - fungi grown on and in seed.
- 8-9% - insects become active and reproduce.

Heating is caused by the natural respiration of cannabis seeds, of fungi and bacteria in and on the seed which may build up rapidly in a moist environment. High moisture levels and high temperature will kill cannabis seeds as quickly as and invasion of microorganisms and insects, so be careful.

Stored seed life is doubled for each 41°F (5°C) reduction in storage environment temperature.

Refrigeration to at least 41°F (5°C) is recommended (yes, this is slightly warmer than regular fridges). The cooler the temperature the more slowly seed vitality declines. This rule apparently continues to apply even at temperatures below freezing. At 41°F (5°C) and below, insects become inactive. Ever see someone freeze a fly and then blow warm air on it to heat it up (“revive” it) and then it flies away? A pretty cool magic trick if ya' ask me.

When the above storing conditions are met, storing cannabis for five years with high germination success rates is entirely do-able.

2

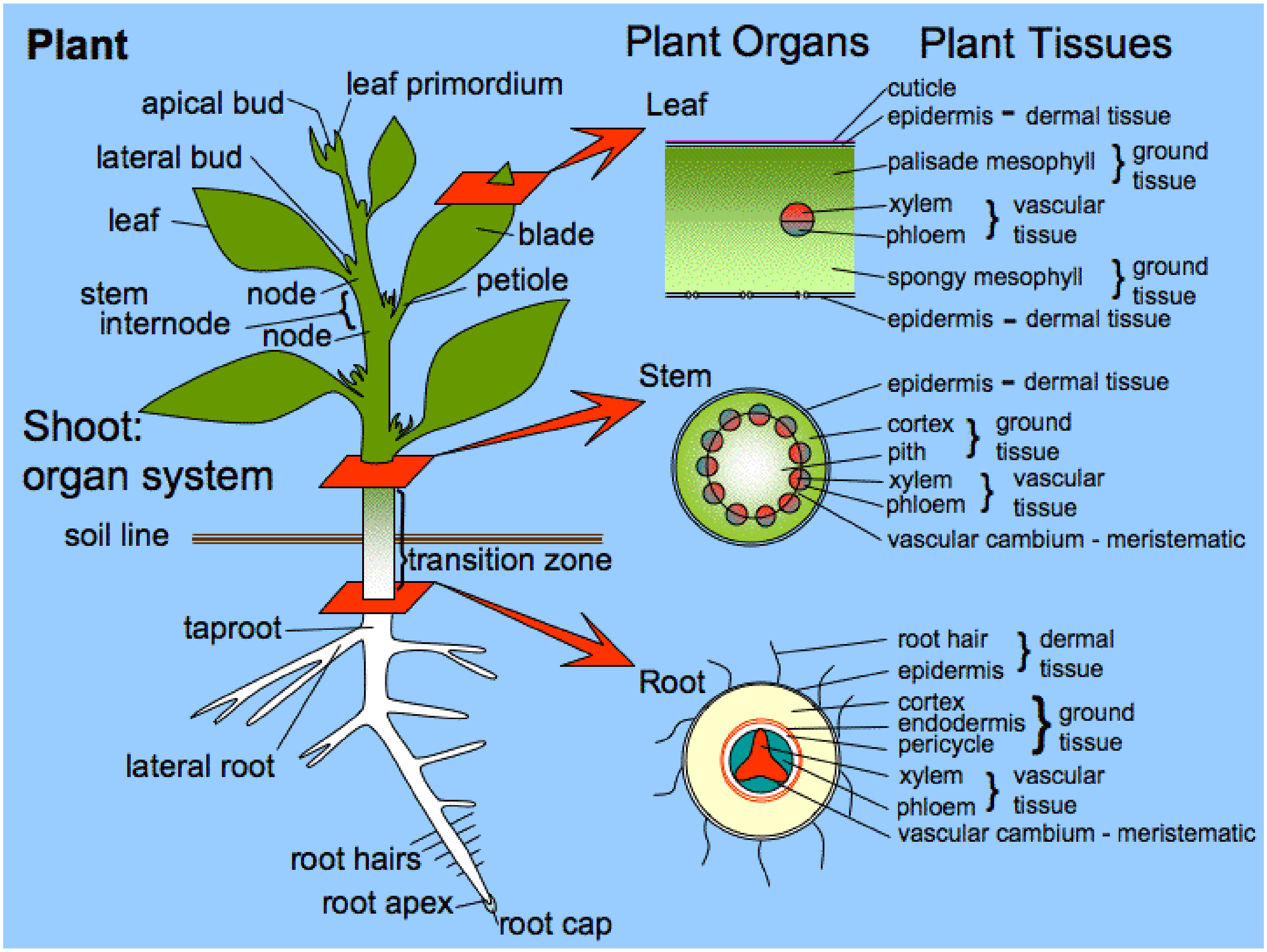
CANNABIS

Cannabis

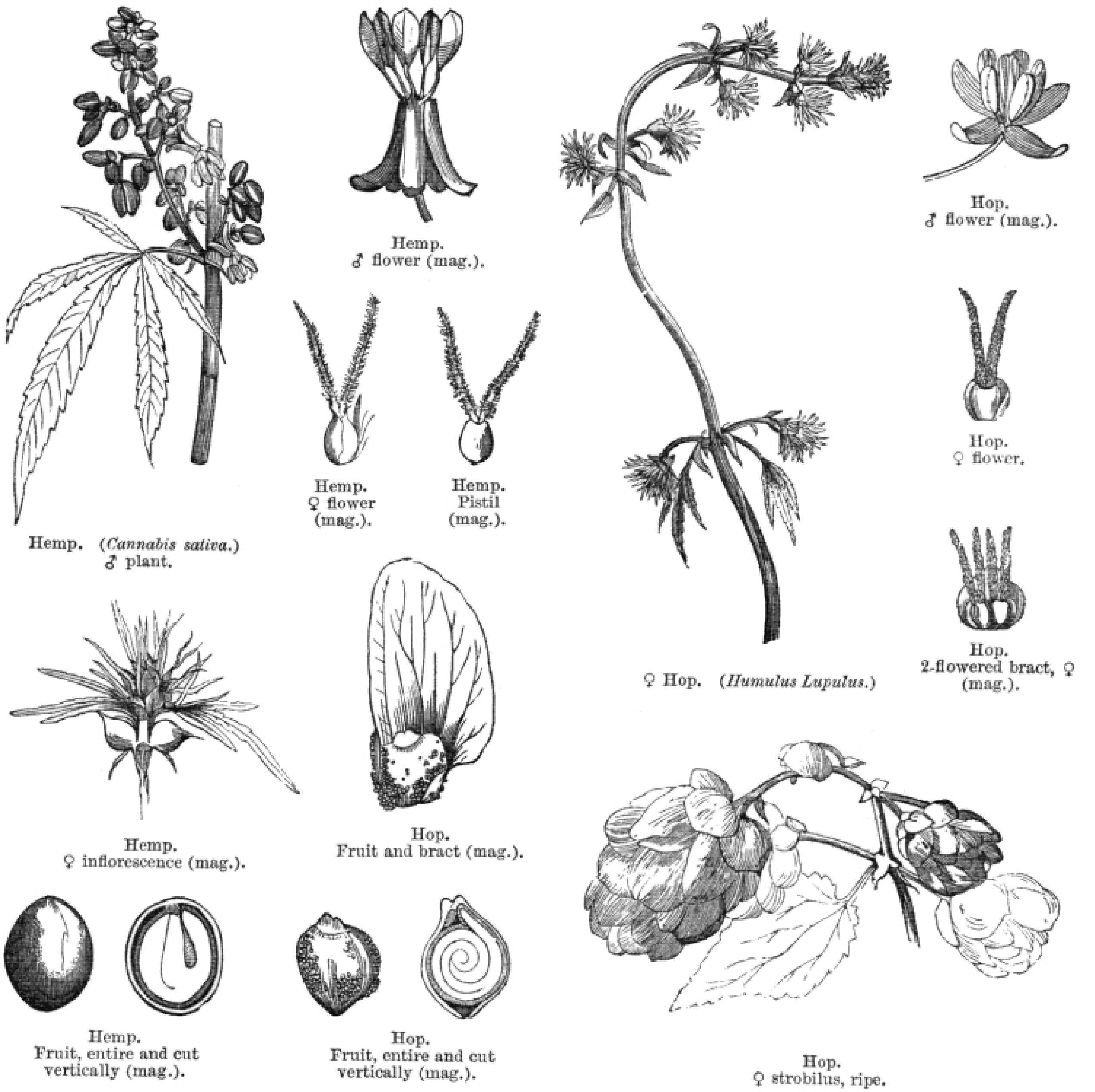
Cannabis plants begin as tiny little sprouts and eventually, toward the end of their flowering cycle, they fill out into a Christmas Tree-like shape. There are primarily three parts to a cannabis plant. The top cola, the mid-section, and the base. The top cola is where a lot of the bud is grown and flowered. The mid-section contains some bud, stems, and a lot of leaves. The buds in the mid-section tend to be smaller than top cola buds, but the potency remains the same caliber. The bottom part of your cannabis plant well contain large fan leaves and a very tiny amount of bud.

Parts of the Plant

There are many parts that make up a cannabis plant. The entire crop contains the psychoactive ingredients which include Delta-9 THC and various other cannabinoids that give each plant its own unique profile of properties and effects. However, not all parts contain them in the same concentrations.



Flowers: The flowers or Buds of the plant contain the highest concentrations of plant resin which in turn contains the highest concentration of active ingredients. The unpollinated flowers of the female plants are the part of the plant that is used by recreational users because they produce copious amounts of potent plant resin in order to try to catch pollen from a male plant.



Marijuana is one of the few plants today that actually is split by gender and has distinct separate male and female plants. Female plants do not pollinate themselves in the absence of males but do contain the genetic capability to produce male flowers and may do so under stress. There are also hermaphrodite plants that produce both male and female flowers. Male plants and male flowers are not very potent and are generally not used for recreational purposes.

Leaves: When leaves are smoked they provide a headache rather than get you high. There are, however, ways to extract the active ingredients from leaves and the different types of leaves have varying amounts of potency levels.

Large Shade Leaves: These are the large classically shaped leaves on the plant and are the least potent. There are extraction methods that can be performed to get something useful out of these but the result won't be very pure and many growers just throw them away.

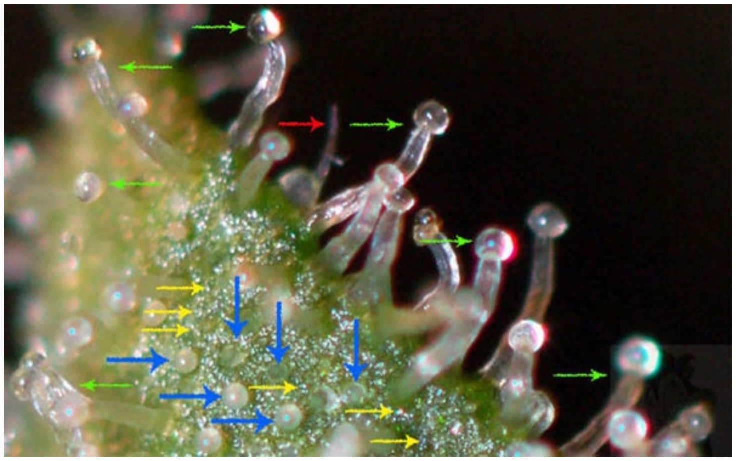
Grow Tips: These clusters of small tender leaves are the point on the plant where new growth sprouts from during vegetation. They are more potent than shade leaves but less potent than trim leaves or bud.

Trim Leaves: These are the sugar coated leaves that are trimmed from around the buds during harvest. The sugar coating of trichomes can make these quite potent and they can be as potent as low quality flowers with seeds.

Stems: The stems are not really useful for psychoactive purposes but they are a great source of plant fiber for rope, paper, durable clothing, etc.

Seeds: The seeds generally contain only trace amounts of psychoactive ingredients but they are one of the most nutritious foods currently known to man. They are one of only a handful of substances that man can sustain off indefinitely with no other food and provide a complete amino acid profile.

Trichomes: Trichomes are the oil glands of the plant and contain the highest concentration of active ingredients of any part of the plant. The flowers on marijuana are sought out because they contain the highest concentration of trichomes. Hash is made from collected and pressed trichomes. Trichomes are very useful for determining the maturity of a plant during the flowering stage.



Roots: Roots serve the plant through nutrient uptake. They have no psychoactive ingredients and aren't typically eaten.

Sexing

Sexing is an important aspect of the overall propagation process for marijuana; cannabis plants normally come in two sexes, male or female. Each sex has its' own very distinct flowers. The female flowers are more potent then the male flowers. Growers typically remove and destroy the males from their garden because of their very low levels of cannabinoids such as THC and CBD. Both male and female plants can turn into hermaphrodites, under stress.

male femelle

The reason you will want to sex your plants right away is so that you can identify and remove males - it is the flowers of the female that you will want to cultivate if you are interested in psychoactive effects. Without chemical extractions the flower of the female is the only part of the plant that is can be used for medicinal and recreational use.

A female plant that is not pollinated will direct the bulk of its energy later in it's growth phase into developing the flower buds and swelling them with the resin that carries the bulk of marijuana's potency. The plant does this so that the large sticky flowers are more likely to catch pollen.

If the flower is pollinated it will instead direct the bulk of its energy to seed production. This is where low quality dirt weed comes from. If you have seedy pot, it is dirt weed. The more seeds contained in the pot the lower the quality. Seeds add dramatically to the weight(they weigh more than the bud itself), this is contrasted with stems that are mostly water weight and have a negligible weight compared to the actual bud.

Plants generally should demonstrate their sex one to two weeks into flowering. During the first ten days of flowering there is very little need for concern about males pollinating your crop. Additionally, if you reproduce by cloning you will only have to worry about males once.

Pre-Flowers

Pre-flowers, as opposed to full blown flowers, generally appear after the fourth week of vegetative growth from seed. Pre-flowering typically lasts about 1-2 weeks. Pre-flowering is the stage in which your plant begins to fill out nicely and its sex becomes apparent. At the start of your plant's growth you will not know whether your plant is male or female. At this time new growth regions begin to appear and change shape depending on your plant's sex, which then becomes obvious to the grower.

Pre-flowering begins when your plant's height stops growing. Also, looking closely at your plant reveals small new growths are beginning to form at the nodes between the stem and the branches. Check carefully above the fourth node. These small new growths will become leaves, branches and flowers!

Note: Pre-flowers are very small and and almost impossible to differentiate without magnification. A photographer's 10x loupe or a magnification lens is handy when examining pre-flowers. More on this later.

Many times pre-flowers will appear at the fourth or fifth node, whereas the plant is on the 7th or 8th node. These pre-flowers usually don't develop into full flowers, but are only an indicator of the plants sex.

Pre-flowering is the stage when you cross your fingers for as many females as possible. It is early in this stage that you can make an accurate guess about your plant's sex.

If you plan to move any male plants out of your garden, you will do it a week or two into this phase. A male plant will produce little balls that are clustered together (much like grapes). The male plant produces these pollen sacks that, when the time is just right, will burst and spread pollen to the female plants. A female plant produces little milky white pistils that look like hairs in a pod. These hairs (pistils) will begin to curl slightly and grow longer and thicker. These hairs are also very sticky, but do not touch them as they contain your much valued THC! The hairs also will begin to cover in resin during the Flowering period (this is for catching the male's falling pollen). If the female is not pollinated then she will feel unloved and begin to produce and grow even MORE sticky THC-rich areas all over her flowers... hence the resulting development of a Sinsemilla crop, which means higher quality frosty incredibly dank buds!

Male or Female?

So marijuana seeds grow into cannabis plants that are either male or female, but how can you tell?

Male: Males can be identified by looking at the inter-nodes where leaf and branch stems connect with the main stalk. Males are often, but not always, tall with stout stems, sporadic branching, and few leaves. When a male enters the stage of flower development, the tips of the branches where a bud would develop will start to grow what looks like a little bud (little balls) but it will have no white hairs coming out of it.

Male flowers will contain balls somewhere between the size of a marijuana seed and a popcorn seed. One ball is not definitive since female pistils sometimes split from a small single ball that opens. But two or three balls in a cluster is sure confirmation that you have a male. Males should be removed and destroyed to prevent them from releasing pollen into your garden. The pollen transports easily so the males can not be safely grown anywhere that shares an A/C or ventilation system unless special precautions are taken beforehand.

The male preflower may be described as a "ball on a stick." However, its most recognizable feature is its absence of pistils. Sometimes, a male plant will develop mature staminate flowers after prolonged periods of vegetative growth. These appear in clusters around the nodes.

The following image shows a male plant in early flowering. Staminate flowers are located at the node between the stipule and emerging branch.

Figure 1. Male[staminate].

The male plant will have balls of pollen which in nature produce pollen and showers & pollinates the receptive hairs of the female plant, which once pollinated will produce seeds. If the female plant isn't pollinated (by keeping the male plants away), she becomes very annoyed and will begin to continuously produce thousands and thousands of hairs in the hope to catch male pollen. So the flowers/buds will continue to grow, develop, and produce lots of rich THC.

Note: Female plants that are pollinated will use life energy for producing seeds instead of THC. This results in lower potency marijuana, and high seed yields. Male plants in general will be less potent and produce less THC than a female plant.

Figure 2. Male after 10 days of Flowering.

Figure 3. Male Preflowers.

Female: Female plants produce tear-drop shaped balls called "calyxes" at the nodes between leaf and stem. Each sprouting two white hairs or, "pistils." Another identifier is that the female plant's leaves will grow closer together forming a strong stem which will hold the clusters of flowers and later the ripening seed. Females will have no balls and will have small white hairs.

As the images below demonstrate, the female preflower is pear shaped and produces a pair of pistils. Frequently, the female preflowers do not show pistils until well after the preflowers have emerged. Thus, don't yank a plant because it has no pistils. Pistillate preflowers are located at the node between the stipule and emerging branch.

Also, some female preflowers never produce pistils. A female preflower without pistils is difficult to distinguish from a male preflower. Thus, hermaphodite issues should not be resolved by the appearance of preflowers, without pistils, on a plant otherwise believed to be a female.

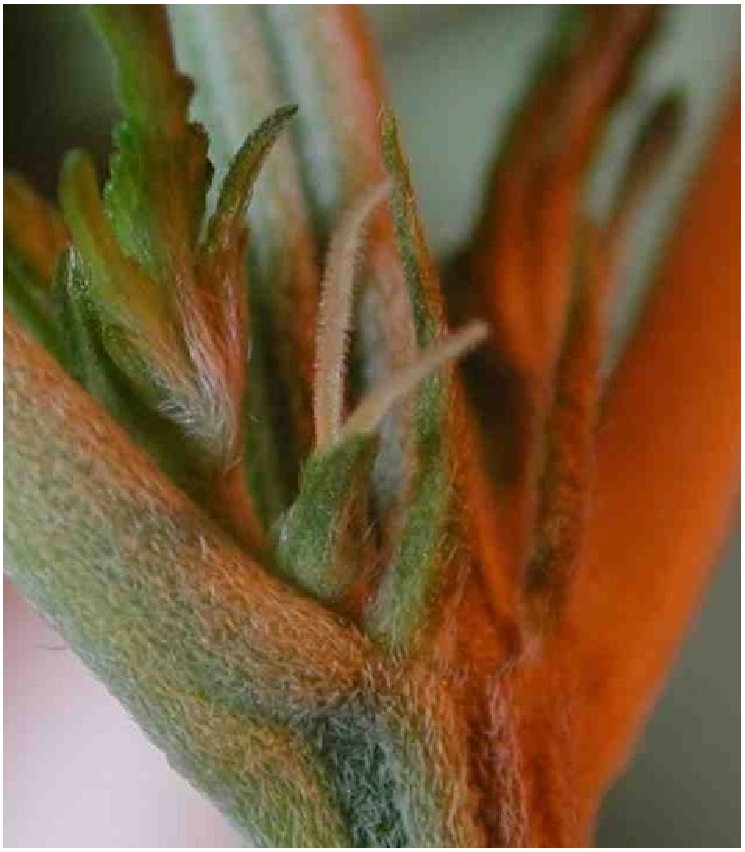


Figure 1. Female[pistillate].

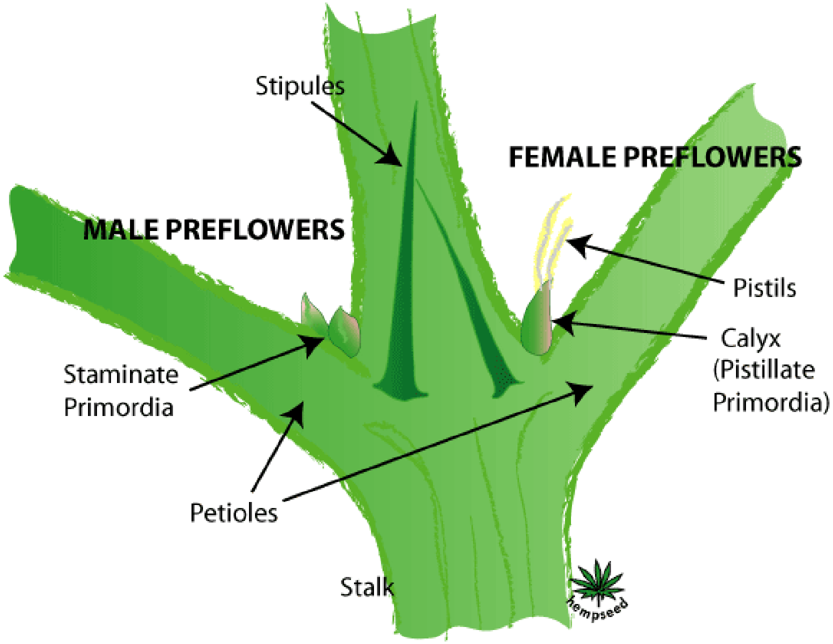
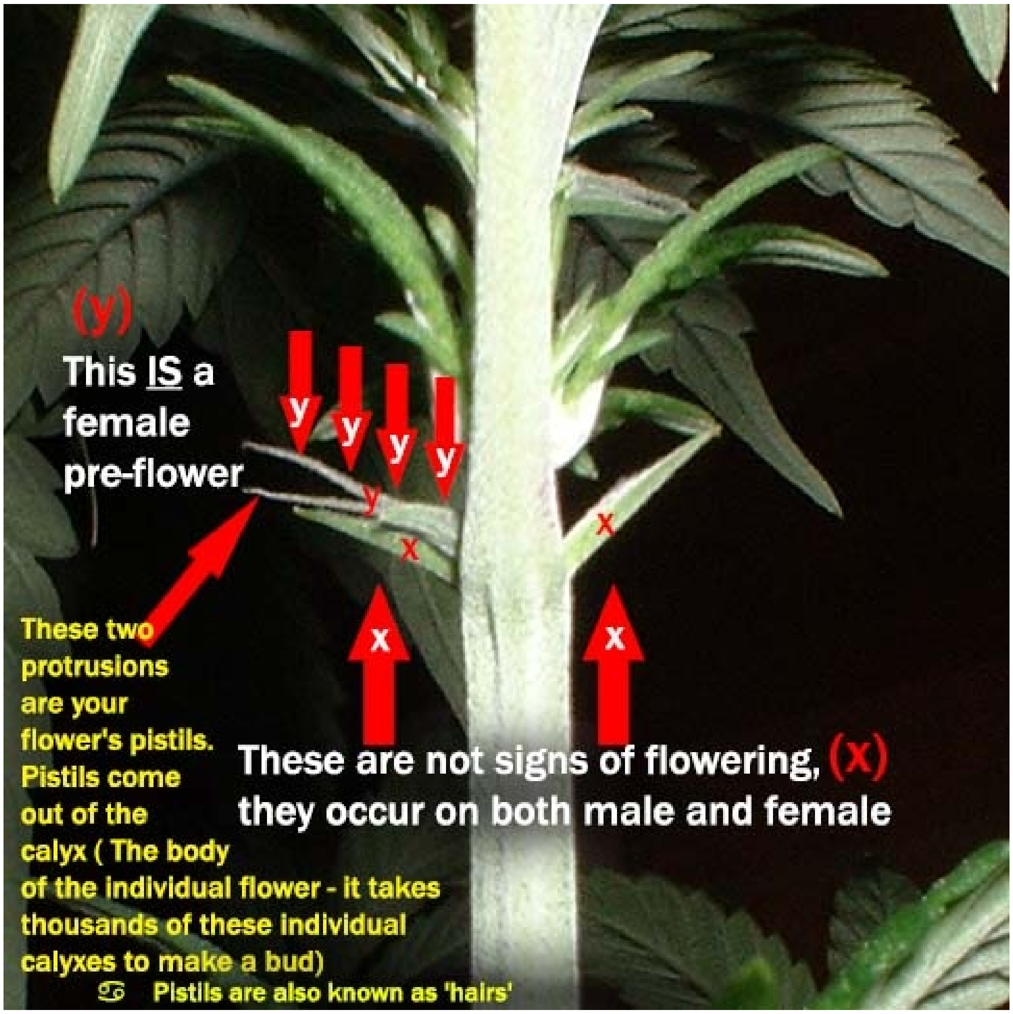


Figure 2. Female After 10 Days Flowering.



Hermaphrodite

A hermaphrodite, or "hermie", is a plant of one sex that develops the sexual organs of the other sex. Most commonly, a flowering female plant will develop staminate flowers, though the reverse is also true. Primarily male hermaphrodites are not as well recognized only because few growers let their males reach a point of flowering where the pistillate would be expressed.

Hermaphrodites are generally viewed with disfavor. First, they will release pollen and ruin a sinsemellia crop, pollinating themselves and all of the other females in the room. Second, the resulting seeds are worthless, because hermaphrodite parents tend to pass on the genetic tendency to their offspring.

Note: Occasionally specious staminate flowers will appear in the last days of flowering of a female plant. These do not drop pollen and their appearance is not considered evidence of hermaphroditism.

The following is an image of a hermaphrodite, or more specifically; a female plant with staminate flowers.

Figure 1. Hermaphrodite. (Note the pre-flowers.)

Methods to Determine Sex

If your plant didn't show any pre-flowers or they showed pre-flowers but you want to be really sure about what sex your plants have, you will have to wait for the real flowers to mature. Indica tends to flower earlier then Sativa dominant strains, so keep that in mind. So by looking at the flowers you can identify the males and females to determine if you want it. Remember if the plant has both males and females flowers it's a dreaded hermaphrodite.

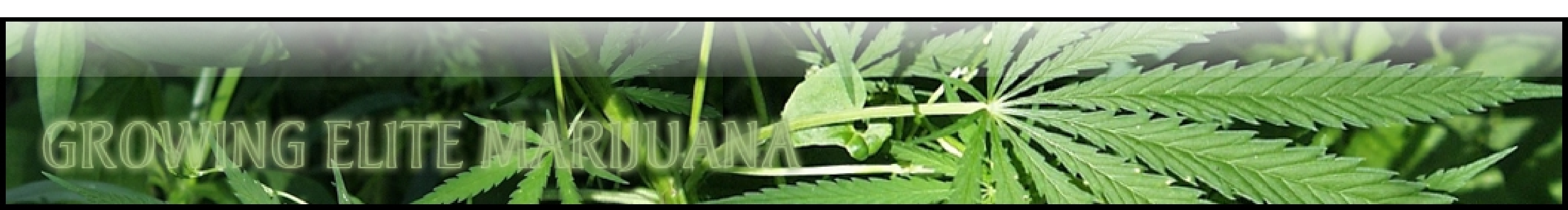
It is possible to induce flowering in plants with 12/12, identify the males, then to re-veg by going to 24 hr. light. The males will show their sex within 2 weeks of 12/12. They will then revert to vegetating after a couple weeks of 24 hrs. However sending back plants into the vegetative phase cause unnecessary stress and stretch. Therefore it better to force flowering on clones. Since you are only interested in the sex and not in the yield of the clone almost any type of grow light will do. Also if you are flowering clones just to figure out the sex, you do not have to root the clone yet, you can just let it stay in a glass of water.

When you are flowering clones just to check the sex you can increase the period of darkness. This will speed up the flowering process – however, it will also decrease the harvest yield significantly so it's not a method to use if you're seriously interested in the production yield.

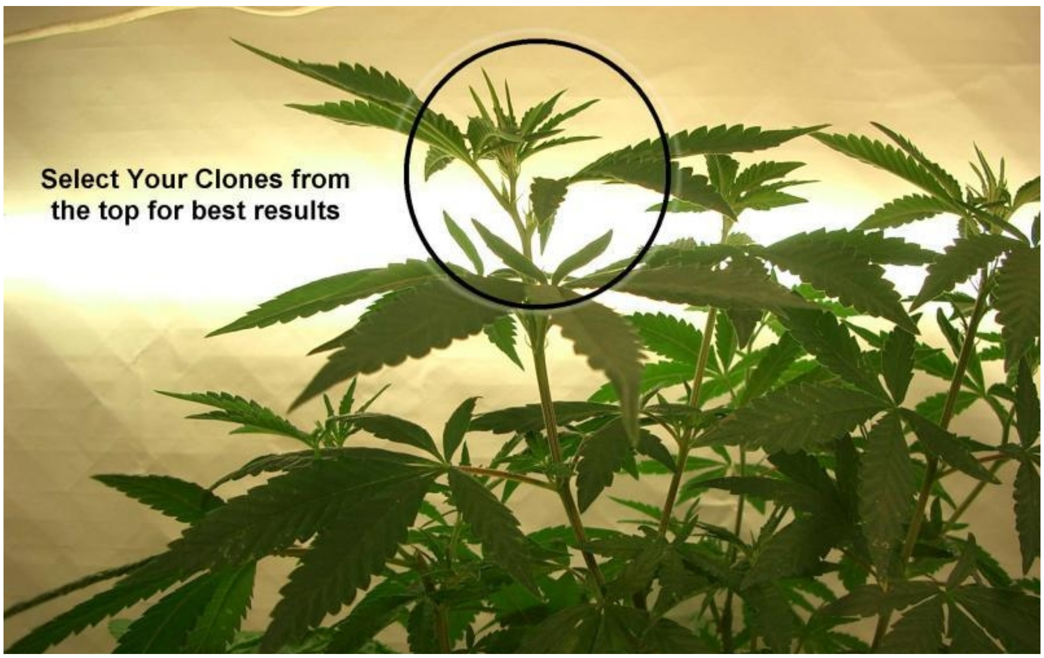
Determining Plant Sex

Plant Height + Pre-Flower Timing: If your using the same seed strains with all your plants, it can be a safe assumption to make that the taller plants are males and the shorter plants are females. Also note that male plants tend to begin pre-flowering much earlier than female plants.

Calyx Method: Another method is to take a magnifying glass or microscope to the plant's calyx. If the calyx is raised on a stem then it is most likely a male plant. If the calyx is NOT raised on a stem then it is probably a female plant.



Forcing Cloning: This method is a 100% accurate way of determining your plant's sex. Begin by taking a cutting (two is best, just in case one dies), from each parent plant whose sex is unknown. It is advisable to somehow place a label or piece of colored tape on the cuttings to identify sets of clones from their corresponding parents. Next give your rooting clones a 12-hour light/dark photoperiod. After a 12-hour day, place the clones in a completely dark area (such as placing a box over them). This will induce flowering. Clones typically tend to show their sex within two weeks.



Paper Bag Method: This is an easy & accurate method. To do this, take a piece of a black plastic garbage bag and be secure it to the end of a branch using twist ties. Apply the bag so that the branch receives 12 hours of light and 12 hours of darkness (i.e. on at 6 P.M. off at 6 A.M.) Within three weeks you will see the male plants will have what look like little balls forming on their branches. The females will have two tiny white hairs emerging from an immature calyx. The males can now be removed from your garden and you are guaranteed a crop of all THC rich, bud-producing females.

Once identified, remove the plastic from the branch of the female and she will begin growing as normal again.

Cull out all the males (unless you are using them for breeding purposes) and keep the mother growing in vegetative mode under 18-24 hours of light.

Stages of Growth

As with most plants in nature, marijuana goes through several distinct phases of growth. It is an annual plant and completes its life cycle in one full season. A seed that is planted in the spring will grow vigorously through the summer and flower in the fall, producing more seeds. The new seeds will sprout the next year, continuing the annual reproductive process. The three basic stages of development are Seedling (also called "germination" or "pre-vegetative"), Vegetative, and lastly Flowering (or "budding").

Marijuana Grows In Stages

The order is as follows:

Germination -> Seedling -> Vegetative -> Pre-Flowering -> Flowering

Germination

This is what will need to happen to your seeds to get your plant started! During germination moisture, heat, and air activate hormones within the durable outer coating of the seeds. Soon, the seeds outer protective coating will crack and the root (a tiny white sprout) is pushed downward outside. Next, seed leaves emerge out from within the shell as they search upward in pursuit of the light. Soon after a complete seedling is formed.

Seedling Phase

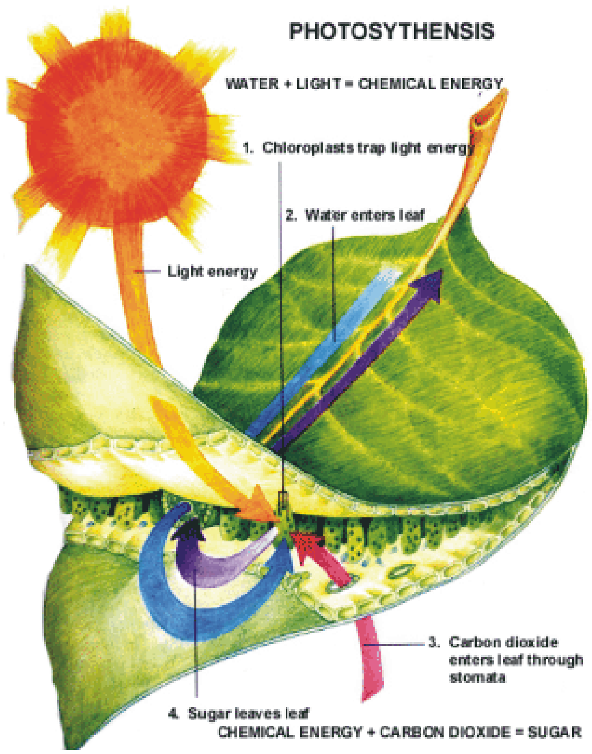
After 3-8 days of germination, plants will enter into their seedling phase of growth that lasts about a month. First a seed that has been germinated and sprouted a root, or a clone, is placed in the hydroponic garden (or soil container) and given food (nutrients) and lighting. After this, the plant will form it's root system, stem and a couple of tender young leaves. Typically during this seedling phase time, the plants are given 16-18 hours of light each day to ensure strong healthy vigorous growth. The seedling growth stage lasts for about 2 to 3 weeks after seeds have germinated.

Vegetative Growth

After seedlings have established a strong root system and foliage growth increases rapidly, your plants enter what is known as its' Vegetative Growth Phase. This begins the moment a seedling or clone takes root and ends as soon as the plant is ready to mature and produce buds.

During this phase of growth your plant will begin to quickly develop and begin growing thick branches, stems, and start producing leaves. As long as plenty of sufficient light, nutrients, CO2, water and other optimal environmental conditions are met you can expect your plant to grow from ½ – 2 inches per day! This is also the stage in which the plant's root system strengthens and matures. The stem also grows thicker. It's cool to see your plant begin to look like a real marijuana plant! This is the stage where this happens. Effects you will observe is a thicker stem and branches, & more “fingers” forming on the leaves.

A very key biological process known as Photosynthesis will begin to occur during the Vegetative Growth Phase. This begins once the leaves grow and expand. Chlorophyll converts CO2 from the air, light energy, and water into carbohydrate food and oxygen. In order for this process to occur, leaves must be kept moist. Stomata (tiny breathing pores located on the underside of the leaf) open and close to regulate moisture preventing dehydration. The stomata also allows waste and water flow to flow outwards. Keep your plant's stomata clean! This means no dust or nasty buildup, your plant's need to breath in order to maximize photosynthesis and other crucial growth-enhancing processes.



During vegetative growth the plant will be photosynthesizing as much as possible to grow tall and start many grow tips at each pair of leaves. A grow tip is the part that can be cloned or propagated asexually. They are located at the top of the plant, and at every major internode. If you "top" the plant, then it has two grow tips at the top. If you top each of these, you will have 4 grow tips at the top of the plant. Since it takes time for the plant to heal and recover from the trauma of being pruned, it is faster to grow 4 smaller plants and not top them at all. (Or grow 2 plants, and "train" them to fill the same space.)

The key to a strong vigorous vegetative growth phase that will reap a heavy, sparkling rich harvest is to supply the roots of your plants with the perfect flourishing growth supportive environment.

The adult life cycle of the marijuana plant consists of two stages of growth. Vegetative and Flowering. The plant determines which of these stages of growth it should be in through the presence of a flowering hormone which is sensitive to light. As long as light levels above 12 to 14 hours are maintained, the flowering hormone will never be present in high enough levels to induce flowering in the plant. At any point during the plants life if the light is on for more than 12hrs a day it will cause the levels of flowering hormone to be reduced and the plant to revert to the vegetative growth stage. If a plant is reverted during flowering by irregular light patterns it can cause stress in the plant and stress can cause hermaphroditism or weak, cruddy buds!

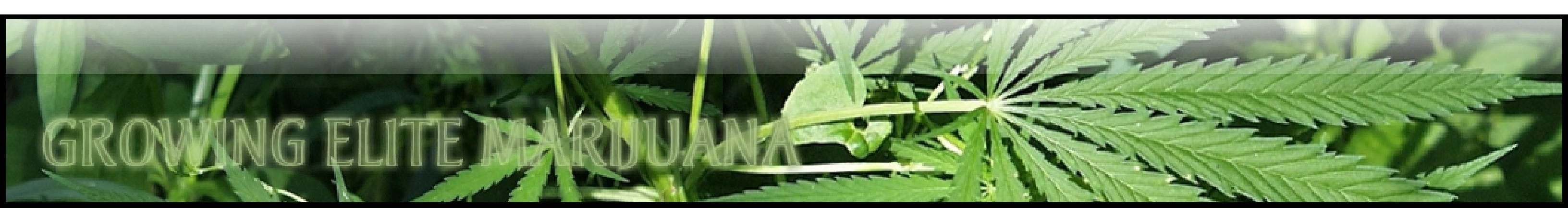
Plants can stay in the vegetative stage indefinitely with no adverse effects. In other words, you have full control of how tall they will grow. As long as the photo period of 16 hours or more light is maintained, marijuana plants will remain in vegetative growth theoretically forever – it us up to the grower to decide when to force the plant to flower. A plant can grow anywhere from 12" to 12 feet before being forced to flower.

The hydroponic growth phase usually lasts 4 to 8 weeks.

Lighting

In this vegetative growth stage the plants will receive light 18 to 24 hours per day. In this stage your plant will need as much light as it can get, so leave your light on for 16-24 hours and enjoy watching your beautiful cannabis plant grow fast and vigourously! During this stage you are going to want to start with your light about 20 inches or more above the top of your plant, and then each day lower the light about an inch or more until you feel the height is just right.

WARNING: If the light is too low it will dehydrate the plants, wilt them and turn them brown. If the light is too high the plants will grow too tall because they stretch trying to get closer to their light source.



Keep lights on continuously for your vegetating sprouts, since they require no darkness period like older plants. You will not need a timer unless you want to keep the lamps off during a certain time each day. It is possible to grow plants with no dark period, and increase the speed at which they grow by 30%. Try to light the plants for 18 or more hours, or continuously at this point. As long as the plants receive 16-24 hours of sufficient light, they will remain indefinitely in this vegetative growing stage.

One heavily debated issue among growers is whether the dark period is needed during vegetative growth. There are various mythical claims that a darkness period is needed for plants resting but there is absolutely no strong evidence to support this. Experienced weed growers agree - extremely healthy and potent marijuana is grown under 24hr vegetative light. What is in dispute is whether the extra light hours bring a great deal of benefit compared with 18hr light.

Also, you can start off your vegetative growth stage with a fluorescent light. The reason you would want to do this is to not give the plants excessive light at the beginning of the growing process when your seedlings are most delicate. Allow them to build up to it as they would in nature where the seeds would germinate in spring when the sun is not as strong & intense as it will be in summer.

Watering

Watering properly is also a key activity during vegetative growth to ensure a healthy grow and bountiful harvest. As the plant gets bigger, so does its root system. This means the soil/grow medium will dry out faster as more water is being used up. Pay close attention to your plants and keep them well hydrated!

Feeding

In this stage water and nutrients will be used more quickly. Including high levels of nitrogen. Also potassium, phosphorus, sulfur, magnesium, calcium, and other trace elements are needed as they are used at much faster rates.

During vegetative growth you will want to use a fertilizer that is high in nitrogen at full strength. Nitrogen is used by the plant to grow stems, leaves, and other green parts and so is absolutely essential during the vegetative phase of growth. As always you should begin with the manufacturers suggestions for the period of growth you are in when adding fertilizer and then adjust up or down based on how your plants respond.

This is the stage where it is common for newer growers to add too many nutrients or screw up their plant's pH level. Always carefully check pH before adjusting nutrients to fix a problem.

At this time, a solution of 20-20-20 with trace minerals is used for both hydroponic and soil gardening when growing continuously under lights. Miracle Grow Patio or RapidGrow or any organic plant food is ideal for this. Epsom salts (1tsp) should be used in the solution for magnesium and sulfur minerals. Trace minerals are needed also, that is, if your food does not include them. Miracle Grow Patio, includes these trace elements, and is recommended if it is available in your area. Any fertilizer with the proper ratio will be fine during vegetative growth. More on amendments, chemical and organic for explosive growth later.

Pre-Flowering

As you recall, the plant's sex becomes apparent during pre-flowering. The particular traits of the plant also become very apparent at this time.

The goal of many modern growers is to select strong, healthy potent female plants as mothers. These mother plants are given a continuous 18-24 hours of light so that they are forced to stay in the vegetative growth stage. Growers then cut branch tips and root them, these cuttings are known as “clones”. Selecting a strong healthy “Bonsai Mother” plant is the key for having access to a constant fresh supply of all-female genetically uniform clones.

(Check out the Cloning chapter for more information.)

When to start Flowering?

Once you are in the Pre-Flowering stage you have a very critical decision to make. Do you want to start Flowering now, or continue Vegetative Growth?

Consider this before you make your decision; the amount of bud your plants will produce is not equal to your plant's height. Your plant's maximum bud production is caused by the following main factors:

A) Your plant's growing environment.
B) The number of nodes your plant has.
C) Your strain's genetic threshold for bud production.

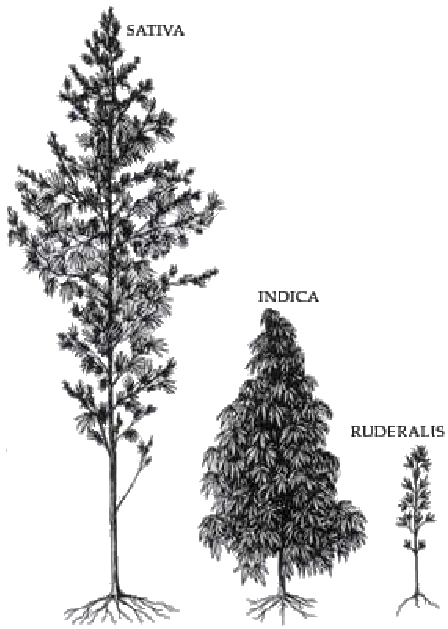
The quality of the buds is not time dependent, nor is it a factor of the size of the plant. Buds maturing on two clones from the same plant, one newly rooted and the other a large plant growing vegetatively for three months, will produce equal quality buds. Ultimately, the decision is yours. Figure out how big you want the plant to be when it's ripe. The smaller the plant is when it is forced to flower, the smaller the bud will be at ripening.

It's totally possible to get more bud with a lot of plants which are flowered as soon as they are mature. This also helps keep the plants shorter and smaller. This can be done rather than extending vegetative growth with the smaller plants until they reach their maximum height and size. The time frame for the smaller plant option may also produce more bud turnover per annum.

Now that you understand this, you can choose to either flower now or choose to keep your plant growing until it reaches it's maximum size threshold before you decide to start Flowering. Your plant will need to have reached a level of maturity where it is producing alternating nodes. If grown from seed this will usually occur a few weeks into vegetative growth.

You can begin flowering when your plants have reached a minimum of 6 inches in height, AND have at least 4 sets of leaves. Depending on certain factors, this typically takes around 2 weeks to a month of vegetative growth in most hydroponic gardens. Clones taken from a mature plant will be sexually mature upon rooting and can be flowered immediately.

Note: If you decide to flower now, make sure you have plenty of room for your plant because during Flowering most Sativa-dominant strains DOUBLE in both height and width! During the flowering stage a plant may grow between 2 and 2 ½ times the size it achieved in vegetation. Plan accordingly.



Flowering

Flowering is the most exciting stage of growing marijuana. This is the phase of growth that produces the most THC (the active ingredient that produces the high). Once Flowering begins, your plants height will slow drastically, do not be alarmed as this is completely normal. The reason this happens is because the plants are beginning to conserve their energy for the flowering itself. Nearly all the THC is produced during the flowering stage. Indica dominant strains will flower faster than Sativa varieties.

Figure 1. Female A Few Weeks Into Flowering.
(Notice the long white hairs.)

For the next two to four weeks after Flowering has started the height of the plant should continue to increase, after that all the plants energy will then be used for optimal flower production.

The final stage of Flowering is also known as "budding". This is the most exciting stage in which the plant fills out all over even more and the flowers continue to grow. Shortly hereafter, plants cease to develop any additional shoots or growth, and overall size will slow. They will now begin redirect their overall energy for bud production. An ideal female will grow short, squat, and bushy with branches close on their stem with dense foliage and buds.

Eventually the female plant reaches a peak period of Flowering. At this time your plant will begin to fill out more with more leaves, branches and flowers, as well as begin to take on the shape of a Christmas tree. During this peak period the female pistils (hairs) tips will swell up, as well as begin to change color. In most cases (and this is touched on in great detail later) they will change from a white tint to an orange tint to a red tint to a brown tint. All strains are different but this is what will generally tend to be the case. If you have access to the breeder's recommended flowering times then all the better. Once the plant does this you are ready to harvest her and sample your tasty new herb.

Keep in mind each strain has it's own specific flowering time and each strain may have a different color tint when they reach their flowering peak. A great time to begin flowering (by initiating the 12/12 light cycle) is when your plant reaches half the size you want it to be. Keep pruning to a minimum during the entire Flowering phase.

Flowering plants should not be sprayed often as this will promote mold and rot. Keep humidity levels down indoors when flowering, as this is the most delicate and important time for your plants.

Feeding

Flowering plants need very high P(Phosphorus) level foods, such as 5-50-20, but 10-20-10 will suffice. Nutrients should be provided with each watering when first flowering. Also, fertilizing should be minimized or cut down to 1/4 strength. Marijuana uses large amounts of phosphorus during flowering so 5-50-20 should be used at 1/4 strength, depending on the solution and instructions.

Trace elements are essential too. Try to find foods that include these, so you don’t have to use a separate trace element food. Many nurseries sell trace element solutions rich in iron for lawn deficiencies, and these can be adapted for use in cultivating the sweet green herb. Prices for these mass produced fertilizers are significantly cheaper than the specialized hydroponic fertilizers sold in indoor gardening shops, and seem to work equally as well. We will get into essential fertilizer nutrient additives in just a moment.

Some growers believe that it is important to begin using flowering nutrients 1-2 weeks before switching over the light for flowering (12/12 photoperiod). Others begin flowering nutrients just as soon as they switch the light.

Don't spray with bug spray during flowering or you will taste it in the smoke.

Another important thing to look for during flowering is the yellowing of leaves. Particularly towards the end of flowering, plants will naturally begin uptaking nutrients from their own leaves. This is perfectly normal and nothing to be alarmed about. Many newbies mistake this for a nutrient deficiency and begin to overfeed their plant, causing nutrient lockup and/or burn, further worsening the problem. You do not need to make an effort to remove the leaves unless they are brown and dead. In fact, many growers agree it is harmful to remove these naturally occurring decaying leaves when they're still being used for flowering.

If growing outdoors, you can use the dead fallen veggy matter as a mulch to help return organic materials back into the soil and provide a ground cover to retain moisture and protect your roots from excess heat or the elements.

Supplements

There are a plethora of supplements on the market and no attempt will be made here to list them all at this time but there are a few general types that most flowering supplements fall into that can be addressed here:

- **Sugar supplements such as blackstrap molasses, etc** - This type of supplement does NOT feed the plant directly. Plants can not utilize already processed sugars like this. What this does do is nourish micro-organisms living in the grow medium. If you are using an organic grow process or growing in soil this can be very beneficial but should be stopped during the flush period.
- **Hormone Supplements** - Naturally the effects depend on the hormone but all in all these are beneficial but expensive. Plant growth hormone extracted from algae is helpful but provides far more benefit during the vegetative grow cycle than the flowering cycle. Plant flowering hormones are beneficial during flowering, largely for creating more flowering sites than without. All hormone supplements tend to be very expensive which limits their practical utility.
- **Taste Enhancers** - There are products with citrus and other flavors that claim if you feed them to plants the plants will take on some aspect of their flavor. This is generally reported to be false, but I have seen it work when you don't flush a few weeks before harvest.
- **Calcium/Magnesium Supplements** - These are very useful for balancing out your nutrient mix, these underrated nutrients are important for sustaining plant growth. The use of a supplement like this is highly recommended during all phases of growth.
- **Nutrient Supplements** - Some boosters are simply tailored to more flowering nutrition. You will see ratios like this; 1:2:1, i.e. 6:12:6. We will get into what these numbers mean in a little bit. For now, just know that how well these solutions work depends on how ideal the mix you are using is already, based solely upon the ingredients used, and the manufacturing processes involved.

12/12 Lighting Schedule for Initiating Flowering

In nature sooner or later the marijuana plants will enter Flowering once the days become shorter. This begins outdoors in nature in the wild and happens in the Fall. This signals to the plants that their annual life cycle is coming to an end, and it's time to pass their genes on by initiating their reproductive cycle.

At this stage the flowers of the female plants would normally become pollinated by a male plant, but if left unpollinated the females will become agitated and grow rich amounts of cannabinoids such as noteworthy THC, without any seeds. If a female plant is fertilized with male pollen, it will grow a seed. Without any seeds, all the plant's energy and resources are used to make big resinous buds. Again, this is called a Sinsemilla crop. When growing indoors we must force this to happen by giving our plants 12 hours of uninterrupted total darkness.

So once you decide to begin Flowering (you should be excited!) it is time to put your plants on a 12 hours on and 12 hours off per 24 hour period lighting schedule. The actual time varies from plant to plant but a guideline is 12 hours light and 12 hours dark. The theory behind 12/12 lighting timing is simple. In nature, cannabis plants in the wild begin flowering in the later Fall/early Winter months. During this time the days (daylight) get shorter and the nights (total darkness) get longer. As you guessed, the plants are under around 12 hours of light and 12 hours of darkness.

Note: The above lighting figure is for most commercial varieties of cannabis. Plants that develop in tropical climates often start flowering under more light and less darkness (~16/8). Take that factor into consideration when choosing a strain.

When this specific lighting combination occurs the plants will undergo an internal chemical-biological process that naturally stimulates them to flower. As long as the 12/12 light cycle continues, the plants will grow big and produce an abundance of frosty flowers. As a grower this is your intention, to produce as many THC rich bud flowers as possible. In order to accomplish this goal you must follow the 12/12 lighting cycle – 12 hours light on, 12 hours light off.

Start this lighting cycle during Pre-Flowering to stimulate your plant to begin Flowering. But make sure you only switch to a flowering lighting cycle when

pre-flower signals are shown. If you get too eager and do this too early (an incredibly common newbie grower mistake!), your plant may encounter sex-related stress problems and become a Hermaphrodite! Not cool. What early “forcing flowering” before they are ready does is create a condition called “self-pollination” where the plant thinks it's chances of reproduction are slim to none, so in order to continue the species it will produce both male and female flowers on the same plant to self-seed. The male flowers then pollinate the female flowers which will eventually produce weak seeds. The plant is shocked into thinking it missed it's time to receive pollen, so the above process gets triggered as a last ditch effort to receive pollen. (During the natural growth cycle male plants release their pollen around the time female plants begin to flower.)

Having pollen floating around in your grow room from a hermaphrodite plant will also spoil your other plants (and breeding projects!) So only go to a 12/12 light cycle when you are absolutely sure your plant is Pre-Flowering.

Additionally, 13 hours light, 11 dark may increase flower size while still allowing the plant to go into the flowering mode, stress-free. Use longer dark periods to speed maturity toward the end of the flowering cycle if speed is of the essence. (8-10 days) but be warned as this WILL reduce total yield.

Complete Darkness

When light within a certain spectrum hits the surface of the plant's chlorophyll receptors, it prompts a hormone called florigen to be produced. Another hormone named antiflorigen is also produced at this time by flowering plants. The ratio between these two hormones is what causes a plant to flower or not.

In the plants leaves, another chemical exists named phytochrome that is necessary to react with florigen to produce flowers. When the phytochrome within the leaves of a plant receive a duration of light that would be considered "short day light" by that exact plant, then the antiflorigen is repressed and the florigen is increased, thus causing the plant to start flowering.

If the duration of light of correct spectrum and intensity is interrupted from a "short day", anywhere within the "dark cycle", it causes the plant to again start producing antiflorigen. The ratio between the florigen and antiflorigen is altered and flowering will decrease or stop. This switch between ratios of florigen and antiflorigen is stressful to the plant and can cause a sexual reversal from female to male or male to female, and greatly stunt growth.

Hermaphrodites form in response to this florigen/antiflorigen ratio alteration.

If you take all of this information and relate it to each of your plants, you'll see that in regards to light interrupting a darkness cycle, many factors come into play. Brief interruptions of low intensity may not be sufficient to cause the florigen/antiflorigen ratio to change enough to change the plants flowering in any visible way. It can however, cause a slowing of flower growth.

Be careful if you visit your garden at night. Any light, even that from a weak flashlight will disrupt the hormone that induces flowering and the plants will revert back to vegetative growth. If you must visit your plants at night DON'T use any light, or better yet, just hold your horses and visit during the day!!!

Note: A green light can be used to work on the garden during the dark period with no negative reactions from the plants. These are sold as nursery safety lights, but any green bulb should be OK. It is best to keep the dark hours at a time when you would normally not wish to visit the garden. I'd still be a tad wary though.

The best way to not affect this ratio of florigen/antiflorigen is to leave the flowering room completely dark for the entire darkness cycle. This makes it foolproof. During the 12 off cycle, make sure the plants are kept in complete darkness. Any light of sufficient strength to be "seen" by the phytochrome receptors in the leaf at night will have a negative effect on the flowering.

So go in there during your dark photoperiod and make sure no light is visible. A desk light across the room will result in continued vegetative growth and will stop your plants from flowering properly. Even small LEDs can upset this process. Your grow area must be completely sealed so that is light-proof. One effective way to do this is use thick black screening (used in photography dark rooms found in most hardware or fabric stores), a thick black cloth, or even a black opaque plastic can be used sealing up all light-entry points. Go in there at night and make sure your plants are in COMPLETE and TOTAL darkness.

Quick Flowering

You can make the plants mature in 36 days if you are in a hurry. This can be done by cutting back on the light to about 14 hours, but the plants will not be as big. You should gradually shorten the light cycle until you reach 14 hours.

You can force the plant to flower quicker by maximizing the length of the dark period. Try 18 hours of darkness and 6 hours of light. Lower temperature during the dark period, preferably under 59°F(15°C). The harvest will however be lower and with reduced quality. Apply ethylene will quicken the ripening even further.

Seeds

Flowering is the stage in which the female plant will produce seeds if she has received viable pollen from a male plant. The seeds grow within the female bud and can take anywhere between 2 weeks to 16 weeks, to grow to full maturity. The female pistils may change color before finally bursting the seedpods, sending them to the soil below. (Breeders like to collect their seed before the seedpods burst.)

Flowering Timeline

Female marijuana goes through several stages once it begins flowering. First a few flowers will appear. Then new flowers develop around the first ones. Flowers also form at each leaf node along the branches and main stem, the bud then begins to fill out so that the cluster becomes thick with pistils reaching out for pollen. They will look fresh and moist. Just as soon as it looks like it is finished, a new wave of flower growth appears, usually in a relatively bare spot. New flowers may appear for weeks! Next the flowers close and the calyxes start to swell; this is a false seed pod because the flowers have not been fertilized. These pods will be totally covered with resin glands. At maturity the glands will be sparkly with resin in bright light. The individual glands will appear clear under magnification. As a rule plants require about 8-12 weeks of flowering to produce ripe buds.

It should be noted that this is just a general average guideline. There are wide variations from this, some strains will move faster and other much more slowly. In some cases that wait is worthwhile and in others it is not:

- **1-2 Weeks** - During this time your plants will be changing over to their flowering period. It is generally during this time that the first evidence of flowers will appear.
- **2-4 Weeks** - During this time the plants will begin to stretch for the light. Flowers will appear at all the nodes but they will be light and airy no matter what you have done.
- **5+ Weeks** - During this period you will likely see lots of yellowing on leaves and if you have done everything else right you will see the buds fill in and thicken substantially.
- **Last 2 Weeks** - During the last 1-2 weeks of your plants life you will want to water it with clean water and feed it no nutrients.
- **Before The Last 72hrs** - Here you will want to flush the grow medium thoroughly.

During The Last 24-48hrs - You should shut off ALL of the lights. THC is light sensitive and the plants will be utilizing sugars already produced by photosynthesis during this period. Overall this will increase taste and potency by flushing the plant of fertilizers & sugars which simply don't taste very good when burned.

So depending on the type of seed, the flowering cycle will usually last you approximately 2 months, sometimes longer. So the total average length of time from germinating to harvest will be around ~3 months, more or less...

Note: This can be shortened even less by using two growing areas, one for the first stages of life and another strictly for flowering. At the end of flowering, marijuana plants are harvested then set to air dry.

3

LIGHTING

The Lighting System

Marijuana plants love light, and LOTS of it.

Lighting is one of, if not *the most* essential ingredient needed for a quick, high-yielding crop. Your lights may very well be your single greatest expense, but very well worth the investment. Maximizing light distribution to your plants will enhance photosynthesis tremendously. Photosynthesis is the process by which carbon dioxide and water are turned into sugary plant food and oxygen. In effect, the more light your plants receive, the faster and bigger they will grow.

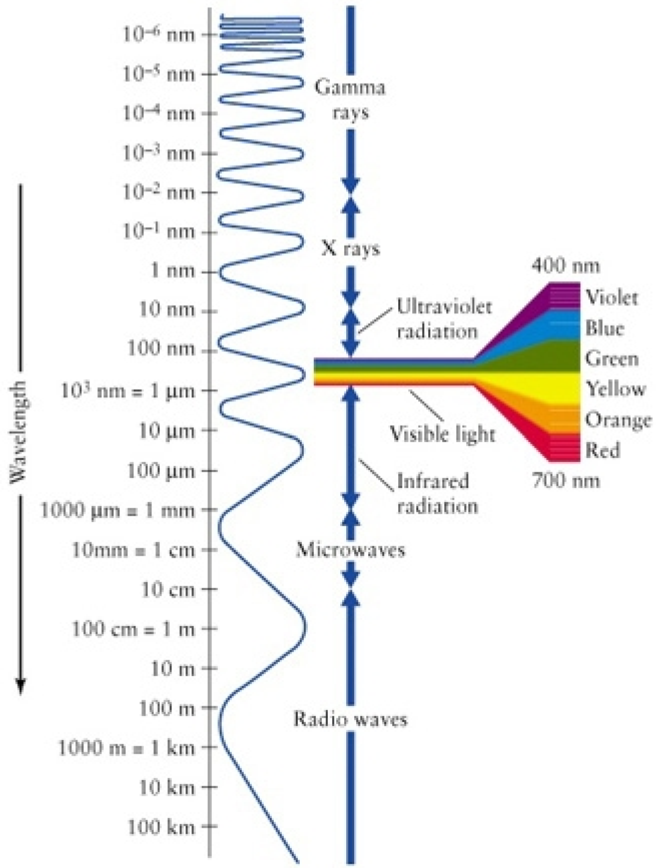
There are many lighting systems available out there today, a complete one will have; a bulb, reflector, ballast, timer, and electrical inputs/outputs. Marijuana lighting systems allow you to emulate the sunlight outdoors for indoor growing as well as completely control and extend the natural "growing season" and manipulate it at will to affect the plant hormones.

When growing indoors, artificial lights produce bigger flowers (bigger bud) than natural sunlight from a windowsill. You will yield way more THC quantity with artificial lighting than you ever could with window-light grown marijuana.

Note: Sunlight is the single best source of light for growing, but for most growers this is not an option and indoor lighting is used as a great replacement.

Natural Sunlight Cycle

In nature, the cannabis plant's life cycle is one year long (annual). A seed planted in the spring will grow strong and tall throughout the Summer, and will flower in the Fall. The annual cycle will then start all over again when the seeds sprout the following year.



Alright time for a crucial lesson in light. The sun emits rays of color energy on a spectrum (High School science class anyone?) As far as marijuana plants go, due to the natural growth cycle of plants on our planet the sun tends to emit more blue spectrum (growth enhancing) ray energy during the summer. Also, general plantation growth is typically better this time of year due to longer days, hence the more sunlight exposure resulting from this natural growth-heavy season.

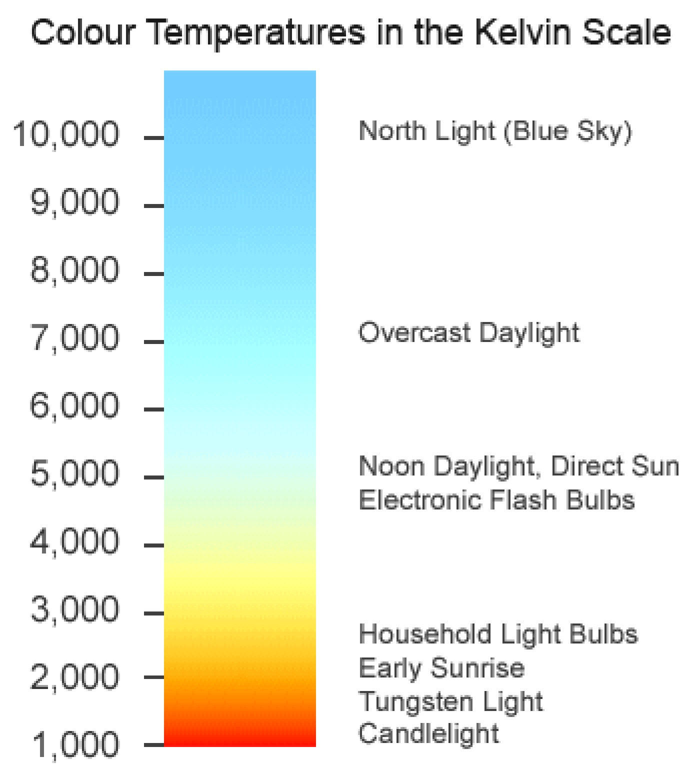
In the late Summer/early Fall, when plants produce flowers, there is more red spectrum energy rays. The change in light (and quicker, shorter days) cause hormones in plants to increase flower production (pollen sacks in males and THC sticky resin in females if left unpollinated).

It is absolutely essential that you select the proper spectrum depending upon what your individual unique needs as a grower are. Failure to do so will result in less than optimal bud production.

Basics About Light

The color of a light source is an important decision in determining the right light source for your garden. The advantage of Metal Halide lamps is that they provide high-quality, crisp white light in a variety of different color temperatures that meet the needs of many different growers.

Correlated Color Temperature(CCT): The first factor in choosing a color of lamp is to determine whether you need a warm or cool light source. The CCT, expressed in Kelvin degrees, relates to actual thermal temperature. If you've ever seen a piece of metal being heated, you know that as the metal gets hotter, it's color changes. The CCT rating of HID and flourescent light sources indicate how warm or how cool your light source is. For example a lamp with a CCT of 2700 Kelvin is considered warm; with a CCT of 4200 Kelvin is considered neutral; and one of 6000 Kelvin is considered quite cool.



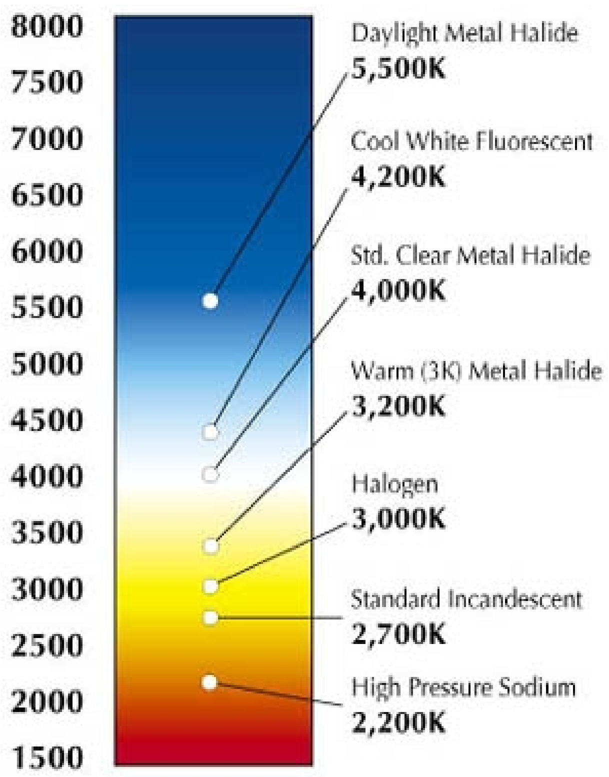
Spectral Energy Distribution: When you look at a light source, you perceive seeing a single color, but you are actually seeing thousands of hues. The combinations of different wavelengths of light make up the color we see. The relative intensity of the various wavelengths are used to determine a light source's Color Rendering Index (CRI).

Color Rendering Index (CRI): The CRI is an indication of a lamp's ability to show individual colors relative to a standard. This value is determined from a comparison of the lamp's spectral distribution compared to a black body at the same color temperature. Light sources, such as metal halide lamps, are rated with a CCT; however, CCT does not provide any information on the quality of the color. For this reason, a CRI is also necessary. In general, the higher the CRI rating of a lamp, the better the different colors will show.

5K - 7K Kelvin: Strong Blue Light. Promotes bushy growth. Ideal for rapid growth phase of plants. This greatly enhances all-around plant growth when used with super high output, (such as high pressure sodium or 3K warm metal halide lamps).

4.2K - 4200 Kelvin: Cool White Flourescents. Can be used as supplemental blue lighting when used with a 3K source.

4K - 4000 Kelvin: Neutral Metal Halide. Best single source for plant growth, producing shorter, bushier growth than 3700 Kelvin and color rendition. Used in general plant lighting.



3.7K - 3700 Kelvin: Softer Metal Halide(coated). This coated lamp is used in general plant lighting and for more rapid growth than 4000 Kelvin produces.

3K - 3200 Kelvin: Warm Metal Halide. Highest photosynthetically active radiation (PAR) value of all HID lighting for all phases of plant growth. PAR watts account for the nutritional value of light and are a direct measure of the light energy available for photosythesis.

2.7K - 2700 Kelvin: High Pressure Sodium Lamps. Redder color mix, used for propagation, blooming, supplemental greenhouse lighting.

Wattage

The first thing to look for before deciding upon and buying a lamp is its wattage rating. A lamp's wattage is the measure of how much electricity it uses, thus how bright it will be. A common household light usually is about 75 watts. Growers commonly use 250, 400, 600, and even 1000watt high intensity discharge (HID) lamps. The more light you provide, the more your plants will grow and produce. The power consumption of these lights mimics what an air conditioner, large refrigerator or other major appliance might add to an electric bill. In the United States if more than ~3500+ watts are used it is a red flag.

If you run your light for 24 hours a day then be sure to replace it after 6 months of use. If you run it for 18 hours a day, then replace it after 9 months. If on for 12 hours a day then replacing it after 12 months is perfect.

Lumens

Lumens is a measurement of how much light per square foot is emitted by your bulb. Lumens are determined by the actual design of the light, not the wattage. Manufacturers will almost always provide lumen specifications for the bulb. Typically a high number of lumens equates to a high quality light.

Never go any less than 2,500 lumens (even if you're only growing one plant!) To ensure maximum light exposure and to produce big dank frosty buds, you must hit AT LEAST the 45,000 mark. This is enough to abundantly supply light to a 3x3 foot grow area, which will hold 6 – 9 plants. The idea here is to utilize as much of the light as possible. You should have enough light to provide 20-50 watts for every square foot of your grow area, the more light the better.

The number of plants in the list below is an approximation of the maximum number you can grow with various wattage MH or HPS grow light systems:

- **250 watts:** will cover 5-12 square feet (a 2.5x2.5 ft. grow area). ~7 plants or less.
- **400 watts:** will cover 8-20 square feet (a 4x4 ft. grow area). ~13 plants or less.
- **600 watts:** will cover 12-30 square feet (A 5x5 ft. grow area). ~19 plants or less.
- **1000 watts:** will cover 20-50 square feet (6.5 x 6.5 ft. grow area). ~32 plants or less.

These numbers assume you have a good reflector around your bulb and also light-reflective wall coverings. You can increase the figures a bit if using multiple bulbs, due to their overlapping effect. You can also increase coverage using a light mover. Use at least 40 (50 is ideal) watts per sq. foot of grow space.

Approximate lumen output for HIDs:

Watts	Metal Halide	High Pressure Sodium
250	20,000	32000
400	32,000	40,000
600	45,000	85,000
1000	110,000	140,000

Some lights may be more efficient than others. Divide a light's lumens by watts to get its lumen per watt ratio. This will allow you to compare the efficiency of lights to different wattages.

Light Sources

There are many different types of lighting sources you can use for lighting up your indoor cannabis plants. But which one is the ideal for you?

Fluorescent Lighting

If you are planning on not growing full flowering cannabis plants, then fluorescent lighting is for you. Don't use incandescent lamps for growing marijuana. Within the last few years the large light manufacturers have come out with an incandescent light made especially for use in growing plants. Even though they are superior to the standard incandescent light bulb we use in our homes, they can't yield the results obtained with a fluorescent lamp. The light emitted from an incandescent lamp is in the red side of the light spectrum, but is very low in the blue. These can however be used for early stages of cuttings.

Fluorescent and some kinds of LED grow lights are good for the seedling and vegetative stages of growth, but they will NOT produce as big of a harvest as Metal Halide (MH) or High Pressure Sodium (HPS) grow lights during flowering. It will also take much more time for the plant to mature. If you compare their lumens (brightness) per unit of energy consumed, Metal Halides will produce up to 125 lumens per watt compared to 39 lumens per watt with fluorescent lights and 18 lumens per watt for standard incandescent bulbs. Due to the low output, fluorescent lights are a poor light source for flowering and budding.

But, since they are gentle, they do however make a GREAT source for starting off your delicate seedlings.

Never buy special grow fluorescent lights for full production such as “growlux”, they do not produce enough lumen output. Use normal full spectrum fluorescent lamps. Fluorescents are good because they don't generate that much heat; High Pressure Sodium (HPS) isn't that good in that aspect. Fluorescents can be equally a bad choice because they do not have good light penetration; High Pressure Sodium (HPS) lights are much better in this regard. Always pay attention to the spectrum of the lamp: cool white/day light has more light in the blue spectrum and warm white/soft white has more light in the red spectrum. You must combine those for the plant to have a healthy growth and flowering, and supply them at the right time. More on this in a bit!

If you are going to use Fluorescent lighting then set it up as follows:

Figure about one plant per two feet of fluorescent tube. Fluorescent light sources should be an average of 6-8 inches from the top of the plant. They may be mounted on a rack and moved every few days as the plants grow.

Please steer clear of shady fluorescent or incadescent light dealers that claim their lights will perform as good as mh or hps lights. This is complete bullshit. Some models can come close, but unless you're planning on spending over $1000 on a Flourescent grow light system, then they don't come close to the quality output that a mh or hps will. A good 400 watt mh or hps grow light can be purchased for well under $400.

Compact Fluorescent Lighting (CFL)

A Compact Fluorescent Light is a type of fluorescent that was originally designed to replace the standard E26 Edison Incandescent Light Bulb. The reason being, CFLs will put out the same amount of visible light using while much less power and have a significantly longer rated life span. Even though the price of the CFLs is higher than Incandescent bulb's, they are generally rated to run anywhere from 8,000 to 15,000 hours. There many advantages of using CFL's. Maybe you are just growing personal smoke, or you can't afford a costly HID system, or an HID system just isn't practical for your grow setup.

For some, HID lights aren't available in their area. However, CFLs are sold almost anywhere. CFLs are in general a much cheaper growing solution, and they're just plain simple to use being self-ballasted and screwing into a regular light socket. I'm not saying CFLs are better for growing than HID's, but in some cases it's the only thing practical that will work.

CFL Wattage: Normally light manufacturers that make CFLs will put two numbers on the box your CFL comes in. One is Actual Wattage and one is the Incandescent Equal. As you can see here on this CFL the Actual Wattage is 23 Watts, and it's Incandescent Equal is 100 Watts. Totally ignore the Incandescent Equal and pay attention only to the Actual Wattage of the bulb.

Color Temperature: You might see a lot of different labels when shopping at the store for CFLs. Labels including Soft White, Warm White, Cool White, Bright White, Halogen White, Daylight White, Full Spectrum. And also labels like 2700K, 3000K, 3500K, 4000K, 5000K, 6400K, and 6500K. These are all the color temperature of the light you are using. This is a measure of how warm or cool the light given off by a lamp appears, with warmer colors having a yellowish tinge and cooler colors being close to a blue. What confuses some people is that the warmer a color is, the colder its color temperature is. (ex. Warm White = 2700K.) Bulbs ranging in the 2700K-3000K spectrum are usually labeled Warm White or Soft White, bulbs ranging in the 3500K – 4000K spectrum are bright white or cool white, 5000K is labeled Full Spectrum, and finally 6400K – 6500K is labeled Daylight. You can grow an entire crop with CFLs if you chose the right spectrum of bulbs. For Vegetation you will want to use 6500K or 5000K, and when you flower you will want to switch to 2700K or 3000K.

The reason being, throughout the year the plants outside receive more 6500K (blue) spectrum light because the days in summer are long and hot and as Autumn/Winter gets closer the day gets shorter, and thus, plants gradually receive less 6500K light and more 2700K light as the plants begin to initiate the process of flowering. Do what you can to avoid bulbs within that 3500K – 4000K because they emit very little light that Is useful to your plant. Take note of (in the above diagram) the difference between the varying color temperatures.

How To Use CFL's: In order to efficiently use CFL's for growing Marijuana you will need to position the lights around 2 – 4 inches from the foliage of the plant. If you place the light too close, then your plant will have nothing to vertically stretch to and it will remain short and stocky. Some people combat this by adding CFL's to the side of foliage instead of on top of it. On the other hand if the light is too far away from the plant, the stem will suffer elongation (stretching), which will result in loose and fluffy buds.

It is very important to note that when using CFL's it is a daily "battle" to have your lights in the right spot. Also many people wonder is it better to have many low watt CFL's or just a few high watt CFL's. Both ways are capable of providing you a good harvest. Choose the configuration that is easiest for you and best suits your grow area.

In the end there are many different great setups so don't set your mind on the one single perfect CFL setup. Just apply these basic tips when starting a CFL grow and you will see success (this applies to a lot of material in this eBook as well).

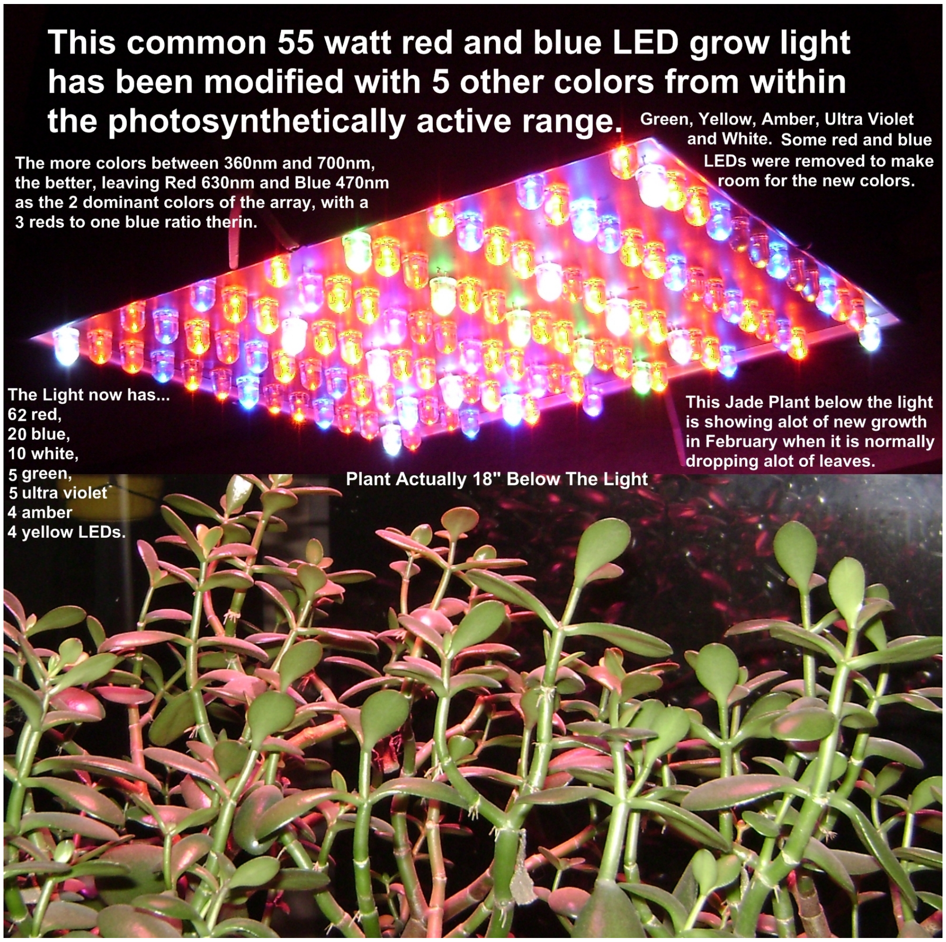
LED Lighting

A couple of years ago if someone mentioned LED Grow Lights for growing marijuana you'd surely hear a chuckle. Nowadays with modern technology this light source is quickly gaining respect as an excellent grow light system.

LED lighting allows for a full-spectrum glow source, with a low heat output.

Benefits of LED Lighting:

- Using LEDs for growing saves around 80% from your energy bill vs. HPS and Metal Halide. This is a green solution which is not only easier on the environment, but also your wallet!
- Low Heat. How many times did you forget to raise your HPS light and burn the tops of your plants? LED grow lights emit very little heat. This also means your grow room won't be so hot, so its easier to control temperature. Your thermal footprint will also be less, providing a more discreet growing experience.
- LED growing lights have a longgggg life span. Most are rated for 50,000+ hours!
- Wide Spectrum. The LED's provide the right blend of light to be equally effective during vegetative and budding stage.



Also these guys (amazing!!!):


Full Spectrum
LED Grow Light
No heat
Save electricity
3 years warranty
Seed to harvest with one light
SUPER
GROW LED
.com

LED Grow Lights and Marijuana?

Yep! LED's are a great light source and are proven to grow marijuana. They are a great inconspicuous way to grow for the modern gardener. According to research, your standard 90 watt LED light system has the same output power as a 400 watt HPS or MH bulb. Just by reading this single point you can see a clear picture as to why LED grow lights are great for marijuana enthusiasts!

LED lighting has a number of unique advantages. The lamps have a fixed angle so no reflector is needed, therefore all the light output is directed at the plants. LED lighting runs cooler and the plants can grow right up to the lights. These lights produce light in a fairly tight spectrum and lamps are available that can be combined to stimulate all the photo sensitive hormones in the plant.

The downside is that high quality full spectrum LED's are extremely expensive.

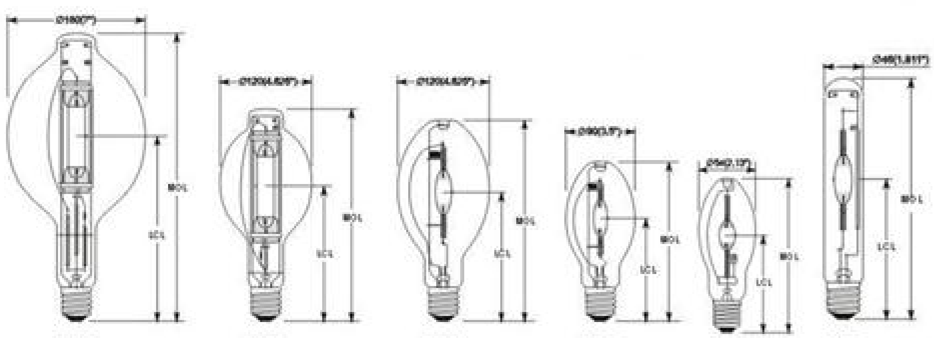
If you're going to take the LED route, this website is known to have the best prices around and ships some really high-quality powerful LED grow lights.

High Intensity Discharge (HID) Lighting

HID lighting is the most efficient & effective way to convert electricity into light that is available on the market today. There are two types of HID grow lights used for horticultural growing, and those are Metal Halide (MH) and High Pressure Sodium (HPS). This is an extremely important purchase decision(as important as choosing your strain!), so make sure you get a high quality light. Be warned, HIDs tend to produce a high electricity bill.

Note: some lights come with a phosphor coating on the outer-bulb, this enhances the yellow area of the spectrum at the expense of a few lumens. Phosphor coated bulbs will also diffuse light and reduce ultra-violet rays.

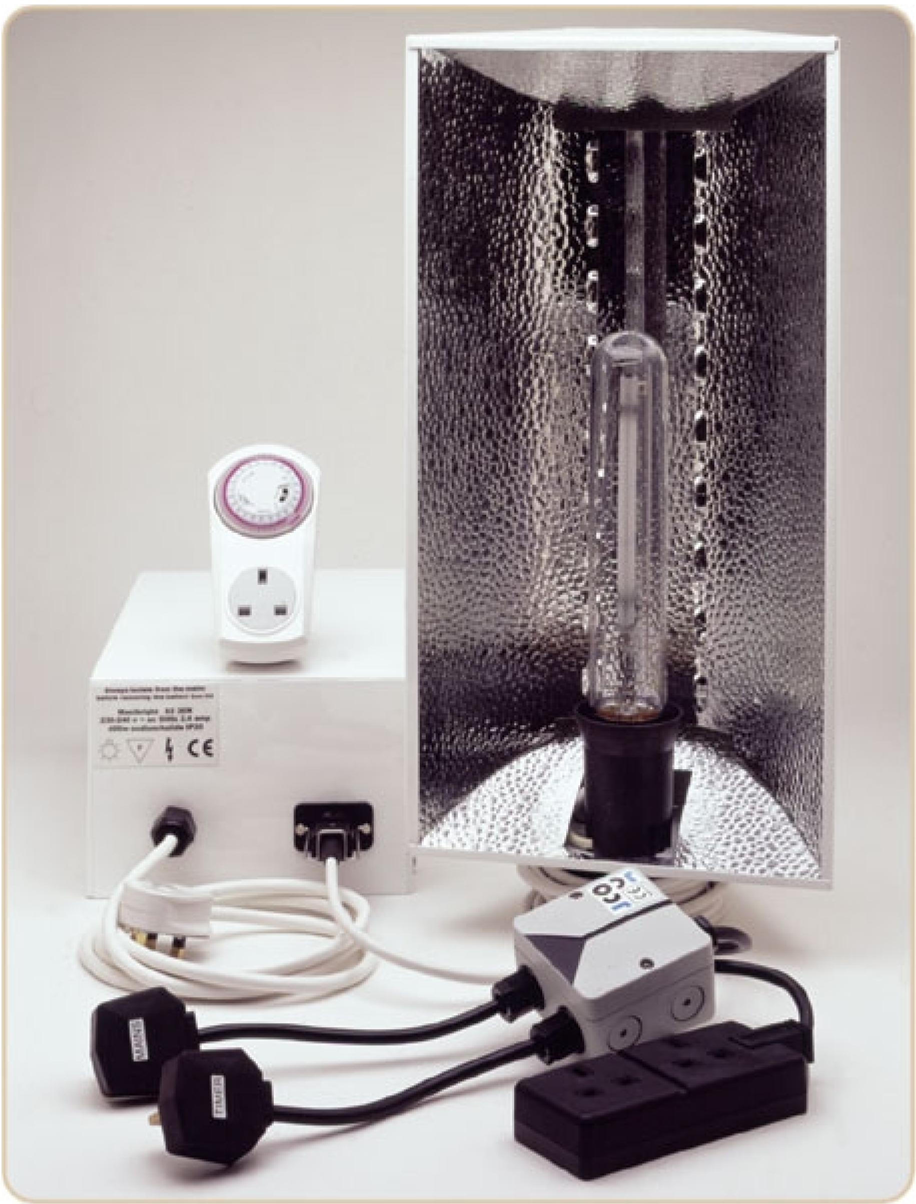
Metal Halide(MH)



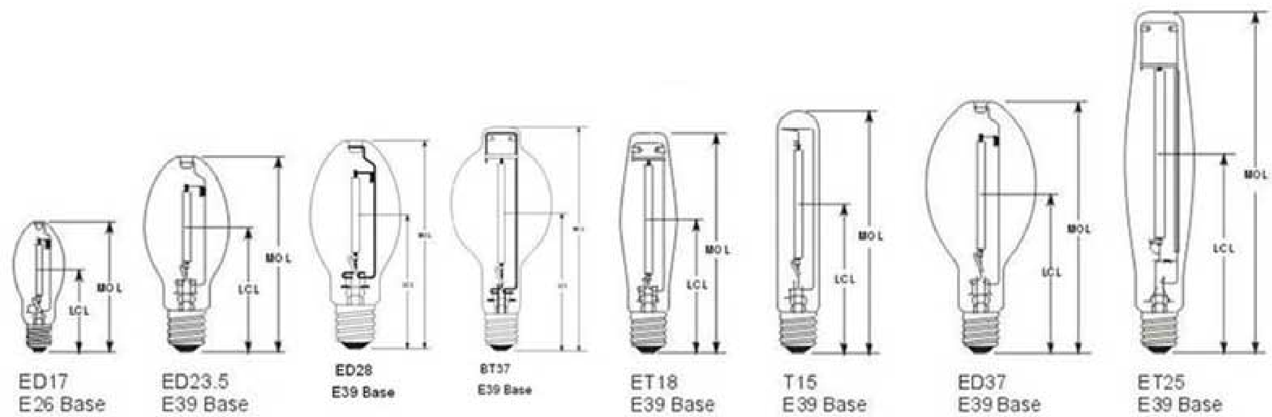
Metal Halide (MH) light fixtures produce and abundance of blue spectrum energy and are best for vegetative (beginning) plant growth. MH lamps promote vigorous plant growth, the kind of light best suited for supporting green leafy growth and keeping the plants compact. The light produced looks very similar to a "cool white" fluorescent light found in modern schools and offices today. The average lifespan of your standard quality Metal Halide bulb will be about 10,000 cumulative hours. The bulb will generally burn longer than this amount, but the amount of blue spectrum energy will gradually begin to decline after this point, so it is best not to wait for the bulb to burn out. Replace it after 10,000 hours.

Metal Halide:

- Well-balanced spectral emission.
- High lumen per watt ratio.
- Strong blue light emission.
- Ideal for vegetative growth.



High Pressure Sodium (HPS)



High Pressure Sodium (HPS) is the most popular type of bulb among growers today, and with good reason. High pressure sodium light fixtures produce large amounts of orange-red spectrum energy and are best for the flowering phase of growth, this is because this glow of light energy triggers hormones in plants to increase flowering/budding in plants. In other words, HPS lights emit the perfect spectrum for growing sparkling rich sticky potent big buds. They are the brightest indoor lights available. The light produced looks similar to the "warm" incandescent lights found in homes, but has a deeper orange-red color. The street lights you see in many cities around the world use HPS lighting.

The average lifespan of HPS lighting is twice that of metal halides, but it is important to note that around 18,000 hours of cumulative use, they will begin to draw more electricity than their rated watts while gradually producing less and less light. HPS bulbs are VERY efficient. They produce approximately 140 lumens per watt.

Their disadvantage: They are deficient in the blue spectrum. HPS lights do not contain enough blue spectrum light for abundant vegetative growth. (Ideally you would use both MH and HPS lights for both the different phases of growth.)

High Pressure Sodium:

- Mostly reddish light.
- Highest lumen per watt ratio.
- Ideal for flowering.
- Lacks blue spectrum strength.

WARNING: Be extremely careful when handling your bulbs; before using either bulb make sure you wipe them with a cloth (and screw it in with a towel), any fingerprint oil on the bulb will burn it out immediately and cause it to literally explode!!!

So Which Light Do I Get?

In general:

- **Cheap cool white fluorescent bulbs:** for germination/seedlings.
- **400 watt Metal Halide/HPS/LED:** for personal home growers.
- **1000 watt Metal Halide and HPS or LED:** for dedicated personal growers and commercial growers.

Don't use regular incandescent bulbs ("grow bulbs") or halogens to grow cannabis. Invest in fluorescent lighting(good) or HID lighting(best) which supply the high-intensity light that cannabis needs for good growth and large buds.

If you're opting for the ultimate lighting setup to produce maximum yields & quality stick frosty buds, and have the money; then ideally it would be best to use both metal halide(mh) and high pressure sodium(hps) lighting fixtures during both the vegetative and flowering stages of growth.

Growers use metal halides for small single light grow room, because when high pressure sodium lights are used by themselves – they tend to produce long thin fluffy buds. Many professional weed growers combine the lights in a ratio of 2 metal halides(mh) : to 1 high pressure sodium(hps).

Here are your choices:

1. HPS through both stages of growth (decent).
2. MH through both stages of growth (decent).
3. MH through the vegetative growth phase followed up by an HPS light through flowering (excellent).
4. Both MH and HPS light through both stages of growth (best option).

Now as far as lighting fixtures and bulbs goes, you aren't able to use a standard high pressure sodium bulb in a metal halide fixture, but you can use a metal halide bulb in a high pressure sodium fixture *ONLY IF IT IS THE SAME WATTAGE!!!*

You can purchase specialty HPS bulbs that can be used in a MH fixture and vice-versa, but these conversion bulbs generally cost double the price of a standard bulb.

If you're only able to purchase one light fixture for the time being, then you can go for getting a high pressure sodium fixture with a high pressure sodium bulb and a metal halide bulb (remember: both bulbs MUST be rated for the same wattage as your light fixture). Use the metal halide bulb for the vegetative growth phase and the high pressure sodium for flowering. When you have enough money, get a proper metal halide fixture. And don't worry if you can't afford both lights, you can still grow great marijuana with just one!

Lighting Your Plants

Ballast

HIDs cannot operate without a ballast. A ballast is a transformer used to alter the electrical current for use by the bulb. It is recommended to get your ballast along with your bulbs so that you are sure to get the right type. If you don't know very much about wiring and you don't want to burn your house down, then be sure to purchase a pre-wired kit done by the experts so all you will have to do is screw in the bulb and plug it in.

Ballasts can become very hot. You need to properly house them, if this is not possible make sure that they are on a heat-resistant surface. NEVER put them on anything flammable.

WARNING: Incorrect wiring can severely damage equipment, injure or even kill you (and start fires!). So be careful.

Light Hanger

You can use a light stand or hang your light from the ceiling using hooks and chains. Your lights will need to be adjustable in order to lower and raise them depending on the phases of growth. The closer the light is to your plants, the more light they receive and the faster they grow, but the hotter they become. Be careful because some cannabis plants can grow up to an inch a day! If the plants get too close to the light they could burn, dry out, and die. It is also necessary to be able to adjust your light due to the heat emitted from these types of lighting fixtures. The recommended distance should depend on bulb size and phase of growth.

Note: If you accidentally get a light burn, do not worry, just clip off the burnt part with a pair of small scissors and move your light to the appropriate distance.

You can build a custom light hanger using parts from a hardware store, or you can buy a pre-made kit. A pre-made kit is great as it wont set on fire or break.

After starting each day lower your light a few inches until your light is as close to the plant as possible without harming the plant. You're going to have to determine the ideal distance yourself, it varies based on reflector quality, bulb efficiency and heat generation, etc.

WARNING: Be extra careful, foliage that gets too close to the light will burn! A good general rule-of-thumb is; if your hand can't stand the light, your plants can't either.

Be sure to purchase (or build) quality lighting equipment as many growers have lost their homes in fires due to sub-par sketchy lighting systems. If you can afford a quality lighting system made for horticultural purposes with a good reflector and ballast, get it.

This is one of those things you DO NOT want to go cheap on!

(Please be safe. Check the Electrical Safety section for more information about your grow area's safety.)

Bulb Orientation

Some bulbs are horizontal, others vertical, and then there's universal bulbs. Vertical bulbs can only be used with fixtures in the vertical position. Horizontal bulbs can only be used with fixtures in the horizontal position. Universal bulbs can be used in a horizontal or vertical position. If you aren't sure what to buy, go ahead and get a universal bulb. It will work in either type of fixture, hence the name “universal”.

HPS (High Pressure Sodium) lamps can burn in any orientation.

MH (Metal Halide) lamps come in three basic types:

- **Base Up (BU):** Must be operated in the base up position.
- **Horizontal (HOR):** Must be operated in the horizontal position.
- **Universal (U):** May be operated in any position.

Orienting metal halide lamps in burning positions other than those specified can result in severe reductions in performance and potential nonpassive failure.

Lamp life, light output and color can be affected by the burning position. Some burning positions may need enclosed fixtures for safety reasons.

Remember when replacing ANY High Intensity discharge lamp, never touch the bulb with bare hands. HID lighting gets exceptionally hot and any oils from your skin left on the bulb will burn and can cause the lamp to burst.

Always use soft, clean gloves or cloth when handling the lamps.

Hanging Your Lamp/Reflector Step-By-Step

Hanging your lamp is easy!

Step 1) First you need to find a stud in the ceiling. When you have located a stud, figure out which direction they run.

Step 2) Next (optional), take a 2x4 and screw it into the ceiling using a drill with screwdriver attachment and 3.5 inch steel screws.

Step 3) After hanging your 2x4, screw “hooks and eyes” in the proper locations along the stud or the 2x4 to correspond with your reflector brackets.

Step 4) Next, if necessary hang your chains to lower and raise the light, otherwise, just hang it and you're ready to go!

Light Placement

In order to reap a heavy potent harvest, keep your plant growth within the penetration area of your lamp. It's very important for indoor plant growers to get their light source as close as possible to their plants. The amount of light your plant receives is directly related to it's yield/flower density. As the light rays get farther from the bulb they begin to disperse and become less intense

Note: This is the primary reason growers will keep plants small so that way the entire plant is closer to the lights.

Remember not to burn them!!!! Growing Marijuana is more of an art than an exact science. You will need to rely on the experience your little buds are having rather than follow set “plant height” recommendations. Use those as general guidelines, but ultimately your plants are going to determine how close you can get your light to them.

The following chart shows the optimal penetration range for most HID lamps:

High Pressure Sodium

Foot-Candles Received from varying distances.

This chart is in reference to the amount of light, not heat.

Lumen Output Of Bulb.	16,000	27,500	50,000	53,000	92,000	140,000
Wattage Of Bulb.	150	250	400	430	600	1,000
Inches From Bulb.						
4	45,837	78,782	143,239	151,834	263,561	401,070
5	29,335	50,420	91,673	97,174	168,679	256,685
6	20,372	35,014	63,662	67,482	117,138	178,254
7	14,967	25,725	46,772	49,578	86,061	130,962
8	11,459	19,695	35,810	37,958	65,890	100,268
9	9,054	15,562	28,294	29,992	52,061	79,224
10	7,334	12,605	22,918	24,293	42,170	64,171
11	6,061	10,417	18,941	20,077	34,851	53,034
12	5,093	8,754	15,915	16,870	29,285	44,563
13	4,340	7,459	13,561	14,375	24,952	37,971
14	3,742	6,431	11,693	12,395	21,515	32,740
15	3,259	5,602	10,186	10,797	18,742	28,521
16	2,865	4,924	8,952	9,490	16,473	25,067
17	2,538	4,362	7,930	8,406	14,592	22,205
18	2,264	3,890	7,074	7,498	13,015	19,806
19	2,032	3,492	6,349	6,729	11,681	17,776
20	1,833	3,151	5,730	6,073	10,542	16,043
21	1,663	2,858	5,197	5,509	9,562	14,551
22	1,515	2,604	4,735	5,019	8,713	13,259
23	1,386	2,383	4,332	4,592	7,972	12,131
24	1,273	2,188	3,979	4,218	7,321	11,141
25	1,173	2,017	3,667	3,887	6,747	10,267
26	1,085	1,865	3,390	3,594	6,238	9,493
27	1,006	1,729	3,144	3,332	5,785	8,803
28	935	1,608	2,923	3,099	5,379	8,185
29	872	1,499	2,725	2,889	5,014	7,630
30	815	1,401	2,546	2,699	4,686	7,130
31	763	1,312	2,385	2,528	4,388	6,678
32	716	1,231	2,238	2,372	4,118	6,267
33	673	1,157	2,105	2,231	3,872	5,893
34	634	1,090	1,983	2,102	3,648	5,551
35	599	1,029	1,871	1,983	3,442	5,238
36	566	973	1,768	1,874	3,254	4,951

Too Close To Bulb.
Optimal Distance Range.
Too Far From Bulb.

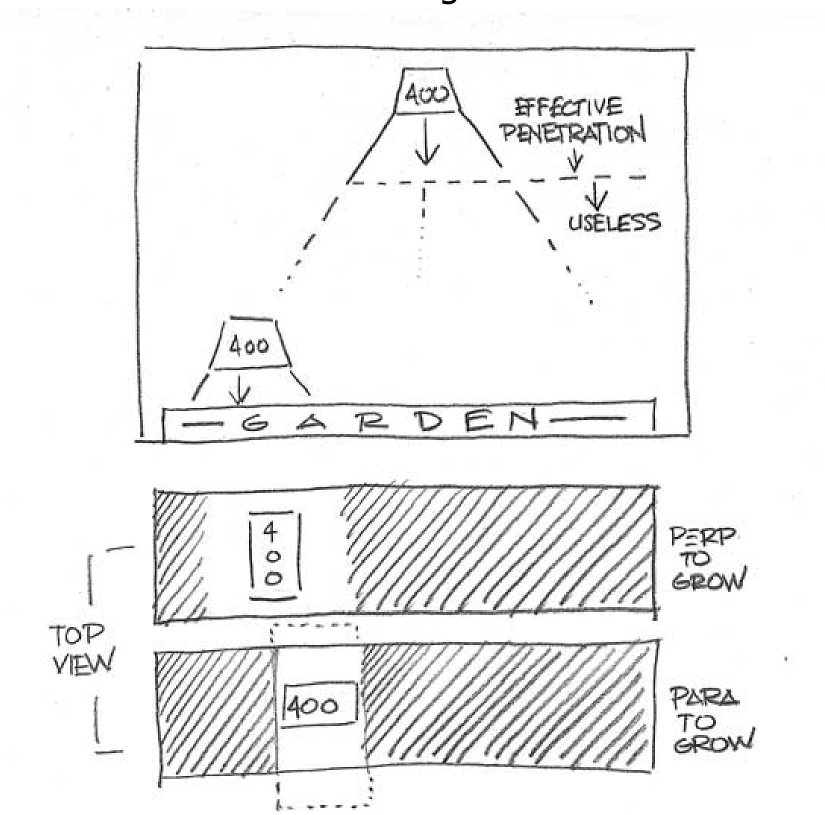
Created by: CaliGrower

Figure 1. HID Penetration Chart - Credit: CaliGrower

Optimum Lamp Height

When growing indoors, there is an optimum distance (height) between the plants and the light source. This distance fully illuminates the whole canopy with direct light from the source and is as close as physically possible to the plants for maximum lumen intensity which supports the best speedy growth. This is called the Optimum Lamp Height (OLH) where Effective Penetration occurs.

Here is a rough sketch:



Ultimately, to get the best light efficiency from your lamp, you want it at the OLH at all costs. Many growers wonder how they can get it there without causing harm to their plants due to bulb heat. There is a way to do this.

First, try moving your light to the OLH and see what it does to your plants. If they have no problem, then you're fine. If you have a high output HID, this probably won't be enough, keep going.

<u>WARNING</u>: If the parts of the plants closest to the light start to turn brown and dry out, raise the height of the light source IMMEDIATELY, as they are too close.

Next, try actively exhausting your light hood by hooking up a direct exhaust system to the hood, and then move your lamp to the OLH and see if the plants are O.K. If the plants still seem affected by the heat, then you must add glass to your actively exhausted lamp hood. Glass will absorb/reflect/filter some of the light-heat energy being emitted by the lamp.

The number of effective filtering would be relatively low, around 2-3% of wattage, but it will effectively filter out almost all of what little UV-B is emitted by the lamp and a great portion of the heat. UV-B control is believed, and has been shown, to have a positive influence on the potency of Cannabis.

Light intensity is directly related to yield and flower density.

Almost all glass offered today for insertion in air-cooled lamp hoods is tempered glass, which is regular glass with low amounts of impurities. If one was looking for the most efficient glass for their hood, quartz glass will allow the transmission of UV-B, but is not made specifically for light hoods. Finding a custom quartz glass can be tough work, but it is the best option if you are looking to make the best buds on Earth.

And also remember, that if you have a rectangular garden, it is important to position the longest side of the reflector parallel to the shortest side of your garden.

You should periodically inspect and clean your light hood and bulbs, especially after foliar feeding or underleaf spraying for insects. The dust and dirt that collects will definitely decrease reflectivity. Isopropanol alcohol, glass cleaner or water (and a soft cloth) can all be used to remove streaks, dust and spots.

Bulb Heat Proximity

There are a number of factors which play a part in the temperature radiated from your bulb (i.e. watts, hood design, and air circulation).

A simple method of testing for temperature is to use the back of your hand; if its too hot for your hand, it's too hot for your plants. Good ventilation is the key to getting your light closer to the plant tops.

Recommended typical Optimum Lamp Height distances:

- **Flourescents:** within proximity.
- **400 watt HPS:** 1 feet.
- **600 watt HPS:** 1.5 feet.
- **1000 watt HPS:** 2 feet.

And here's a rough guide for when first starting out:

- **Fluorescent:** Tips of leaves almost touching bulbs.
- **400 watt Halide:** Two feet away from seedlings and one foot away from grown plants.
- **1000 watt Halide:** Four feet away from seedlings and two feet away from grown plants.

Light Bending/Stretching

Light bending happens when your plant tries to grow at an angle towards your grow light. The problem is if your plants excessively begin to grow at an angle they may eventually grow towards and into another plant. This is bad because your other plant will then be smothered and not receive enough light. Also, during Flowering the buds can get really heavy and fall over. In order to avoid light bending be sure to switch your plants around accordingly. If your plant is bending too much one way, simply move it around. It shouldn't take more than a day or two until your plant straightens up. If you can't move your plants like in a most hydroponics systems, then you can tie your plants up so that they don;t bend. If growing major outdoor plants you can use mini Bamboo poles, PVC pipe, a garden stake, toothpicks, (even chopsticks will work!) etc.

Note: Bending plants are a loud warning sign from your plants - they need more DIRECT light! Bending is different than wilting, which is an entirely different issue

Light stretching happens when your plants aren't placed close enough to their light source. If your plants are too far from the light source they will grow very tall and skinny searching for more light. This is bad because then the nodes will develop fewer and farther between. That means is fewer sites for buds to grow. Keeping your plants closer to the light source will encourage them to remain bushy and more compact. This is ideal for MAXIMUM bud production. Remember, the closer your marijuana is to a light source the better it will grow!

Focus the light on your plants where exactly they need it the most. Areas such as tops that are the closest to the light source will produce the largest, most potent buds. Light stretching is all-too-common and occurs when plants crowd each other for canopy space. Lower parts of the plant will tend to stretch as high as a higher ratio of infrared light, rather than direct red light, reaches the lower canopy. This can be prevented by reflecting light from the floor to target lower plant sections. This unfiltered light is higher in red spectrum energy, counteracting the stretching effects of the infrared light. You can achieve this by covering the floor of your garden with some sort of reflective material or painting it a flat white. Also be sure to space the plants out properly. Due to most of the light in your grow area hitting the floor, covering your floor with Mylar or painting it a flat white will greatly increase the amount of light received by your plants. This will also prevent stretching because the lower canopy is being properly illuminated.

(Please refer to the Lighting and Setting up Your Grow Room sections for proper illumination guidelines.)

Reflectors

Light bulbs are spherical, tube-like, or egg shaped. Observe how these shapes direct the light out from the bulb, in all directions!!!! This means HALF of your precious light will be wasted by being directed it upwards out of the top of the bulb, away from your plants. There are two methods to ensure maximum light efficiency.

The first is to position your bulbs in between the plants (hanging from the reflective coated ceiling socket-up) so that the base of the bulb is below the tops of your plants. This will make sure all your light is being directed at the plants in all directions and any upward bound light will not be wasted. This method is good for large, multi-light gardens with very large plants.

The next method is to position the bulbs above the tops of the plants and use a reflective hood to reflect upward bound light back down. The closer the reflector is to the light, the more intense the reflection will be. This method allows the grower to concentrate more light to one plant area. Reflectors come in many different shapes and sizes, some being more effective than others. Retailers usually tend to sell them along with the bulb in a complete package. Remember, don't go cheap on ANY part of your lighting setup if you want high yields and stellar potent bud.

Note: Clean your light reflector constantly. Dirt and grime can leach as much as 15% of your light!

Also before making your final purchasing decision be sure to take these factors into consideration; a hard or shiny white and mirror images are going to create massive hot spots as well as any folds or bends in the reflector. The best reflective surfaces are either a dull or matte finish, a pebble finish, an aluminum, or a silver.

Titanium whites are very good and tend to be the brightest.

WARNING: Do not EVER use a cone-shaped hood! These are the most ineffective, inefficient hoods ever created by all mankind, ever.

Horizontally oriented lamps are more efficient for several reasons and should be seriously considered as the grower shops for a good light solution.

In a horizontal lamp arrangement, the arc tube that produces the output is oriented with its full length exposed to the reflective hood insert and plants. This provides excellent efficiency due to a proper direct and indirect lighting arrangement.

The reflector should be small (for reasons already stated) and should be well designed with a gull wing insert which uses a quality baked-on white enamel designed to resist discoloration from the adverse affects of heat over time. A much better solution is to choose a corrosion resistant specular aluminum insert. The use of quality specular material is the way to go regarding getting the most from your investment.

Bulbs Matching Ballasts

Ballasts and bulbs should be matched. HID bulbs generally need specific ballasts, and any given ballast can usually safely and effectively operate only one type or a few types of HID bulbs.

The bulb wattage must be matched to the ballast. A smaller bulb will usually be fed a wattage close to what the proper bulb takes, and will generally overheat and may catastrophically fail. Any catastrophic failures may not necessarily happen quickly. A larger bulb will be underpowered, and will operate at reduced efficiency and may have a shortened lifetime. The ballast may also overheat from prolonged operation with an oversized bulb that fails to warm.

Even if the ballast and bulb wattages match, substitutions can be limited by various factors including but not limited to different operating voltages for different bulbs. Examples are:

Pulse-start sodium lamps often have a slightly lower operating voltage than metal halide and mercury lamps of the same wattage, and ballasts for these sodium bulbs provide slightly more current than mercury and metal halide ballasts for the same wattage would. The higher current provided by the pulse-start sodium ballast can overheat mercury and metal halide lamps. Mercury and metal halide lamps may also "cycle" on and off in lower voltage sodium ballasts, such as many 50 - 100 watt ones.

Metal halide lamps have an operating voltage close to that of mercury lamps in many wattages, but have stricter tolerances for wattage amount. Also, metal halides usually need a higher starting voltage. Most metal halide lamps 100 watts or smaller require a high voltage starting pulse around or even over 1,000 volts. 175 to 400 watt metal halide lamp ballasts can power mercury lamps of the same wattage, but the reverse is not recommended.

Mercury lamps 50 to 100 watts will work on metal halide ballasts, but hot re-striking of mercury lamps 100 watts or smaller on metal halide lamps may be hard on the mercury lamp since the starting pulse can force current through cold electrodes and the starting resistor inside the mercury lamp.

1000 watt mercury lamps come in two operating voltages, one of which is OK for 1000 watt metal halide ballasts. A few wattages of pulse-start sodium come in two voltages. A low voltage lamp in a high voltage ballast will be underpowered, resulting in reduced efficiency, possible reduced lamp life, and possible ballast overheating. A high voltage lamp in a low voltage ballast will usually cycle on and off, operate erratically, or possibly overheat. This will usually result in greatly reduced lamp life in any case. One class of sodium lamps is made to work in mercury fixtures, but these only work properly with some mercury ballasts. Certain sodium lamps may suffer poor power regulation and accelerated aging in the wrong mercury ballasts, especially after some normal aging changes their electrical characteristics. Also, these lamps may overheat and will probably have shortened life with pulse-start sodium ballasts.

Many sodium lamps require a high voltage starting pulse provided only by ballasts made to power such lamps.

To prevent dangerous accidents keep remote ballasts away from tap points and on an elevated position (approx 5 inches off the floor) using a block or shelf.

A switchable ballast allows you to run a standard halide or sodium bulb from one ballast, you just insert the appropriate lamp and set the switch to the correct operating setting

This type of ballast enables growers to bypass costly conversion lamps and maintains the higher light output from non conversion bulbs.

Conversion Bulbs

A Conversion bulb offers you the opportunity to switch the bulb in your Halide or Sodium fixture without changing ballasts.

Many cannabis gardeners prefer Halide light for vegetative growth and a Sodium light during blooming but a separate fixture is normally required. A Conversion bulb is a convenient option when you only have room for a single fixture but want the advantage of both Sodium and Halide lighting.

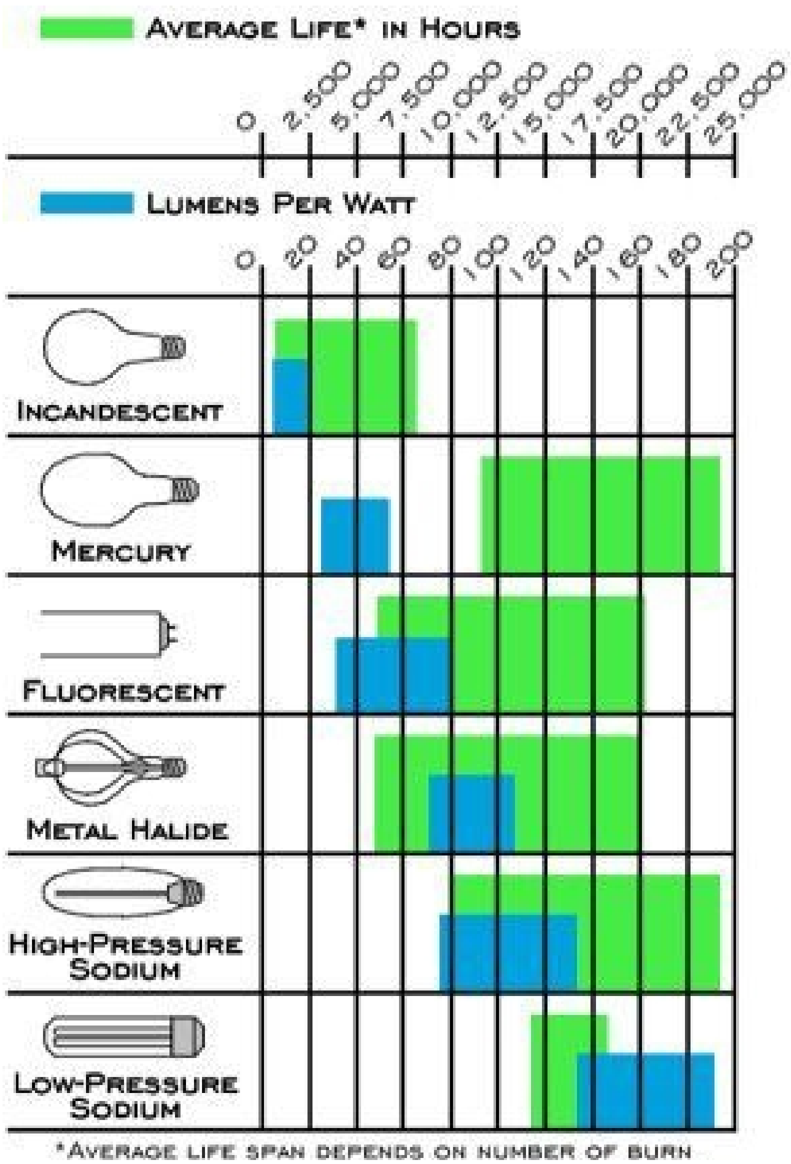
Note: High intensity Discharge conversion bulbs are system specific. Sodium conversion bulbs are designed to be used in metal halide or mercury vapour fixtures only. Halide conversion bulbs are designed to be used in high pressure sodium fixtures only.

Replacing Bulbs

Bulb replacement really depends on what type of lamp you're using. These recommendations are based on 18 hours of daily use:

1000w (MH) Lamps	12 Months
1000w (MH) Lamps "son agro & warm deluxe"	15 months
1000w (MH) Lamps "u cool deluxe" 6500k	12 months
400w (MH) Lamps	18 months
400w (MH) Lamps " u cool deluxe" 6500k	15 months
250w (MH) Lamps " u cool deluxe" 5400k	12 months
175w (MH) Lamps daylight bulb 5500k	15 months
All regular 75w - 250w (MH) Lamps	15 months

Replace all HPS after 24 months, with the exception of the son agro and super agro, replace after 15 months. Fluorescents should be replaced every 15 months. After 12 months, check the tubes if running more than one tube on a single ballast. Always replace all fluorescent tubes at the same time. Remember to always write down the day that you start using a new HID lamp. This will allow you to calculate when to replace it for optimal results.



Electricity

If you plan on using a 1000w or more than one 400 watt and one 600 watt lamp, then you should carefully consider the electricity available in your home. HID lights draw enough power to blow fuses or switch breakers if they share the same circuit with other household appliances.

Electricity comes in from the street and is dividable into useable circuits. (Can be seen inside your circuit breaker located on the side of your home.)

Depending on the size of your home and the construction the number of circuits can be as little as 2 to 3 and up to as much as 20 or more separate circuits!

A fuse or breaker switch will regulate the amount of electricity (measured in amps) that will be available to that circuit. Household circuits are generally set at 15 amps. Electrical devices all come with their own amp rating, which determines how much power they will draw. This can be found usually on a label or in the documentation that comes with the electrical device.

You can use multiple devices on any given circuit as long as their amp rating does not exceed 15 (or whatever your circuit breaker is set to).

A single 1000w HID light bulb + ballast will use about 9 amps.

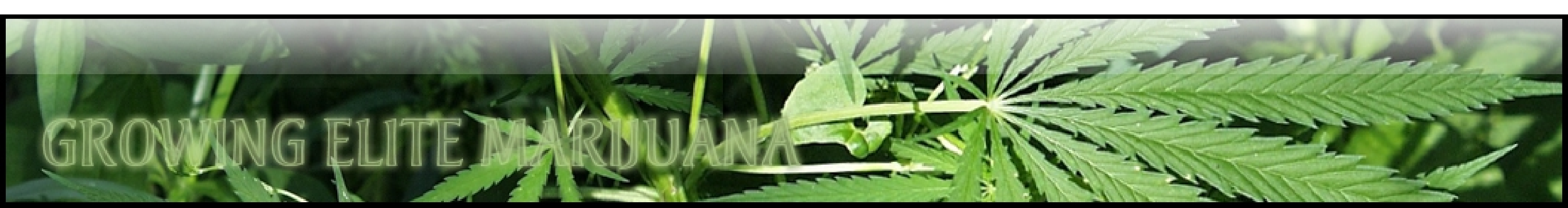
Converting Watts to Amps

Watts divided by voltage (W/V) equal amps. A 400 watt ballast plugged into ordinary house current (120v) would draw 3.33 amps. Using a little math we can see then: Voltage = Watts / Amps.

A lot of growers wonder how many lights/watts they can I put on a standard 15 Amp service. The rule of thumb is to only load a breaker up to 80% of its capacity. On a 15-amp service with 14/2 gauge wire one should only load it up to 12 Amps MAX. Since most lights will draw 1 amp per 100 watts a 15-amp breaker can handle one 1000 watt light each.

This brings up another point in regards to indoor growing – it is always good practice to have the fans and the light that they cool on the same breaker. That way if the breaker is somehow tripped then both the light and its cooling system are down. Instead of the cooling system for the light going down and the light still shines away because it was on another breaker.

The above figures are estimated based on 110V supply. Purchasing a CAT III meter before doing any electrical work is a sound idea. It will allow for safe testing of the circuit before commencing work. A clamp meter is also handy for testing how many amps the circuit is drawing without having to break the circuit



to do so, great to see if you get a peak when your lights first come on or just how many amps a given device is using.

Ground Fault Circuit Interrupter (GFCI)

A Ground Fault Circuit Interrupter (GFCI) is a device to protect against electric shock should someone come in contact with a live (hot) wire and a path to ground which would result in a current through his/her body. The GFCI will trip in a fraction of a second at currents well below those that are considered dangerous.

WARNING: A GFCI is NOT a substitute for a fuse or circuit breaker as these devices are still required to protect equipment and property from overloads or short circuits that can result in fire or other damage.

GFCIs can be installed in place of ordinary outlets in which case they protect that outlet as well as any downstream from it. There are also GFCIs that install in the main service panel.

If you are growing a hydroponics grow, there is no doubt that you need a GFCI. Any place where it is likely or possible that someone may be standing in a puddle of water and will come in contact with a plugged in electrical device needs a GFCI.

Converting Sockets

Some growers face a problem. The circuit which goes into their grow room only has two wires, but their light has a 3 prong plug! What should they do?

For starters they shouldn't use one of those adapters that converts a 3 prong to a 2 prong unless they know for certain that the socket has been properly grounded.

They can install a new breaker in the service panel and run 3 wire Romax to their grow. Then they can install a 3 prong outlet (preferably a GFCI).
Buying a basic wiring book and following the instructions EXACTLY is crucial here. In fact, one would do better hiring a professional electrician to do the job. Compared to hospital costs they are pretty cheap.

The Cost To Run

In order to determine the cost of your lighting setup, you need to know three things:

1. Watts: The wattage of the appliance
2. Hours: The duration it will be on.
3. Dollars: How much electricity costs.

Electric companies charge by the kilowatt / hr.

Say you use a 400watt HID light, and you run it for 18 hours at .06 cents a kilowatt, it would be 400 x 18 x .06, divided by 1000 = .432 (43 cents). This will give you the cost per hour of your light.

The average cost of running a 1000 watt light on 12/12 is about $20-$30 a month in electricity.

Watts	1x400W	2x400W	1x1000W	1x400W 1x1000W	2x1000W	1x400W 2x1000W
Hours	400	800	1000	1400	2000	2400
10	120	240	300	420	600	720
12	144	288	360	504	720	864
14	168	336	420	588	840	1008
16	192	384	480	672	960	1152
18	216	432	540	756	1080	1296

Reducing Your Wattage & Electric Bill

Suddenly spiking your electric bill is never a good thing as this may send up a red flag. Utility companies can tell your bill is way off from the same time last year, and growers are being found this way. When moving into a new place, immediately establish patterns of high electricity usage.

Here are some great tips you can use to offset and reduce your wattage and electric bill each month:

- Add a timer to your hot water heater. You can obtain one of these at your local hardware store. The installation info is easily available (or have an electrician do it - it's a common request).
- Turn off any lights or other electronic devices when you leave the room! You don't want to waste any wattage. This one single tip if adhered to can save you lots of money and wattage each month like you wouldn't believe.
- Be sure to check the temperature your hot water heater is running. This can be viewed at a small dial right usually behind that small cover on the front. Some factory settings are ridiculously high and waste precious electricity heating to extreme amounts.
- One great solution many growers have used effectively is to use outdoor natural sunlight for flowering and use continuous light indoors for germination and vegetative growth. This takes advantage of the natural light/dark cycle and can cut your energy use in half compared to the same operation indoors. You can build a small greenhouse using fiberglass or PVC sheets that looks like a small storage shed or tool shed that will not raise any suspicions.
- Add a water heater "blanket" - available at any home improvement or hardware store. This will greatly assist the water heating process, conserving lots of electricity.
- Insulate the hot pipes running out of the water heater. Same as above.
- Check the caulking on all your windows and doors. Air leaks add up to extra heating / cooling costs. If you can afford it, replace your windows

with newer, more energy efficient models.

- If you live in a very hot climate, it is advisable to apply a to tint the windows that get the most direct sunlight and heat during the day (east, west and south windows).
- Unplug any dryers, washers or other large unneeded appliances that draw a lot of electricity.
- Shower at another location such as the gym if possible.
- If you have an attic, install an attic fan. This will save your overall cooling costs a lot in the sultry summer months.
- Install, or have installed, a programmable thermostat. It is a complete waste to waste electricity on keeping the house too cool or warm when no one is home.
- Add insulation to your attic. If your house is older and you (or someone else) have been up there crawling or walking around for years, your current insulation may be compacted (that's a bad thing). Check your local yellow pages to have someone come out and blow in some more insulation. It's not cheap, but not as bad as you might think. And it will save you lots of money on heating and cooling bills.
- We have heard of some people steal their neighbor's power through extremely careful stealthy wiring but we do not recommend this at all. Stealing power can cause a huge risk and create even more unwanted exposure than paying for it! Not to mention stealing what is not yours is morally wrong and as Maximus from Gladiator says, "What we do in life echoes in eternity." :)

WARNING: Electrical Safety

There is nothing worse than coming home to a burned down house for not implementing the following effective safety precautions. Please be safe!

- Keep electronic hardware and cables organized and away from areas where you can trip on them. Make sure you keep all electrical devices and cables away from water.
- Place smoke alarms inside and out of your grow room. If your grow room is in an attic or basement, make sure you will be able to hear the smoke alarms going off from other rooms in the house.
- Safety glasses or goggles should be worn whenever power tools are used, especially if you wear contact lenses.
- Make sure the power is off at the breaker box before doing any electrical work.
- Always work in a clean, dry area free from anything wet.
- Wires should only be connected at accessible junction boxes (containing fuses and other protection). Never splice wires together and conceal them within a wall without a junction box.

- Never attempt to strip wires with a knife. Aside from endangering your fingers, you will nick the wire metal, which will create an electrical hazard.
- Ground fault circuit interrupter outlets should be used under damp conditions (basements, bathrooms, outdoors, etc.), as required by the National Electric Code.
- Don't create fire hazards by over-loading an outlet with too many lights or by using an extension cord. Running too many lights on an ordinary household circuit can be VERY dangerous and can easily start a fire.
- ALWAYS have a full fire extinguisher nearby and know how to use it in case of an emergency.
- Avoid electrical shock by mapping and marking your switch and outlet boxes. Put the map on the door of the main power service panel.
- Leave a warning message that you are working on the circuit at the service panel, and tape the circuit breaker in the off position. With a fuse box, take the fuse out.
- Never change the size of a fuse or breaker in a circuit.
- Be certain your connector is CO/ALR rated when you splice aluminum wire. If it is marked CU/ALR, use only copper wire. Do not use aluminum wire with push terminals; use only copper or copper-dad aluminum wire.
- Always correct the problem that caused a fuse or circuit breaker to blow before replacing the fuse or circuit breaker.
- Replace wiring that shows signs of fraying or deterioration.
- Avoid breaking your knuckles by bracing the powerful right-angle drill so that it cannot spin around if it gets stuck while drilling.
- Before working with wires or electrical connections, check them with a voltage tester to be sure they are dead.
- Plumbing and gas pipes are often used to ground electrical systems. Never touch them while working with electricity.
- Don't use metal ladders with overhead electricity.

- Never ignore safety to save money or to rush a project.
- Use the proper protection, take precautions, and plan ahead.

Be safe, and remember; it <u>CAN</u> happen to you!

Lighting Schedules

As you can recall, at different stages in a marijuana plant's growth cycle it requires varying amounts of lighting. Marijuana regulates it's growth and flowering stages in response to the hours of daylight and darkness.

Seedling Phase: Plants receive 16-18 hours of light each day.

Vegetative Growth: In this vegetative growth stage the plants will receive light 18 to 24 hours per day. The longer it is on, the faster the plants will grow.

Flowering: 12 on, 12 off. Total and complete uninterrupted dark period. Ensure that your environment is *completely* dark during the dark cycle (12 off).

Note: In Veg 24 hours is best. In the words of famous Ed Rosenthal:

"Cannabis under continuous light will grow 33% faster than the same plants on an 18-6 light regime."

Lighting Timer

You will need to purchase a lighting timer that will turn your lights on and off automatically respective of their lighting cycles (dependent upon what phase of growth the plant is currently in). If you're using fluorescent lighting, then you can use any standard light duty grounded timer. Fluorescent lighting doesn't take up much power.

If you are using High Intensity Discharge lighting then you're going to need to get a heavy duty grounded timer. You can find these industrial-grade heavy duty timers in any hardware store. Heavy-duty timers are strongly recommended primarily due to their durability, quality, safety, and longevity. A decent one will last you a very, very long time.

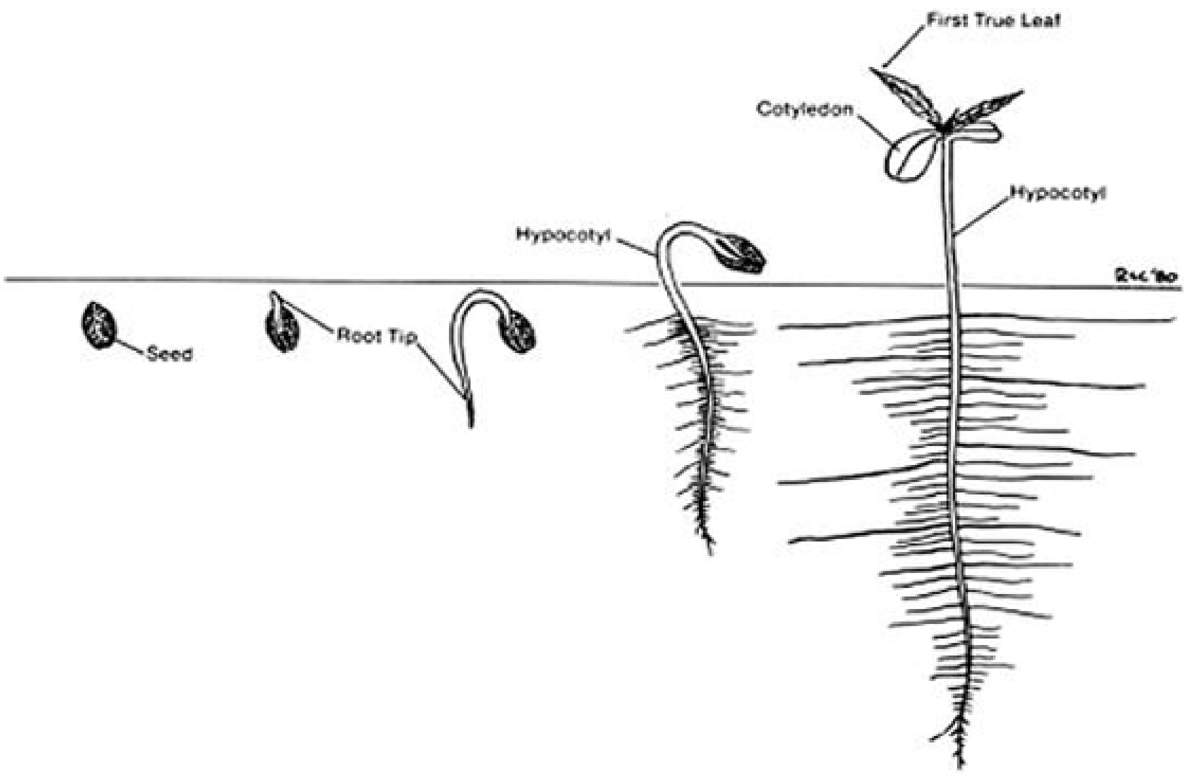
After you make your lighting timer purchase, all you need to do is set it properly according to whatever phase of growth your plant is currently in – it automatically handles the rest. That way you can relax and enjoy watching your buds grow without stressing about turning on and off the lights at proper times.

4

GROWING MARIJUANA

Germination

Once you have decided that it is time to use your seed to grow a plant, you will have to initiate plant growth by germinating the seed. During germination moisture, heat, and air activate hormones within the durable outer coating of the seeds. Soon, the seeds outer protective coating will crack and the root (a tiny white sprout) is pushed downward outside. Next, seed leaves emerge out from within the shell as they search upward in search of light. Soon after a seedling is formed. Regular mineralized spring water contains all the nutrients a seed needs in order to germinate properly. Once the seeds sprout fertilizer is then added 2-4 weeks later.



The first thing you need to know is to expect out of 10 seeds approximately 2 will germinate into strong healthy female plants (the end goal). The rest will be male, weak, or not germinate at all. Please note that seeds that are stored too long will germinate slowly and have a higher failure rate. Most healthy vigorous seeds will begin to sprout within 2-7 days. Some seeds may take even a month to germinate, even if the best conditions are met! But these will probably grow very slow. At least half your seeds will have germinated by 21 days.

As the seedlings mature, remove any sickly, male, and underdeveloped plants from your garden. Focus your attention on caring for the strong female plants that have the potential to create for you a massive rich harvest. The next step is to select the best mother plant for the cultivation of super clones.

Cannabis seeds need only water, heat, and air to germinate. They do not need fertilizer, extra hormones, or any light (right now). All the plant needs at this time is contained within the tiny seed.

Properly germinated seeds (ideally strong, mature and under a year old) will sprout in 2-7 days when kept moist at 70-90°F (21.1-32.2°C) with pure water.

Unfortunately sometimes your seeds will not germinate. With high-grade cannabis seeds costing so much money, it is extremely important (and not to mention cost effective) that you pay very close attention to this section. Misinformation and bad technique are often used in cannabis seed sprouting. Fortunately, the information presented here for you is literally what I have found to be the most successful ways of germinating marijuana seeds. This information will allow you to get the highest germination success rates possible.

Cannabis seeds can be stored for up to 5 years in a cool dark place with relatively medium humidity. But they do go bad, so germinate early!!

Note: if you buy your seeds from a quality seedbank, you have a right to expect that close to 100% of them will germinate (if guidelines outlined below are followed) and breed true to the variety you have selected.

For soil simply place your seeds 3/8 of an inch deep in soil. One fresh seed per each pot. Keeping the seeds moist is critical. The water activates hormones within the seeds and begins the enzymatic seed sprouting process.

Most growers will plant twice as many seeds as they need, because generally half (or more) of their plants will turn out to be male, which will then be eliminated from their garden. This gives rise to Sinsemilla plants (unpollinated female plants – the ultimate harvest). Sinsemilla is Spanish for "without seed".

As far as lighting goes, delicate sprouts are placed under lights about 6 ft. from a 400W HID and about 8 ft. from a 1000W HID. Keeping the sprouts and seedlings at a temperature of about 75-80°F (23.8-26.6°C) is BEST.

A warm, moist growth environment breeds high germination success. I recommend you get a growth mat, or germinate in the warmer months.

When the appropriate conditions are given to the seed for an adequate length of time, the plant will sprout a root. After the root is about a quarter of an inch long the seed can be placed in it's new home environment where it can grow.

If you are going to be growing marijuana in soil, you can germinate the seed directly on the spot where it will grow. Simply place the seed where you want the plant to grow and cover it with about a half inch of loose soil. Press down firmly, but don't compact the soil or else you risk decreasing its' oxygen supply!

Keep the soil around the plant moist (not soaking wet) by spraying it with water aged for at least 3 days in a hand sprayer. Keeping the seed moist but not wet by spraying it may not be possible especially if you are growing outdoors. So you may wish to germinate your marijuana seed indoors using the method described below.

Temperature

Regular room temperature (approximately 60-80°F[15.5-26.6°C]) is suitable for seeds that originated in a colder climate, but a higher temperatures are necessary to ensure optimal speed and health when germinating and growing some seed strains that originated in areas where it is very warm all year long.

If you have no freaking clue where your seed originated from, not to worry, just try germinating a single seed at room temperature (78°F [25.5°C] being the best). If your seed doesn't sprout, try germinating it at (10°F [-12.2°C] hotter, or perhaps a little colder until you find out what temperature works best.
The majority of growers feel that 75-80°F [23.8-26.6°C] is the absolute best temperature range for high germination rate success, myself included.

Air

Air (oxygen) is a critical factor to take into account when germinating your seeds. Quality fresh abundant air is a crucial component for germination and general vigorous marijuana plant growth. If your grow medium is too soggy and moist it will literally drown the seed by cutting off it's air supply. Also planting seeds too deep can cause this poor germination to happen as well. A general guideline is to plant the seeds twice as deep as the width of the seed.

Germinating Techniques

Germinating a marijuana seed is comprised of supplying the seed with moisture and keeping it in a dark place that has a fairly consistent warm temperature. You must learn and understand proper germination techniques (and do it right) in order to get a high percentage of successful sprouts. In nature, seeds germinate underground where it is dark and moist, usually in the spring. Before planting seeds, they can be soaked in water (or a vitamin mixture); this speeds germination. When growing in soil you can will soak them for one day.

There are many different ways of germinating seeds, depending on the growth environment. For example, if you are growing marijuana hydroponically, you can germinate the seed directly on a small piece of the media that will be used in your hydroponic garden, such as rockwool.

Note: If you're a first time grower and you bought for example 10 seeds, for your first time start off with only germinating 3 for the first week, then once you get the hang of it, go for all of them.

Soaking

In this method, the grower places his/her seed(s) in a cup of some sort, which is filled with warm water.

Materials: Cup/mug (one that retains heat well; i.e. ceramic coffee cup), plate/dish/lid (big enough to cover cup/mug/etc.), warm pure water.

Procedure: Place the seed(s) inside the cup filled with warm water. Next, cover it with a ceramic plate (this will prevent heat from escaping, as well as shield the seeds from light).

For best results, use water that is a bit warmer than room temperature. This will compensate for any drop in temperature. It is normal for the seeds to float on the surface; just let them soak for a while then give them a little tap to make them sink (the best, most viable seeds will sink to the bottom). Although it is hard to accidentally over-soak, it's worth mentioning that seeds using this method should only be soaked until the taproot has emerged.

This method is extremely effective if executed correctly. Most seeds should show their taproots within 24 hrs., and all seeds should show taproots within 48 hrs. (assuming you are using good, viable seeds).

Crucial Tip (for soil-growers): If you want to further increase your germination rates, simply plant your seed(s) shallow; approximately 1-2 cm. deep. The seedling(s) should break the soil-surface within 24 hrs., or 48 hrs. for the most (again, assuming you are using good viable seeds – otherwise, it may take another day or two). Once the seedling(s) has/have sprouted, add a little extra soil at the base of the stem(s) for additional support and root-protection.

You can prepare the seed by soaking it in a glass of lukewarm water overnight, keep it room temperature and stable, for 12 - 24 hours, and if the seed has sprouted put the seed so the sprouting points downwards, i.e. the crack in the seed should face downwards. Make sure the seeds get nice and soaking wet to activate growth hormones.

Once soaked your seeds are ready to be placed between moist paper towels to sprout or they can be planted in a medium such as a rockwool cube.

WARNING: DO NOT soak seeds more than 24 hours. They may get too wet and suffer from oxygen deprivation and rot.

Note: Many professional weed cultivars have a secret; they claim that if you put the seed in Gibberellic acid and the seed is more likely to produce a female plant.

Germinating In Soil

Put soil in a pot and pour water until water fully drains out of the bottom of the pot. Poke a hole, around ~0.4" deep in the soil with a pencil. Put the seed in the hole and cover the hole gently with dirt. Spray the surface with water, and continue to do so. Place the pot in room temperature (78°F[25.5°C] is best) and keep on spraying the soil with water until you see the sprout emerging.

Take care so you don't drown the plant at this stage. The seed will germinate in around 5-7 days.

Propagation Kits for Easy Germinating

Another method is to purchase a propagation kit. This functions like a miniature greenhouse. The seeds are placed in tiny holes in rockwool cubes and then the germination hormone that comes with the kit is added, followed by the closure of the unit's cover. You can also use this kit to help root your clones with ease.

Propagation kits tend to have a very high success rate (oftentimes 100%). They are inexpensive, but you can make your own! Old water-bottle cases work perfectly. You know, the cardboard/plastic ones. Just get a hold of some seedling pots and you can use it as your mini-greenhouse. This is essential for amplifying germination success because these containers can hold the moisture in. Adding a heating pad underneath is essential in colder weather, or else your seeds might still think it's winter and remain dormant.

Paper-Towel Method

Materials: Paper-towels (at least 2 sheets), 2 plates/dishes (or similar object), warm water.

The Method: The paper-towel method involves placing the seed(s) onto a damp paper-towel (which is placed on a plate/dish, or similar object), and covering them with another damp paper-towel. Boil some water and run it all over the plate to kill any bacteria or germs. Run some boiling hot water over the paper towel also, but make sure it doesn't fall apart. Then squeeze the paper towel until it is damp but not dripping wet with water.

It is imperative that you use water that is warmer than room-temperature. This will compensate for any drop in temperature. Next, cover the plate/dish with another plate/dish/bowl (to prevent heat from escaping, as well as protect the seeds from light). The bowl should cover the paper towel so that no sunlight gets in.

Also, using more than one sheet of paper-towel above and below the seed(s) will yield better results, as well as adding more warm water to the paper-toweling/bottom dish before covering the whole arrangement with the optional second plate/dish/bowl.

WARNING: It is imperative that the seeds are removed from the paper-toweling as soon as the taproots have emerged. If the seeds are left to soak for too long, delicate micro-roots can be torn when the seeds are removed from the paper-towel, which will temporarily retard germination/growth as well as stress the plant (which could possibly result in an unfavorable male or a dreaded hermaphrodite).

WARNING X2: NEVER LET THE SEEDS DRY OUT!!! Water the cloth and keep it moist. Let the excess water drain away freely and keep it in the dark. The cloth will retain enough moisture to germinate the seed in a few days or so. If fungal attacks are a concern you can water with a mild two-percent fungicide or bleach solution.

Figure 1. Germinating Seeds Placed on a Warm Surface

Germinating Using The Peat Briquette Method

This is a great method! It's super easy to handle, little risk of damaging the sprouting and easy to maintain the moistness:

Step 1) Take a peat briquette, and put in water and let it swell. When the briquette is done swelling, put one seed in the hole in the middle. Wait for the seed to grow. Don't let the briquette dry out, add water when necessary and keep the briquette at a warm place 95°F (35°C), preferably in a box with a lid to keep a warm environment. Open the lid very once and in a while to let new oxygen in. When roots have sticking out, it's time for replanting. Put the peat briquette in a pot and cover the briquette with soil.

Germinating In Rockwool Step-By-Step

Germinating in Rockwool is one of the most widely used germination methods done today. The great thing about starting on hydroponic media (such as rockwool) is that once the seed germinates then you can place the media containing the seed directly into the garden without touching the seed itself. This is a good idea because a minimum of stress is caused to the plant.

The Method:

Step 1) Soak rockwool cubes in solution of pH-adjusted water.

Step 2) Drain off excess water from rockwool cubes.

Step 3) Place small hole in the middle of the rockwool cube with a match (or any other similar apparatus). Make the depth of the hole about twice the depth of the seed you intend to germinate.

Step 4) Place seed into this hole in the rockwool that you have made and gently brush across rockwool so seed is completely covered.

Step 5) Now place these cubes with seeds in a tray on top of a heat pad if you've got one. Keep the temperature between 75-80°F (24-27°C) for optimum germination. Some strains may prefer it warmer, but this is the temperature for the majority of strains. Place a clear cover over the tray so you are creating a humidity tent. This retains much needed moisture.

Step 6) At least once a day, check the moisture of the rockwool cubes. If they need more, apply purified water with a spray bottle. Keep the cubes damp, but not drenched.

Step 7) When you see the plant just penetrate the surface of the rockwool gently remove the seed shell from the recently germinated embryo.

That's all there is to it! Good luck!!!

Faster Germination With Scarification

You can get reliable (and quicker) germination results using the following technique. It takes a little practice though because there is a little risk involved...

Equipment Needed:

1. Seeds
2. Paper towels
3. Air-tight plastic container
4. Pocketknife or sandpaper
5. Water

The Method:

Step 1) LIGHTLY chip/scarify outer seed coat in one place. Emphasis on *lightly* because if you do it too roughly it will ruin a perfectly good seed.

Step 2) Dampen paper towels and place seeds on it. Either fold or roll it up so that its pressing against the seeds.

Step 3) Put paper towels with seeds inside into an air-tight plastic container.

Step 4) Place in a warm location (i.e. on top of a TV set, VCR, or refrigerator).

Step 5) Open every 12 hours to allow oxygen into the container and check on the seeds. Most should germinate in about 24 hours, but there may be a few that need a bit longer.

How Long Will it Take?

Some seeds can take up to 12 days to start germinating, but most will germinate between 24 to 72 hours. The general time frame as mentioned above is 2-7 days. Be patient and give your precious seeds a chance to sprout!

Advanced Germination Procedure Example

Oftentimes professional weed growers will use weak solution of nutrition and protection products in the pre-soak, germination and early growth periods for seed growing.

As an extremely advanced example, one experienced veteran cannabis cultivator combines beneficial fungi, nutrients, a catalyst, and B-vitamins in dilute form to pre-treat cubes and ensure proper feeding of the sprouts after they have sprouted. To create this mixture he uses products such as Piranha, h-1 Humic Acid, B52, and Jump Start made by a Canadian company called Advanced Nutrients that sells its products in Europe.

Together these products prevent harmful fungi while providing nutrients, protectants, hormones, growth boosters and vitamins that increase sprout survival, health, and grow rate.

Note: If you are a beginner grower, don't stress just yet! I just want to give you a complete overview of an advanced germination scenario so you know what to decide on doing in order to tailor to your individual growing needs.

Within a day or two of the time seeds sprout, he will then begin a feed program that provides nitrogen-rich basic fertilization, B vitamin supplementation, beneficial microbes that feed roots, enzymes, and inoculants. He begins gradually increasing ppm basic fertilizer called Advanced Nutrients Sensi Grow Two-Part combined with H-1 humic, Piranha, Voodoo Juice, B-52 and Scorpion Juice.

The Jump Start is discontinued when the Sensi Grow starts. He then carefully monitors and adjusts his nutrient mixture ppm and pH in combination with close watch of his plant leaves and growth rates to make sure that he is maximizing growth and later harvest potential.

Again, utilizing the above easier germination methods you can get get incredibly high germination rates. But if you are opting for an elite procedure, it would look something very similar to the above.

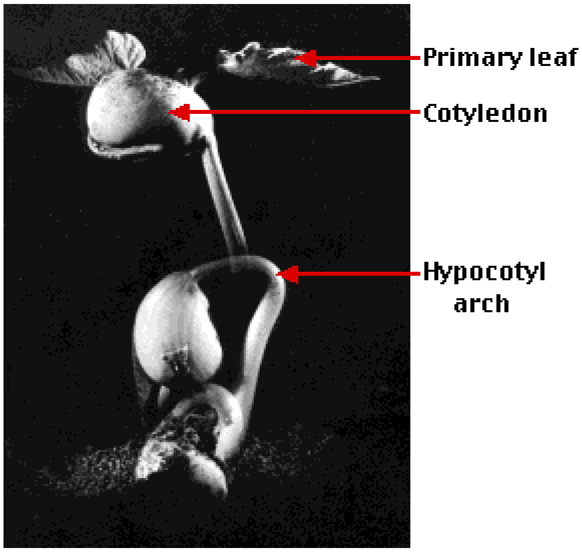
Once Your Seed Sprouts

Check daily to see if your seeds have sprouted roots (when one does immediately transfer to a grow medium) and add small amounts of water in order to keep moist. This is also true if you germinate seeds in a piece of cheesecloth, rockwool, oasis cubes, etc or medium other than paper towels.

Once the seeds sprout and a white shoot sprout emerges about a quarter inch, transplant root down into your soil or grow other grow medium. (Transplant them into the progressively larger containers.) Handle it very very carefully, preferably with tweezers and make sure you do not touch or break the tip. Try to minimize the delicate rootlet to prolonged intense light or air. Bury the germinated seed with half an inch of planting medium covering it with the white root tip pointing down. If using rockwool simply pre-drill a .5" hole and place the germinated seeds inside it with the white root tip pointing down. Cover it with one-half inch of moist rockwool. Keep the rockwool evenly moist.

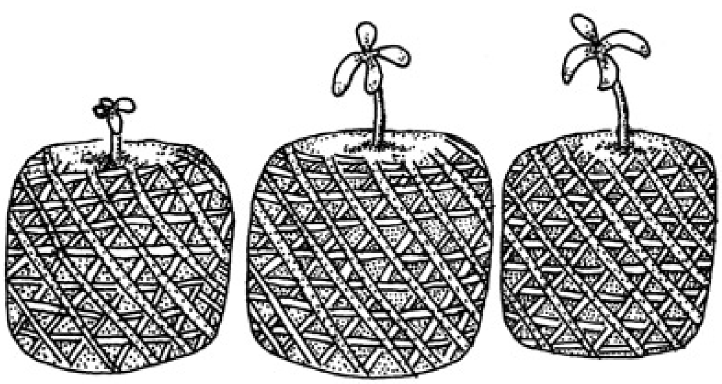
Note: Try and transplant the seeds into the same substance they were sprouted in. This GREATLY minimizes the chance of the all-to-common problem of transplant shock.

WARNING: NEVER TOUCH THE DELICATE ROOT TIP!



Seedling

A cannabis seedling has 2 leaves that are known as a “seedling leaf”, or “cotyledon.” These leaves function as the seedling's initial food store while it develops a vascular system for being able to take care of itself. Those are the first leaves that the plant develops and they are rounded in their shape. As the stem grows the leaves spread out and true leaves begin to appear. The little plant at this point in time officially becomes a seedling. Water and heat are *critical* at this point in the plant's development.



When the cannabis plant develops, those leaves turn yellow and die, this is quite normal at this stage. A slight yellowing on the first real leaf might be possible, it is translocation as your plant is now trying to turn food from the soil into twigs, stems, branches, leaves. Same goes for the first set of real leaves, and the subsequent set of leaves that have 3 lamina. Although these real leaves will last a little longer, their life span is also limited. Over watering here is the most common mistake of the newbie grower. It is important to delicately supply the correct amount of lighting - keep the seedling a few inches away (if you are using fluorescent) from the lamp.

It is important to understand that during a seedlings growth a lot of activity is happening “behind the scenes”. This means that in this growth phase the seedling is primarily focused on developing a root system while above-ground growth appears slow. New growers often think they are doing something wrong so they tend to over-water or over-fertilize at this point. Little do they know the plant is speedily right on track.

The new developing fragile root system requires an optimum constant supply of water and warmth. Too much water and you will drown and rot your roots. Too little water and your fragile root system will dry up.

The seedling growth stage lasts for about two to three weeks after seeds have germinated.

Top 10 Reasons Your Seeds Wont Germinate

1. Too Cold: Cold temperatures can kill seedlings and prevent germination. Cool temperatures can result in slow, uneven germination, and can trigger attack by soil diseases. You may want to jump start your seeds indoors, before outplanting. Make sure planting is not done too early, when it is still cold and there is a probability of encountering a dreaded frost hazard.

2. Too Hot: High temperatures result in excessive soil desiccation and injury to seeds and seedlings.

3. Too Wet: Seeds need to be damp, not soaking wet for germination. Excess water prevents oxygen getting to the seed. Poorly drained soils may also cause soil fungi-related diseases. The condition of wet soils may be improved by adding perlite or vermiculite, which will aerate your soil exceedingly well.

4. Too Dry: A certain amount of water is essential for germination, so maintaining a constant soil moisture during the germination period is vital, cover containers with glass or plastic sandwich wrap to prevent your soil from drying out. You want to continually spray the topsoil all throughout the germination.

5. Planting Too Deep: This will result in delayed emergence - seeds may not be able to grow enough to reach the surface on the limited food storage within the seed. Soil temperature is also lower with depth. Plant your seed 1/2 and inch to an inch down for best results.

6. Planting Seeds Too Shallow: If you plant your seeds too shallow they can dry out quickly.

7. Soil Too Firm: Making your soil mix too firm can prevent oxygen from getting to your seeds and affect drainage.

8. Soil Too Loose: Soil that is too loose will result in too much air surrounding the seed(s) - they will not absorb moisture and will most likely dry out.

9. Soil fungus: Seeds can root well or seedlings can fall over and die. Over-watering, poor drainage, and lack of aeration will increase the likelihood of this occurring. Plant seeds in sterilized potting mix, and make sure your containers are cleaned properly.

10. Non Viable seeds: If your seeds have not been stored correctly they can deteriorate. As aforementioned, look for viable quality dark brown seeds. Avoid immature seeds (typically light colored or whitish that are brittle and break up in your hands).

Planting Seedlings

Cannabis seeds grow best at 78°F (25.5°C). Plant seeds twice as deep as the width of the seed. Yes, that means it barely is deep. Too deep and it wont germinate correctly. During seedling growth a root system develops rapidly, and spreads out to the desired depth. While green, above ground growth remains slow. The emerging new fragile root system requires a constant supply of water and warmth. Too much water drowns the root causing oxygen deprivation and leads to root rot, killing your plant altogether. On the other hand, a lack of water will cause the root system to dry up.

Also temperature is important. By placing a heating mat underneath your tray this is guaranteed to heat your growing medium to the optimum temperature. If the growing medium stays a few degrees warmer the roots will grow much faster.

As for light: Seedlings require at least 16 hours of light daily. At first they require less intense light than they will need at later stages of growth and development.

Note: Healthy roots will be a bright white, not brown or any other color.

WARNING: Only transplant your clones or seedlings once sufficient healthy strong long root mass has developed.

Transplanting Seedlings

Transplanting is done when the seedlings are ready to be transferred from their rockwool tray (or other medium) to another grow medium. The process is simple; carefully lift the seedling from the tray still inside the rockwool cube and place it in another medium such as soil or directly into your hydroponic setup. When transferring the seedling to soil – dig a small hole in the soil and drop the cube in, then cover the cube with soil. If you're not using a rockwool cube, simply carefully transfer your seedling into a small hole into the soil and bury it.

Note: The cube doesn't affect your plant's growth in any way, some people feel it actually helps support the plant.

Temperature

Temperature is a very important factor in sprouting seeds, and it is a commonly misunderstood one. You can buy heating mats to send bottom heat to the seed zone, but an ambient room temperature between 68-85°F (20-29.4°C) is ideal for most seeds. Temperatures lower or higher than that will interfere with germination. If your seeds are from a hot, equatorial region, they may most likely need slightly higher temperatures to germinate properly. Healthy seeds will germinate within 2-7 days of being placed in cubes or peat pots.

Lighting

Seedlings will need a minimum of 16 hours of light daily. For the first 2-3 weeks they require less intense light and grow very well under fluorescent tubes (an HID light or a Compact Fluorescent Light (CFL) can also be used here). If using a compact fluorescent place it 12-18 inches above the seedlings. If using an HID then place it 3-4 feet above at least to ensure optimum initiating growth.

Note: Many studies have revealed that sprouts can handle high intensity metal halide spectrum lighting for 18-24 hours per day beginning two days after the sprouting, provided the lights aren't so close to the seedlings that they singe or burn by excess heat. But fluorescents are still preferred and the most widely used method today for newly developing delicate seedlings.

Seedlings that are given insufficient light (such as those grown under fluorescents or on short daylengths below 18 hours a day) will become skinny & stretch. Stretching occurs when a sprout has put on more than an inch or two of stem before its first leaves. A common reason is that plants are given too little light, so they stretch to reach the light. This results in unsteady stems that will never become stable enough to ensure proper growth, and ultimately, produce weak fluffy scrawny buds.

Tapping

This is a great little trick. As soon as the sprouts emerge above-ground, they should be lightly tapped several times a day. This promotes internal strengthening. After the sprouts have been alive for a week or more, their stems should be gently bent back and forth daily VERY CAREFULLY in order to further strengthen the stems. These first steps are crucial for developing strong healthy plants that produce a big beautiful quality heavy harvest.

After the sprouts have been alive for about two weeks, an oscillating fan blowing enough current to make the stems bend very slightly should be directed across the sprout area.

All of the tactics above will make for a thicker, sturdier stalk that will produce bushier, more productive plants.

When to Fertilize Seedlings

Mixes composed of perlite, vermiculite, rockwool, and basically any other grow media should be treated with a mild application (300-400ppm) of fertilizer prior to seed introduction. This will provide available nutrients and help buffer the pH.

Many growers agree: adding some sort of auxin/vitamin based supplement will accelerate early plant development. It is not beneficial to apply additional fertilizer to seedlings in rockwool or other inert media until the first set of true leaves appear, at which point a ¼ to ½ strength application is made.

Excessively rich organic soil mixes are best avoided until the tender, young plants are well established. It is possible to feed young seedlings in soil with a ¼ to ½ strength solution of fertilizer after two to three weeks, or after the first set of true leaves appear; but only if the soil is not overly saturated in terms of nutrients.

What to Look For

It is useful to know that nutrient deficiencies can have the same symptoms as nutrient excesses. In general, if sprouts are gaining an inch or more of height per day, have leaves that are solidly lime green in color, are branching out to be bushy and dense, and have upright (not drooping) leaves and sturdy stems, this is a sign that pH, ppm, water supply and feed regimen are ideal for the plants.

At this point you should have a general idea of which seedlings are healthy and which are sickly. By the 3-5th week of growth your seedlings will be big enough to determine whether or not they are strong and healthy. Remove from your garden any weak, sickly plants and focus your attention on the remaining strong survivors.

Purple Stems

Often growers will find their tiny seedlings begin to exhibit purple stems.

No worries - A seedling's purple stem doesn't necessarily indicate an unhealthy plant. Purple Stems could be a result of plant genetics, if this is the reason, you are to expect a purple stem throughout the entire life of the plant. It must be noted that purple stems aren't a dominant trait, and are rarely genetically induced.

A baby sprout with a purple stem is almost always 100% natural. Young seedlings are still adjusting to their environment and may be slightly lacking in a nutrient. If this is the case, healthy plants will regain their green/greenish-brown color within a few days to a week or two tops.

If you have ruled out the possibilities of genetics and the seedlings adjustments to life, you should begin looking for a nutrient deficiency. Purple stems are commonly caused by a Phosphorous (P) or Magnesium deficiency, if there is a Phosphorous deficiency you may also notice symptoms such as brittle leaves or greyish spots. To assist the uptake of Phosphorous (as well as most other nutrients) you should ensure the pH is slightly acidic-- 6.0 will suffice.

Increasing Female Plants from Seeds

Remember how a seedless (Sinsemilla) female plant is your ideal goal as a grower? Well, environmental factors begin influencing your plant's sex the moment the seedling has three pairs of true leaves (cotyledons don't count!)

These factors are:

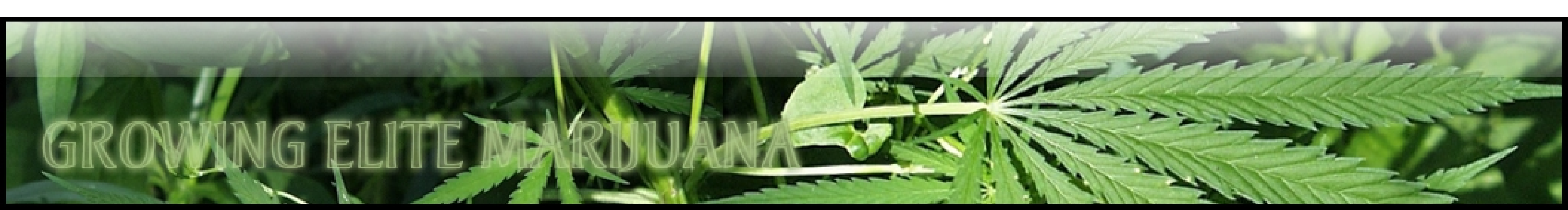
- **Humidity:** High humidity increases the chances of female plant development. Low humidity increases male plants. Low grow medium moisture also increases males. The same is valid for the moistness of the seedbed.
- **Temperature:** Lower temperatures make for a larger number of female marijuana plants, higher temperatures for more male marijuana plants.
- **Lighting:** More blue spectrum light energy increases the number of females, whereas red light increases males. Fewer hours of daylight (about 14) increases the number of female plants. Longer light exposure (18 hours+) will tend to make more male plants.
- **Nitrogen:** Increasing the level of nitrogen (N) makes more female plants, lowering creates more males.
- **Potassium:** Lowering levels of potassium (K) encourages the development of female plants, increasing potassium (K) increases the male tendencies. (So for the first two weeks a higher level of nitrogen and a lower level of potassium will encourage female plants to develop.)
- **Environmental Stress.** Any environmental stress will greatly increase the chances of male plants growing from your seed.
- **Colour of Light: M**ore blue light makes for female cannabis plants from seed, more red light makes for more male cannabis plants.
- **Hours of Daylight:** Few hours of daylight (i.e. 14 hours) makes for more female individuals, a long day (i.e. 18 hours) makes for more male cannabis plants.
- **Soaking:** Soaking your seed(s) in Gibberellic acid makes it/them more likely to produce a female plant.

Plant Stress

Cannabis crops grow the fastest and produce the richest, heaviest harvest when they are given a stable optimal growth environment. Stressed plants produce much less than unstressed plants. Examples of common stress factors include, but are not limited to; lack of water, drowning of roots (too much water), ultraviolet light, nutrient toxicities, acidic exposure, overly cold or hot growing conditions (including soil and grow medium temperatures as well as air), photoperiod fluctuation, low light intensity, plant mutilation (from pruning too much or too fast) etc.

Stress will greatly reduce growth. Although in some rare cases stress may actually cause your plant to produce more resin, the slow inhibited odd growth simply outweighs the extra resin advantage. Many new growers make the mistake of removing their plants large green shade leaves thinking that it is allowing light to shine on their lower leaves, enhancing growth. Although this is good logic in theory, it is simply not the case. The aforementioned method will cause growth as slow as molasses and greatly diminish harvest.

Only ever remove leaves that are half damaged by burns, pests, death, or disease. Also do not make the newbie mistake of removing a yellowing leaf to early, oftentimes once the stress is eliminated the plant will regain it's vigor and health, including it's vibrant green coloration. For maximum growth enhancement remove only spindly, dimly lit lower branches. This stresses your plants very little and speeds growth of the upper foliage. Stress can also affect your plant's sex.



The 9 Common Culprits of Slow Plant Growth

1. Light Deprivation: Although your plant may be receiving light, particular strains may require higher light levels than others. A recommended light level for optimal full bud development is 50 watts/m^2. Full sunlight is 100,000 lumens max.

2. Light spectrum: Light that does not contain enough red spectrum (too much blue). Light spectrum can have a dramatic effect on plant growth, with different light frequencies affecting different photosynthetic and various other crucial processes within the leaf. Selecting a blue spectrum in a vegetative growth phase is preferred, with red spectrum in flowering.

3. Over-watering: Soil moisture that is not absorbed rapidly turns stagnant; the plant quickly uses up any oxygen within the water, then is unable to respire further, resulting in moisture low in oxygen. Pythiumaka “root rot” (a common plant problem) thrives in low-oxygen conditions. Over-watering will slowly suffocate your roots, preventing sufficient oxygen uptake by the roots, and ultimately causing dreaded root rot.

4. Low Nutrient Strength: The plant is unable to acquire the necessary amounts of nutrients to sustain high growth rates. Large and mature plants can take higher nutrient strengths.

Note: Nutrient strength is also related to the light intensity; plants under fluorescent lights usually require a lower nutrient concentration than under HIDs.

5. Nutrient Lockup: Adding too much of a nutrient (ex. Magnesium) can lockup one or more nutrients, rendering them chemically unavailable to the plant. Nutrient lockup can occur at extreme pH ranges (ie. under 5.0, over 7.0).

6. Soil With High Bark Content: Bark is very acidic and may affect soil water pH. The roots will not be able to grow through the bark, preferring to grow around the chunks of bark. This slows down root growth and most obviously plant growth. Once transplanted into proper soil, plants will show remarkable recovery.

7. pH: pH that is too high or too low (acidic soil) will result in plants that are unable to absorb nutrients, or in adequate quantities within certain pH ranges. Optimum pH varies with each medium:

Hydroponics and aeroponics: 5.6-5.8
Soilless: 6.0-6.3
Soil: 6.5-7.5

Many soilless mixtures tend to be fairly acidic, due to their high % bark content.

8. Low Temperatures: Plant metabolism will decrease at low temperatures. Chemical reactions within the plant will take longer. Optimum plant growth often requires close temperature regulation; daytime temperatures between 77-86°F(25-30°C) are preferred. Differences in daytime and nighttime temperatures should not be dramatic; as this difference may shock the plant and stunt growth.

9. Low Soil / Medium Temperature: Evaporation from a medium(i.e. peat pots) tends to chill the medium quite a bit due primarily to the evaporation cooling effect. As the peat pot warms, it draws moisture outward, the evaporation effect cools the peat (like sweating). New growers often make the mistake of adding excessive amounts of water, resulting in cold soil, poor root formation and severely slowed growth.

Pests, Fungi, & Diseases

(For complete pest identification, prevention, and elimination please refer to the Cannabis Care Manual.)

5

GROWING WITH SOIL

Growing With Soil

There are many benefits of growing marijuana in soil. For one thing it is very cheap and easy to get started right away if you cannot afford your hydroponic system immediately (that can come later so relax!) If you're going to be growing with hydroponics feel free to skip ahead, but be warned; a lot of great information that applies to hydroponics can be learned in the following sections as well. (If you are a total newbie, hydroponics is a growth system that doesn't use soil.)

It is of the opinion of many growers that soil is the only medium that can produce the best tasting bud. Soil tends to be more cost effective, forgiving and simple for inexperienced growers to manage. The single most important benefit soil provides is the "live soil". When you feed organic fertilizer to a soil-based grow setup, most people think they are directly feeding their cannabis plants.

This is true in some cases, but it's mostly false. When we feed organic matter into the soil, we are actually feeding the MICROGRANISMS that reside there. These microorganisms feed on the various constituents within the soil, and poop out fertilizer. Ever hear of worm castings? One of the richest organic fertilizers known to man? This is the same thing, but just imagine this similar process going on a microscopic level with literally MILLIONS of microorganism species in the soil. They're eating up all the elements in the soil, decomposing organic matter, and converting it into extremely bio-available plant nutrients.

That is why you must NEVER water with chlorine. Yes, that means tap water. Tap water kills off the microorganisms in your soil and will literally starve your plants to death! You will be SHOCKED at what using pure, filtered alkaline water can do to your buds when you sustain a healthy & flourishing microorganism growth environment. Also, this is why composting is important, and adding lots and lots of healthy inoculants to your soil, as well as plenty of raw organic matter for these little guys to feed on. Your plants will be very very healthy!

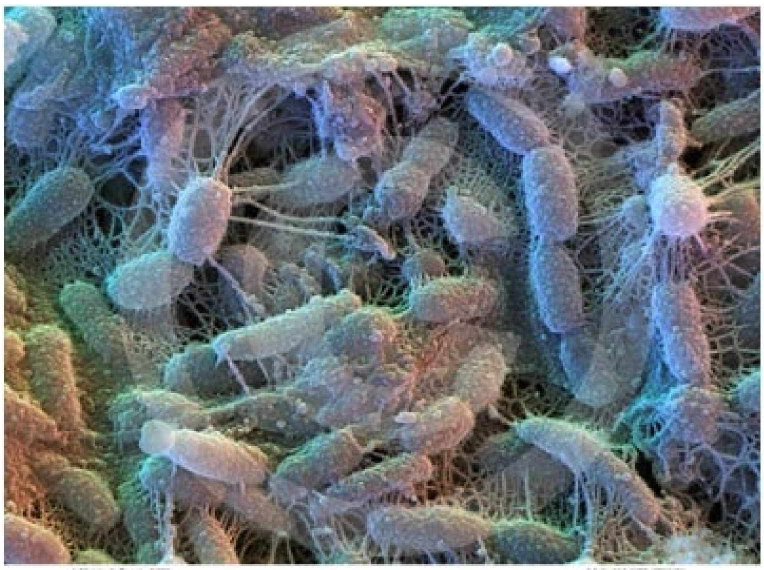


Figure 1. An Actual Microorganism Soil Population.

I can sum up the whole process of composting simply: It's like my best friend said to me one time, “If it was alive and growing at some point, throw it down on the ground and it will return to the soil!!!!” Organic food for plants comes in ANY living form. Ever watch a deer carcass totally disintegrate after a few months? Or watch a discarded apple wilt away back into the Earth?? It's not magic!!! These little guys, nature's helpers, are literally eating up this organic raw material and returning it back into power-packed nutrition that can now be utilized by the surrounding plants, and then the cycle starts over again.

Soil has some disadvantages though. It is difficult to ascertain and maintain consistent and optimum moisture, nutrient and pH levels. It is more messy, and one has to deal with things such as transplanting.

Containers

Containers allow you to care for your marijuana plants each individually. Weak, sick, and problematic plants can be easily removed from your garden. You can grow your soil-based marijuana in virtually any container. Examples include troughs, pots, buckets, aero-pots (my favorite) or the method of using a large growing container such as a wooden box/bed aka the “full dirt” method, which allows your roots and plants the maximum amount of space. Many veteran organic cannabis cultivators swear by this bed method when growing in soil.

Make sure your containers are a solid color, preferably black. This will ensure no light reaches your roots, and this is a critical step to ensure flourishing growth.

Because you will probably want to move and rotate your plants from time to time, you will most likely want some sort of container that is portable and lightweight. Your primary concern is size. You will probably start off using small pots for young plants, and soon transplant them to larger pots. Starting with smaller pots for smaller plants will allow you to fit more plants in a smaller grow area (wow I said “smaller” a lot). The pot size that works best for growing marijuana in soil are large 3 – 4 gallon ones (a 4 foot plant will be very happy in a 4 gallon container!). Cannabis tends to grow very long roots, so large growing pots are absolutely essential. The two most common containers are plastic pots, and growing bags. They are both light and inexpensive, but aero-pots are best.

You can easily also purchase or make your own plastic containers to house the soil in. You can really use anything that hasn't had chemicals stored in it, just make sure the containers are clean & sterile! The height of the planting container should be 12 to 26 inches. The width should be approximately 12 inches. Same goes for depth. Growers agree; 3–6 gallon containers work best. You will need enough soil to fill each container to within 4-6 inches of the top.

Note: A Russian study showed that seedlings with at least 4" of soil to grow the taproot were more likely to go female. This may be why some farmers get female/male ratios as great as 80%/20%.

When picking a container it is important start in as large a container as possible, square is best. 16 ounce plastic cups work OK, and 2 litter soda bottles cut down may be big enough for the first harvest when growing hydroponically. One-gallon plastic milk or water containers (squarish-style) will work too.

You can also start seeds and rooted cuttings in 16 oz plastic cups. It's better to have fewer seedlings than it is to have many seedlings that need constant transplanting. These larger cups take only a little more space, and allow you to transplant only one time before harvesting the first crop.

Next step is to add drainage holes at the bottom of the containers if they do not have them already. The holes need to be large enough for excess water to drain out, but small enough so no soil washes away. Place your container or pot on a dish so the excess water can be collected in the dish then emptied to avoid excessive messing.

Using a pot or container with perforated holes in the bottom is actually a safety net and is not used by experienced growers. The holes prevent over-watering your plants which cost you time, nutrients, and can even kill your crop. These perforated holes also supply quality oxygen to your plant's roots. In time you will be able to determine the exact amount of water to add so you never run the risk of over-watering your prized Cannabis Cup Winner plants.

Some last words: clean your pot or container out thoroughly before use. Make sure it's clean! Also make sure not to place more than one plant per pot. This ensures each plant will get its' share of optimum nutrients and water, and also if you happen to screw up on one your mistake wont affect your entire garden.

Note: If using a used container be sure to sterilize it with hot water and diluted bleach. Never use containers that once had chemicals in them.

Spacing

The amount of space a plant needs depends solely on the height the plant will grow. For example an 8 foot plant will be wider than 4 foot plant, and so forth. Remember, as a marijuana grower you should be interested in beautiful buds, not beautiful plants. Bigger is not necessarily better when growing marijuana, as the leaf matter tends to shade and suppress the smaller plants in your grow area from gaining adequate light!

Allow plants to be spaced to allow for adequate side growth. Generally 1 or 2 square feet per plant is best, and tends to yield the highest.

Grow Medium

There is no one perfect soil (growing medium) for marijuana. The two main important factors to take into consideration are the texture of the soil and the nutrient content (fertilizers). You want a soil that has good drainage, but doesn't drain COMPLETELY – it must retain some water, without drowning your plants. Many growers never spend a lot of money on soil, and so they cut down on it.

Cheap soil lacks good nutrients and a stable pH level. It's a good idea to purchase it locally, due to soil being very heavy. A 1.5cu/ft bag can be anywhere up to 60lbs!! This is expensive to ship. A premium potting soil self-made works fine. Stay away from soils with a lot of bark dust in them as these tend to be way too acidic and have too much nitrogen concentrates. Also stay away from anything that is a heavy clay. A nice, light potting mix is what you are going for. Ideally you should mix your own though using the guidelines outlined below.

There are three main factors to consider when buying soil. These are the Texture, Nutrient Content (fertilizers), and pH level. Complete, balanced, organic-based soil produces the most healthy viable delicious crops with the most beneficial bacteria present. All true organic soils contain bacteria populations that drastically support plant growth. They literally contain “alive” elements in the soil that assist in various growing abilities of cannabis crops, including enhancing & protecting root mass, providing nutrients, and even buffering pH!!! Organically grown pot also has more flavor and taste than pot grown on synthetic salt-based or harsh chemical products. Also later in the plant's life cycle it will produce more mature, healthy, viable seeds.

Soil is many master grower's favorite medium, and for good reason.

So how much? When growing, for each foot of growth, a ¾ gallon of growing medium is required (provided fertilizers are applied during the growing period).

Example:
2ft. Plant – 1 ½ GAL
5ft. Plant – 3 ½ GAL
10ft. Plant – 7 ½ GAL

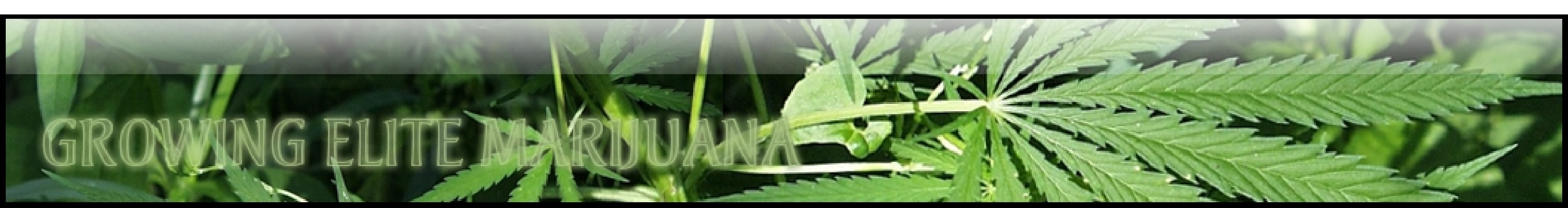
Ideally the soil should range between 60-70°F (15.5-29°C). Anything above that, you will have fungus trouble, insect problems, rotting roots etc.

Texture

Texture of your soil should be course, light, and spongy to allow drainage, sufficient moisture retention, and proper air circulation. Head to your local hardware / gardening supply store and ask around for a potting soil for growing vegetables indoors extremely fast. The salesperson will most definitely point you in the right direction and recommend the best brand they have available.

Things to look for: Make sure the soil becomes fluffy when moistened, in other words, it doesn't clump together if you gently squeeze it in your hand. The medium must be heavy enough for the roots to take a firm hold, but light enough for them to be able to push their way through and for air to be present. It also needs to allow for a good balance between water retention and drainage. Too much water retention will lock up the fresh air the roots need, causing them to rot. Not enough retention will leave the soil too dry making it difficult for the roots to obtain nutrients.

Some soil is labeled wet, and others are labeled dry. Try to find a middleman. If the soil gets too wet and muddy it will drown your roots and they will not be able to get any oxygen and breathe. If the soil is too dry it will dry up quickly and require frequent watering. Try to get organic soil if it is available, as this is the best due to it being pesticide and chemical free. If you're confused, relax, just try to get something that is medium-soft. The store employees are usually really helpful! Stay away from heavy wood products that contain very few nutrients, or are way too moist and acidic etc.



Testing Soil: Here's a simple test to determine optimum soil structure. Squeeze some soil in your hand to form a clump. The clod should break apart when poked. If the clod stays together, you can add vermiculite, perlite, gardener's sand, etc. Soil mixes that are made up of peat moss, vermiculite, and perlite have no nutritional value and are pH balanced (neutral) so it is like starting with a clean slate. You will then need to provide all the fertilizer. Typically I like to go 1/3 Organic Compost [Humus], 1/3 Peat Moss, and 1/3 Vermiculite as a foundation. After that I'll add an incredibly rich supply of organic material such as worm castings, bat & seabird guano, kelp meal, fish emulsion, worm castings, inoculants, mycorrhizae fungi, chicken manure, bone meal, blood meal, and I top it off with some heavy organic mulch, like wheatgrass clippings or leaves from around the yard. Then I like to throw in some red worms. These little guys keep the soil fresh and dig little caverns, providing aeration. They also help to break down and re-condition the soil over time. I suggest you get some!!! They're fun little guys to take care of!

Remember, soils only purpose is to supply a growth medium for the plant's roots. The nutrients and water is what the plant needs for excellent growth.

Warning: Never reuse soil. Pathogens and toxins will contaminate soil over time. Start new crops with soil.

Amendments

Soil amendments increase the soil's air, water, and nutrient retaining abilities. These remain very close to neutral on the pH scale and contain few, if any nutrients. Using a mixture of peat moss, perlite, and vermicuite will ensure these needs are met.

Follow the instructions when adding these ingredients to your grow medium (soil) so you don't end up causing any unwanted effects. Generally you will mix these three ingredients in equal amounts. By adding more perlite the mix will be more airy and drain faster. Adding more vermiculite water retention will be greater and watering can be done less often. Use a mix that best suits your needs.

Note: Organic soil amendments such as coco fiber, peat moss, and compost contain carbon, food (they supply nutrients), and bacterial activity.

Soil amendments are added to a planting medium in order to provide plants with various nutrients. Here is a comprehensive listing:

- **Guano** - Dried excretory wastes. May be derived either from bats or birds. Guano is available in high Nitrogen, high Phosphorous and balanced formulations. Guano will burn your plants, so use conservatively.
- **Worm Castings** - Worm poo. An excellent source of micronutrients. Also functions as a supplemental source of Nitrogen. Castings ought to be in every soilless mix. They will not burn your plants, and, when cut with perlite and vermiculite, make a fine medium in their own right.
- **Bone Meal** - As the name implies, this is ground up bones from the slaughter house. Bone meal provides phosphorous. Be careful - will attract animals to your grow if used outside. Will attract pets if used inside.
- **Blood Meal** - Again, made from animal blood on the slaughter house floor. A source of nitrogen. Also, attracts animals to your grow. Particularly odoriferous. Blood meal will burn your plants, so use conservatively.
- **Kelp Meal** - Made from dried and ground seaweed. If made from ascophyllum nodosum, provides a growth hormone which promotes rapid growth of both roots and foliage. Also contains trace elements and enzymes. The first time I added this to my plants, the results were nothing short of fantastic!
- **Perlite** - A non-porous volcanic byproduct, perlite is pH neutral and improves the drainage of planting mediums.
- **Vermiculite** - A porous volcanic byproduct, capable of nutrient and cation exchange. Helps with drainage and aeration as well.
- **Dolomite Lime** - Frequently used in planting mediums to offset acidity, that is, lime raises pH. Dolomite lime is slower acting and more buffered than hydrated lime.

Soilless Mixes

As the name implies; a soilless mix is a mixture of components in which it is possible to grow a plant but which does not contain soil in the traditional sense, that is, no garden soil or compost. Soilless mediums can contain peat moss as an ingredient along with worm castings, perlite, etc.

Here is a simple example of a Soilless mix:

50% Perlite
50% Vermiculite

Here's another:

40% Worm Castings
30% Perlite
30% Vermiculite

Soilless mixes are great, but can cause problems. If you happen to miss a couple of waterings the plant can dry out very quickly. This is because the mix will not hold much moisture. Soil is much easier and will provide nutrients throughout the grow, lessening the need for fertilizers.

Backyard Soil

Many growers often inquire if they can use backyard soil. The answer is yes and no. Backyard soil contains weed (the bad kind) seeds and pathogens. Soil can be sterilized and weed seeds killed by baking the soil in a hot oven at at least 392°F (200°C) until the core of your lump reaches 140-212°F(60-100°C), and is maintained there for a while.

But, baking a lump of garden soil will release pungent smells into your kitchen. Unless you have a spare oven out in the garage, you might skip this one and just use commercially made potting soils. Some have had success with this method by adding some Perlite, vermiculite, worm castings, bone meal, chicken manure (or compost, generally) to it to restore micro-bacteria growth.

It is generally not recommended. Stick with the other safer mediums.

Transplanting

Once your plant becomes too big for its container, its growth becomes severely stunted due to the cramped root system. Changing to larger pots (transplanting) allows the root systems to grow very large inside the new container, supporting healthy flourishing vigorous plant growth. You see, small containers hinders the growth of your plants root system which will cause sickly stunted growth and sickly wilted weak plants, so transplanting is absolutely crucial. Starting seeds and clones in cubes or peat pots makes them super easy to transplant.

You know your crop is ready to transplant when strong healthy white roots are surrounding the entire outside of the grow medium. To do this remove the plant from its pot and examine its roots to see if they are deeply matted on the bottom and surrounding sides of the pot. Roots should be everywhere around the edge of the container.

Ideally you should initiate the traumatic process of transplanting your crop when it is in its healthiest, strongest state.

Keep in mind transplanting is the second most stressful procedure as plant can undergo other than cloning. Roots thrive in a dark, moist secure environment. When roots are taken out and are in contact with light, air, or human hands too long they dry up and die. When you transplant your primary goal should be to upset the roots as little as possible, be very careful! Keep the entire grow medium and root area moist so that they don't dry out.

It is best to transplant at night so that your plants have a full night of rest to recover. Newly transplanted crops need subdued light at first so that the foliage grows at a slower rate, enabling the roots to supply sufficient water and nutrients. To help your transplanted marijuana plants, give them filtered less-intense light for a couple of days. A fluorescent light, if available, is a good substitute lighting source for a couple days for transplanted plants.

WARNING: Always transplant into the same, or similar type of grow medium. If you fail to follow this advice a water pressure differential could develop between the two varied growth mediums which will slow water movement and cause severe stunted slow root growth.

Feeding

As far as nutrients go, transplanted cannabis plants require low levels of N (Nitrogen) and K (Potassium), but high levels of P (Phosphorus) for maximum transplantation success. Also, as mentioned in the Cloning section, any commercially available product that contains trichoderma bacteria will greatly help ease transplantation plant shock. You don't have to worry about this if you follow the following steps carefully, take special concern not to disturb your plants roots, and give it adequate rest (by transplanting it at night); there will be zero symptoms of transplant shock or wilting.

Note: If you want your roots to develop a dense, healthy, vigorous root system then it is best to transplant them RIGHT BEFORE they have outgrown their container.

Transplanting slows you down. It takes time, it's tricky, it's hard work, and threatens the plants. There will be little or no shock if you are quick and tender in your handling of the plants. Make sure you only need to transplant twice, or better yet, once if possible, through the entire growth cycle. Pick the right containers.

Transplanting Step-by-Step

Step 1) First soak the entire grow medium and wait several minutes for the excess water to drain.

Step 2) Prepare the larger container by making a moist layer of grow medium at the bottom.

Step 3) Gently flip the plant upside down and gently place it in the new container. Fill the outer edges with more soil and finish by soaking the entire container again(a mild trichoderma + vitamin B solution is best). Make sure you make a good strong contact with the root edges and your new grow medium.

Note: Containers that have the same width on the top and bottom are ideal for easy transplanting success.

Once transplanted your plant will immediately require low levels of nitrogen and potassium, and increased levels of phosphorus. Water and nutrient absorption is slowed as the plants get used to their new grow environment. Transplant during the evening so plants have all night to recover. To minimize shock, you may also want to give your transplanted crop filtered, less intense light for just a couple of days, then from there it's smooth sailing.

Maximizing Root Growth in Soil Containers

Space is one of the major concerns for indoor growers, who generally cannot move to bigger and bigger pots to allow for bigger root masses. A lot of container space often goes unused, because roots will not grow into the top inches of soil that are often dried out from powerful lights and low humidity. (This is where mulching comes in – it drastically helps to conserve moisture and simultaneously feed the topsoil with lots and lots of organic nutrients.)

Since marijuana soils are typically very airy and light, the top inches of soil are easily disturbed when watering as the dirt is pushed and moved around by the water. This inhibits roots from growing into the top inches of soil too.

Say for example in a one foot tall pot the top three inches of soil will not allow root growth, you are wasting 25% of your soil mass that could be used for roots! In pots that are wider at the top than the bottom, this wasted soil could be even greater.

You need to prevent the soil from being disturbed and keep it moist. You can use a cool little technique to do this. Hydro growers have been using an ideal product for similar purposes for a long time - Hydroton clay balls. Hydroton clay balls are very light. They won't compact your soil the way putting pebbles on top would. A layer of hydroton clay balls on top of the soil will help the soil underneath it lose moisture through evaporation and low humidity. Some growers even put them at the bottom of their grow containers and add small pvc pipes to increase their root oxygenation even more!

By adding a layer of hydroton on top of the soil, soil disturbance is prevented since the water does not directly touch the soil until it has filtered through the layer of hydroton balls. Soil moisture is then trapped underneath the hydroton and less likely to evaporate due to heat and/or low humidity.

This way it is possible to grow plants with roots stretching up all the way to the top of the soil. Those roots will rapidly provide nutrition to the plant when it is watered. It also will help the plant be able to go a longer time without watering since moisture that would have been lost to evaporation is now available to the plant.

Note: A strong root mass is critical in flowering if you want to reap a big frosty harvest. Wimpy roots = Wimpy yields.

Oxygen

Proper oxygen supply to the roots is a big concern, since the plant requires O2 for nutrients to be available, and to rid itself of toxins etc. One of the easiest things to do is use food grade hydrogen peroxide in the water to increase the availability of oxygen in the water. H2O2 has an extra oxygen atom that will easily break away and can be used by the plant. Certain commercially-available additives such as Oxygen Plus are plant foods that contain 25% hydrogen peroxide and is perfect for this use. Oxygenated water helps, too.

Using a planting medium that allows for plenty of aeration is also really important. Be sure you have good drainage by using perlite, sand, or gravel in your mix and at the bottom of pots. Don't use a medium that holds too much water, or you may significantly reduce the oxygen available to the plant and quite literally suffocate it. Aerating the water before watering is also a good idea. In the case of soil potted plants, use an air pump to aerate the water overnight before watering your plants, or if you're on a budget; put the water in a container with a cap and shake it up really good before giving it to the plants.

Fertilizers

Basically you need two kinds of fertilizers when growing marijuana. One for vegetative growth, and one for flowering.

Vegetative Growth: Needs high amounts of nitrogen, adequate calcium, magnesium, and trace elements.

Flowering: Needs low amounts of nitrogen, high potassium & phosphorus, adequate calcium, magnesium and trace elements.

Most soils and potting mixtures available in nurseries are fortified with nutrients. These mixtures should provide enough nutrition for marijuana for several weeks. After this you will need to add fertilizer. You will get the biggest harvest possible if you give all your plants exactly what they need, and NO MORE.

Plants growing in containers have a limited amount of nutrients in the soil. Their growth and health is curtailed until more nutrients become available to them. The solution to this problem is then to supply the missing nutrients. It is easiest for growers to use a high-quality, prepackaged, sterilized mixture. Modern potting mix is made of many ingredients. Each brand is different. Remember unless the fertilizer is added the plant will have no nutrients. Fertilizer can also take the form of organic live matter if your bacteria population is sufficient.

Depending on the various growing phases you will want different concentrations of these nutrients. During vegetative growth you will want high nitrogen and low phosphorus and during flowering you will want high phosphorus and lower nitrogen. Essentially, these are what "nutrient ratios" are for.

WARNING: Beware of potting mixes with time-released fertilizers. They will make it very difficult to judge what is available to the plant at any given time and are not recommended to use.

Growing Organic

In many countries it is illegal to grow medical marijuana. Many suffering sick people rely upon the positive effects of marijuana to help soothe their various dis-eases and ailments. I have personally witnessed the incredible joy and healing this magical herb can provide for patients in need.

In order to obtain their precious herb, these people must rely solely on third party growers that supply the medical marijuana distribution facilities. This may be you! Patients depend on your expertise and ethics to supply them with high-quality medicine, 100% free from contaminants such as pests or chemical toxins. It is your duty to supply the best organically grown marijuana to those in need. An organic grower's goal is to cultivate top quality organic pharmaceutical-grade marijuana.

Note: If pests do happen to invade your organic garden, instead of using those harsh chemicals you can use alternate natural pesticide solutions such as oils, soaps, and biocontrols.

In order to grow the healthiest plants possible you must honor the basics. Too often do people look for the flashy techniques, tips, and tactics, when rather if they just followed and mastered the basics of cannabis cultivation their bud potency and yield would increase naturally!!!! The basics of quality light, water, air, and nutrients must be very carefully and properly maintained. Simple as they may seem, these are the building blocks of great cannabis and the foundational skills mastered and deployed by veteran growers. The flashy tips and tactics come only AFTER you master the basics of cannabis cultivation.

Chemical vs Organic

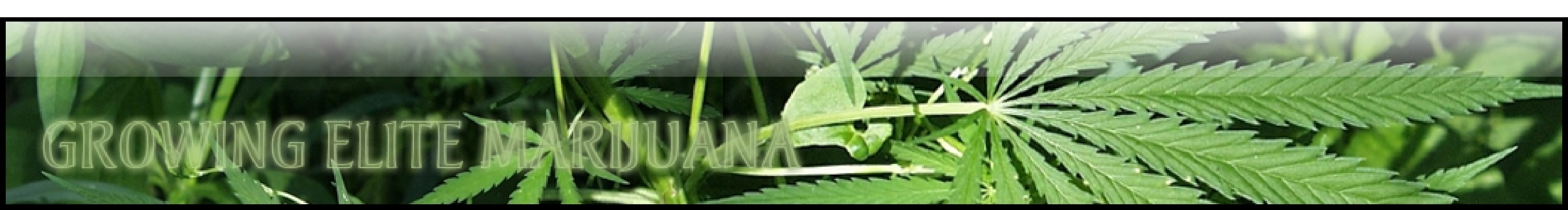
Quality is the most important aspect to growing marijuana. You can only grow top quality marijuana in soil using organic biological 100% natural fertilizers. Many growers agree that organic fertilizers are best as they produce a delicious better tasting bud than chemical fertilizers. Buds grown from organic soil and products just taste so much better, and the yields are eye-popping!!! Growing organic marijuana is also essential for medicinal cultivation purposes.

Also with organic fertilizers plants cannot be over-fertilized. Chemically-based fertilizers are precise, sterile, and simple to administer. But, organic fertilizers on the other hand are not always as simple to use, and usually tend to have foul unpleasant odors. Plants grown with organic fertilizers will produce slightly more bud and it will be of legendary quality in terms of taste, aroma, and potency, you just have to get used to handling their unique aromas and, uh, forms.

Worm castings and bat guano are the two of the most effective fertilizers. They both contain a dense amount of nutritional content that the plants will consume to supercharge their growth. They are mixed with water and applied twice a week. If you want the upmost top-shelf quality buds when growing in soil with high yields, these are CRUCIAL. Get your hands on these awesome fertilizers immediately, you will be ecstatic with the results they produce for you!!!!!

However some growers argue that the plant "material" that cannabis uses to grow is identical in structure and content regardless of which method you use. The plant only uses basic building blocks, taking molecules from the air and the nutrients and assembling them into the organic plant matter. The by-product of this process is oxygen. The real (practical) difference between organic and inorganic growing is how the raw materials are provided. I find this to be false.

The organic grower will utilize larger elements that will be broken down by a system of organisms living in the nutrient solution, grow medium, or the soil. An inorganic grower uses nutrients that are already broken down into a form that the plant can utilize. Non-organic nutrients might contain organic components. For instance, many fertilizers intended for soil will include urea nitrogen. This nitrogen requires micro-organisms to break it down before the plant can use it.



These organisms won't thrive without soil organism present so these fertilizers may not work in hydroponic systems.

There are hydroponic mixtures that are organic and there are those which are not. Either way, you have control over what you feed your plants and can be sure that no harmful pesticides or other chemicals are used in your own marijuana. Provided you flush your plants properly they won't contain any of the nutrient solution so the actual plant material that results should be the same.

To sum things up;

Chemical Nutrients

Pros:

-Permits precise adjustments and formulations with high element availability and purity.

Cons:

-Health concern questions regarding buildup of heavy metal impurities and residual taste. Also the waste from hydroponic reservoirs can contaminate the area's ground water.

Organic Nutrients

Pros:

-Addition of live and beneficial compounds much improves the aroma, flavor, harvest yield, and resin (both quantity & quality).

Cons:

-Difficult to ascertain exact amounts of required nutrients, and can be harder to maintain and ideal growth environment to support healthy micro-organism populations. Without regular food and water they, too, will die.

Nutrients

All plant food is measured in the N-P-K format:

(N) for Nitrogen.
(P) for Phosphorus.
(K) for Potassium.

Nitrogen(N): Used to build proteins and chlorophyll. It is responsible for leaves, stems, and overall size and growing other plant elements.

Nitrogen:

- Most essential nutrient.
- Needed for stem and leaf growth.
- Provide lots of nitrogen during vegetation.
- Nitrogen deficiencies will result in yellow leaves (oftentimes yellow leaves that appear in vast amounts are because of nitrogen deficiency).

Note: During vegetation use a lot of nitrogen to ensure vigorous growth. But during flowering taper off the nitrogen to ensure bud growth and avoid unnecessary leafy buds or any other unnecessary veggy matter.

Phosphorus(P): Used to photosynthesis, respiration, and creating energy compounds to help the plants develop efficiently. It is also a critical factor for healthy seed and bud production. During flowering is when you provide more phosphorus than any other nutrient.

Phosphorus:

- Crucial for bud, flower, and seed production
- Provide more phosphorus than nitrogen during flowering

Potassium(K): Used to build and transfer sugars. It is also important for water and nutrient absorption. Potassium assists in the growing of strong sturdy stems, root growth, and helps fight off disease.

Potassium:

- Helps with nutrient absorption, aiding in faster, better growth.
- Provide a relatively steady, moderate amount of potassium throughout the plant's entire life cycle.

At different stages of growth you will emphasize different elements. The three numbers on your fertilizer is the percentage the fertilizer contains of these three primary nutrients. A 15-15-15 solution contains 15% Nitrogen, 15% Phosphorus, 15% Potassium. 20-10-5 solution contains 20% Nitrogen, 10% Phosphorus, 5% Potassium. The remaining percentage of the solution makes up the rest of the soil material.

N-P-K can come included within the actual soil or in a separate stand-alone fertilizer.

Cannabis plants grow best with a good level of Nitrogen and a normal level of Phosphorus and Potassium during vegetative growth. You're going to need to pick a bag that has all three, not just a 10-20-0 ratio. There are a lot of N-P-K ratio varieties out there but the 12-12-12 and 20-20-20 are the best ones to find. Something like 8-20-20 is not suitable for vegetative growth. Bags with higher Phosphorus are for flowering plants. The method is never to transplant to a new soil with higher phosphorus levels, instead we simply use plant food to bring up the Phosphorus levels during the flowering phase, as this is easiest.

Micro-Nutrients

As well as N-P-K there are also secondary supplements and “trace minerals” - These are Calcium(Ca), Magnesium(Mg), and Sulfur(S) - aka CaMgS. Secondary supplements can oftentimes be found within the soil but sometimes not all of them are present. In addition to secondary supplements there are also micro-nutrients. These are zinc, iron, manganese, boron, chlorine, cobalt, copper, molybdenum, selenium, sulfur, and silicon. You can purchase a formula for these. Don't worry too too much about micro-nutrients as when compared to the big three, they do very little to affect your plant's overall health, the primary N-P-K and CaMgS nutrients are the most important and newer growers should focus their energies on mastering these three levels first before worry sets in!

Check your bag to see if it has secondary supplements included.

Organic Fertilizers NPK Values (and amounts to use)

Here is a list of common organic fertilizers, NPK values and how much to use per square foot of garden:

FERTILIZER	(N-P-K)	TYPE	USE
Blood meal	(12-0-0)	Fast Release	10g/sq. ft.
Corn Gluten	(6-0-0)	Average Release	15g/sq. ft.
Compost	(1-1-1)	Slow Release	125g/sq. ft.
Bird Guano	(10-3-1 variable)	Fast Release	25g/sq. ft.
Cow Manure	(2-0-0 variable)	Average Release	60g/sq. ft.
Horse Manure	(5-2.5-6 variable)	Average Release	20g/sq. ft.
Soybean Meal	(6-1.5-2)	Average Release	20g/sq. ft.
Worm Castings	(1-0-0)	Slow Release	150g/sq. ft.
Kelp	(1-0.2-2)	Fast Release	15g/sq. ft.
Insect manure	(4-3-2)	Fast Release	35g/sq. ft.
Fish emulsion	(5-2-2 liquid)	Fast Release	1ml/sq. ft.
Cottonseed meal	(6-2-2)	Average Release	20g/sq. ft.
Bone meal	(2-11-0)	Slow Release	25g/sq. ft.
Alfalfa Pellets	(3-1-2)	Average Release	40g/sq. ft.

Note: Bird and Bat guano have variable compounds and can be very rich in Phosphorous (Peruvian/Chile seabird guano, for instance). Poultry manure is also more balanced. Worm castings and composts are low in nutrients and are considered more like soil amendments than ferts. Cow manure and Horse manure should be composted. Don't use fresh crap. Sewage sludges should never be used.

WARNING: Do not over-fertilize. It will kill your plants. Always read the instructions for the fertilizer being used. Use ½ strength if adding to the water for all feedings in soil or hydroponics if you are unsure of what your plants can take. Build up slowly to higher concentrations of food over time. Novice soil growers tend to over fertilize their plants. Mineral salts build up over time to higher levels of dissolved solids. Use straight water for one feeding in hydroponics if it is believed that the build up is getting too great. Leach plants in pots every month. If your plants look REALLY green, withhold food for a while to be sure they are not being over-fed, or you're doing something right.

Feeding

Feeding your plant is basically resupplying the nutrients that the plant has absorbed to aid in it's growing processes. Throughout your entire plants growth cycle you will only need 3 different types of feeding solutions. Plants deficient in any type of the major primary three (N-P-K) nutrients will not develop.

Overfeeding plants is probably the most common mistake made by novice growers. Overfeeding can harm plants severely so make SURE you properly read the instructions on your product label.

The first feeding solution you're gonna need is a bottle where the N-P-K has equal or higher levels of N than P & K.

The second feeding solution you will need is a bottle that has higher levels of P than N and K.

The third solution you will need is a bottle of secondary nutrients.

Only ever feed your plants when they need it!!! You should never have to feed your plants once a day. Also be sure to never mix your solution at 100%, the marijuana plants are sensitive and they can burn easily. Check the label for recommended dilution and feeding levels. (For example 1 cap full per 3 gallons of water is pretty standard.) During flowering simply switch the feeding bottle over to the one with the N-P-K, where P has higher levels than N and K.

Note: For enhancing plant growth, once every 3 weeks add the most important secondary nutrient of Mg(Magnesium) to your plant. This can be done easily by using Epsom salt, as it is very rich in Mg. To do this simply feed your plant a 1/3 spoonful of Epsom salts per 3 gallons of water once every 3 weeks.

Feeding must be done throughout the entire plant's life cycle to ensure optimal flourishing growth. Administer properly as dictated by your product's instructions. Following directions is critical and will save you from much stress and frustration further down the line.

Organic Fertilizer Super Grow Tea

Here's a recipe for my favorite organic tea fertilizer. I would suggest this when your leaves show signs of yellowing. It often means lack of N (Nitrogen) and store bought chemical fertilizers don't always do the trick, plus they build up salts in the soil and don't do much for acidity!

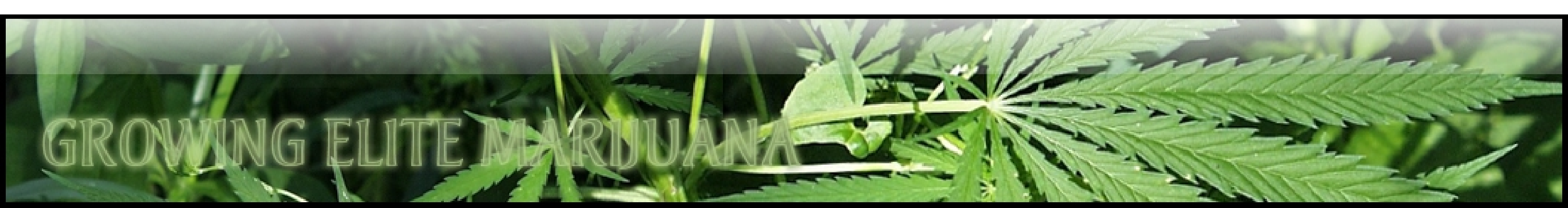
Try this:

Step 1) Put 2 cups of high-nitrogen bat or seabird guano (found at your local garden center or nursery, or online) in the corner of a cloth bag. Old pillowcases are perfect. You can also throw in there nettles and some kelp powder.

Step 2) Tie it in a knot around a stick and suspend it in a 5-gallon bucket of fresh (preferably distilled or RO) water. It is now like a tea bag. Just shake the tea bag around several times a day. It should emit a dark secretion from the bag. After 2 days the water should be pretty dark.

Step 3) Take out the tea bag and dispose of it, or rinse it out to be reused. Use this dark water at a rate of 1-2 cups per gallon of fresh water and mix it up. This will give you a "tea" to water your plants with. Use it to water once, and then wait a few days to see if your plants like it. You can use this high Nitrogen tea whenever your plants tell you they need it (yellowing leaves).

To make a potent flowering tea for frosty heavy bud development, use the same steps but replace the high-nitrogen guano with high-phosphorous guano.
It will provide the essential nutrients for a long time before your girls tell you



they need something, by showing symptoms of deficiency. You can also use either tea more frequently, according to the growth rate of your plants, to greatly increase growth rate and flowering.

WARNING: Never fertilize the plant just before you are going to harvest it since the fertilizer will encourage foliage production and slow down resin production.

Worm Castings

A word here about the most organic of fertilizers: worm castings. Worms are raised commercially for sale to gardeners. The breeders put the worms in organic compost mixtures and while the worms are reproducing they eat the organic matter and expel some of the best cannabis food on the planet. After the worms have eaten all the organic matter in the compost, they are removed and sold and the remains are then sold as worm castings. These castings are so rich that you can grow cannabis in pure worm castings. This isn't really necessary, however, and it is somewhat impractical since the castings are very expensive. If you can afford them you can, however, blend them in with your soil and they will make a very good organic fertilizer.

Worm castings contain many beneficial bacteria. These bacteria are responsible for turning ammonium in soil into nitrates. Nitrates are the most easily used form of nitrogen for the plants. As well as containing these beneficial bacteria, they also contain amino acids which help in the growth and development of your plants. For hydroponics, worm castings are available in liquid form to cover all stages of plant development or additives to give your plants an added boost. Worm castings are a cost efficient way of supplying the needed nutrients to the plants and in most places are readily available.

Worms improve soil airation due to their tunneling action; this keeps the soil loose. The worms will stick around so long as there is enough organic matter for them to digest, especially if you add blood and bone meal, or other various organic fertilizers. If the worms are crawling out of your medium, then its time to add organic fert or transplant into a more organic decomposing medium.

Why Worm Castings Are a Beneficial Soil Additive:

- 10% worm casting in soil mix improves germination rates, plant growth, and gives them a healthy appearance.
- Great fertilizer that can be used a lot but wont burn the plant.
- Hold water and give nutrients in a consistent natural way.
- Introduce micro organisms to the soil, increasing disease resistance.
- Castings also contain plant growth hormones.

Making Your Own Worm Castings

Making your own worm castings is a lengthy process and takes anywhere from 6 months up to 2 years, depending on comparison to how much decomposed matter vs number of worms you have. But it is well worth it. This method takes a little time, but then again, a little time and effort will certainly beat the store prices!

Which Worm Species To Use

The best worms to use for homemade worm castings are Red Wrigglers, a common worm that can be almost found anywhere. Night Crawlers can also be used - they are much larger and also eat a lot more than the wrigglers. You can find Night Crawlers easily around your yard.

What Compost To Use

Raw scraps are indigestible, and must be broken down first by bacteria. Worms are better able to digest and process organic scraps that have been pre-decomposed.

Cow manure: Cows are poor digesters, they only digest about 15% of what they eat, leaving another 85% of the stuff an organic sludge; worms absolutely love cow manure! It is better to have the manure pre-decomposted prior to the vermicomposting. Consider cow manure an essential ingredient.

Any vegetable/fruit scraps: Recycle your food waste! Take your scraps, and place them in a blender, mix it around for a couple seconds. Mixing makes it easier and faster for the scraps to decompose and makes it easier to mix in with other ingredients for a blend.

Dry leaves, grass clippings, rotting wood: These ingredients take a bit longer to decompose, but they seem to be richer in the end. Anything you rake up for your lawn is great. DO NOT kill the mushrooms growing on logs!!!! They provide a whole host of beneficial nutes to your soil composition by breaking down woody organic matter.

Note: Meat scraps and sauces tend to make things a little too rancid and stinky, as well as attract flies and large pests. Keep to vegetable scraps.

Materials and Directions For Making Worm Castings

Here is a list of the materials you will need:

1. A standard Rubbermaid tub (15 gal)
2. 50-150 worms, the more the better.
3. Your decomposing matter
4. Water spray bottle

Directions

Take your pre-decomposed matter and fill up your tub with it (up to 6 inches from the top of the tub, so the worms can't escape). Even it out gently.
Now take your worms, and place around the edges of the tub - the worms will dig down and eventually find their way into the soil.

Maintenance

Spray water on the surface of the scraps to keep everything moist (including the worms). Typically, you can do this about twice a day. There is no turning, or sifting required, as the worms will do all the work.

Harvesting the Worm Castings

The top layer of the matter should turn a dark brown when your worm castings are finished. This new soil looks like brown chunky sand. It looks like dirt, and it smells like dirt. But its genuine, fresh worm castings – the best soil additive known to man!

Using Worm Castings In A Soil Mix

Worm castings can be used in a multitude of ways - mixed into a soil mix, a soilless mix, or as a tea or slurry.

Usually worm castings is thought of as an additive. Recommendations vary wildly, but I would recommend adding one tenth to one fifth in any organic mix (10-20%).

Top dressing with worm castings would work well too, *especially* with indoor containers. Make a worm castings tea by steeping the castings in clean well aerated water makes for a life giving plant-nutrient. Filter your worm tea before use and returning the dregs into the worm bin after a couple of rounds.

One can use plain worm castings as a growing medium, it works very well. But usually finished worm castings tends to be mud-like in consistency, and needs something to aerate and lighten up the texture. Perlite and expanded clay work very well for this. 50% of expanded clay (multiple size) and 50% worm castings makes for a nice quick-n-dirty primo soilless mix.

The Classic Worm Castings Mix

The mix that many elite growers will use is basically nothing but castings and drainage. Including soilless peat-based mixes like pro-mix and other additives will just introduce a source for pH problems - especially when others try and duplicate it but can't find the right brands then substitute with a peat-mix that is too acidic.

A Basic Mix:

40% castings
30% perlite
30% vermiculite

Casting Tea

You can simply spoon some more or less finished castings into a cheap nylon stocking and dump that in a bucket and a reservoir.

Another effective way is by using 100% finished worm castings with a high quality filter material. You simply place that in a bucket with water, aerate the water for 48 hours, and then use that water for watering (provided it doesn't contain visible pests and doesn't smell like rotten fish).

Watering

Using HID lights cause plants to grow very fast but also consumes a lot of water. Plants grown in soil are watered ONLY whenever they dry out, usually only after the top layer has lost a bit of it's moisture. When soil that is too fine is used, drainage problems will develop. For roots to remain healthy, air and water must be able to penetrate deeply. So by knowing this, you must understand that it is perfectly healthy for the soil to become drenched in water as long as it doesn't stay that way and drains properly. Roots need air to breathe so some dryness is good, but not too much or the plant will dehydrate. Ideally a good soil grow mix will hold a great deal of water, yet become over dry if left unwatered for 2-4 days. Your grow mix can be modified to allow plants to hold more water for longer periods (less watering is then required) but plants will not grow well due to poor root growth. Excess water = suffocating roots.

Note: It is very important when watering for the first time to make sure you COMPLETELY saturate your soil with water. This will ensure no dry pockets form that will block fertilizer and roots from growing there. An easy method to do this is to wet your soil, wait a little bit for it to drain, and then wet it again.

When To Water

Usually you will have to water every other day. An example is on Day 1 you water your plant, Day 2 it dries, Day 3 you again water it etc. Watering really depends on the size of your pots, and the intensity of your lighting source.

Sometimes it can be hard to tell if your soil is dry or not. A great method I have found is to physically lift up your pot or container when the soil is completely dry, then water it like normal, and then pick it up again. This will give you a good base judgment on how each water level feels. Be careful because if over or under-watering your plant continues it could die. :(

WARNING: Be sure to NEVER get a SINGLE drop of water on a hot bulb: this may cause it to burst!!!

Before watering break up the surface of the soil with your fingers. This will ensure water is distributed evenly to all of your plant's roots. Your plants leaves will be a good indication as to if you are over-watering them or under-watering them. If the leaves point happily upwards to receive more light than good job, you've got it right! But, if they wilt or curl downwards like claws then you are either over-watering them or under-watering them. Check the soil using the methods mentioned above to determine your next course of action.

Note: Quality water is important to support extraordinary plant growth. Always use water that is room temperature. Using water that is too hot or too cold will damage your precious roots. Also be sure to keep the pH of your water between 6 and 8. If it isn't it is advised to use an amendment to remedy this.

Over-watering your plant generally is OK, but you must make sure the excess water fully drains away. Dehydrated plants on the other hand will show obvious symptoms. The leaves will become droopy. The plant will go back to normal when proper watering is resumed.

The chlorine in most tap water can eventually cause the soil to become acidic. Letting tap water sit in a tub for a day or two will allow all the chlorine to evaporate, but it's still risky. And here's a cool tip; you can purchase a small aquarium-type pump to blow bubbles that will ensure your water is well aerated. Bubbly, oxygenated water is amazingly beneficial for the roots. This will greatly enhance your bud development, and deliver extraordinary results!

Never pour the water OVER your plants, only around the stem! You can spray your plants leaves tops and the undersides of the leaves with a mist bottle in order to keep any dust off them and any micro pests. This misting can only be done before bud production becomes visible. Applying water after buds appear may lead to mold growth. Moldy buds are a no-no, as they are completely toxic. To help prevent mold when utilizing heavy misting be sure to use an oscillating fan to supply proper ventilation and drying.

Watering once a week is ideal for soil and twice a day with a hydroponic flood and drain system. Another good indicator is when top 2 inches of the topsoil dry out. Occasionally provide periods of extra dry and wet soil and allow 10% extra water to drain out of the bottom of the tray. This will prevent and toxic fertilizer build up and keep your buds healthy & strong.

The “Lift The Pot” Method

The "lift the pot" method is a widely practiced, and very accurate method of knowing exactly when to water your container plants.

Many growers agree – one of the best ways to know when soil grown potted plants need more watering is by checking how heavy the pots feel. This method is very simple to learn once you get the feel for how light a ready for watering pot of soil feels.

Get an equal size pot and fill it with your soil. The medium should be about as moist as a new bag of potting soil. Use this planter as a learning tool to get a rough idea of how much the pots should weigh before watering again. The pots with your plants will feel only just *slightly* heavier when the soil is ready for more water. Pick up one of your planted pots, if its noticeably heavy, do not water it until it feels "light". Next time you water a planter, pick it up and feel how much heavier it feels compared to the sample pot of soil.

It only takes a few times picking up the pots until this skill is like a "second nature" to you. You wont even need the sample pot after you get accustomed to the lifting method. Sure, your plants are always putting on more weight as they grow larger, but once you're proficient at lifting the pots, you'll also know how to compensate for the weight of the plants with ease. It's instinct. Anyone who learns this method will always know when its time to water their marijuana plants in a surprisingly accurate way.

Watering Drooping Plants

Plants droop after flushing or heavy watering due to lack of O_2 in the rootzone. Take a thin wood dowel or pencil and poke some holes down into the mix for aeration.

Many growers wonder how they can tell if their drooping plant is overwatered or underwatered. Determining the difference is simple once you know what to *specifically* look for:

-Leaves that are drooping from underwatering will look limp and lifeless.

-Leaves that are drooping from overwatering will be firm and curled down, even from the stem of the leaf.

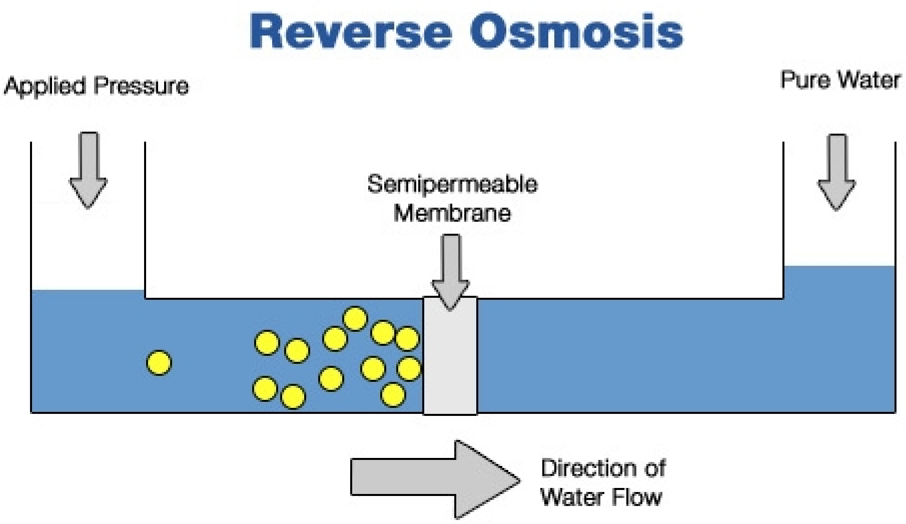
Best Water To Use

Depending on the area in which they live (especially in the snowy mountain areas), most growers will have no problems using tap water. You can have the tap water analyzed to determine if it will give you problems or you can buy a good filter and start with a totally clean slate.

The most common problems with tap water will be:

- pH - usually caused by lime or calcium in the groundwater supply.
- High parts per million (lots of dissolved junk in it) – prominent in city water. Certain elements dissolved in the tap water may cause lockups and then deficiencies if you are using chemical fertilizers.
- Chloramine/Chlorine - used in wastewater treatment.

The best filtration system to use is called Reverse-Osmosis. Under-the-sink models can be purchased at any home improvement store for around $200 USD. They will require cleaning and filter replacement around once a year, depending on how many gallons you put through it. The typical model can clean 50 gallons of tap water down to 0 ppm and 7 pH daily.



The downside to R.O. is the amount of wastewater it produces in the filtration process. This loss to drain can be cut by up to 85% with the addition of a "permeate pump" to the R.O system, it is an easy installation that should require no tools in most cases. Permeate pumps require no electricity and can be purchased online or at your local water filter supply company.

Permeate pumps are the newest breakthrough in Reverse Osmosis System Technology. Designed to operate as a non-electrical energy recovery device, the Permeate Pump uses the available energy from the brine (wastewater out of the R.O. Unit) water after the flow restrictor to essentially force purified water into the R.O. storage tank. The permeate Pump eliminates the need for hydraulic shut-off valves and can be used for replacing booster pumps in well water applications. The Permeate Pump advanced technology is capable of bringing the tank up to incoming water pressure and shutting the R.O. system down when the storage sank reaches full capacity.

Distilled water is also great to use. Mountain or spring water will generally tend not to be 0 ppm as it will have dissolved minerals. Using cheap home filters like Brita pitchers is pointless as they do little to clean the water.

Note: It's not advisable to use plain R.O. water in a hydroponic medium for flushing. The shock of 0 ppm will start leaching nutrients from the roots. Clearing should be done around 100 ppm instead.

Tap Water

Tap water in most areas is highly chlorinated, this kills off all of the micro-organisms in the soil, causing nutrient deficiencies. Stay away from it!!!

Chlorine is introduced to water as the gas Cl(subscript)2 which formulates slightly acidic water, the chlorine could influences the plants indirectly by killing beneficial microorganisms in the soil and creating a highly acidic environment, blocking the uptake of certain trace minerals. Organochlorine takes longer than chlorine to dissipate, so the best procedure is allowing the water to stand in an open container for three days at room temperature, if you must use it.

If the water has dissolved CO_2 in it (like some bottled water labeled as pure), the pH will rise as that comes out. Letting it sit out is used to evaporate the chlorine, which is fine if thats what your district uses. Some areas have switched to chloramine, which is chlorine and ammonia. This will not evaporate and you need a reverse-osmosis filter (or you can use a distiller) to remove the chloramine.

To determine which is in your water, have a sample tested or call your utility company. Even with chlorine or chloramine, your plants may grow “okay” from the tap, but if you wouldn't drink it, why should your plants?

Distilled Water

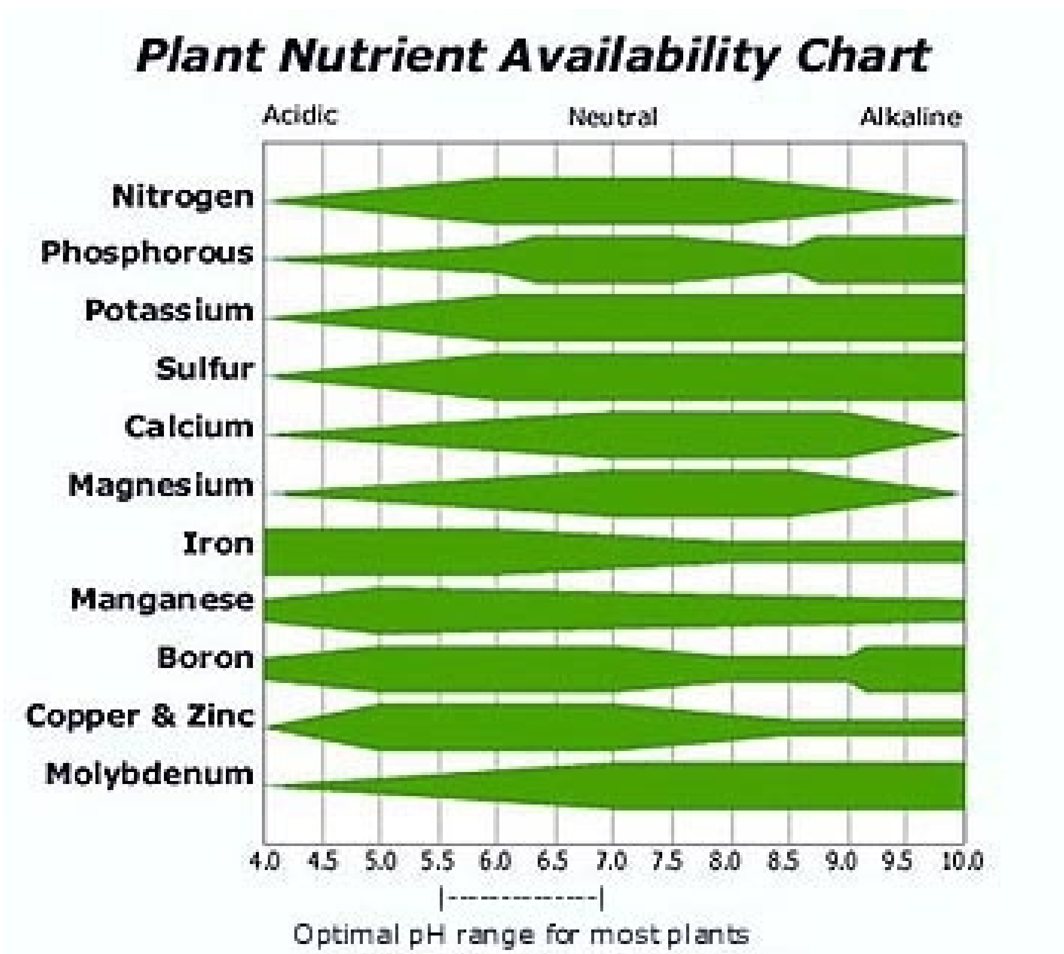
Some growers report purified or distilled water helps their plants grow faster. This is perhaps due to sodium and heavy metals found in hard water that are not present in purified water. Hard water tends to build up alkaline salt deposits in soil that lockup trace minerals, and cause iron, copper, and zinc deficiencies. There are several types of purified water, but many are not free of minerals that could be causing salt build up over an extended period of time. Tap water comes in two flavours; Hot and cold. The cold pipe has less calcium and sodium build up in it, and should be freer of sediment once the water has been turned on and allowed to flow for 30 seconds. Hot water will have rust, lead deposits, and lots of sodium and calcium (you will see it easily).

Use only the amount of hot water needed to make the water the correct temperature 70-80°F (21-26.6°C). Tap water filtered through a carbon (charcoal) filter will be free of chlorine and most large particles, but will still contain dissolved solids such as sodium and heavy metals (lead, arsenic, nickel, etc.). Purified bottled water will be either Reverse Osmosis or some form of carbon/sediment filtered water. When purchasing water at a store, unless it says R.O. or Distilled, don't bother buying it. It could still have the same dissolved solids and heavy metals your tap water has.

pH Level

A lot of gardeners have trouble with the pH (potential Hydrogen ions) of their soil. It is very important to keep the pH level within certain limits when growing marijuana. Even newer growers need to monitor the pH of their nutrient solution or soil to keep it at optimal levels.

The pH level will determine how well your plants are able to absorb nutrients. If the pH level is out of the optimal range, the growth rate of the plants will slow down or even stop entirely. A high pH can lock out needed nutrients and mimic other problems like Fe and Mg deficiencies. The biggest mistake new growers make is to try and correct pH problems too quickly. The first step in determining if high pH is the real problem, is to pick up a good pH tester. Don't be afraid to shell out the cash for a good one, it's well worth it!



pH is a scientifically based measurement of acidity levels. The pH scale ranges from 1.0 – 14.0. **7.0** is "neutral", 1.0 is VERY "acidic", and 14.0 is "alkaline". Cannabis plants grow best when the pH level of the soil is kept at a range of 6.2 - 7.0 . When pH levels are too high or too low, the roots cannot absorb nutrients! This can commonly lead newer growers to believing their plants aren't getting enough fertilizer, which isn't the problem. When purchasing soil be sure to check it's pH levels and opt for a 7.0 . If you're serious about growing then it is important that you monitor the pH (acidic level) of the soil. Your soil should be in the range of 6.0 and 7.0 at all times. In order to do this, if you are serious, you'll need to purchase a pH tester.

As your plant grows it will naturally consume the minerals and nutrients in the soil. The plant also naturally expels waste products during this process through its' root system. This may increase or lower the soil's pH levels. Again, we must strive to keep it between 6.2 and 7.0. Marijuana thrives in neutral to slightly acidic mediums. Soil and soilless mixes should aim for pH of 6. Hydro growers should go slightly lower which helps prevent pythium and other root rots - 5.5 to 5.7 is ideal. 7.0 is safe.

pH Meters

Here are some popular reliable pH meters used today (get a good one, it's so worth it!):

Milwaukee - makes two styles of hand-held pH meters. A small "pen" called the *Sharp* and the larger *Smart Meter*. Both are easy to use. The Sharp pens are splash-proof (although not totally waterproof), and have a large easy to read display. They also have a detachable, replaceable probe.

Oakton - Same type of pH tester as Milwaukee makes, but it's made a little better. These are totally waterproof. It even floats!

Shindengen ISFET - these are state-of-the-art pH pens and work with a totally different method of measurement. This pen uses a solid state Ion Sensitive Field Effect Transistor(ISFET) instead of the fragile glass electrodes used by traditional pH pens. They have replaceable tips that change from opaque to clear when they need to be changed.

Controlling the pH Level

Once you have determined the pH of your soil with a good tester, you can amend the soil if needed to accommodate the plants in your garden using inexpensive materials commonly available at your local garden center.

Note: Adjust soil pH slowly over several days time, and check pH often as you go. Radical changes in pH may cause osmotic shock damage to the roots.

As a general rule, be sure to check the pH level about once a week for the plants you grow in soil. Another ideal time to check pH levels is right after you fertilize your plant. Most grow shops sell pH testing kits. If you find your pH level has fallen out of the 6.0 – 7.0 range then there are methods of bringing it back.

It is generally easier to make soil mixes more alkaline than it is to make them more acidic. The addition of dolomite lime, hardwood ash, bone meal, crushed marble, or crushed oyster shells will help to raise the soil pH.

In soil add dolomite limestone to the soil; use small amounts of hydrated lime. Another easy way to stabilize soil pH that is too basic is to add a fertilizer that contains sulfur.

Raising Soil pH: (to make it more alkaline)

If your soil pH becomes too acidic you need to bring it back to neutral. This can be done using lime. You can purchase lime in small containers in most grow shops. The next time you water your plant, add some lime to the mix. Start off with small amounts and then the next day check the pH level again, and adjust as needed until your pH is back in the 6.0 – 7.0 range. It is generally easier to make soil mixes more alkaline than it is to make them more acidic. The addition of dolomite lime, hardwood ash, bone meal, crushed marble, or crushed oyster shells will help to raise the soil pH. Add dolomite limestone to the soil; use small amounts of hydrated lime.

Lowering Soil pH: (to make it more acidic)

If your soil becomes too alkaline then you will need to bring it back as well. This can be done by making your soil more acidic. You can use the following ingredients to induce a mild acidic environment in your soil to bring it back to neutral; cottonseed meal, coffee grounds, lemon peels, and some fertilizers.

Sawdust, composted leaves, wood chips, cottonseed meal, leaf mold and especially peat moss, will lower the soil pH as well. You can use bloodmeal/cottonseed meal during vegetative; bonemeal during flowering.

Again with both the suggested methods above be sure to only apply a small amount of pH altering solution at first, then check your results. Make moderate adjustments! Don't be afraid to experiment and learn but don't go overboard, either.

Note: You can also find pH up and pH down agents in most grow shops that do exactly what they sound like. These chemicals are becoming quite popular nowadays.

You can also use vinegar to lower pH, and baking soda to raise it.

WARNING: Never ever mix pH up and pH down together directly in a concentrate. This stuff is very dangerous and needs to be handled with care. Use one pipette for each job and color code the pipette to the bottle.

Stabilizing pH with Dolomite Lime

One of the easiest ways to stabilize the pH of soil is to mix one cup of fine dolomite lime per cubic foot of soil. The best way to stabilize pH is by adding 1 ounce of Dolomite Lime per 1 gallon of planting soil.

Dolomite Lime is available in garden nurseries. The best is the fine Dolomite powder (depending on your area there may be several kinds of Dolomite such as Rough, Medium, Fine). Dolomite lime is also high in two secondary nutrients that can often be overlooked by fertilizers; dolomite is high in both (Mg) Magnesium and Calcium (Ca).

Dolomite Lime has been a useful pH stabilizer among commercial growers for years. This is because it has a neutral pH of 7.0 and when added to your soil it stabilizes your soil at pH 7.0

Mix the dry soil medium and dolomite together really well, give the mix a good watering then after the water has had chance to settle and leech into the soil a bit give the mix a really good stir. Then water the soil/lime mix and give it another stir.

The best plan is to mix fine dolomite lime into your mix before planting. Fine Dolomite will help stabilize your pH; however, if the pH becomes unstable or changes, you can then use Hydrated Dolomite Lime. You can add some of the hydrated lime to lukewarm water and give it a good stir and then water your plants with it. Give the plants a good watering with this hydrated lime added and your pH should fall or rise back to 7.0.

Adjusting pH in Organic Solutions

To lower pH use acetic and citric acid. This will facilitate the "kreb" cycle.

To raise pH add small amounts of sodium bicarbonate or lime.

pH And Fertilizers

pH can make or break your carefully crafted nutrient solution. 6.7-6.2 is best to ensure there is no nutrient lockup occurring. Hydroponic systems require the solution to be pH corrected for the medium before exposing to the plants. Phosphoric acid can make the PH go down; lime or potash can take it up when it gets too acidic. Invest in a pH meter for $10 and use it in soil, water, and hydroponic mediums to make sure you're not going alkaline or acidic over time.

Unless composted, most fertilizers cause a pH change in the soil. Adding fertilizer to the soil almost always results in a more acidic pH level. As time goes on, the amount of salts produced by the breakdown of fertilizers in the soil causes the soil to become increasingly acidic and eventually the concentration of these salts in the soil will stunt the plant growth and cause browning out of the foliage. Also as the plant gets older it's roots become less effective in bringing food to the leaves. To avoid the accumulation of these harmful salts in your soil and to ensure that your plant is getting all of the food it needs you can begin leaf feeding your plant at the age of about 1.5 months - dissolve the fertilizer in worm water and spray the mixture directly onto the foliage. The leaves absorb the fertilizer into their veins. If you want to continue to put fertilizer into the soil as well as leaf feeding, be sure not to overdose your plants.

6

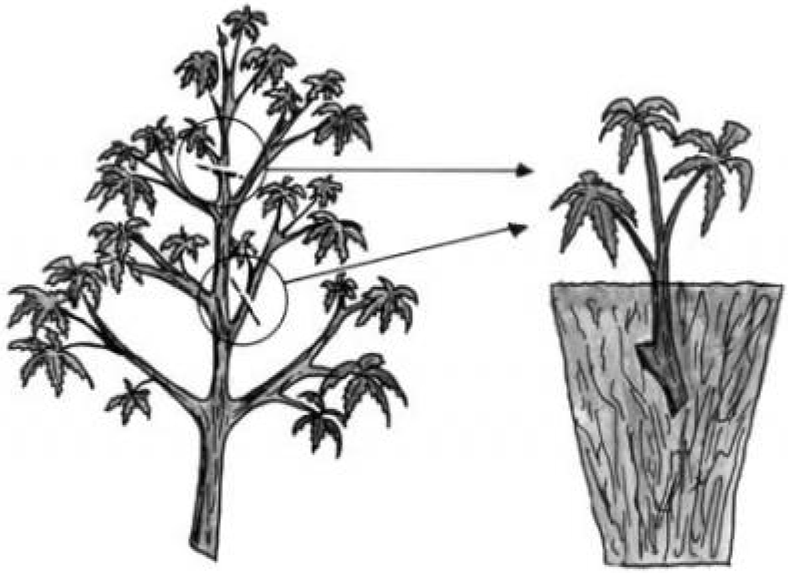
CLONING

Introduction to Cloning

Cannabis can be reproduced asexually or sexually. Asexual propagation is what is known as “taking cuttings” or “cloning”. Many growers take advantage of this awesome process known as cloning. Simply stated, the cloning process is when growth shoots or branches are removed from chosen donor plants and induced to form roots in a separate grow medium. By taking cuttings from a mother, every single clone will be a guaranteed female plant. A garden can be perpetuated indefinitely by taking cuttings before plants begin to flower.

Cloning offers growers many benefits. For one it allows them to have a constant supply of female plants - by using clones, a grower has a healthy, steady supply of guaranteed female-only plants. A clone is an exact genetic duplicate of its parent. So, you can use your most vigorous and potent plants to use as mothers, and every clone you take from it will be vigorous and potent as well!!! Clones will always keep the same sex and vigor of the mother plant. It is also possible to create a garden of plants that will last for decades through cloning from a single female “bonsai” mother plant.

Mothers("Bonsai Mothers") can be kept alive for a very long time to continue to produce healthy offspring, but, the longer you keep it alive the longer it has the chance to fall prey to insects, mold, fungi and disease.



Cloning is a popular simplified method of replicating your plants. To clone marijuana is to take a "cutting" from a growing branch tip and root it. Cloning is by far the most efficient and productive means of cannabis propagation for growers, both indoors and outdoors. The best time to make and use clones is when you have an exceptional unique plant whose particular genetic code is worth preserving and perpetuating. Uniformity is a common cultivation goal among quality cannabis growers. Since indoor grower's usually cannot devote time and space to plants that may have quite different habits in growth, flowering time, or yield, clones offer the advantage of uniform genetics.

Uniform genetics simply means that your plants will be the same height, have the same growth habits, will ripen and flower at the same exact time, and have the same potency, taste, aroma, smell, traits, etc. They will also respond to the same external stimuli in the same exact fashion (such as fertilizer, lighting, bending, cutting, stress, etc). After a while the grower will then know exactly what to do to his crop to ensure a quality, heavy harvest *every time.*

The benefits of creating a garden of genetically identical cuttings from a specifically favored mother plant will allow you to produce a consistent, known quality and quantity from each plant and expect that all plants will mature at the same time. This guarantees the same consistent, quality, harvest from consecutive crops (as long as the same high quality clones are used for planting!) This method is CRUCIAL for commercial-oriented weed farmers.

Genetic uniformity works both ways though. This means if your chosen stock plant is lacking potency, health, harvest weight etc; it's clones will be lacking those traits as well. That is why choosing healthy parent plants is essential.

If you find a seed strain you really like with an awesome genetic profile, you can keep it indefinitely by cloning her correctly. You can create literally 100's of healthy female plants from one single mother! Cloning is great for those growers who have little cash to spend on multiple seeds.

Cloning has the added benefit of reducing the time it takes for a plant to mature. Clones can flower as soon they reach 12 inches, so cloning can shorten the total growing time (which normally takes 90 – 130 days from seed to harvest) to only 10 days! In this way, cloning allows the grower to plant THC potent plants that will continue to grow into full potency at a very rapid rate.

A one month old rooted clone acts exactly like a four month old plant and can be triggered easily to flower by using the 12/12 photoperiod.

An exceptional plant can be rejuvenated and cloned even after it has flowered and been harvested! If a small amount of vegetative matter is left growing on the bottom of the plant and it is placed under an eighteen hour light cycle then all the little nuggets will stretch into vegetative shoots, which may then be cloned and grown into a full mother plant, which can then be cloned indefinitely. This will provide you with many uniform harvests of your favourite plant.

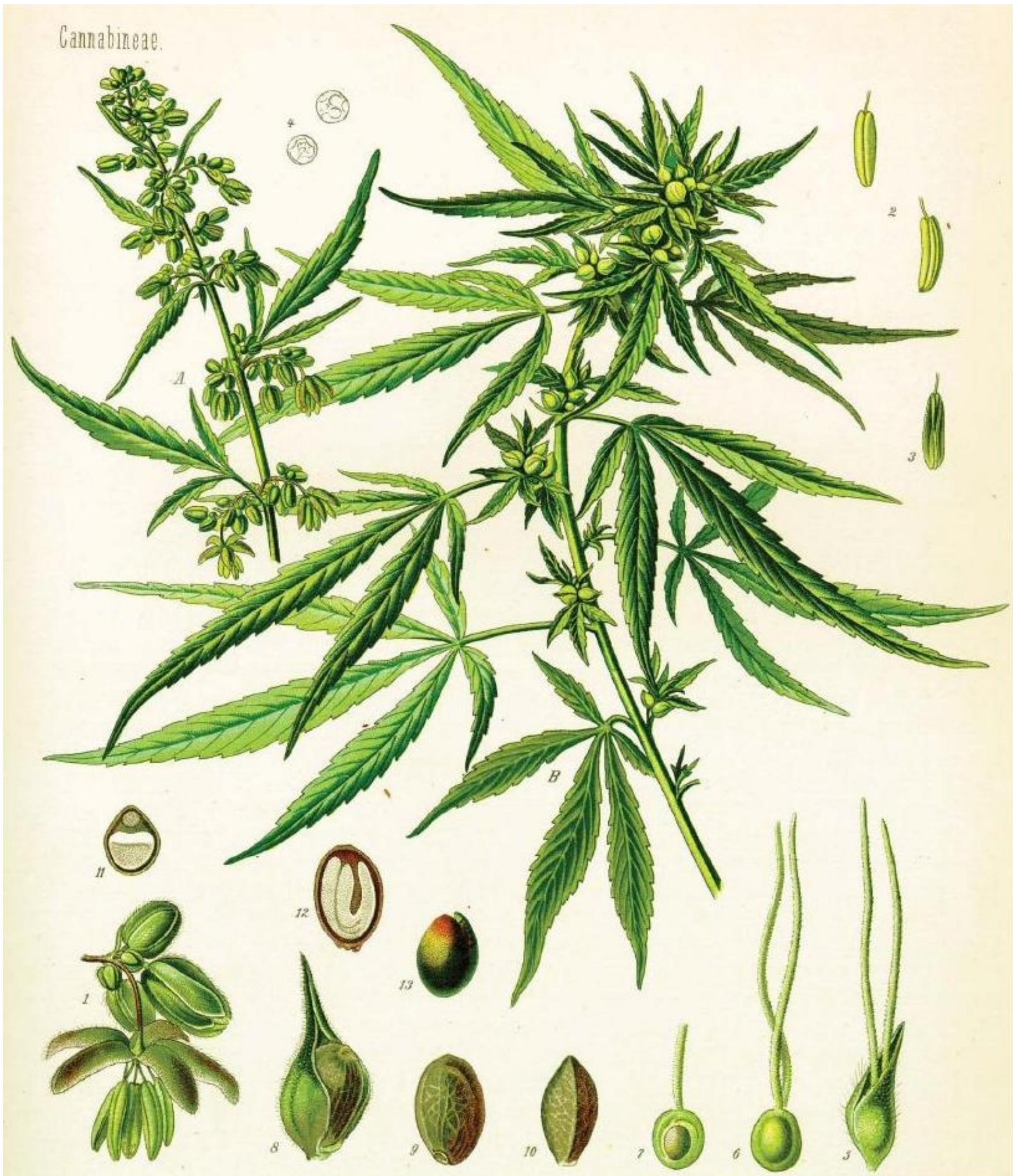
When using clones for regenerating, your garden can be designed and used most efficiently because you know the plant's exact growing habits. Also when commercial growing, since the plant's qualities are already known, you can establish a perpetual income generation cycle properly. The downside to clones is that they can be tedious to prepare and are subject to heavy failure rates.

WARNING: It is imperative that you take clones from a mother plant only. Taking clones from clones may cause the plants to suffer from "genetic drift" and form mutations or undesirable growth characteristics.

Growers often will make clones from their plants when they are still in their vegetative growth stage (cuttings are made easier while the plant is still in its vegetative growth stage). This method of propagating growth asexually to ensure uniformity in growth, yield, and consistency is quite popular nowadays.

Starting From Seeds vs Clones

Many novice growers ask; "should I start from seed or should I grow clones?"



Growers commonly face the decision to begin their grow from seeds or rooted clones. There are distinct advantages and disadvantages to both. The traditional way to begin growing a new marijuana plant is to plant seeds. About half of the seeds will develop into plants that turn out to be male. The males are then removed from your garden and the remaining females will be of varying quality. But what about clones? Let's just say you get an AMAZING female plant that you now want to continue to produce. How do you do it so that you can grow out future generations of the exact same identical awesome plant uniformly, producing a constant flow of incredible buds? This is known as recropping and is the method of obtaining a second identical harvest from the same plant. The answer of course is to take a cutting (clone) of the desirable female mother plant. This is the only way to get a uniform crop.

Growing from clones means that you will harvest more bud sooner. Many people who start a garden nowadays know someone who will give them a few clones for the simple pleasure of sharing a good thing. Some people sell clones only, often growing an exclusively vegetative garden without ever flowering.

These clone aficionados keep a variety of select mothers from high-quality strains, and grow them on a continuous eighteen hour light cycle. They can make good money selling trays of cuttings, either rooted or simply fresh cut. Rooted clones are more expensive than fresh cuttings.

If you have access to someone who grows, you can ask them for some clones, as this will be the easiest way to obtain them. If you don't have access to any clones you will then have to buy seeds as mentioned above. Some people sell specific strain clones only, utilizing an exclusively vegetative garden without ever flowering their bud. They can make good cash selling trays of cuttings, either rooted or freshly cut. Rooted clones are far more desirable than fresh cuttings.

I recommend growing from seeds so you can choose the particular plant that suits your needs, and so you can select the best “leader” plants. Make sure when you're starting from seeds to take two clones from the bottom of each plant right before putting the plants into the flowering phase of growth. Keep them alive, and watch future generations soar!!!

It doesn't matter which grow system you use, you are bound to use clones sooner or later. They can greatly improve the efficiency of your growing area, and are a fantastic way to preserve your favorite plants.

Advantages of Starting With Clones:

- An excellent way to keep a steady supply of plants around.
- Saves a ton of time.
- Guarantee of having a female plant.
- Clones are much faster to veg up and flower than starting from seed, resulting in a quick harvest and a much shorter turnaround time.
- Clones can be quickly grown into mothers and re-cloned, for an instant vegetative and flowering crop
- Since indoor growers usually cannot devote time and space to plants that may have quite different habits in growth, flowering time, or yield; clones offer the advantage of uniform genetics.
- Clones are genetically identical, but some differences will still be evident in the phenotype. In general clones will exhibit even growth and uniform growing characteristics.
- Rooted clones can be flowered immediately if space or time is a problem.
- Clones can quickly provide the grower with a strain's characteristics (smell, vigor, branching pattern, Sativa/Indica dominance, rooting quality, etc).

Disadvantages of Starting With Clones:

- Genetic uniformity means similar resistance and susceptibilities to insect attack, disease, microbial infections, nutrient deficiencies, and any other kind of weakness the parent plant may have that normally would be less likely to harm the plant had it been bred of many different varieties. In other words, degeneration is likely to spread more quickly.
- Lack of variety. Clones from the same parent will all taste extremely similar and create the exact same high. This is perfect for commercial growers seeking uniform standardization growth to increase profits on a large scale, but most smokers growing their own cannabis tend to prefer many different varieties of pot.
- Clones can be difficult to find. Clones from unknown sources are of suspect quality and questionable genetic predisposition.
- Growers run a high risk of inheriting problems from the last grower: Root rot, spider mites, powdery mildew, etc. If these problems are not identified and treated, they can quickly spread to an entire crop (and garden!)
- Unhealthy clones may die or remain in shock for an extended period.
- Availability. Shipped clones may be in shock and take weeks to recover. There are countless horror stories of medical clones shipped without any protection and arrived flat!
- Clones are more light-sensitive and delicate than seeds. Clones take time to become established, and are easily burned by excessive light (and nutrients). They require more attention and care in the early growth stages.
- As clones are almost always female, breeding options are limited. Hermaphrodite development is always possible with unstable clone crosses.

Advantages of Starting With Seeds:

- Seeds obtained from reputable seed banks are of known lineage and genetics. You will have a reasonable idea of what the strain will do in terms of yield, quality and flowering time.
- Your seeds should produce healthy plants, free of disease and pests.
- Hybrid vigor. Females grown from seed are often higher yielding than clones. Strains can lose their vigor over time; growers may want to rejuvenate their grow with the same successful strain
- Breeding and crossing options are possible with male seeds. (Feminized seeds produce a higher percentage of female seeds, but 100% female is never guaranteed.)
- Gives growers more control over evolution and selection.

Disadvantages of Starting With Seeds:

- Problems with ripoffs, shipping/customs seizing seedbank deliveries, switched seeds.
- Cost. Seeds can be expensive, not only per seed pack, but in the time they take to produce a flowered crop.
- Unstable hybrid strains.
- Not all seeds will be viable (germinate) and only 50% of the unfeminized seeds will be female (feminized seeds may produce up to 90% females).
- It may take many seed packs to discover an excellent mother.
- Seeds take a long time (and there is more labor, money and time involved) before a harvest can occur.
- The final results are uncertain.
- Indoor grower's usually cannot devote time and space to plants that may have quite different habits in growth, flowering time, or yield.

Cloning

So let's get started! But before you begin cloning you need to prepare an ideal parent.

Preparing Bonsai Mothers

The most important process when selecting clones is to properly choose a mother plant. A Bonsai Mother is a female strain kept in the vegetative state, never allowed to flower. Female plants will produce 100% females, all exactly like their mother. A Bonsai mother can be kept for several years, but it is suggested to begin anew each year by seed in order to propagate a new fresh healthy mother. You take cuttings/clones from your Bonsai Mothers. Take clones from mother plants that are at least two months old. Plants that are clones before 2 months may most likely develop unevenly and have excruciatingly slow growth.

Any female plant can be converted into a bonsai mother. She can be grown from a seed or be a clone of a clone. The moms should be healthy, pest/disease free and fully into vegetative growth. Clones can be taken off moms up to 2 weeks into flower; however, these flowered clones experience reveg shock and are often difficult to root. It is wise to keep several bonsai mother plants in the vegetative growth stage for a consistent source of cloning stock. If you want to ensure maximum quality bud production, then start new mothers from a seed every year.

A common secret cloning habit among professional weed growers is to foliar feed the mothers with a formula containing a Nitrozyme kelp extract containing growth hormones 3-4 days prior to cloning. This will encourage unbelievable lush and healthy shoot growth.

Bonsai Mother Growth Tips

Lighting: Under 24 hours of constant light the mother will have a very hard time flowering, the downside being that the mother might grow faster than necessary. Under 18 hours of light and 6 hours of darkness (generally referred to as 18/6) that plant will have much slower growth, the plant will receive a nice rest period, and you get a lower electrical bill. The downside of 18/6 is that sensitive strains might begin to flower or at least produce pre-flowers, particularly if the mothers are kept for long periods of time. Some strains are more prone to flower. Generally pure sativas require maximum light in order to trick the plant into thinking it's summer, while stable indicas cope better with 18/6. Going with a lower light regime then 18/6 should be considered experimental. 1200 lumens of blue spectrum rich light is plenty. You want to give mothers 18-24 hours of light per day to maintain fast and vigorous growth.

Note: Always start with the best mothers you can find!

Nutrients: While the plant is active in vegetative growth stage, feed it with a good quality, all-purpose or high Nitrogen fertilizer. One week before taking a cutting feed the Bonsai Mother plant with a low nitrogen, high Phosphorus flowering fertilizer. Lower nitrogen promotes rooting in clones, so about 1 week before you take your cuttings lower it. Reduce the amount/ratio of Nitrogen in the mother's nutrient solution 3 days prior to cloning (flush soil mothers with water). Nitrogen inhibits root growth; reduced N levels in the mother help the clones to root faster.

The flowering fertilizer will lower the amount of stored nitrogen in the plant and increase the amount of stored carbohydrates necessary for the production of roots. Spraying the foliage with water daily will help accelerate this process.

Taking Clones From A Flowering Plant

If you take clones during flowering, the clones will take at least 2 weeks to start vegging again. It might also take a few more weeks for the buds to be re-absorbed. During this time root growth is often painfully slow. Since you've never harvested any buds from these clones future yield will not be compromised. You should however not trust that clones taken from a flowering plant will survive, because clones taken from a flowering plant generally will not survive – if you do not know what you are doing and know your strain then you are gambling. It is recommended to take clones only from plants in Vegetative Growth.

Since a cutting taken while the stock plant is flowering will need to be forced to revert back to a vegetative state under a 24 hour light, this causes additional stress, slowing growth and development. Rooting may take up to three times longer when the cuttings are taken during the flowering cycle. The cutting may not have enough stored nutrients or carbohydrates to survive. If you must do this then take the cutting when the mother plant is only a week or two into flowering.

Some growers do not like to top their moms, preferring to take clones from lower lateral branches to maintain vertical growth and prevent bushy growth. Topping will produce 2 more shoots at the same node, and even more clones can be taken the next round.

How Many Clones Should I Cut?

There will always be natural differences between clones. Clones taken in large numbers will compensate for poor performers and mortality. The fastest rooting clones have the most vigorous vegetative growth and usually the best flowering potential. Taking approximately 50% more than you need is a good starting point.

When Exactly to Take Cuttings?

Although cuttings can be taken at any time in a plant's life cycle, the best time to take them is before the plant is flowering. This helps the cutting to root more easily. Many growers will grow out a plant until it has begun to grow internodes, then they take their clones and discard the plant.

Perpetual Harvesting

Productive growers have two grow rooms! One for vegetative growth / cloning, and the other dedicated for flowering. Commercial growers combine eight-week flowering/harvest cycles with continuous cloning to form what is known as a “perpetual harvest”. An example is to take two clones every four days, and harvest one ripe female every other day. This way, every time a plant is harvested, one or two rooted clones are moved from the vegetative room into the flowering room. The above example will yield the grower 30 flowering clones that are on a 90-day schedule. This means it will take ~90 days from the time a clone is cut from the mother plant until the day it is harvested. If this schedule was used, the grower would have 30 clones, 10 vegetative plants, and 30 flowering plants growing perpetually at all times.

The key of course is to have a separate veg and flowering chamber going at the same time. Each time a plant is harvested it gets replaced with a clone from the veg room - so that the bud chamber's always filled to capacity. Eventually, as you learn the flowering times and cloning times of your strains, you can close in on the goal of 100% occupancy(with no extra clones laying around and no place to put them). This does take a little calculating, but once done you can get on a fairly precise schedule to where you're picking your buds like clockwork. It's the ideal setup for growing multiple strains with different flowering times.

Hydroponic/soil systems: Since the plants will be of varying sizes, you'll want a hydro or soil system that's conducive to moving them around under the lights - to keep them in that bowl formation (or, if you're vegging under fluorescents, in a staircase arrangement with the lights hanging diagonally). You want it to be easy to position the plants wherever you want in the chamber, plus be able take them to the next chamber. Good systems include ebb/flo and drip, and also soil/pots. Systems with fixed plant spacing (aero and nft tubes) and/or systems where the roots intertwine may prove difficult in an ever-changing perpetual harvest setup.

An exceptional plant can be rejuvenated and cloned even after it has flowered and been harvested. If a small amount of vegetative matter is left growing on the bottom of the plant and it is placed under an eighteen hour light cycle then all the little nuggets will stretch into vegetative shoots, which may then be cloned and grown into a full mother plant, which can be cloned indefinitely. This will provide you with many uniform harvests of your favorite plant. This means you wont have to continually purchase seeds!

Cloning Technique

There are several methods of taking cuttings from your selected parent plant. The techniques with the most success rate and easiest to do will be outlined in this section.

Successful cloning requires cleanliness, warmth, healthy stock, and a little care. Clones are sensitive to their environment. Harsh conditions (ie. bitter cold) will delay rooting and increase mortality rates.

Before Beginning

Before you begin cloning in order to ensure as close to a 100% success rate as possible please review the following suggestions:

- Select a strong healthy female mother plant ("Bonsai Mother").
- Wash your hands thoroughly beforehand.
- Keep your work area, tools, and work surfaces clean and sterile. (You can sterilize tools such as a razor, sharp scissors, x-acto knife etc by dipping them in alcohol or vinegar. Bleach that is diluted to a 5-10% solution also works wonders.)
- Have your pH balanced grow medium ready for immediate planting.
- Be sure to have all your cloning supplies in reach and immediately available before you start to take clones.

Taking Cuttings Using Rockwool

Rockwool is an excellent medium for cloning: sterile, cheap, biodegradable, and portable - rockwool can be transplanted into any system with minimum transplant shock.

Required Materials:

- Rooting gel / hormone.
- Fresh sterile razor blade(s) / quality trimming scissors.
- Cutting board.
- 1" rockwool cubes.
- Slotted tray / solid tray / High hat humidity domes.
- Flourescent lighting.

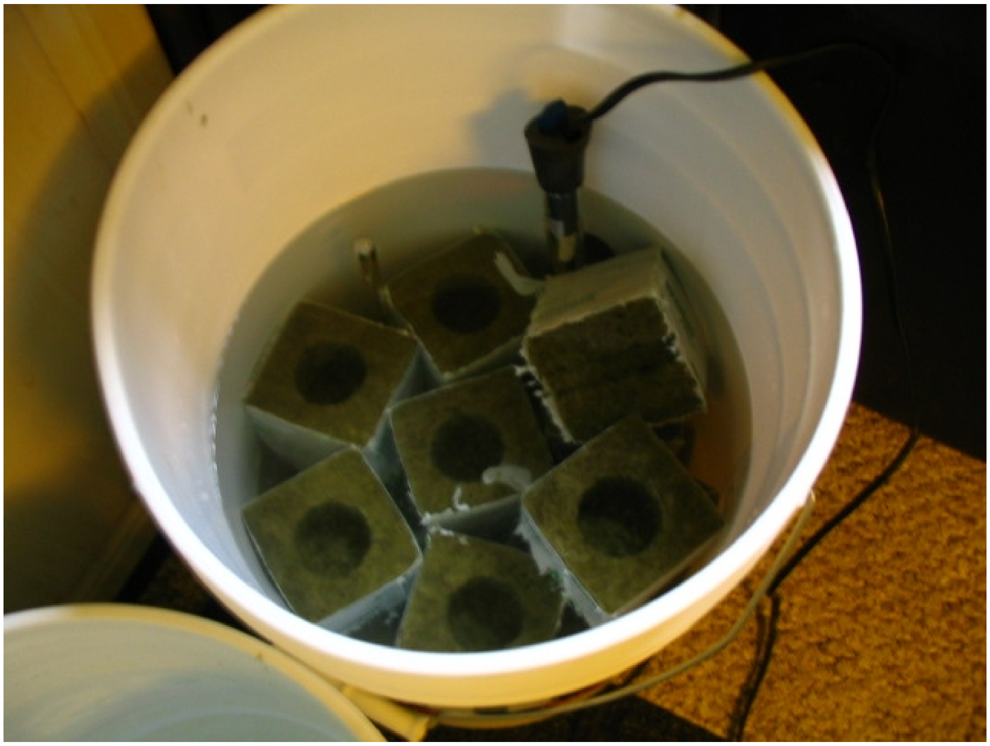
Optional Materials:

- Heating mat.
- Isopropyl alcohol.
- Tray inserts (to keep cubes upright, evenly spaced, and slightly raised off the slotted tray).

Note: always use "high quality water" when watering clones - distilled, reverse-osmosis (RO) or "24 hour" tap water left for 24 hours to dissipate chlorine. All water should be at room temperature.

Prepping The Rockwool

The first step is to treat the rockwool by soaking overnight in a pH treated solution:



Step 1) Remove plastic wrapping from cubes (The plastic can incubate algae)

Step 2) Prepare some pH 5.5 - 6.5 water.

Step 3) Immerse cubes for 24hrs.

Here you can use plastic inserts to keep cubes upright, evenly spaced, and slightly raised.

Many find the standard 1" cube too big; it remains damp and cool (even on a heating mat). A better idea is to cut the 1" cube into 2 halves; the ½ sized cube dries out faster, stays warm, air can reach all sides, roots exit faster, and you get twice as many! Cutting a cube into 4 makes even more...

Note: Labeling your mom and the clones taken from a particular mother plant is a good idea to backtrack on a "monster mom".

Prior to cloning exposed clones will wilt within a few minutes, so it is best to have all materials ready before you start to take cuttings:

- Dip scissors and razor blade into alcohol.
- Wipe cutting board with alcohol.
- Drain cubes, place into tray.
- Poke a 1/8" hole halfway into the center of each cube.
- Cover prepped cubes with dome until you are ready to start(pre-warming the rockwool by putting the filled tray on the heating mat for ½ hour before you start to take cuttings ensures a damn-near 100% success rate).

Choosing Clones

Actively growing tops are preferred, as they contain the most growth hormones. Clones taken lower down are often spindly and less developed. The best is 3" top clones with a 1/8" stem, 2-3 fan leaves and a slightly firm (but not yet woody) stem.

Short clones are best (no more than 2-3 nodes), otherwise the newly forming roots must support a large leaf and shoot. The clone should also be "mature", with alternating leaves. Immature clones have leaves opposite each other and are usually pale and spindly.

Avoid stem cuts (no node) and plug cuts, as they do not root nearly as well (roots form primarily at the nodes). Trim large fan leaves in half to minimize the leaf area the newly forming roots must support.

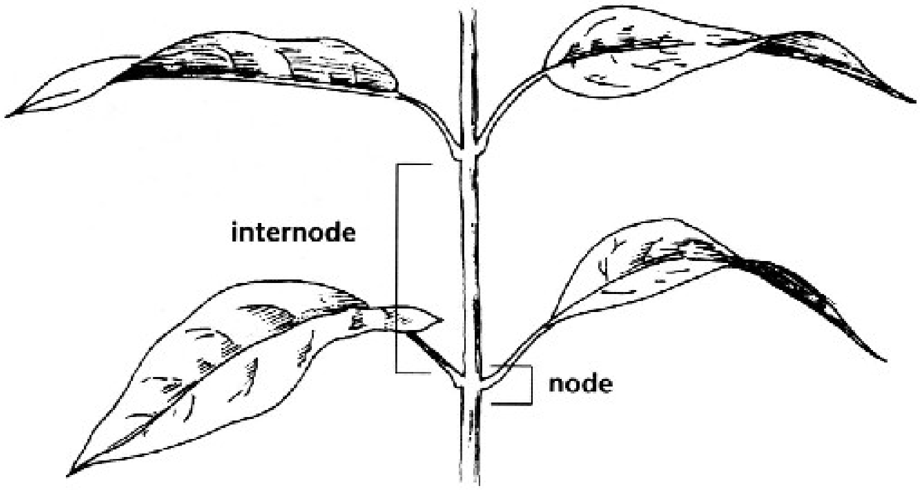
Selecting The Clone - Where Do I Cut?

Select a vigorous growing top on the mother, cut the main stem just above a fan leaf / auxiliary shoot node about 2 nodes down (as shown in red in the image below).

The cut can be done with sterilized trimming scissors or a razor blade.

Leaving a shoot and fan leaf on the mother allows the remaining shoot to continue growing and another shoot to grow from that node.

When taking a cutting you must cut it long enough to have at least one trimmed internode under the medium. Try to take a cutting that is at least 3 inches long. Once the cut has been made, trim off all leaves and branches except the top two fan leaves and the growing tip of the branch. This will leave a nice stem for planting. Make sure you use a sterile clean tool when making your cut.



An internode is the place on the stem where the leaf (plus its' stem) intersects the main stem. Cuttings taken from wood-like parts of the plants won't root as well as cuttings taken from the soft veggy part of the plant. Take them from the fresh soft parts to ensure maximum rooting success.

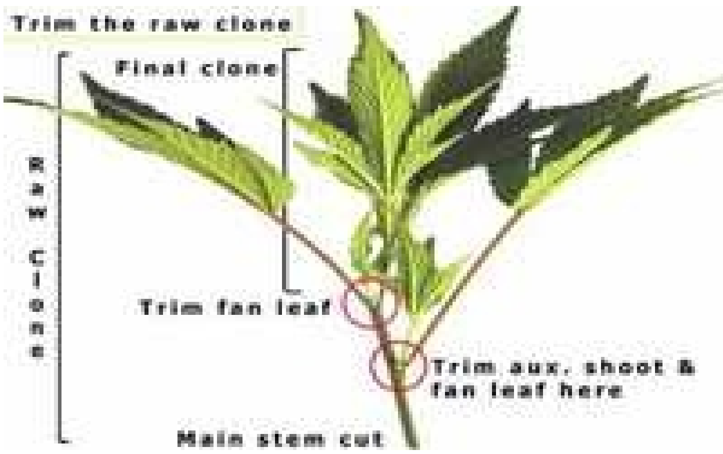
The larger branches of a cannabis plant will oftentimes have little white protrusions near the base of the stem. These are known as “adventitious roots”. These most commonly will appear in a humid environment and readily grow into roots when placed into a grow medium.

Cuttings taken from the lower branches are best as these often contain a higher amount of sugars and they root much faster than the slips from the top of the plant.

Note: Be very delicate with your clones throughout their entire life cycle. Any kind of stress will greatly disrupt hormones and slow its growth.

Pre-Trim The Raw Clone (Removing Lower Nodes)

Once the growing top has been selected and cut from the mother, trim shoots and fan leaves from the lowest nodes (as seen in the below image).
The lowest node will be inserted into the rockwool.



Cut ¼" below the lowest node with the razor blade at a 45 degree angle on the cutting board for a clean cut.

Removing the large fan leaves ensures that the fragile cutting's water and nutrient uptake processes won't be overburdened.

The Trimmed Clone:

This “ideal” trimmed clone was taken from a vigorous top. A fan leaf and shoot were both removed at the lowest node. The clone will soon be inserted dipped into rooting gel / solution, then inserted into a rockwool cube.

Trim large fan leaves in half. This will vastly affect enhance your clone's early development - (It reduces transpiration; so the newly forming roots don't have to initially support as much leaf matter.)

Planting The Clone

Before placing your cutting in a medium if should be treated in a rooting solution such as fungicidal-b[1] mix, or the powerful Willow Water as described below. Rooting solutions promote healthy root growth which is an essential building block for growing dank, heavy sensational buds.

WARNING: An embolism might form in your stem (an air bubble) if you lay your cutting down on a counter before placing it in a grow medium. It is advised to take your cuttings only under lukewarm water. This will remove the possibility of an embolism forming. An air bubble inside your stem will stop fluid uptake and kill your clones. The best way to prevent this is right after taking your cutting to immediately dip them into your grow medium or water.
This will prevent air from getting trapped in the hollow stems.

Dip the trimmed clone into the cloning gel / rooting solution, making sure the lowest node is also thinly coated with gel. Remove any excess on the cut surface itself (so the cutting does not suffocate).

Gently push the stem into the rockwool. If the hole is too big, gently squeeze the rockwool around the stem to seal it.

Dome and Lighting

Spray inside of humidity dome with No-Damp solution or similar, you can simply mist them. Do not spray clones directly, as this can encourage powdery mildew.

Rotate edge clones to keep their leaves inside of the tray. Cover the freshly cut clones with the dome.

Put the clone tray + dome under "warm white" fluorescent lights (delicate unrooted clones require low light levels at first. Do not blast them with direct HID lights or direct sun just yet!!).

The humidity dome should be left on for 3 days, lifted daily for air exchange. On the 4th day prop up the dome ¼" (slightly) on one side to acclimatize them (if wilting occurs, leave dome on for another day and try again).

On the 5th day remove the dome. Roots should begin to exit the cube after 10 days or so.

If the lower leaves start to turn yellow and die, don't worry that's perfectly normal. It is the plant feeding off of itself to sustain life by moving valuable nutrient and water from the older growth. Do not remove any dead growth until the plant is well rooted. If you remove the dying growth the plant can starve and die completely. When the clone has developed roots, replant it where you want it.

Daily Maintenance

Air exchange: Lift the dome at least once a day (for first 3-4 days, then remove dome). Here's a little trick; exhale inside the dome to increase CO2 levels. As the Native Americans say, when we exhale, the plants inhale.

Watering: Water every second day when the clones are under the dome, then once/day thereafter. Once roots show, you may have to water twice a day to keep the roots moist.

The pH of the water inside of the rockwool will rise slowly; re-hydrating at 5.6-5.8 will restore proper pH levels inside the root zone. Allowing the cubes to dry slightly will force roots to search for water and encourage vigorous rooting(but dont allow the cubes to completely dry out!)

Mix 5.6-5.8 pH "24 hour" water and fill solid tray about halfway with water.

Note: After the dome has been removed, add small amounts of nutrients.

Dip clones + inserts + slotted tray into the ½ filled solid tray. Make sure all clones are getting water by 'swirling' the edges of the tray.

Lift clone tray out and allow to drain. Shake tray to remove excess moisture. Place clones back under fluorescent lights, and a gentle fan.

Root Check

Roots should begin to exit the cube in 7-10 days. A gentle upward tug on the clone will tell you if it is rooted (only do this after 10 days). Unrooted clones will pull out. Roots may be present, but not yet exiting the cube. If in doubt, carefully open the cube to see if any roots are exiting.

Initially clones will draw their nutrient needs from the fan leaves, and may turn slightly pale. This is a good sign, as it is proof the clone is rooted, and is actively growing. Often unrooted clones appear healthy and green (and will stay that way for weeks!!!).

To make things easier, you can sort out the clones (unrooted, few roots, vigorous) into their own trays. Roots should be white and fuzzy. If a clone has not shown roots in 2 weeks, I'd consider removing it. Brown roots indicate rot, and nature is beginning to return your plant back into the soil. (It's dead.) Occasionally, root tips will become air burned: a sign to water more often!

Weak nutrients (50-200ppm) should be started on the rooted clones, and watered more frequently to avoid drying the exposed root tips out. You could also try a weak foliar feeding with any kelp extract. Gradually begin to increase Nitrogen levels.

Once Rooted

When you first see the cutting is rooting through the cube bottom, you can stop spraying and start watering the cube, and let the solution drain from the cube.

This is a critical time:, when you see roots, water the cube and open the tent a little to allow humidity to escape and check every twenty minutes for ANY sign of wilting. If after the first hour with no wilting open the tent a little more, and check every hour. After 4 to 6 hours with no wilting, you're ready to rock n' roll.

If any clones start to wilt replace the tent, spray leaves, and try again the next day. If you have some rooted, some not, go for the humidity for a couple more days.

Once the clones have fully established roots, they can be put under weak HID light and a weak (250-500ppm) nutrient regime, or outplanted into soil, hydro or aeroponic systems. Clones are given 18-24 hours of light so that they stay in the vegetative growth stage. Clones generally will take 10-20 days to grow a strong healthy root system. Once the root system is established, clones are transplanted into a larger container or grow medium.

Now they are ready to grow for 1-4 weeks in the vegetative growth stage before they are forced to flower.

Tips

- Do not put the clone tray directly onto a heating mat. The heat will cook the roots, even on a timer. It is better to raise the tray off the mat. A coroplast strip or two to sit the tray on works great raising the tray approx. ¼".
- A low-level continuous heat is preferred, but a timer may be required to reduce temperatures. Running your mats 30min on, 30 min off, 24/7 is perfect. But keep close watch - the heat will dry out the clones, and frequent watering may be required.
- Occasionally, fresh cloning gel will be very thick. Add some water to container, shake. The gel should pour easier.
- If you are using rooting powder, take care to remove excess powder from the stem cut as you plant the cutting, as this can inhibit the uptake of water.
- Give your rooted clones a foliar feeding with any Kelp extract to give them a quick growth boost.
- Cut many tops at once to speed up the cloning process.

- Mark and date all trays, so you know when to expect roots. Try to keep different strains organized in their own trays, watered separately.
- Use a fresh mix of nutrients, and keep the bottle sealed. pH can shift radically, but usually wont do so for the first 10 days if the bottle's kept sealed, out of light, and at room temperature.
- Although most clones will be ready to plant within 10-14 days, you can keep them for months if need be by utilizing certain preservation methods(discussed below).
- And don't forget HUMIDITY, HUMIDITY, HUMIDITY. But don't overdo it for too long or you risk mold and damping off.

Cloning – Step-By-Step

If it's your first shot at cloning, to help make things easier, I have created a simple step-by-step printable section (condensing the above information and adding a few extras) so you can print it out and follow along easier:

Step 1) First you must select your mother plant. Refer to the section above titled "Bonsai Mothers". Begin by taking a sharp blade and cutting a healthy 2-4 inch branch (about 4 nodes[branches] down) from the mother plant with a sterilized, clean, SHARP razor blade or scissors. Take clones from the lower branches of the vegetative females. Look for branches that are firm and healthy (0.125 - 0.25 inches wide). You will make an angular cut right before the first set of nodes. Make the cut at a 45 degree angle (diagonal) so there is more surface area at the base of the stem for roots to initiate. Take your time to cut very precisely, make sure you do not smash the end of stem when you're making the cut. Immediately dip your clone into water until you are ready to dip it into growth hormone and plant it (or you can store your cut clones in water while you are making more clones). It is also recommended when making your cut to slice it halfway between the sets of nodes.

Step 2) You may have to trim off a set or two of leaves and growth nodes so that the stem can fit into the medium. Quickly trim off extra little branches/leaves and when ready to plant, immediately dip the clipping into your already prepared rooting hormone. You need to leave at least two sets of leaves above the soil line and one or two sets of trimmed nodes should be below ground level.

Step 3) After applying your rooting hormone, gently place the cutting into a moist (wet with distilled water) TREATED grow medium (Rockwool or Oasis cubes are preferred). Take some sort of chop stick, unsharpened pencil, bottom of a pen etc to make a hole in the medium(a little larger than the stem) about half an inch deep, leaving room for the root structure to develop. Next gently pack down around the stem. (Cuttings and rooted cuttings can also be planted in hydroponic units at this time.)

Note: If using a rooting hormone powder or gel, make sure to keep a solid layer around the stem when gently packing the soil.

Step 4) Lightly and evenly water the surface of your rooting medium until moist, taking special care not to over-water and drown your clone's delicate developing root system. Keep your clones moist at all times. At this point in order to keep your clone success rate as close to 100% it is recommended to place them under a moisture dome (this will keep humidity in and help stimulate root growth beyond measure) to retain high humidity.

Step 5) Place the clones 6 to 12 inches from a Flourescent light(cool-white and warm-white bulbs being ideal), and provide an 18-24 hour daily photo period (lights on).

Step 6) After planting roots generally tend to start after around 7 days and within 14 days a complete root system will be grown and your plant is ready to transplant.

Cull any clones that show signs of brown, rotting damaged roots. These clones will have severely slow weakened growth.

Note: Don't panic - some cuttings may show signs of wilt but regain their health and rigidity within in a couple days. If it takes more than 6 or so days for your clone to regain it's rigidity, that is to say if it is still wilted, then it probably will grow so slowly that it might never catch up with the others. It's advised to either remove these from your garden or keep them in your cloning chamber so they can

grow a stronger abundant root system and eventually flourish.

You can place your clones in their cubes inside a tray lined with perlite. This will create a nice moist environment. Dome top retains humidity within and around the plant. This is incredibly important for the first few days, humidity should be 95 – 100%. Touch the top of the surface and make sure it is evenly moist. Pay very very close attention.

Note: A b1 Vitamin helps stimulate root growth, you can dip your clones in this before planting.

WARNING: Remember to only clone plants that are in their vegetative state. (That means they are receiving 16-24 hours of light.)

Cloning in Perlite & Vermiculite

Perlite and vermiculite, combined at a 1:1 ratio, make an effective, cheap, and widely available cloning medium. Simply mix 50% perlite with 50% vermiculite, add enough water so it's moist, and fill your small containers. Make sure you keep your medium moist. Wash/rinse any new perlite with ~pH 6.0 water to remove any dust residue before use when cloning.

Step-By-Step:

Step 1) Prepare your mother plants at least 6 hours in advance with a fresh drink of water so they are fully loaded before you cut.

Step 2) Using a screwdriver, toothpick, or alien probing device, make a small hole in the medium, approximately 3 cm deep at each clone site.

Step 3) Take the growing tips from the mother you wish to propagate with sharp scissors - they should be around 6 to 9 cm in length.

Step 4) Cut off all leaves except for the top 1 or 2, plus the small growing shoot.

Step 5) Recut the stem end with a sharp X-acto or scalpel, making it as angled as possible for large surface area contact and water uptake.

Step 6) Optionally dip the cut end into a rooting hormone containing fungicide.

Step 7) Carefully insert into the growing medium, gently patting the hole closed.

Step 8) Place containers in propagation tray and cover with humidity dome. Place prop tray on heating pad set to "low."

Step 9) Keep under fluorescent lighting, misting them daily for the first few days if your climate requires. You might have to lightly water the medium once or twice before roots show in 7 to 14 days.

There are different "grades" or sizes of perlite and vermiculite. For cloning, the small to medium perlite and the medium to large vermiculite are best, but don't worry if you can't find the exact size you're looking for. The 50/50 mix holds water rather well when there are no plant roots sucking it up, so don't overwater your cuts.

The Simplest Cloning Method Known to Man

As easy as cloning is to the masses that use powder, liquid/gel rooting hormone, bubblers and soil, etc, there is an even less complex method of cloning that is so easy, it must have been around for decades, if not centuries. The only ingredients involved are water, light, and the cutting you would like to root. In the following example, you can see cuttings of three different sizes of clone.

The first with two leaves and a single growing tip (S). The next has four nodes, but still only a couple large leaves (M). The third is 6” tall, has seven nodes and several sets of good-sized leaves (L).

As with normal cloning, you immediately dip the cutting in the water for about 15 to 30 seconds, tweaking it to dislodge any air bubbles that may be present.

But the biggest difference is, you won't be removing the cutting from the water until it has roots big enough to support the foliage above. Make sure the cup, which contains the cutting, is opaque. This prevents the light from shining directly on the roots.

The cool thing about this method is the lighting technique. Cloning using this method works 100% of the time simply by sitting cuttings on a windowsill that receives no direct sunlight. In fact, slightly shaded would be even better. In the evenings (short days), you can sit them on an end table over seven feet from a ceiling mounted 100-watt incandescent bulb. At bedtime, just turn off the lights like normal, and when you get up in the A.M. Place them back on the windowsill. During the longer daylight hours they can be left on the sill full time. But remember, no direct sunlight.

The picture shows three cuttings in their water cups. M & L have barely an inch of water to sit in. Any more and it would cover one of the leaf stems. The smaller one stayed in the plastic because the stem was too short to sit in water and stay upright in the cup. Do what's necessary to keep at least ½" of the stem in the water.

Notice the glass that diffuses light, an extra measure against too much light exposure.

The clones grew roots at far different speeds. S showed in seven days, with a small ¼" long root and another small protrusion.

By the time (S)'s roots reached this level of development (nine days), (L) was just putting out the first nubs that would be roots. (M) has shown no inclination of rooting at all. It boils down too the thickness of the stem. Both (M) & (L) have the same size stem but (L) has far more foliage on top.

(S) is doing far better than the others (seen below) and (M) is finally starting to show.

(M) showed roots in 14 days and was planted on day 18.
This picture would be taken just before transplant.

(L) showed roots on day 11 and was in soil at day 18.
This picture would be taken just before transplant.

(S) showed roots at seven days and was in the soil at 15.
This picture would be taken just before transplant.

Transplanting is as easy as it ever is. Using a pre-fertilized potting soil, mixed with ½ perlite, you can use clear cups so you can see how soon they can be removed from the humidity dome. Fill a 4 oz cup with soil mix and swirl a hole an inch deep in the top, insert the plants roots and cover.

WARNING: Do not water right away! Watering will actually delay the roots growth into the new medium. You want it almost dry below so they search for the moisture. Make whatever mix you use semi-moist before transplant.

The dome you see is a cheapo Styrofoam cooler available from any grocery store for $2-$3. Toss the lid and cover with saran wrap with a ½ dozen ¼" holes in it. What you see in the picture is a spare piece of plexi glass. It sits off centre to provide some venting. Simply set an open jar of water inside and close. The jar itself will keep the humidity at around 75%. If you don't like this, just spray a couple times a day with water.

(L) showed itself almost overnight.

All were in the 320-watt veg area in roughly three weeks from cutting to final transplant.

That’s it, the easiest cloning method known to man there is. No spraying, no overheating, no drying out, no expensive hormones, just plant, light and water. Following these instructions, there was a 100% success rate. Simple. If you're on a budget and this kind of method sounds good for you, go ahead and try it. Good luck!

Transplanting Clones

In approximately 3-5 weeks your cuttings will form a solid root structure. At that time it is time to transplant them to a larger container so that their root structure can expand out and grow even further. Make sure there is plenty of air in the growth medium, as this will greatly enhance healthy root growth.

Following this, in approximately 1-3 weeks, root structure should be developed enough so that the cuttings can be placed directly under an HID. You will then take your female clones and place them in a larger growing medium. Transplant only the strongest, vigorously-rooted clones. The lights will be located just a few inches above their tops. Keep them growing in vegetative (following the light cycle as recommended in the guide) and then flower them when ready.
For best results and to ensure a heavy, frosty harvest; do not transplant clones until they develop a dense solid root system. Signs that clones have rooted include yellow leaf tips, roots growing out of drain holes, and the vertical growth of your cuttings.

Note: When transplanting be very very careful with the delicate roots!

Transplanting is important as soon as plants outgrow their containers. This is because plants with cramped root systems will grow sickly, stunted plants.

Try to keep the grow mediums the same to prevent plant transplantation shock. If you are using rockwool to transplant into soil, you need to regulate moisture levels for optimal results. Let your rockwool cube dry out just enough whilst keeping the soil moist so that the roots will penetrate into the new growing medium in search of moisture and nutrients.

Note: For best results, water your clone with a half-strength bacterium vitamin B complex (such as trichoderma) approximately 2 days before you transplant.

Transplanting Clones – Step-by-Step

Step 1) The first step is to prepare your new container. Fill a 2.5/3 gallon container with quality potting soil. Fill it up leaving about ~2 inches between the soil and the top rim of the container.

Note: When cultivating a Bonsai Mother she will need a larger container, anywhere from 10-30 gallons is ideal if you plan to keep her for a year or longer.

Step 2) Fertilize your new grow medium by watering it with a quarter strength quality hydroponic fertilizer solution until your grow medium is adequately rich and saturated. Make sure the solution drains freely out of the bottom.

Step 3) Prepare a hole (use your best judgment depending on the original growing medium and root ball size) in your container.

Step 4) Very carefully pop the root ball out of it's container. An easy way to do this is turn the container upside down placing your hand over the top with your fingers in between the stem, flip the container over and slide it off allowing the root ball to sit in the palm of your hand. Be very careful not to disturb the delicate roots!

Step 5) Gently set the root ball into the prepared hole inside the new and ready container.

Step 6) Pack around and fill soil around the root ball.

Step 7) Water. For best results, mix a half-strength fertilizer that ideally contains trichoderma bacteria or vitamins(B). You want your soil to be very wet, yet draining freely.

Step 8) Place your plants near a light source. At first an HID is too intense, to remedy this simply place your container at the periphery of your garden or under a screen. After a couple days of reduced-intensity light your plants should begin to look strong and healthy, they will then be ready to be moved under full light.

Rooting Hormone

Rooting hormones greatly speed up cellular-level plant processes. You see, when a stem is taken and needs to develop roots in order to continue the plant's survival, it has to adapt and transform from producing green stem cells to manufacturing new root cells. Rooting hormones quicken this process tremendously. As soon as you make your first cut, clones begin to naturally create these hormones and send them to the wound. This takes about a week. When you dip your cuttings into a rooting hormone it will fill in the need until natural hormones take over and greatly speed up growth. When dipping, give them a 5-10 second dip.

Napthalenaecetic Acid (NAA), Indolebutyric Acid (IBA), and Dichlorophenoxyacetic Acid (DPA) are three substances that stimulate this process and greatly assist in root cell production. Look for a commercial rooting hormone that contains all three (if you can find it) of the above ingredients.

Note: When mixing and you need to find out the ppm (parts per million) of your rooting hormone, simply multiply the percentage listed on the product by 10,000. For example, if your product says it contains .8% DPA, it contains 8000 ppm DPA.

Another great ingredient available in many products today to assist in clone rooting is known as trichoderma bacteria. This bacteria when introduced to your clones will cause the roots to grow faster and the bacterium also assists them in absorbing nutrients better.

If using a spray, gel, or other form of rooting hormone make sure to follow the instructions carefully. When spraying be sure to use only enough, do not spray your clones so much that their leaves are dripping with rooting hormone.

Willow Tree Water

If you're looking for a trick to produce incredible speedy vigorous root growth when cloning, you need to obtain natural Willow (tree) Water. There's a substance inside of all willow trees that promotes incredible root growth. Imagine those huge gigantic trees with their massive deep root systems!

When willow water is used on your tiny little clone's root systems and mixed with commercial growth hormone, it produces unbelievably awesome results! You will be shocked at how fast and how vigorous your clones roots develop.

To make your willow tree water compound is easy! Go to your nearest Willow Tree and locate branches that were grown this year. They should be approximately 1.5 inches in diameter. Remove any leaves and cut the stems into 1” lengths. Place as many of these little chopped willow stems as you can inside a glass or a quart jar. Soak them overnight for 24 hours in distilled water. After soaking, pour out the willow water to use it for an incredible rooting hormone.

For best results, simply soak your clones in the willow water rooting compound for 24 hours, then plant into your rooting medium. When using a commercial rooting hormone compound, substitute the willow water in place of regular water in the mix.

Variation: Willow Rooting Hormone Tea

Cut some willow branches (all willow species produce this natural rooting hormone), into 2" or 4" long pieces. You should cut enough pieces to fill a bowl.

Put the willow cuttings into a big kettle (or pot) on the stove, fill with water (all cuttings should be covered by water). Turn on minimum heat setting, cover with a lid, and leave on low (but do not boil) for 2 hours. Then turn off heat and leave kettle covered for 12 hours.

After the mixture has cooled for 12 hours, the willow water should be a dark brown. Strain out the willow water, and discard the branches. Pour the mixture into a container with a plastic top with holes pre-made, and just drop your cuttings in. Let the clones sit in the hormone for 12 to 24 hours (thus allowing the cuttings to fully absorb the rooting hormones), then plant into your medium.

Use as much rooting hormone as you require, then discard the used portion. The unused hormone can be stored in the ice box for years.

Cloning Devices

When you take cuttings and are ready to transplant you are going to need some sort of device to keep your fragile clones in optimal conditions until they grow strong roots. Obviously you will put them directly into a medium, but then what?

Here are a few devices used for this purpose:

Two Liter Bottle

This is probably the cheapest and easiest consistent method to root a small number of clones. Just cut the bottom 40% off a two liter soda bottle, put a clone in rockwool or a whole small jar with another medium inside the bottom. Cover with a plastic bag and hold the bag down with a rubber band. Before sealing give it a puff of exhaled air to fill it with CO_2. This traps humidity inside - it is normal and desirable for moisture to condense on the container. You will need to exchange air every day until roots appear.

Humidity Dome

The most common tool used is the humidity dome. These can be purchased for ~$10-$15 U.S. Dollars at any hydroponic grow shop.

They consist of a plastic tray that is just the right size for a sheet of small rockwool cubes to fit inside of. There is then a clear plastic cover that fits on top of the tray to trap humidity. Depending on the number and size of clones you will need to exchange air between 1-3 times a day.

Micro-Bubbler

These can be purchased or constructed.

Essentially a bubbler consists of a tray with a cover. In the cover there will be numerous net pots and inside the tray will be water & aquarium air stone strips. The strips bubble air through the water causing the bursting bubbles to moisten and oxygenate the medium in the net pots. These can be used with or without a humidity dome cover. If a cover is used air exchange is required as per a simple humidity dome.

Wick Cloner

These simple and prolific cloners are generally constructed rather than purchased. A system similar to the bubbler is used with a tray and cover. Instead of net pots the tray has half pint plastic containers suspended over the water. A wick, usually a 1½ ″ piece of shoelace or strip of cloth, then goes from a hole in the middle of the bottom of the container down into the water. The containers are then filled with perlite. The wicks pull up moisture into the perlite. A dome cover is not used with this method.

After Cutting Care

After you take your cutting and safely pack it into its new growing medium home, the work isn't done! This is the most delicate part of a clone's life – this is the critical stage that determines the health and vigor overall of your little developing plant.

How Long Clones Take To Root

After about a week you can test to see if your plants have started to root. Remove the humidity dome and leave it off for between twenty minutes and two hours. Watch the clones for any signs of wilting while the dome is removed. If the plants have not wilted at all then they probably have enough root development to support themselves. If no wilt is noticed leave the dome off, if they are wilted, spray the cuttings and dome and replace the dome on the tray.

Once you have determined that the plants can support themselves, stop misting the cuttings and leave the humidity dome off.

WARNING: Once the plants have roots, constant misting can actually be harmful to the plants (and can cause mold!)

Lighting

You're probably wondering what amount of light is necessary to ensure the clones maximum and fastest rooting time right? Well I will tell you! Clones root the quickest with 18-24 hours of Fluorescent light. As aforementioned, it has been often recommended by advanced growers that you shouldn't use an HID light right away, but if you must (if you do not have access to fluorescent lighting), place the plants on the perimeter of your garden so they receive less intense light. You can also shade them with some sort of cloth or screen, this works equally well.

Your cuttings are very delicate at first. To ensure they wont wilt, keep them in an area that gets only a moderate amount of light. Let the clones stay in a 6/18 (6 hours of light on, 18 hours of darkness), in a micro-hothouse for the first two days of soft fluorescent light. The darkness stimulates the clone to grow roots instead of spending precious energy and resources on photosynthesis.

Place the fluorescent tube 6 inches above your clones for optimal light exposure and growth enhancement. Direct light will burn them because without roots the stem cannot supply the leaves with enough water to match the leaves' rate of transpiration.

Note: When using fluorescents, a combination of both cool white and warm white are most excellent for rooting.

Do not move clones below intense bright light until they have fully developed their root systems!

Fertilizers

When rooting, clones require minimum amounts of nitrogen, and high levels of phosphorus. This will greatly assist in promoting fast vigorous root growth. Precisely after 5 days your cuttings should be fertilized with a high phosphorus fertilizer. Dilute it to ¼ of normal strength, once per week.

The key to getting a 100% consistent clone survival rate is to practice your cloning technique until you get it absolutely perfect, down to the exact amount of fertilizer at the exact same time, including the same handling procedure and light exposure/moisture levels etc. It takes practice, but with time and following the tips outlined in this guide – you'll get it sooner or later.

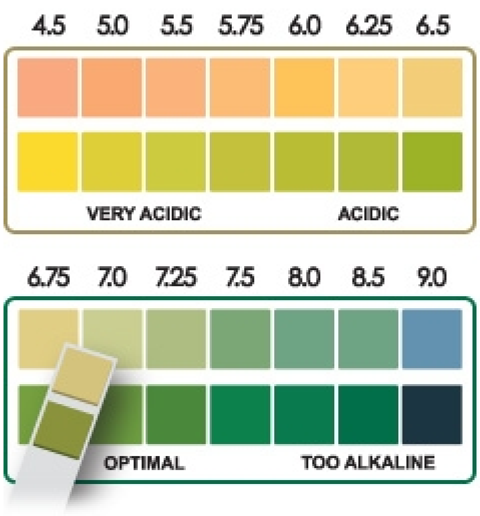
A common grower mistake is to think more is better. This is NOT the case with fertilizing! Over-feeding your clones will greatly hinder and slow down root growth. Following the recommendations above is plenty.

Note: you may want to use a root complex during the growing phase of your cuttings. A root stimulator is a perfect starter for the cuttings. It activates the plants to develop thick stems and a healthy root system.

Temperature

Cold cuttings may never root. If the temperature at clone root level is less than 65°F (18.3°C), you'll want to use a heating mat. Temperatures of around 75-80°F (23.8-26.6°C) will promote the best growth.

ph Level



The optimal pH level to support the best possible vigorous root growth in clones is between 5 – 6.

Watering

Watering clones is easy! Just dip them in a very lightly fertilized (about 100-200ppm) water, or make your own watering can! You can use a standard plastic waterbottle with holes poked into the cap.

Plant roots growth is greatly enhanced by oxygen. Aerate your water before use. You can do this easily by shaking it vigorously.

The cube should NOT sit in water. As long as humidity is high, you can spray with the 6.5 pH solution twice a day for the first 2 days, then once a day until it roots. But the humidity must be high; you should see condensation inside on the tray walls and maybe the leaves. I also spray the walls of the tray to keep it humid. Spray only the leaves not the cubes.

Keep in mind that the longer you have humid conditions the more likely it is to get mold or fungus; rooting quickly is one way to avoid lengthy humid conditions.

Water must be provided by plant's leaves and the cut stem until roots can supply it. When watering your rooting medium make sure to keep the surface evenly moist, taking special care not to over-water and drown your poor plant's newly-forming root system. Water as needed to keep the grow medium evenly moist and never let it get soggy!

WARNING: DO NOT over-water your precious clones! Keep the medium evenly moist. You don't want it to get soggy or drown your roots!

Check for roots around the eighth day by opening a cube in half very carefully. White roots should be exiting the node.

How do I know if the rockwool cube requires watering?

To get watering of rockwool cubes absolutely right, use scales. Weigh a dry cube. Then, saturate a cube and weigh it. Subtract the weight of the dry cube from the wet one. You now know how much water is in the cube when fully saturated(1g=1ml).

Your cube needs water when weight drops to 20-40% of saturated weight. Once you have done this a few times, you will be able to estimate the weight and need for water by feel.

When using this approach with clones, you'll have to guess the weight of the clone - perhaps 10-25g depending on the size of the cuts. When weighing a cube with a clone, subtract the estimated clone weight and dry cube weight from what is measured to closely estimate water available in the cube.

In most cases, especially when using a seedling warming mat, they will require water once every 24 hours. Cubes should never completely dry out.

Watering The Individual Cubes

Immerse the cube halfway into a bucket of pH adjusted (5.5-6.5) water for a few seconds. Gently shake out (but don't squeeze) excess water.

Rooted clones (roots are showing from the cube) should get fully soaked for about 15 seconds, as they have the capacity to uptake water rapidly and will use that quantity in 24 hours. Unrooted clones should just get a little dip; 3-5 seconds at most. Key: Moist is better than saturated for encouraging root formation.

Do not allow cubes to stand in water. If excess water drains into the tray they sit in, empty it out.

Start high nitrogen nutrients when roots have emerged from the bottom of the cube - ¼ strength for first four to five days, ½ - ¾ the next four to five days, then full tilt thereafter.

This method should give 85-100% success, with roots showing in 5-7 days and profuse root development in 10 days.

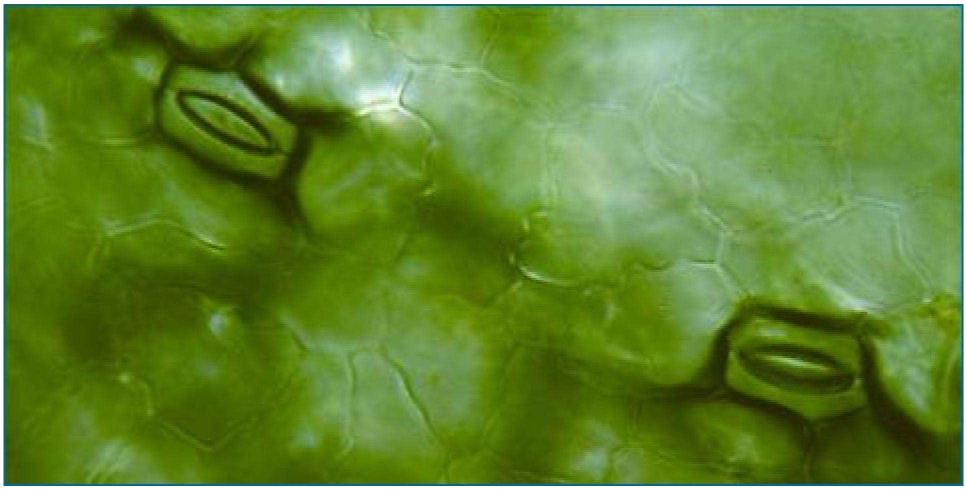
Humidity

When cloning it is important to keep environmental factors at optimal levels to ensure as close to a 100% success rate as possible. One of the most influential components of clone success to regulate properly is the humidity, also known as moisture level in the air. Clones will root the fastest when humidity levels are at 95-100 percent for the first two days, and gradually decreased to 80-85 percent during the following week. Air should be approximately 70°F (21.1°C).

If you want a successful harvest, it is strongly advised by many veteran growers to place your clones under a moisture dome (this will keep humidity in and help stimulate root growth greatly) to retain high humidity. Be sure to mist them frequently with a spray bottle filled with distilled water, and remove the dome several times daily to make sure that they receive fresh air. The reason you mist them frequently(yes, the tops included) is because these clones have no beginning root structure to supply water to the plant. When the plants are covered in moist water they will not dry out fast due to the humidity you are supplying them while they begin to establish their fragile little root structures.

Note: If you're strapped for cash you can easily make your own humidity tent using hard plastic, plastic bags, or glass. It is best to buy one that properly seals and retains moisture though for maximum results.

Transpiration is the process in which water and nutrients travel up the stem from the roots to the leaves, where they are used in photosynthesis. Tiny hairs called stomata (tiny breathing pores located on the underside of the leaf) sweat out the moisture to allow the stream of nutrients to continue flowing. Wind aids in transpiration by blowing the moisture off the stomata, which is why the humidity dome is so important.



Another way to protect the stomata is to spray a light wax onto the cuttings. This slows transpiration to the point where you don't even need a lid, and the waxy coating serves as a protection against pests. I suggest you just try using a humidity dome at first, as this wax method can be a bit tricky and an undesirable option for organic-intended growers.

Remove the lid once a day and fan the cuttings with it for a few seconds. Some growers like to cut small holes into the corners of the lid so that there is a little ventilation. Putting holes into the corners of the tray to also benefits by allowing for drainage if the plants become over-watered. The roots need oxygen to thrive and survive!

Leave the cube in a humidity dome at around 80-85°F (26.6-29.4°C), with about 30-40 Watts/sq ft of fluorescent lighting on for 24 hours a day.

Heating Clones

Clones root best when the grow medium is warmer than the ambient air temperature of the room. When the medium is a few degrees warmer it increases the chemical activity and hastens root formation. Growing medium should be 75-80°F (23.8-26.6°C), as this is best. Anything above 85°F (29.4°C) can be dangerous and harm the plants. Heating mats help dry out and warm the cubes.

Oftentimes here a heating pad, heating cables, or an incandescent light bulb placed below the rooting cuttings is used. You will want to keep the air temperature 5 to 10°F (-15 to -12.2°C) cooler than the medium. A warm growing medium combined with a cooler air temperature will slow diseases and conserve moisture levels.

Reduce Cutting Stress

By controlling light levels, humidity and temperature, your job is to keep the delicate cutting in a complete state of dormancy. Cuttings with out roots are very sensitive to stress. Every effort should be made to minimize evaporation from the cuttings and avoid extreme light and temperature levels. Keep humidity as close to 100 percent as possible and maintain water and substrate temperatures at between 70-84°F (21-29°C). Cooler water will slow root formation; warmer water will encourage disease. The lower the humidity level, the more water the plant will transpire, causing the cutting to use up stored food for things other than root production. It is important to hold the leaves as dormant as possible and permit the cutting to use more of it's energy on root development.

Preserving Clones in the Fridge

You can keep clones stored for later use for a couple of months in a cold refrigerator – just soak them in cold water and then transfer to a zip lock bag. Open the bag every week or so to allow fresh air in. You can also place them inside a damp paper towel or cloth. Keep the temperature in your refrigerator above 40°F (4.4°C). Temperatures below this level might cause the plant cells to damage.

This can be useful for a number of reasons. It is possible for very small cultivators to grow without the use of mother plants. It is also possible to hold the males in reserve without wasting space or having to worry about dropped pollen. Holding clones in the fridge offers many new possibilities for testing many different males, holding strains while evaluating, changing the way you time your mothers, etc.

Clones that are stored in the fridge this way actually root faster than non-fridged clones once they are removed – up to a point of 2 or 3 weeks, when they will take longer to root and you may lose a few. When they are removed from the fridge to be replanted, be sure to recut the stem with a sharp clean sterilized razorblade, knife, or X-Acto knife.

Another method of preserving your clones is by purchasing a commercially available gel that will enable you to store your cut clones until needed.

Yellowing leaves on unrooted clones can be from too much light, or the stem may not be firmly touching the rooting medium. Turn off any CO2 until they root. Too much fertilizer can shrivel or wilt clones - plain tap water is fine.

Having Trouble Cloning?

Some varieties are easier to clone than others. There are Sativas that will sprout roots so easy, you can (almost) stick them in the ground and forget about em'. But then there are some early Indicas that you can baby and they will just sit there and starve to death. Here are some things to focus on.

Help the roots grow: Figure out where the roots will grow on your cutting before you actually cut it. Keep this portion of the stem dark for a week or two by wrapping some tape around it. This is called "etiolation" and will encourage rooting. Make the cutting with a sharp anvil pruner or very sharp pair of scissors, and sterilize them after each cut. A dull pruner will crush the stem and it will be harder for the roots to form. A razor blade will make an even cleaner cut, which will also help rooting, but be careful not to cut yourself. Try to make the cut at an angle to increase the surface area it has to absorb water.

Air Bubbles: The plant needs air to help the roots form, but don't let any get in the stem. This will cut off the capillary action and make the poor cutting work ten times harder. *Immediately* submerse the cut end in water or rooting solution to prevent this from happening. You could even take it over to the sink and make a second cut under running water if you're really worried about it. Leave the cutting in the rooting solution for a day or so. If you just leave it in the water, you might get lucky and sprout some roots, but they really need some oxygen. You can actively provide O2 by aeration or passively aerate by using an airy medium.

Another thing that makes the cutting work harder is breathing itself. Make good use of your plastic dome or humidity tent to limit transpiration and keep the medium from drying out. Another way to limit transpiration is to cut about half off of each leaflet. You will still have the same number of leaves on the stem, but the surface area has decreased. This also helps control fungus by preventing the leaves from contacting the dome or the medium.

Lighting: The proper lighting is also important. Direct sunlight will heat the air in the dome too much, but they're not going to root in the dark either. Fluorescents are ideal for this. An HID is OK if it's not too close, or you could even give them a bit of indirect sun from a window if you can keep them warm.

You've kept an eye on the pH and the notes, and you see it's starting to grow again, so its safe to assume that it has roots and you can remove the humidity dome. Occasionally a cutting may wilt a little at first, but give it a mist and it should perk up. If none of these tips help, either consider tissue culture or finding a different mother.

Wilting Clones

If your clones are wilting make sure they're firmly seated in the medium. If they are "too firmly" seated, you may have bent or broken the stem and stopped water uptake. Make sure that the lights aren't too bright, fluoros are all that's needed. Next time, an anti-transpiration spray will greatly reduce wilting - they form a waxy barrier that keeps water inside the cutting.

The cuttings may be too large with too much leaf mass. You can trim off the half of the fan leaves to reduce area or take smaller cuttings.

And remember to monitor closely the ambient air temperature as anything above 80°F (26.6°C) is starting to get too hot and this will serve to accelerate both transpiration and the drying out of your medium.

7

HYDROPONICS

Growing Marijuana Hydroponically

Growing marijuana hydroponically is method of growing cannabis plants without soil. The plants get fed by soluble fertilizers that are dissolved in water. Hydroponic gardening can be more productive than soil growing, but it is not nearly as forgiving. Soil works as a buffer for nutrients and holds on to them longer than a hydroponic grow medium does. Hydroponic grow mediums contain no nutrients - all the nutrients are supplied via a nutrient solution. Contrary to popular belief, hydroponic gardens often require more care than soil gardens. Because the plants grow faster, there are more things to check and way more things that can go wrong.

How it basically works is that scientists in the 19th century discovered plant roots absorb the nutrients when dissolved in water. Soil acts as a nutrient reservoir, but the soil itself is not essential for plant growth. Hydroponic gardening is ideal if you are looking for massive bud quantities or growing bud all year long. Most growers claim a hydroponic system will grow plants much much faster than a soil medium, given the same genetics and environmental conditions. Fast growth allows for earlier maturation which means shorter total growth time per crop. The plant's in a hydroponic garden system also breathe easier, therefore their growth time is greatly reduced.

Hydroponics should be used indoors or in greenhouses to speed the growth of plants - so you have more delicious bud in less time. Hydroponics allows you to water the plants daily, and this will speed growth. Also, hydroponically grown plants do not derive nutrients from soil, but from the solution used to water the plants. Hydroponics reduces worries about mineral buildup in soil, and lack of oxygen to suffocating roots, so leaching is usually not necessary with hydroponics. Hydroponics allows you to use smaller containers for the same given size plant, when compared to growing in soil. A 3/4 gallon pot can easily take a small hydroponically grown plant to maturity. This would be difficult to do in soil, since nutrients are soon used up and roots become cut-off from oxygen as they become root-bound in soil.

This problem does not seem to occur nearly as quickly for hydroponic plants, since the roots can still take up nutrients from the constant solution feedings, and the medium passes on oxygen much more readily when the roots become bound in the small container. Plant food is administered with most waterings, and allows the gardener to strictly control what nutrients are available to the plants at the different stages of plant growth. Watering can be automated to some degree with simple and cheap drip system apparatus, so take advantage of this when possible. Hydroponics will hasten growing time, so it takes less time to harvest after planting. Growing Hydroponic marijuana will also produce very potent and clean crops. Clean crops should be of concern if you are using the marijuana you grow for medical reasons or selling it to a clinic.

The Benefits:

- No soil is needed, so the entire operation is easier and cleaner.
- No nutrition pollution is released into the environment because of the controlled system.
- Increased plant growth rates and yields with improved aromatics, potency and taste.
- Dry spots and root drowning do not occur.
- The water stays in the system and can be reused; lower water costs.
- It is possible to control the nutrition levels in their entirety; lower nutrition costs and more potent specialized formula.
- No “repotting” labor if rockwool is used.
- Very clean, potent crops.
- Pests and diseases are easier to get rid of than in soil because of the container's mobility; clean, potent crops.
- Fast total growth time.
- Hydroponics can be used in places where in-ground agriculture or gardening is not possible, such as a bedroom.
- Stable and high yields.

The Disadvantages:

- Price tag.
- Regular maintenance is required.
- Requires close monitoring of pH and ppm levels.
- Total reliance on constant electricity.
- Nutrient screw-ups are less forgiving than soil.

In addition to the above disadvantages, larger plants can deplete 5 litres of water in a single day so you are also in constant danger of the system literally running out of water. To emphasize this a little better, as plants uptake water they do not necessarily uptake nutrients at the same rate and as this occurs, the plants might be drinking lots of water but not eating much food. The result is that in a matter of hours, as the water is depleted, the concentration of the nutrients in the bucket can reach toxic levels. So it is critical to always under feed your plants in this system. With this in mind, the pH will also fluctuate as the water is depleted but the nutrients are not. So, you are advised to keep a constant check on monitoring and maintaining this system.

Now, assuming you're new to growing hydroponics, most of the people who want to learn how to do it never get around to it thinking it is going to be some insurmountable herculean task, and I am here to tell you that growing hydroponic marijuana is actually pretty simple, anyone can learn and succeed in due time. So have at it!

Remember you start it is important to fully acknowledge that growing hydroponic marijuana requires a decent amount of monitoring & regular maintenance, so if you plan on being away from your grow area for extended periods of time then hydroponic growing may not be the best option.

Hydroponic Taste

Some growers feel that Cannabis or any other plant grown hydroponically using chemical fertilizer salts, must have a chemical taste. This is not always the case and has been shown in many research studies that hydroponically grown produce tastes no different than that which is soil grown. Plants that are hydroponically grown take up plant nutrients in exactly the same way as a plant does in the soil, no matter what the original source of nutrients (organic or inorganic) was, if you can notice a difference in taste, it may be you have not flushed or cured correctly. Still, others are convinced soil grown entirely organic holds supreme bud taste, and this is logical. Try both and see for yourself. If you want to play it safe, stick with organics.

How Hydroponic Growing Works

The gist of it is simply this: a reservoir containing your nutrient solution is located below a growing tray. The growing tray contains the containers that hold the plants growing in some medium such as rockwool, clay pebbles, sand, gravel, etc.

The system itself consists of a top layer and a bottom lower layer. The top layer holds your grow medium and the bottom layer holds the water with added nutrients. The plant is grown in the medium where it will develop it's stem and a set of roots. The roots will then grow through the medium and down into the nutrient solution. The bottom layer growing bed is filled with nutrient solution using a small pump on a timer that feeds and waters the plants. The timer then shuts off the pump and the nutrient solution drains freely back into the reservoir.

Another great thing about hydroponics is that due to the plants' hanging root structure, they get exposed to air. This allows the plants to beautifully flourish! A key secret of hydroponics is that the plant's energy can be used for maximizing growth instead of wasting precious energy on growing roots in soil and searching for water, food, and air. Get ready for a mass of root clusters! As you will come to see, Marijuana plants truly thrive in Hydroponic systems. If you decide to go with a hydroponics system over soil, you will not be disappointed as the results are nothing short of incredible.

Hydroponics have become massively popular among modern cannabis growers today. Hydroponics isn't all milk and honey though, if you do not properly maintain your garden your plants will die off just as quickly as they will flourish into frosty big buds. Hydroponics allows growers to grow bigger and higher quality buds in ¾ the time it takes to grow the same strain in soil.

Choosing Your Hydroponic Garden System

Now that you have chosen your ideal grow location, you will now need a hydroponic system, also commonly referred to as a Hydroponic Garden. There are different types of hydroponic systems available to marijuana growers today. Hydroponic systems are distinguished by the way that the nutrients are applied. Passive systems have no moving parts, so seldom does anything break or malfunction. These passive systems rely on capillary action to transfer nutrients to roots from the reservoir to the grow medium via a pump. Growing mediums such a peat moss and vermiculite are ideal for passive systems. Low initial cost, and low maintenance are the main reasons why growers choose passive systems.

Active hydroponic systems actively move the nutrient solution. Examples of these include flood & drain (also known as Ebb & Flow), nutrient film technique, and top feed. Active hydroponic systems use growing mediums that drain rapidly and hold plenty of air (such as expanded clay, pummus rock, rockwool and coconut fiber).

The ones most commonly used today by growers worldwide are Manual hydroponics pots, Automatic hydroponics Pots, Aeroponics, Drip Irrigation Systems, Nutrient Film Technique (NFT), and Flood & Drain Ebb & Flow. Keep in mind the NFT and Aeroponic systems are the most efficient types of systems, but they are the hardest to maintain and the most expensive. Ebb & Flow tends to be the easiest, these have proven track records of the easiest to use with low maintenance.

Flood & Drain – Ebb & Flow

The Ebb and Flow system is currently the most popular hydroponic method for growing weed. It will produce potent quick-flowering crops and is easy to use!

This is an all-in-one system. The plant is grown in the medium where it will develop it's stem and a set of roots. The roots will then grow through the medium and down into the nutrient solution. The bottom layer growing bed is filled with nutrient solution using a small pump on a timer that feeds and waters the plants. The timer then shuts off the pump and the nutrient solution drains freely back into the reservoir.

A basic Ebb & Flow setup will have the individual plants and pots set up in rockwool cubes or some other growing medium on a table called the growing bed. The growing bed can usually hold about 2 inches of nutrient solution. Nutrient solution is then pumped onto the table or growing bed, flooding the medium from the bottom up while also pushing out oxygen. Once the liquid nutrient solution reaches it's maximum level a drain pipe is filled.

An ebb and flow system uses a timer to activate a pump that periodically floods the plants grow medium with nutrient solution and then drains the solution out. Often these system are designed using two plastic tubs, one sitting in another. The bottom tub contains the nutrient solution reservoir, the water pump, and an air stone (more oxygen means healthier roots) and the top tub or tray contains the plants. A single hole in the top tub allows the pump tubing into the tub, when the pump shuts off or in the event of a pump failure the water drains right back down the hole it came out of.

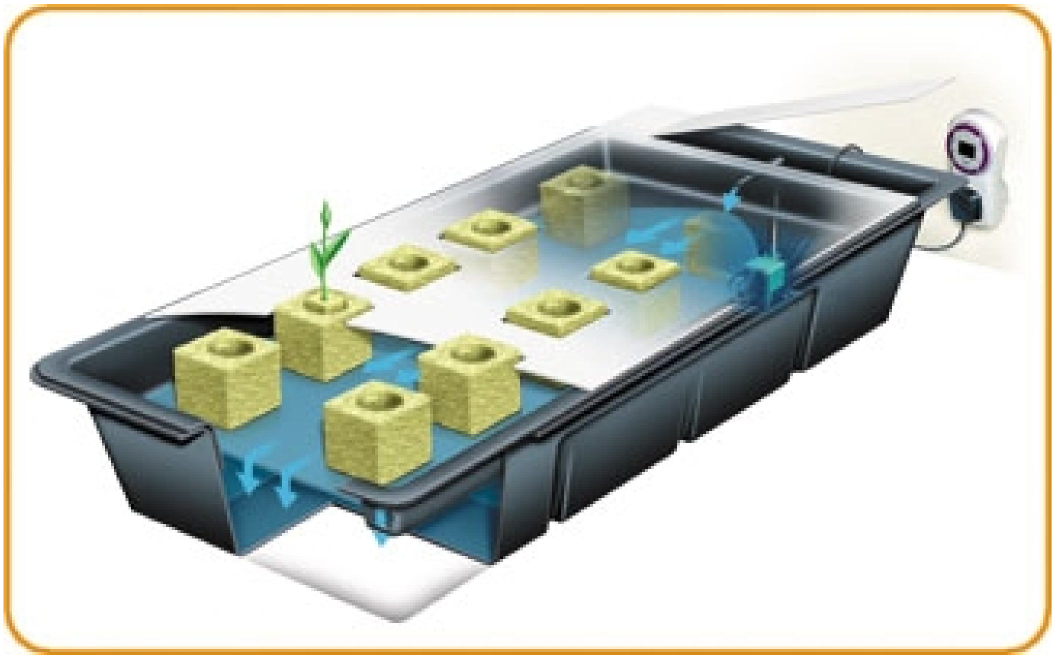
It is usually best to put another hole where it will drain down to the bottom tub at the highest level you want the water to reach. This prevents flooding. A system like this can run at different intervals depending on the grow medium you use but a common choice is 15min on and off cycles, or 30 minute on and off cycles.

Be very careful with a system like this. If a pump failure is not detected plants can die in a very short time period.

pH and Nutrient problems can be corrected in the reservoir with the need to fiddle with the plants themselves.

Nutrient Film Technique

An NFT system is an all-in-one package system. The reservoir that holds the pump and nutrient solution is contained within the same system. This enables a constant flow of aiirated nutrients to the roots (located in gullys) and the runoff nutrient solution is then directed back into the reservoir. These systems tend to be flat, and long.



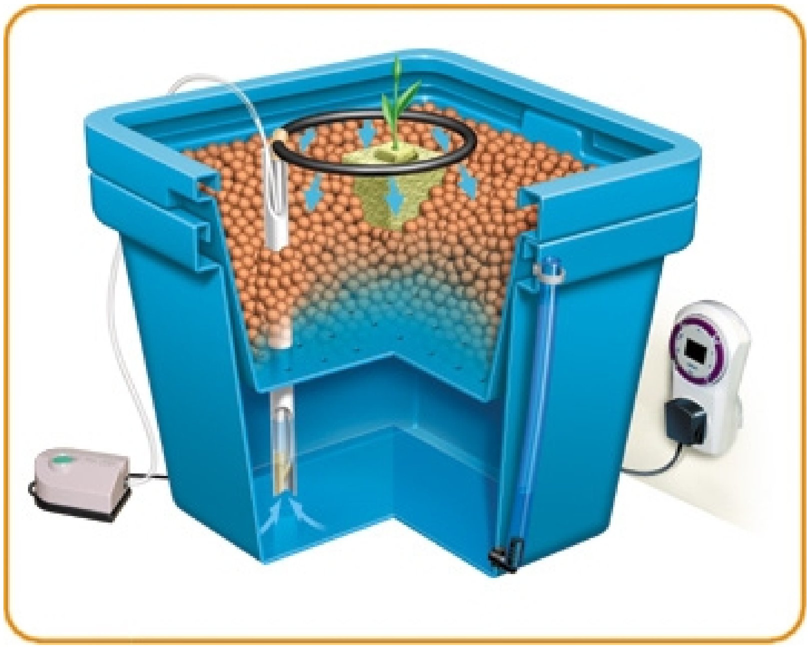
NFT generally involves plants potted so their roots dangle down into a thin film of constantly running nutrient solution. This technique can work well for large scale hydroponic growing operations but if the nutrient film is interrupted it can be devastating.

A separate reservoir is maintained in this technique and it is not commonly used in practice.

Seedlings or cuttings with a strong root system are placed on capillary matting (located on the bottom of covered channels). Constantly aerated nutrient solution flows down the channel (gully) over and around the roots and back to the reservoir. Only growers with a year or so more of experience should try growing with a Nutrient Film Technique setup, as they tend to be quite tricky!

Drip Irrigation System aka “Top Feed”

The Drip Irrigation System is another all in one system that feeds each plant individually. Each plant is located in separate chambers where the nutrients are fed to the medium by means of a small dripper. The solution is cycled and drained very much like an Ebb & Flow system.



Deep Water Culture aka “The Bubbler”

Another effective hydroponics system is the classic simple Hydroponics system known as Deep Water Culture(DWC) or called by it's street name, “The bubbler”. Growing in a deep water culture system is easy and productive. The benefits of using this system is that it is very cheap to assemble and it provides pretty good growth rates. As you will see, the bubbler is also a very fun rewarding way to grow some serious buds.

A Bubbler, as complicated as it may sound, is actual quite simple. It's basically a bucket with a pump. Seedlings or clones are held in net pots in expanded clay pellets, rockwool, or another growing medium. The net pots are nestled in holes in a lid that covers the reservoir. While the roots of seedlings and cuttings dangle down into the nutrient solution, a submersible pump lifts nutrient solution to the top of a discharge tube where it splashes into the access lid. Nutrient solution then cascades down, wetting the roots and splashing back into the self-contained reservoir below, aka it BUBBLES constantly. The potential of this little hydroponics system is awesome – it can grow a plant from 5 ft. to 8ft. with an abundance of fresh quality buds. That is, if you maintain it properly.

How To Start Marijuana Seeds In DWC System

A deep water culture setup is excellent for the personal use marijuana grower. Starting marijuana seeds for this popular cannabis growing method is rather easy. This system is excellent for germinating marijuana seeds.

Start with standard rockwool cubes. Soak them in water. Get your marijuana seeds ready. When your cubes have soaked up enough water take them to a bathtub. Give them 2 or 3 hardy shakes. DO NOT SQUEEZE OUT!
A few hard shakes will release plenty of water, making air pockets within the cube itself. These air pockets are very important for marijuana seed growth. By shaking out the cube you keep your marijuana seed from drowning to death (too much moisture will kill delicate little marijuana seedlings).

Poke the marijuana seed in the rockwool cube where the hole is pre-made. If you find that's too big for your marijuana seeds, turn the cube over and poke a smaller hole.

With most of the water out, pick the marijuana seeds you want to grow and drop them in the hole about 1/4"-1/2" down. Carefully squeeze the hole closed and place in a humidity dome. Light isn't all that important until the marijuana seed sprouts, however its very important to keep the temps around 80°F (26.6°C). Warmth will speed up the process considerably.

Within 4 to 7 days (up to 14) you should see marijuana seedlings poking out of the cube.

When this occurs move the cubes to a 2 gallon rooter DWC bucket with 3" net pot holes with a few rocks on the bottom to support the cube. Leave plenty of space for the roots to grow.

This method of marijuana seed germination isn't too difficult to learn. It might take a few times to master, but use the free marijuana seeds most marijuana seed banks offer to learn on.

These free marijuana seeds are excellent way to learn germination without possibly ruining the best marijuana seeds you actually want to grow.

Deep Water Culture is excellent for the personal use marijuana grower who plants a few marijuana seeds. The method of gardening cannabis is known to produce very heavy yields.

Automatic Hydroponics Pots & Manual Hydroponics Pots

These systems consist of pots used for growing one plant at a time. Each pot has it's own pump that delivers the nutrients. You can also feed them by hand. The nutrients are fed into the bottom of the pot until they reach the roots, then the roots suck up the nutrients until dry, where more nutrient solution is then added and the cycle continues. These Hydroponic Systems are ideal for the grower who wishes to grow very large bushy cannabis plants in a simple stand-alone unit.

Wick/Hempy Bucket: Wick systems and Hempy buckets are very similar. In a wick system a pot with medium has a wick placed down it that extends down into a reservoir and draws up nutrients via capillary action as they are needed or water evaporates. This is much like the way a lantern or wick lighter works,

drawing flammable fluid up the wick to be burned until it is exhausted.
A simple 2.5 to 5 gallon bucket has a 3/4 inch hole drilled about 2-2.5 inches above the bottom.

Depending on the medium and size of the medium used it may not be needed but it is common to glue a piece of plastic screening over the hole on the inside of the bucket. This bucket is then filled with a mixture of perlite and vermiculite (popular mixes are 3 parts perlite to 1 part vermiculite and 1 part vermiculite to 1 part perlite).

The bucket is then watered with full strength nutrient solution every 3-4 days, you water until nutrient comes out the hole in the bottom. This flushes out any built up nutrient salts with every watering assuring that you have a perfect balance.

A hempy is as simple as hydroponics gets and is capable of producing the same yields and quality output as other more complex hydroponic systems. Because it allowed to mostly dry between waterings and pulls nutrients up via perlite wicking the roots are very well oxygenated. Since fresh nutrient is added every 3-4 days there is no reservoir to become imbalanced. Although it looks like dirt the perlite/vermiculite medium is completely inert, it contains no nutrients and provides no pH or nutrient buffer. Plants can drink all the nutrient they want just as in other hydroponic systems.

The hempy system has the advantage that because it is simple there are fewer mistakes to be made. Also important is the fact that the hempy bucket has no pumps of any kind that can fail without you noticing. Hempy buckets can be used in a greenhouse outdoors with no power at all. Like a soil grow the medium retains moisture so you can leave the bucket for up to a week with no adverse affects.

The downfalls compared with other hydroponic systems are that plants must be moved one by one in buckets if moved. You also must water a hempy bucket by hand every 3-4 days and with a large number of plants that can become very labor intensive. For instance, for someone who could not carry a five gallon bucket filled with water a hempy installation of more than 3-4 plants would probably be unmanageable unless the water source was very close by. Because you flush out the nutrient solution and any unused nutrients in it every few days the hemp bucket also requires more nutrients than other hydroponic methods.

Aeroponics

Aeroponics are an extremely efficient hydroponics systems. Expert growers unanimously agree, these are the best systems money can buy.

Aeroponic systems are very expensive and generally are only used by professional growers. They offer the highest performance possible featuring unsurpassed plant growth, resin, potency and yields with incredible aromatics and taste. They also require heavy maintenance and great attention to detail. Aeroponic systems require extremely close monitoring of pH and ppm levels and have a total reliance on constant electricity.

Aeroponics is a relatively new technique. Like in NFT, plants are suspended over the nutrients, but instead of a film of moving nutrients there are instead air stones spread under the roots in the nutrients that highly oxygenates them and produces bubbles. The bubbles burst and splash the roots with highly oxygenated nutrient solution.

This can stimulate very impressive root growth, which leads to unbelievable bud growth. In practice aeroponics aren't considered especially effective for large plant growth, though there is no theoretical reason they could not be. This type of system is very often used for maintaining small clones.

There is no growing medium to act as a water nutrient bank, which makes the system very delicate to use. The plants are grown in a medium that is placed into slots along a long tube. Roots are suspended in a dark chamber without growing medium where they are misted with oxygen rich nutrient solution at regular intervals. If the pump fails roots will soon dry and plants will suffer almost immediately. Tubes can vary in length anywhere from 1 meter to 20 meters! Looking inside the tube we will discover nozzles which mist down the roots of each plant with grow nutrients. The nutrient-filled reservoir is kept outside the tube in a tank. The nutrients are pumped from the tank into and out of the nozzles and then the remaining solution that drips down from the plants is drained into another tank that is monitored and modified before being recycled and used again.

Growing the Stealth Hydro Way

Some growers want to reap the amazing benefits of utilizing hydroponic growing methods to enjoy the unbelievable bud they produce, but they feel they can't afford these expensive systems or worse yet, can't fit them in their limited grow space. Well, Stealth Hydro has done it again and came up with a solution for modern day growers. Many growers right now are raving about their newly developed Bubbleponics line. Their most popular “beginner” Bubbleponics system right now can grow six huge flowering plants and they've made it available for only $99! It literally is the world's first continuous plant feeding system. Bubbleponics is a hybrid design that takes the best from both worlds of the bubbler and drip systems. Since the nutrient mix is highly oxygenated, Bubbleponics converts its drip function to a constant feed flow directly to the inner roots. Without needing to take breaks to allow the root base to drain and absorb oxygen, plants in the Bubbleponics system are able to deliver unparalleled growth energy.

(Stealth Hydro's famous system, The Bubbleponics 6 Plant Starter Kit)

This advantage is particularly pronounced during early vegetative phases when the plant’s root mass is still relatively small. Cuttings placed into the system experience no noticeable transplant shock and practically start growing immediately. In experiments measured against leading Aeroponic systems, the Bubbleponics design shaved, on average, four days from a two week growing cycle, a 30% growth rate increase over Aeroponics in the early vegetative stage; truly amazing. This is incredible, a small-time closet grower with one of their systems can reap the EXACT (actually more) benefits of extremely expensive professional Aeroponic systems, and the best part is they're super inexpensive. Many growers report “unreal” buds coming from these systems. But shhh keep it a secret, people aren't going to believe the buds you're going to be holding in your hands.

As the root mass of the respective plants grow larger, growth rate advantages were less evident, however, the plants in the Bubbleponics planter maintained their 4-5 day lead over the Aeroponic plants throughout the entire cycle.

In a series of stress tests, plants in the Bubbleponics system performed remarkably when recovering from an over-fertilized condition. With almost the entire root mass destroyed, Bubbleponics was able to revive 67% of the plants which started re-growing new roots and were able to complete their cycle. None of the other plants in the Aeroponic products survived this stress test. The tests concluded that the Bubbleponics system provided significant recovery advantages over other systems when it came to anything that stressed or killed that root mass.

The Bubbleponics system is great for the grower who is turned on to the incredible benefits hydroponic systems offer growers, but turned off from the heavy maintenance and complicated operation involved. Stealth Hydro has designed their Bubbleponics line with ease of use in mind. Considering that there are no timers to set and tweak for the water pump, and that the unit is totally self contained and mobile, this is one of the simplest hydroponic designs most growers report they have ever used. From setup to final clean up, bar none, one of the best high speed hydroponic systems on the market. Stealth Hydro's Bubbleponics line has raised the bar and changes everything we are to expect from modern-day hydroponics.

Final Considerations

Before you make your final decision on what type of hydroponic system you are going to use, consider these last crucial factors: It is important with any hydroponic system to remember that unlike with soil, there is no buffer. Plants will respond very quickly if there are no nutrients being supplied and/or water or the pH of the nutrient solution is incorrect. Roots need high oxygen levels or they will rot. And remember that plants need ample space to grow and should never be planted where their roots will intermingle.

If you can effectively monitor and maintain a hydroponic system, go for it. You will not be disappointed. They are incredibly fun systems to grow some awesome weed in.

Oxygen

Hands down the single most important aspect of Hydroponics. The importance of clean fresh air or oxygen in the water is critical for vigorous plant growth (aka dense heavy big resin-rich potent buds!). Add an air pump. Heck, add two. The addition of a 2nd air stone can make a significant difference in the speed of growth. You can use a plastic T-coupler so you can add a second stone to the one air pump. You can force growth spurts by draining the tank, waiting five or ten minutes to allow the roots to "air out" and then replenishing the water, even if you add back the same water and nutrient mix that you just drained out. Try it! Your plants will thank you.

Lighting

Refer to the Lighting section, same rules apply. 400 watts is about the best size of light for growing hydroponic marijuana in a personal garden. You should be able to grow about 4 to 12 plants at a time. 250 watts should be good enough for up to about 2 to 6 plants. Anything bigger (next standard size is 1000 watts) and you are going to draw a lot of electricity. Anything smaller will limit the size of your garden to one or two plants.

Growing Mediums

Hydroponic grow mediums exist to provide a stable base for your plant to grow its roots through and to hold up the weight of the plant. Over the years many substances have been found to fill this role and they have different properties. Often a grower will use one or more of these mediums depending on the methods he has chosen for growing and the desired properties of the medium in the container being used.

Remember the media will not provide any nutrition, it is just a support for the roots. All nutrition comes from the hydroponic solution. Also keep in mind rockwool and other media may have to be soaked in pH adjusted water prior to use, especially when seeds are involved.

Grow mediums are designed to be the perfect substance for your plants will take root in. Growing mediums such as rockwool or clay pebbles are the most popular and commonly used today. Grow mediums are artificial grow substances designed to contain all the plants mineral needs and allow air to reach the roots to promote exceptional growth. Rockwool is the most widely used.

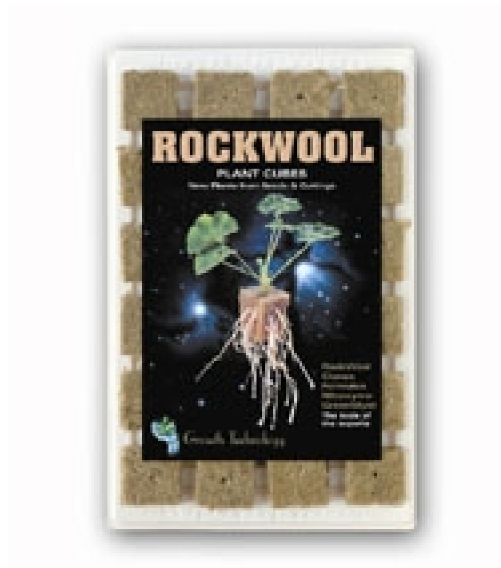
The main difference between hydroponics and soil growing is that the hydroponic soil or "medium" is made to hold moisture, but drain well, so that there are no over-watering problems associated with continuous watering.

Rockwool: Rockwool is literally spun rock; the rock is spun into a material that looks similar to the spun glass used for insulation. Most growers are using rockwool in some form. If allowed free drainage rockwool will retain just the right amount of moisture.

Rockwool comes in multiple sizes of cube. There are smaller cubes or plugs that are typically used for seedlings or clones and larger blocks that are used in hydroponic systems (such as Ebb & Flow trays). Some of the large blocks have holes in them to make it easy to insert the small plugs or cubes you used to clone the plant directly into the larger block. Rockwool must be completely submerged in water for 8hrs prior to use in order to remove any air bubbles in the medium.

Rockwool cubes can be reused several times, and are pre-made for use with hydroponic systems. Just place the plant's cube on top of a larger rockwool cube and enjoy your extra leisure time. Some find it best to save money by not buying rockwool and spending time planting in soil or hydroponic mediums such as vermiculite/lava mix. Perlite is nice, since it is so light. Perlite can be used instead of or in addition to lava, which must be rinsed and is much heavier. Rockwool cubes vary in sizes from 1” to 6” cubes. They are also excellent for cloning. A lot of growers also use rockwool cubes for seed germination and rooting cuttings, as this is one of the easiest methods.

Rockwool has many advantages. For starters it isn't very expensive, and it is reusable. It is also impossible to over water and there is no transplanting involved. Rockwool holds 10 times more water than soil, yet is impossible to over-water. This is because it always retains a high percentage of air. There is no transplanting - just place a starter cube into a rockwool grow cube, and when the plant gets very large, place that cube on a rockwool slab. Since rockwool is easily reused over and over, the cost is divided by 3 or 4 crops, and ends up costing no more than vermiculite and lava, which is much more difficult to reclaim, sterilize and reuse (repot) when compared to rockwool. Vermiculite is also very dangerous when dry, and ends up getting in the carpet and into the air when you touch it (even wet), since it dries on the fingers and becomes airborne. For this reason, I do not recommend vermiculite when growing indoors.



Rockwool doesn't have very many disadvantages. The thing is, it has a base alkaline pH, so you must use something in the nutrient solution to make it acidic(5.5) so that it brings the rockwool down from 7.7, to 6.5(vinegar works just fine). And it is irritating to the skin when dry, but is not a problem when wet. To pre-treat rockwool for planting, soak it in a solution of fish emulsion, trace mineral solution and phosphoresic acid (pH Down) for a minimum of 24 hours, then rinse. This will decrease the need for pH concerns later on, as it buffers the rockwool pH to be neutral. This will properly stabilize the pH level of your rockwool, creating the ideal grow medium that'll assist in producing high quality big buds. You must do this. After check the pH of the medium every time you water to be sure no pH issues are occurring.

Hydroton: Hydroton clay pellets are also very effective and quite popular. Be sure to occasionally move them around so that the hydroton stays wet all the way through. Hydroton consists of lava rock or clay pellets that are available in different sizes and usually have a red coating on the outside. This inert medium is effective in continuous drip and ebb and flow systems. It is also an excellent choice anywhere you need drainage and some have used it for the bottom couple of inches of a hempy bucket to facilitate free drainage.

Soil: Mother Earth's plant food. A.K.A. plain ol' dirt. Soil is actually a composite of a number of substances and varies from on location to another. It is typically composed of rock, sand, clay, and organics. Organics are decomposed plant and animal matter and provide the nutrient content that is contained in soil, clay binds soil together and retains moisture, rocks and sand provide drainage to allow for root oxygenation. Additionally soil is usually teaming with microorganisms that are feeding on and breaking down the organics contained within it.

When growing a potted plant indoors you will probably want to mix perlite with your soil to enhance moisture retention. It is also highly recommended that potting soil be used in a pot rather than soil that you have dug up from the ground. A potting mix can be more carefully designed for optimal plant health and the soil outside will contain many unwanted forms of insect life that can, and will, infect and kill your plants.

Another common concern with soil is that potting soils often already have fertilizers in them (in addition to the nutrients contained in the organics). In general, try to avoid potting soils with time release nutrients. If you do purchase a bag, be aware that the plant will not need any nutrients for a period of time. You'll need to just water with clean water to avoid burning the roots.

Perlite: Perlite is a porous white substance that is very absorbent and excellent at retaining and wicking moisture. Perlite is often used for cloning and mixing with other grow mediums, but it can also be used on its own. Growers who use perlite as a sole grow medium will often purchase large coarse chunks rather than the smaller porous perlite that is more readily available in most areas. It is not recommended to use perlite in a circulating system because the fine dust that comes off the perlite will clog pumps over time. The same fine dust brings a recommendation that when handling perlite you utilize a respirator device so that the dust does not harm your lungs. Perlite is a unique volcanic mineral which expands from four to twenty times its original volume when it is quickly heated to a temperature of approximately 1600-1700°F (871.1-926.6°C). This expansion is due to the presence of two to six percent combined water in the crude perlite rock which causes the perlite to pop in a manner similar to that of popcorn.

When expanded, each granular, snow-white particle of perlite is sterile with a neutral pH and contains many tiny, closed cells or bubbles.

The surface of each particle is covered with tiny cavities which provide an extremely large surface area. These surfaces hold moisture and nutrients and make them available to plant roots. In addition, because of the physical shape of each particle, air passages are formed which provide optimum aeration and drainage. Because perlite is sterile, it is free of disease, seeds, and insects. Perlite has been used for many years throughout the world for soil conditioning and as a component of growing mixes with materials such as peat moss or bark. Extensive studies have shown that the unique capillary action of perlite makes it a superior growing media for a hydroponic growth medium.

Perlite is a completely inert substance so will not interfere with your feeding schedules. That being said, there are some manufacturers that put nutrients in their brand of perlite even though it is not indicated on the product label. This material can be used but should be flushed thoroughly with water to wash out the nutrients. Perlite should be washed anyway to remove the fine dust that builds up in it.

Vermiculite: Vermiculite is a crushed volcanic rock medium that provides excellent drainage when mixed with other grow mediums. Vermiculite is inert but is not particularly suitable for use as a grow medium by itself. It consists of any of various micaceous minerals that are hydrous silicates resulting usually from expansion of the granules of mica at high temperatures to give a lightweight highly water-absorbent material that both is sterile and light in weight (5 to 8 lbs).

The pH of vermiculite will vary depending on where it is mined. Most U.S. sources are neutral to slightly alkaline, whereas vermiculite from Africa can be quite alkaline (pH = 9). Vermiculite is used extensively in the greenhouse industry as a component of mixes or in propagation. It is usually sold in four size grades: #1 is the coarsest and #4 the smallest. The finer grades are used extensively for seed germination or to topdress seed flats. Expanded vermiculite should not be pressed or compacted, especially when wet, as this will destroy the desirable physical properties.

Coconut Fiber: Many modern growers are beginning to use this newer grow medium. Coconut fiber offers some of the buffering capacity of soil, drains well, retains enough moisture to be useful, and has little nutrient content.

Hydroponic Nutrients

Proper hydroponic nutrient use is arguably the most important aspect of your entire setup. Your nutrient choice and mix will determine whether your plant will shrivel up and die in a couple hours, grow, grow big, or grow very very big.

Nutrient Ratio

As you recall, all plant food is measured in the N-P-K format.

N for Nitrogen
P for Phosphorus
K for Potassium

A 15-15-15 solution contains 15% Nitrogen, 15% Phosphorus, 15% Potassium. 20-10-5 solution contains 20% Nitrogen, 10% Phosphorus, 5% Potassium. The percentage of the solution not used by N-P-K is trace elements and inert material. Make sure when choosing your hydroponic-designed fertilizer that it supplies adequate amounts of nitrogen during early growth stages. Typical hydroponic fertilizers (nutrient solutions) have a nutrient ratio of 9-5-10 or 18-6-16. Fertilizers that will be used for later growth should have lower rations of N. In order to get vigorous growth from your plants, you will need to find a nutrient solution that also supplies secondary and micro-nutrients. This will be listed on the label of the package.

Note: If your nutrient solution is deficient in magnesium (very common) then you can use Epsom salts as described in the soil nutrient section. You can also purchase an iron-zinc-manganese combination solution at your local grow shop.

Depending on what stage of growth your crop is in, you can adjust different nutrient levels needed at different times to optimize growth for producing the highest quality and biggest size buds that grow as fast as biologically possible.

You must change plant foods often to avoid deficiencies in the plants. I recommend using 2 different plant foods for each phase of growth, or 4 foods total, to lessen chances of any type of deficiency. Change the solution more often if you notice the pH is going down quickly (too acidic). Mostly due to cationic exchange, solution will tend to get too acidic over time, and this will cause nutrients to become unavailable to the plants.

Higher amounts of N are needed when the temperature will be below 80°F (26.6°C) in the grow room during vegetative growth. 20-20-20, or 23-19-17, or 12-6-6, or something similar, with trace elements should do it.

If temperatures are higher than 80°F (26.6°C) in the grow room, you need not worry about more N in the formula during vegetative growth.

During flowering the plant needs lots of Phosphorus, regardless of temperature. 15-30-15, or 5-20-10, or 2-4-3, or something similar, with trace elements should do it.

WARNING: Do not over feed your plants!!!! Too much nutrients will kill your plants. Especially when growing in hydroponics, there is no buffer! It is always better to use too little than too much. If you under feed, the plants will not die, but instead take longer to grow. Follow the instructions on your nutrient solution's manufacture label. If you're not sure *always* go with the "less is more" rule.

Best Ratios for Hydroponics 3-part

These mixes work well and are the accepted standard mix recommended for newer growers. It is simple to remember: 3-2-1...2-2-2...1-2-3.

The 1-2-3 Recipe:

- Vegetative stage: Use 3-2-1 (3 parts grow, 2 parts micro, 1 part bloom).
- Early flowering: first 2-3 weeks or until stretching stops: Use 2-2-2 (2 parts each).
- Late flowering: Use 1-2-3 (1 part grow, 2 parts micro, 3 parts bloom).

*Teaspoons per US gallon (5ml = 1 part)

**Dilute final mixture (or adjust part size) to suit your plants nutrient strength (EC/TDS) requirements. If your nutrient solution is lacking Mg, add 1/8 to 1/4 teaspoon epsom salts per gallon of final mix. Dissolve the salts in some warm water before adding to your nutrient reservoir.

TDS, PPM, and EC

If you have any desire to mix your own fertilizers, it is important that you have a basic understanding of these three critical terms.

Electric Conductivity (EC) & Conductivity Factor (CF)

Electricity is conducted due to the presence of ions (electrically charged particles) in any given solution. In hydroponic marijuana growing, the ions get there by introduction of salts via your fertilizers.

EC (electrical conductivity) is a representation of how much potential a solution has to conduct electricity. So by testing the ability of a solution to conduct electricity, we can indirectly determine the amount of salts present....thereby knowing if we have the right concentration of fertilizers.

E.C. is a measurement of salinity by measuring its conductivity. You want an E.C. under 2.0. Anything around 4.0 signifies an extreme excess of salt which calls for immediate leeching. There are multiple devices for measuring. Getting an accurate device is critical. Many newer growers feel they can use their own "eye measurement" as a more accurate means of testing these levels, when they just end up destroying their plants.

CF (Conductivity Factor) basically represents the same information but expressed differently. 1 ms/cm is equal to a CF of 10. Conductivity Factor isn't used nearly as much as EC.

Total Dissolved Solids (TDS) & Parts Per Million (PPM)

Total Dissolved Solids (TDS) is the best measurement of the nutrient concentration of a hydroponic solution. To estimate TDS, one can use a meter that measures the Electric Conductivity (EC) of a solution, and convert the number to TDS in parts per million(ppm). Many meters will do this conversion.

Total dissolved solids (TDS) is typically expressed in parts per million (ppm). It is a measurement of mass and determined by weighing, called a gravimetric analysis. A solution of nutrients dissolved in water at a strength of 700 ppm means that there are 700 milligrams if dissolved solids present for every liter of water. To accurately calculate total dissolved solids (TDS), one would evaporate a measured filtered sample to dryness, and weigh the residue. This type of measurement requires accurate liquid measurement, glassware, a drying oven, and a milligram balance. For example, 50 mL of the 700ppm solution would leave 35 mg of salt at the bottom of a crucible after drying.

Electrical Conductivity (EC) is expressed in siemens per centimeter (s/cm) or milliseimens per centimeter (ms/cm). It can be determined with an inexpensive hand held meter. Nutrient ions have an electrical charge, a whole number, usually a positive or negative 1, 2, or 3. EC is a measurement of all those charges in the solution that conduct electricity. The greater the quantity of nutrient ions in a solution, the more electricity that will be conducted by that solution. A material has a conductance of one siemens if one ampere of electric current can pass through it per volt of electric potential. It is the reciprocal of the ohm, the standard unit of electrical resistance. A siemens is also called a mho(ohm backwards).

EC measurements often are converted to TDS units (ppm) by the meter.

The meter cannot directly measure TDS as described above, and instead uses a linear conversion factor to calculate it. Everyone's nutrient mix is different, so no factor will be exact. The meter uses an approximate conversion factor, because the exact composition of the mix is not known. Conversion factors range from .50 to .72, depending on the meter manufacturer, which actually do a good job of approximating a TDS calculation from the meters measurement of EC.

Note: All ppm pens actually measure the value based on EC and then convert the EC value to display the ppm value, having different conversion factors between differing manufacturers is why we have this problem communicating nutrient measurements between one another.

EC is measured in millisiemens per centimeter(ms/cm) or microsiemens per centimeter(us/cm).

One millisiemen = 1000 microsiemens.

EC and CF (Conductivity Factor) are easily converted between each other.

1 ms/cm = 10 CF

The problem is that different ppm pen manufacturers use different conversion factors to calculate the ppm they display. All ppm (TDS) pens actually measure in EC or CF and run a conversion program to display the reading in ppm's.

There are three conversion factors which various manufacturers use for displaying ppm's...

USA 1 ms/cm (EC 1.0 or CF 10) = 500 ppm
European 1 ms/cm (EC 1.0 or CF 10) = 640 ppm
Australian 1 ms/cm (EC 1.0 or CF 10) = 700 ppm

For example:

Hanna, Milwaukee 1 ms/cm (EC 1.0 or CF 10) = 500 ppm
Eutech 1 ms/cm (EC 1.0 or CF 10) = 640 ppm
Truncheon 1 ms/cm (EC 1.0 or CF 10) = 700 ppm

TDS Meters

Total Dissolved Salts (TDS) meters are essentially little volt meters that look at the voltage produced by a sensor, usually a couple of metal pins. The nutrient solution acts like a battery electrolyte and the pins function as do plates (electrodes) in a battery. The idea is that a nutrient solution is more electrically conductive when there are more nutrient salts in solution, so more salts means more voltage. A little math is done in the machine to convert the voltage to ppm(parts per million of dissolved solids). There is a calibration adjustment so this math can be touched up to compensate for various factors.

You will need a test solution to verify your meter once a week. Usually you will find a single measurement at about 1500-1700ppm is enough to verify it's reading what it's supposed to.

You need one that will read at least 0-2000ppm (or 0-1999ppm). You could use a 0-999ppm meter in a pinch if you added an equal volume of plain water to a sample from your tank - you'd just double the meter reading. It's best to simply get the correct meter. There are other scales of measurement of nutrient concentration. In Europe, the "EC" (electrical conductivity) meters are preferred. They measure in units of millisiemens or mS instead of parts per million (ppm).

The numbers are convertible one scale to the other, but most references and discussion here cite the ppm scale. Waterproof meters are both more expensive and worth it.

Calculating the Conversion Factor

If your meter allows you to switch between EC and TDS units, your conversion factor can be easily determined by dividing one by the other.

Place the probe in the solution and read TDS in ppm. Change to EC on the meter and read EC in ms/cm.

Conversion Factor = PPM / EC.

Note: ms must be converted to us: One millisiemen = 1000 microsiemens (1.0 ms/cm = 1000.0 us/cm

According to the chart below:

1.0 ms/cm = 500 ppm (USA Hanna)
1000 us/cm = 500 ppm

Conversion factor = ppm / (ms/cm * 1000)
.50 = 500ppm / (1000us/cm)

Your meter's conversion factor and should be a number between 0.50 and 0.72. To improve accuracy, take EC and PPM readings from your nutrient reservoir daily for about ten days. Average the conversion factors. The more data points that you use, the closer you will be to finding your true conversion factor.

A Note to Organic Growers: An EC meter has fewer applications for a soil grower because many organic nutrients are not electrically charged or are inert. Things like Fish Emulsion, blood meal, rock phosphate or green sand cannot be measured with a meter reliably when they are applied or in runoff. Meters can only measure electrically charged salts in solution.

EC	Hanna	Eutech	Truncheon	CF
ms/cm	0.5 ppm	0.64 ppm	0.70 ppm	0
0.1	50 ppm	64 ppm	70 ppm	1
0.2	100 ppm	128 ppm	140 ppm	2
0.3	150 ppm	192 ppm	210 ppm	3
0.4	200 ppm	256 ppm	280 ppm	4
0.5	250 ppm	320 ppm	350 ppm	5
0.6	300 ppm	384 ppm	420 ppm	6
0.7	350 ppm	448 ppm	490 ppm	7
0.8	400 ppm	512 ppm	560 ppm	8
0.9	450 ppm	576 ppm	630 ppm	9
1.0	500 ppm	640 ppm	700 ppm	10
1.1	550 ppm	704 ppm	770 ppm	11
1.2	600 ppm	768 ppm	840 ppm	12
1.3	650 ppm	832 ppm	910 ppm	13
1.4	700 ppm	896 ppm	980 ppm	14
1.5	750 ppm	960 ppm	1050 ppm	15
1.6	800 ppm	1024 ppm	1120 ppm	16
1.7	850 ppm	1088 ppm	1190 ppm	17
1.8	900 ppm	1152 ppm	1260 ppm	18
1.9	950 ppm	1216 ppm	1330 ppm	19
2.0	1000 ppm	1280 ppm	1400 ppm	20
2.1	1050 ppm	1334 ppm	1470 ppm	21
2.2	1100 ppm	1408 ppm	1540 ppm	22
2.3	1150 ppm	1472 ppm	1610 ppm	23
2.4	1200 ppm	1536 ppm	1680 ppm	24

2.5	1250 ppm	1600 ppm	1750 ppm	25
2.6	1300 ppm	1664 ppm	1820 ppm	26
2.7	1350 ppm	1728 ppm	1890 ppm	27
2.8	1400 ppm	1792 ppm	1960 ppm	28
2.9	1450 ppm	1856 ppm	2030 ppm	29
3.0	1500 ppm	1920 ppm	2100 ppm	30
3.1	1550 ppm	1984 ppm	2170 ppm	31
3.2	1600 ppm	2048 ppm	2240 ppm	32

Combination Meters

The combination type meters (like the one pictured above) are real handy for the convenience of being able to take both readings simultaneously, or with a single touch of a button to switch between modes.

The problem with combination meters is pH sensors like to be stored in a fertilizer solution, but TDS probes like to be stored in distilled water. Storing the pH probe in plain or distilled water will damage the ph membrane, so the combination probe needs to be stored in a fertilizer solution so as not to damage the pH portion, so the TDS probe ends up being "dirty" from salt buildup.

Purchasing "single function" pH or TDS meter for this purpose is advised.

A Guideline for NPK Strengths

There are many parameters for acceptable PPMs floating out there today. Here is a decent guideline for the N-P-K standards. Feel free to experiment, but make only gradual changes. These guidelines act as a foundation. Approximate tolerance range of PPMs per nutrient; most micro-nutrients are tolerated by plants within the same ranges (but the plant just doesn't need nearly that much!)

N - 200-400
P - 200-600
K - 200-600

Approximate Tolerance Range of TOTAL PPMs in soil/medium:

(Obviously the plant can tolerate more as it gets larger and has more root area to uptake nutrients and leaf area to transpire water.)

Seedling: 500-600ppm
Vegetative: 800-1000ppm
Flowering: 1000-1500ppm
Flushing: 0-500ppm

Approximate Tolerance Range Hydroponic Nutrients TDS/EC:

The ideal TDS for a hydroponic solution is 500-1000ppm, EC .75-1.5. A reduction in solution TDS/EC reduces osmotic pressure and allows the roots to draw the nutrients "easier". Young, established seedlings or rooted cuttings are started at 500-600ppm. The TDS is increased to 800-900ppm during peak vegetative growth. During the transition from early to heavy flowering, TDS is further raised to 1000-1100ppm. It is then reduced to 400-500ppm during the final 2 weeks of flushing. The plants demonstrate their preference for a lower TDS/EC when running a lower pH by clearly sustaining higher growth rates.

PPMs for Each Growth Phase

You may desire more Nitrogen during vegetative growth stages for example. The key is NOT to obsess over the exact numbers. There are many other factors involved in the actual UPTAKE of these nutrients by roots to claim specificity. These are just general parameters that you can tweak under your own conditions. And again, the plant can tolerate more as it gets larger and has more root area to uptake nutrients and leaf area to transpire water. Start light, gradually increase with each feeding as your plant can handle it.

Keep in mind, the following estimates are given for soil mediums which can tolerate higher levels because the soil components will bond with many elemental ions; a hydro system needs to be more precise. Also remember that these parameters are based on the assumption of using distilled water. Tap water will add another 200-400 PPMs, so you would have to adjust accordingly...especially with Cl, Ca, Na, and in rare case, S.

Seedling:

(2-3 weeks...look for 4-5 sets of alternating nodes
before moving to veg.)

N - 150
P - 100
K - 150
Ca - 75
Mg - 75
S - 25-50
Fe - 15
Cl - 15
Mn - 7
Cu - 9
Zn - 3

Total: 600ppm

Vegetative/pre-Flower:

(Usually 2-4 weeks.)

N: 300
P 100
K 200
Ca 100
Mg 100
S 50-75
Fe 25
Cl 25
Mn 10
Cu 15
Zn 5

Total: @1000pm

Flowering:

(Strain dependent; usually 6-8 weeks.)

N - 300-400
P - 400
K - 200
Ca - 100-150
Mg - 100-150
S - 100-150
Fe - 25+
Cl - 25+
Mn - 10
Cu - 15
Zn - 5

Total: @1300-1500ppm

Flush/Harvest:

(2 weeks)

N - 0
P - 75
K - 75
Ca - 50
Mg - 50
S - 50
Fe - 25
Cl - 25
Mn - 10
Cu - 15
Zn - 5

Total: @400ppm

It cannot be stressed enough that these are estimates. I wanted to offer a solid foundation for newer growers to measure from. These are quite conservative ones due to the fact that chemical fertilizers allow less room for error. Also, different strains and conditions will result in different ratios. Experiment often and use caution when making adjustments!

How To Tell If Your PPM/EC is Too High or Too Low

It's simple to find out if you are using too much food or not enough by watching the nutrient concentration levels in your tanks day to day. Don't be concerned with the exact reading, rather watch how it rises and falls from each day to the next. The differences between when you put the solution into the tank and the readings you get several hours later or the next day are what tell you if your plant is eating, drinking or happy.

Start with 1.00 EC (or a SAFE nutrient strength). Next day, if it reads 1.4, it means your plants have been using water and your nutrient solution is becoming more concentrated.

This means the concentration of nutrients is too high, so you dilute.

If the meter reads lower than the previous day, 0.7 say, it tells you that the plants are eating nutrients faster than they are drinking water, so you should increase your nutrient strength. If it remains the same, your feeding schedule is on target for now. The nutrient/water intake fluctuates with the growth of the plant, so you must continually monitor it day to day.

Your plants will tell you the optimum nutrient levels. When they are receiving optimum food and water, the readings remain constant. The more you do it, the easier it gets. The reason no one can tell you what PPM/EC levels to use is because every garden is different and every plant has different requirements due to their particular environment. That's why you have a ball park starting figure, but after that your plants will tell you almost exactly what they require.

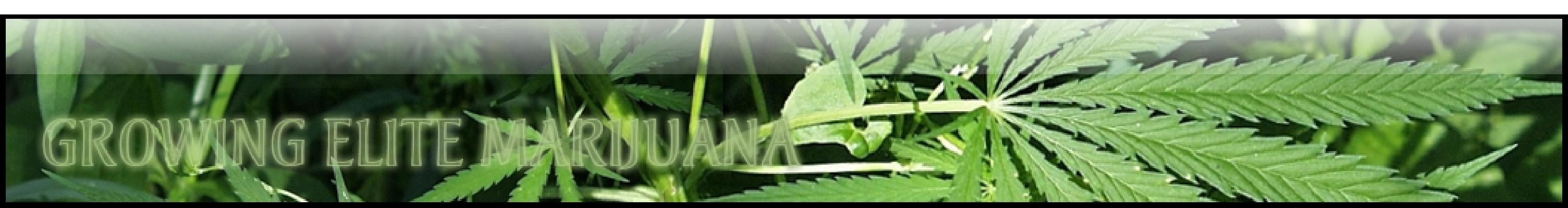
When to Add More Nutrients?

New growers tend to rely on a ppm meter, but a veteran grower has learned how to read the plant. It actually takes a few grows to learn how to be able to read the plant. The plant can tell you if it is getting too much or too little nutrients. Most of the nutrient mixes are explained extremely well on the packs. If you follow the instructions properly and remember that cannabis grows best within 30% – 50% strength nutrients then you will be fine. Cool beans.

The ppm depends on what stage your plants are in, it should NEVER exceed 1600.

Here is how one grower does it:

~4 days: ppm = 200
~10 days: ppm = 300
~17 days: ppm = 400
~22 days: ppm = 450
~24 days: ppm = 500
~26 days: ppm = 650
~30 days: ppm = 800
~38 days: ppm = 800



~40 days: ppm = 1200
~52 days: ppm = 1300
~59 days: ppm = 1400
~66 days: ppm = 1550
~70 days: ppm = 1550 (the ppm during the plant's final days are cranked high)

Figuring Out The PPM of Fertilizer

To figure out the ppm of your fertilizer (or fertilizer mix), you need to be able to measure grams and liters. Look at the 3 numbers on the side of a fertilizer bag. These are the percent contents of the nutrients. For every one gram of said fertilizer in one liter of water, it contributes 10 ppm of the given nutrient per percentage point.

A 20-20-20 gives 200 ppm (10 ppm X 20) of each nutrient for each gram in a liter of water.

The formula is this:

grams of fertilizer per liter = A/B
A=your desired ppm
B=10 ppm X the % of nutrient in mix or your ppm = C X B
B=10 ppm X the % of nutrient in mix
C= grams of fertilizer per liter

So to make a 200 ppm-100 ppm-200 ppm NPK mix using a 13-0-44 (potassium nitrate), a 12-62-0 (monoamonium phosphate), and a 33-0-0 (ammonium nitrate) you would work backwards from your sole P and K sources (it makes it easiest in this case), and make up the N at the end. I have rounded numbers to the nearest 0.1 g for the following. You would use 0.5 g of potassium nitrate (200 ppm/(10 ppm X 44 K)) and 0.2 g of monoammonium phosphate (100 ppm/(10 ppm X 62 P)) in one liter.

This would give you 89 ppm N (10 ppm X 13 N X 0.5 g + 10 ppm X 12 N X 0.2 g), 124 ppm P (10 ppm X 62 P X 0.2), and 220 ppm K (10 ppm X 44 K X 0.5 g). 111 ppm are needed to raise the N to the 200 ppm level, so we can use 0.3 g of the ammonium nitrate (111 ppm/(10 ppm X 33 N)) to bring us up to finish. The actual mix would yield a 188 ppm N, 124 ppm P, 220 ppm K mixture in one liter of water. To get more precision, you need to mix larger batches or get a better scale (you would need to make a 10 liter batch of the above with a scale that is only accurate to the gram). If you mix your own fertilizer, you can adjust your N source to meet your pH needs, rather than being dependent on adding acid or base, which is nice. This works for formulating hydro mixes, as well as for us dirt farmers

Nutrient Solution

The first step is deciding upon which nutrient solution to get. Nutrient solutions come in lots of forms. Make sure you get a hydroponic nutrient solution only. Some are made for soil and we do not recommend you use these in your hydroponic garden. This is because soil-based nutrients contain many wrong elements for hydroponic use, this will severely negatively effect your plant's growth.

Most hydroponic nutrient solutions available on the market today are complete nutrient solutions. They provide every element required for optimal plant growth. When planning your hydroponic setup financially make sure you DO NOT go cheap on the nutrients, as taking any short-cuts here will greatly undermine your ideal growth goals.

Dry or Wet Nutrients?

Wet nutrients are very trendy and hip in the hydroponic world. There is nothing wrong with a “wet” nutrient, they mix quite well. But, wet nutrients generally tend to be more expensive. This is because the bottle contains more water and less actual nutrient content. This makes them more expensive to ship and transport. When it comes time to mix them and feed your plant either dry or wet works equally well. Many prefer liquid.

Mixing Nutrient Solution

Whether using liquid or dry hydroponic nutrients, you should only add to the water after filling the container rather than adding nutrients and then filling. Adding before filling can lead to severe nutrient imbalances.

Here's a great tip for you to avoid your nutrients locking up (greatly lowering absorption rates): Mix your solution in the sink. Get a watering can and clean it. Let your water run directly into it and while water is flowing into the can then pour in your nutrients. This will keep your nutrients from locking up. Rumor has it that when you mix your nutrients inside a cup they will lock up. This is very bad! Now just carry your watering can over to your reservoir and pour it in.

Nutrient Packs

Single packs are not ideal. This is because having all the nutrients in a single pack runs the risk of having the elements in the pack combine and precipitate. When precipitation occurs this causes your solution to become unbalanced. This will render your solution not only completely useless to your plants but most likely toxic and harmful as well.

For best growing results the solution then is to obtain your complete nutrient solution in a bottles labeled "twin" or "triple" packs. The chemicals are held in different packs to entirely prevent precipitation. 3-part system triple packs allow you to adjust these nutrients to get optimum thriving growth from your plants. Check the specific instructions on the bottles for an explanation how to mix the nutrients into water.

Note: When growing in an organic garden, make sure to buy nutrients that are hydroorganics, for organic hydroponic growing only.

Example Nutrient Solutions

Many growers wonder what a sample quality hydroponic nutrient solution would look like when mixed together. Using popular products today I have included some samples to give you an idea:

Hydroponic Vegetative Growth Phase Solution, per gallon:

-Chempak no3 20-20-20 balanced feed (UK) / Peters 20-20-20 (USA).
-Epsom salts 1/2 teaspoon.
-Human Urine (OPTIONAL - may create odors if used indoors.) 1/4 cup.
-Oxygen Plus Plant Food (OPTIONAL) 1 teaspoon.

This mixture ensures your plants are getting all major and minor nutrients in solution, and will also be treating your plants with oxygen for good root growth, and potassium nitrate for good burning qualities.

Another good vegetative growth phase mix is 1/4 tsp Peters 20/20/20 fertilizer per gallon of water, with trace elements and oxygen added, or fish emulsion. Fish emulsion is great in a greenhouse or outdoors, where smells are not an issue - it is not recommended indoors due to its pungent odor. If you don't mind the odor, you will love the results!

Hydroponic Flowering Solution, per gallon:

- 1 tsp. high P plant food, such as 15-30-15, or 5-50-17, etc.
- ½ tsp. epsom salts.
- 1 tsp. Oxygen Plus Plant Food (Optional).
- 1 tsp. Trace Element food.

Example of a Standard General Hydroponics Flora Series Feeding Strategy

Here is another quality hydroponic nutrient solution example, as well as how exactly one would apply it. This should give you a general overview of how to correctly mix and apply nutrients.

The Formula:
G-M-B (Grow-Micro-Bloom)
0-5-10 - For Vegetative cycle (~18/6)
0-8-16 - For Flowering cycle (12/12)

The numbers above indicate the number of milliliters (ml) of Flora Grow, Micro or Bloom formulas that you'll use in one gallon (U.S. Liquid) of nutrients.

You will notice there isn't any of the Flora Grow formula included, this is because it is not needed, the Flora "Micro" provides plenty of Nitrogen.

There are two ways to work with this formula:

1. Top off the reservoir daily using a pH corrected water solution as required to maintain full reservoir level. After adding back an amount of water equal to the amount of your reservoir capacity you should change the reservoir and put in fresh solution.

2. Top off the reservoir daily using a pH corrected 100% strength nutrient solution as required to maintain full reservoir level. Continue to use this nutrient solution without dumping the tank unless the PPM rises above acceptable levels.

Between vegetative and flowering cycles you should dump your nutrients, then flush (perhaps with a commercially available clearing solution) to remove salt buildups, then change to the other feeding program. Always shake your nutrient bottles before using them!

For young plants (freshly transplanted into the hydroponic setup), give them

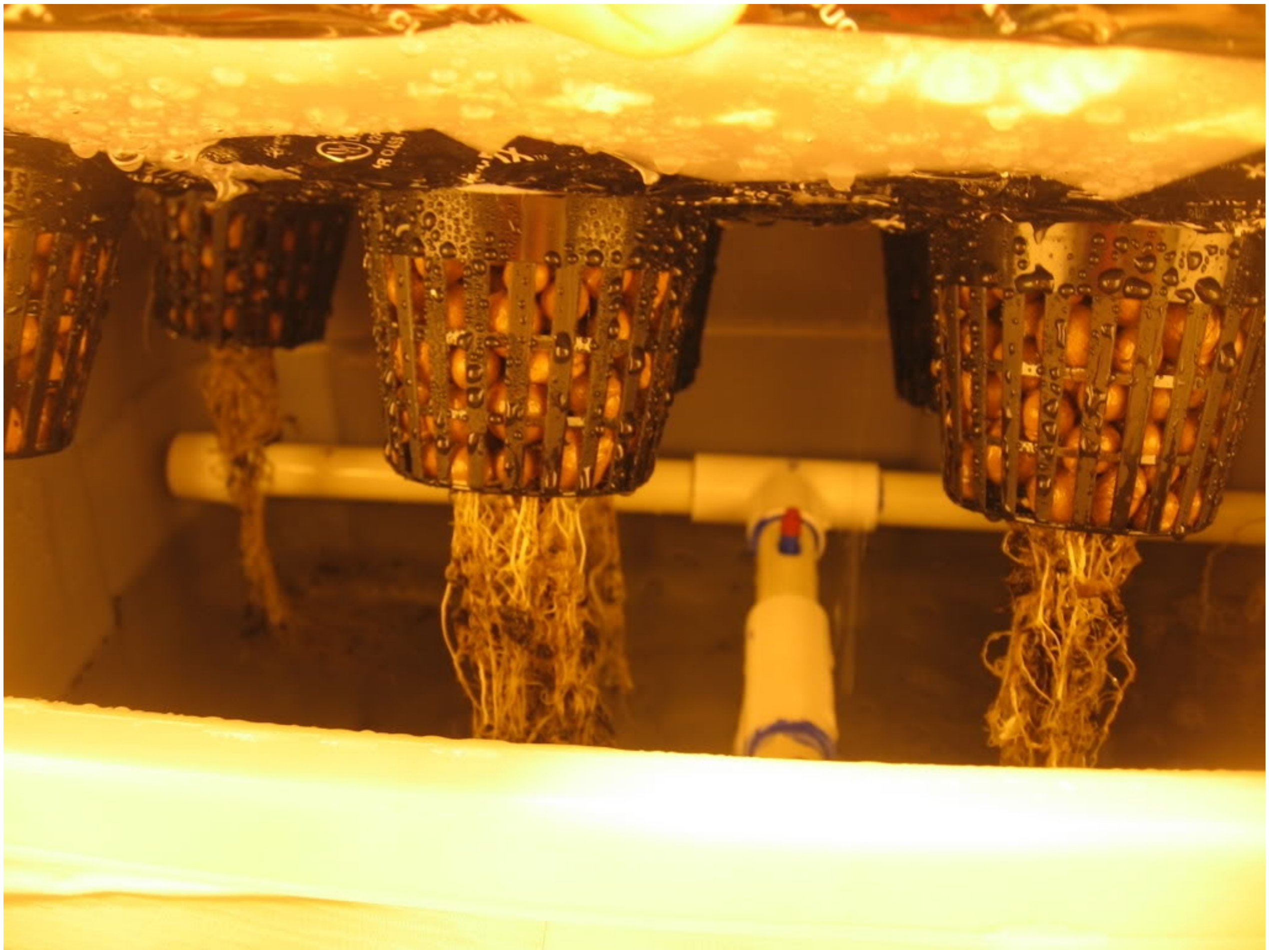
50% strength nutrient mix to prevent overfeeding them while their young. Gradually bring up the mix to full strength as they grow over the next few weeks or so.

The lucas formula is normally intended for use with RO or near 0 PPM water.

Note: The Lucas formula eliminates the need for Epsom salts to correct (Magnesium) Mg deficiencies in most normal feeding programs recommended by manufacturers. Cannabis will need a lot of Magnesium to thrive and flourish.

As you can see, The Flora Micro is providing the Nitrogen and the Magnesium in the proper balance, thus there is no need for the Grow formula and little or no room under the maximum acceptable ppm limit of 1600 @ 0.7 conversion.

Regulating Your Hydroponic System Water



Many newer growers have concerns that the water is not flowing rapidly or strongly from the ends of the tubes into the rock wool cubes. A strong flow is not necessary at all. A slight trickle (bubbling) is all that is needed to keep the rock wool cube moist and the baby roots fed until they reach into the deep water. You do need to check for crimps and folds in the water tubes, especially when you first set up your system.

Water Quality

The water must be clean. Hydroponic plants must be grown in a sterile medium. In this context clean means that you have to make sure that the water does not contain microorganisms, harsh chemicals, algae and that the water doesn't have the wrong pH values (which will create nutrient lockup). The easiest way to make sure your grow medium stays sterile is to change water on a regular basis and check the pH each and every time you add nutrients.

It is important to check your water. Crusty faucets and shower heads mean your water is "hard," usually due to too many minerals. Tap water with a TDS level of more than around 200ppm is "hard" and should be looked into, especially if your plants have a chronic problem. Ask your water company for an analysis listing, which will usually list the pH, TDS, and mineral levels(as well as the pollutants, carcinogens, etc) for the tap water in your area. This is a common request, especially in this day and age, so it shouldn't raise an eyebrow. Regular water filters will not reduce a high TDS level, but the costlier reverse-osmosis units, distillers, and de-ionizers will. A digital TDS meter(or ECM = electrical conductivity meter) is an incredibly useful tool for monitoring the nutrient levels of nutrient solution, and will pay for itself before you know it.

The best waters to use with your hydroponic garden are spring, distilled or reverse osmosis filtered water. If you can get access to these many issues that plague growers can be bypassed. However, most household water is also fine to use. If you have city supplied water you can use it directly from your faucets inside your home or apartment. Or, if your house has a well and softener system, you will want to take your water from a faucet that supplies water straight from the well; i.e. water that has not been through the softener system.

Softener systems add salts to the water that are harmful to plants. Note that well water can potentially cause mineral build up and blockages, so regular cleaning is required. The faucets in your yard generally supply un-softened water; and there should also be one right next to your softener system that also supplies water that has not been through the system yet. If you have a Reverse Osmosis System, you should use the RO filtered water as it is close to the quality of spring and distilled water.

WARNING: It is critical that you keep a close watch on your plants to be sure they are never allowed to dry too much when growing hydroponically, or roots will be damaged.

If you will not be able to tend to the garden every day, be sure the pans are filled enough to last until next time you return, or you can easily lose your precious crop. It is necessary to change the solution every month if your circulating it with a pump, but the reservoir system does away with this problem. Just rinse the medium once a month or so to prevent salts build up. This can be accomplished by watering from the top of the pot or rockwool cube with some pure water as mentioned above.

Green Algae

Algae is one of the problems you will encounter if you do not take the following steps to prevent it. Algae will grow anywhere there is nutrient solution and light. Many newbie growers allow algae to grow in their tank, and this is a big problem! Algae appears in your tank following several mistakes but have no worries; as it can be remedied pretty easily.

Preventing Green Algae: First off you must never allow a dead root or fallen leaf to stay inside the tank and decay. Also do not allow the lights to shine into the water through the rocks. If the grow cup is full of rocks, the lights can not penetrate through the cups. And most important, you have to start with clean, pure water. You can not use rain water, or water from a stream, river or lake.

You should exchange the water after the first ten days, and then every 10 to 14 days as you grow. As the plants get over 12 inches tall, exchanging the water every 7 days is more efficient. Your water should smell like clean green alfalfa sprouts. If you detect an unpleasant odor, you have waited *way* too long to drain and exchange the water. When you do replenish the water and nutrients, you should look for and remove any dead roots that were accidentally torn from the plant. You can use chlorinated city tap water (some growers even recommend it for it's purity).

If you're concerned about the chlorine being harmful, no need to worry because the chlorine dissipates fast and is never a problem. You can use RO filtered water, or store bought distilled or spring water. If you use well water or detect algae growing in your tank, you can add 1/6 teaspoon of Hydrogen Peroxide per gallon of water to your tank as a cure or preventative. Be sure to never ever use more than a level teaspoon per tank of 6 gallons of water!

Also do not use water that sat out uncovered or was stored for an extended period of time.

Green Algae Slime on Rockwool: Algae needs light and nutrients to live, it will spread to your reservoir and will block feed lines. Because of rockwool's unique vertical tube-like structure(which takes up nutrients via capillary action and pulls air into the medium as the nutrients drain outward), a heavy buildup of algae can effectively block this crucial breathing action. To prevent this from happening, use light-proof and water-proof material to cover your rockwool. Black/white panda film or thick black bin liners work great.

Algae will tend to grow on the medium with higher humidifies in hydroponic systems. It will quickly turn a slab of rockwool a nasty dark green. To prevent this, use the plastic cover the rockwool came in to cover rockwool slab tops, with holes cut for the plants to stick out of it. It's easy to cut a packaged slab of rockwool into two pieces, then cut the end of the plastic off each piece. You now have two pieces of slab, each covered with plastic except on the very ends.

Now cut 2 or 3 4" square holes in the top to place cubes on it, and place each piece in a clean litter pan. Now your ready to treat the rockwool as described above in anticipation of planting. If growing in pots, a layer of gravel at the top of a pot may help reduce algae growth, since it will dry very quickly. Algae is merely messy and unsightly; it will not actually cause any complications with the plants.

Mixing Nutrients Properly

So many growers get upset and post on forums; "Dudes when I throw in a packet of nutrients into my tank, they just settle to the bottom and don't dissolve!!", that is the wrong way to introduce the nutrients and feed your plants. These nutrients are natural elements, so they do not perfectly dissolve in water. For example, seashells are not ever going to completely dissolve in water, no matter how much they are pulverized, but are an excellent source of calcium. You should add the packets to a quart jar half full of warm water and stir them rapidly, mixing them as well as possible in the water. Then pour them through a tea strainer or some kind of mesh screen or filter, to filter out the small particles that did not dissolve. Then add the nutrient water mix to the tank.

Be sure to remember when you first start and set up your system, you should start with 1/4 of a packet of grow nutrients if you are starting with seeds, sprouts or baby seedlings. If you started with clones or baby plants, then start with half a packet of grow nutrients. Your plants should be about 3 inches tall before you use the nutrients full strength. Then stand back and watch for a growth explosion!

-Easy to use
-Easy to clean
-Very popular
-Great for anyone who wants to produce a lot of plants in a short period of time

Solution Strength

Mixing a hydroponic nutrient solution is as easy as following a recipe in the kitchen, but the first couple times you do it you are going to have to be VERY careful to make sure you have go the right proportions. Be careful of using full, and even medium strength nutrient solutions, as they can burn your plants! Rich bud content can be produced with only a 40% strength solution, be sure to check your package for the recommended strength. One of the most common problems reported with hydroponics is plant burns. Be sure to consult the information printed on the packs. Over feeding is a very common, not to worry though as time goes on you will get to know your strain and what it likes and eventually be a master of controlling your nutrient amounts.

Generally speaking though, you will use a half strength solution for your young plants for the first two weeks, after that it is going to be full strength. Always read the directions before you mess with them!!!! If you mix your solution too strong it is going to kill them, if you mix it too weak there isn't going to be enough nutrients to grow big potent buds!

Nutrient Tips

Marijuana plants tend to be very adaptable, but a general rule of thumb is to use more nitrogen & less phosphorous during the vegetative period,and the exact opposite during the flowering period.

For the vegetative growth period try a N:P:K ratio of about 10:7:8 (which of course is the same ratio as 20:14:16), and for flowering plants, 4:8:8.

Check the pH after adding nutrients. If you use a reservoir, keep it circulating and change it every 2 weeks. A general guideline for TDS levels is as follows: seedlings = 50-150 ppm; unrooted clones = 100-350 ppm; small plants = 400-800 ppm; large plants = 900-1800 ppm; last week of flowering = taper off to plain water.

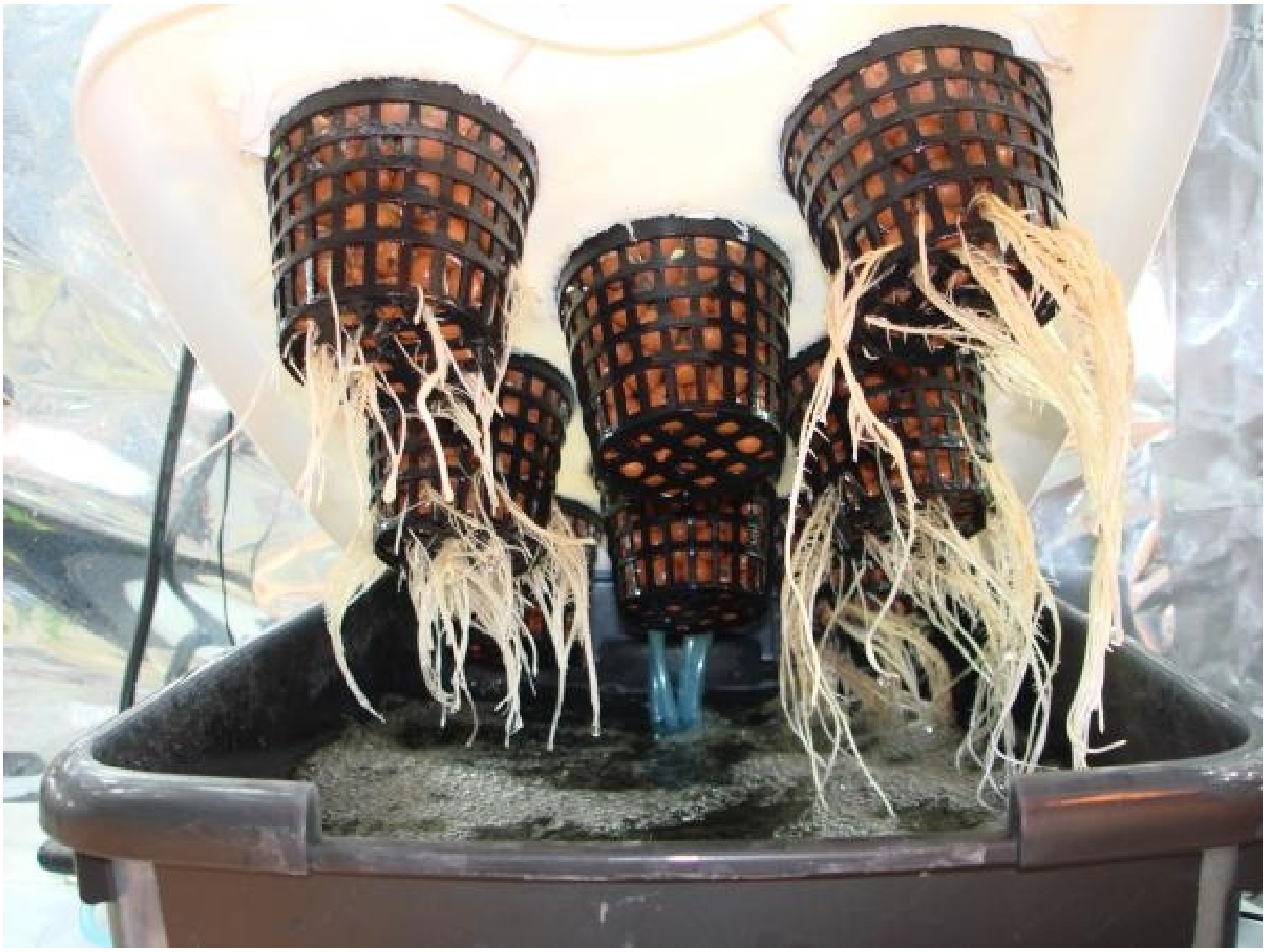
These numbers are just a guideline, and many factors can change the actual level the plants will need. Certain nutrients are "invisible" to TDS meters, especially organics, so use TDS level only as an estimate of actual nutrient levels. When in doubt about a new fertilizer, follow the fertilizer's directions.

System Maintenance

Maintaining your hydroponic garden is what makes the difference between okay weed and the greats. Take your time with this section.

Maintaining a Reservoir

Proper maintenance of your reservoir is essential to growing healthy vigorous marijuana.



If you want your buds to grow out to their fullest potential than you will need to maintain your reservoir right. The most influential factors are nutrient levels and pH, as discussed in their appropriate sections.

Nutrients pH Level

The pH of water after adding any nutrients should be around 5.9-6.5 (in rockwool, 5.5-6.1). Generally speaking, the micro-nutrients (Fe, Zn, Mn, Cu) get locked out at a high pH (alkaline) above 7.0, while the major nutrients (N, P, K, Mg) can be less available in acidic soil or water (below 5.0). Tap water is often too acidic. Soils with lots of peat or other organic matter in them tend to get overly acidic, which some dolomite lime will help fix. Soil test kits vary in accuracy, and generally the more you pay the better the accuracy. For the water, color-based pH test kits from aquarium stores are inexpensive, but inaccurate. Invest in a digital pH meter($40-80), preferably a waterproof one. You won't regret it!

Your nutrient solution's pH level is incredibly important. Just like with soil, you must adjust your pH level, but this time the methods used to raise and lower the pH is much different. The pH level will affect the solubility of your nutrients. It's harder to maintain a set level of your water, so shoot for being within the above ranges for the maximal amount of time possible. An easy way to measure your pH is to use pH paper. You can pick this up cheap at any garden or grow shop, but remember, it may not be as accurate as a well invested meter.

The good news is, it's super easy to adjust hydroponics liquid nutrient pH levels. This can be done by purchasing a pH UP and pH DOWN solution, which is added accordingly. These are typically very cheap and are all you need for balancing your solution's pH level.

WARNING: Never ever mix pH up and pH down together directly in a concentrate. This stuff is very dangerous and needs to be handled with care. Use one pipette for each job and color code the pipette to the bottle.

A pH level of 6.5 works best. The method is simple. Before mixing nutrients into the water, adjust the pH using sulfuric, nitric, or citric acid if it's too high. If it's too low: lime or baking soda. When you first set up your tank, you should do a pH test on your water before adding the water to the tank. Then adjust the water with pH UP or pH DOWN before it goes into the tank. That way, the pH perfect nutrients will work best.

It can be dangerous to adjust the pH in the tank, especially if you overly adjust it. It is also dangerous to adjust it frequently. A very slight adjustment is OK, but if you change it drastically in the tank by using a large amount of PH UP or PH DOWN, you are taking a big risk of seriously harming your plants. If you do a test on your tank's water and it is extremely out of range from 5.8 to 6.8, then it is best to drain it and replenish it with PH corrected water and nutrients. Let us repeat, you should add the nutrients to PH perfect water to start with. If you insist on adjusting it in the tank slightly, then use no more than 1/2 level teaspoon of PH UP or PH DOWN to the tank, and no more frequently than 4 hours apart. Plants do not adjust well to rapid changes in PH levels.

The results can be dreaded Nutritional Lockout.

(No worries, consult the 8-Step Complete Nutritional Lockout Remedy located in the Cannabis Care Manual.)

In order to measure your pH level easily you can use an electronic meter reader.

Note: Be sure to check your pH level as much as you possibly can. Unlike when growing in soil, with Hydroponics systems the pH level can tend to fluctuate very rapidly. You will get a feel for it.

In a normal hydroponic system keep the pH between 5.5 and 5.8

In an organic solution keep the pH between 6 – 6.5.

pH Adjustment Tips

The pH of the nutrient solution is a major determinant of nutrient uptake by the plant. If the pH wanders outside the optimum range of between pH 5.1 and pH 5.9, then nutritional deficiency and/or toxicity problems can occur. For hydroponic nutrient solutions used with inert media, keep the pH at 5.2 for optimal elemental uptake. It is at this point that roots most readily assimilate nutrients. This pH recommendation may seem low relative to the normally suggested range, but are based upon information garnered from "Hydroponic

Nutrients" by M. Edward Muckle and Practical Hydroponics and Greenhouses. They both document the low pH resulting in increased nutrient uptake and discernible health and yield improvements at a ph of 5.2 over higher levels.

The widely accepted soil based pH chart growers base their hydroponic pH ranges on is frequently misapplied to water culture applications. His research and that done by others, documented in Practical Hydroponics and Greenhouses, indicate that iron and phosphorous precipitate in nutrient solutions at pH levels above 6. Stay below a pH of 6 by all means to avoid this problem and watch your plants benefit.

Raising hydroponic pH: (to make it more alkaline)

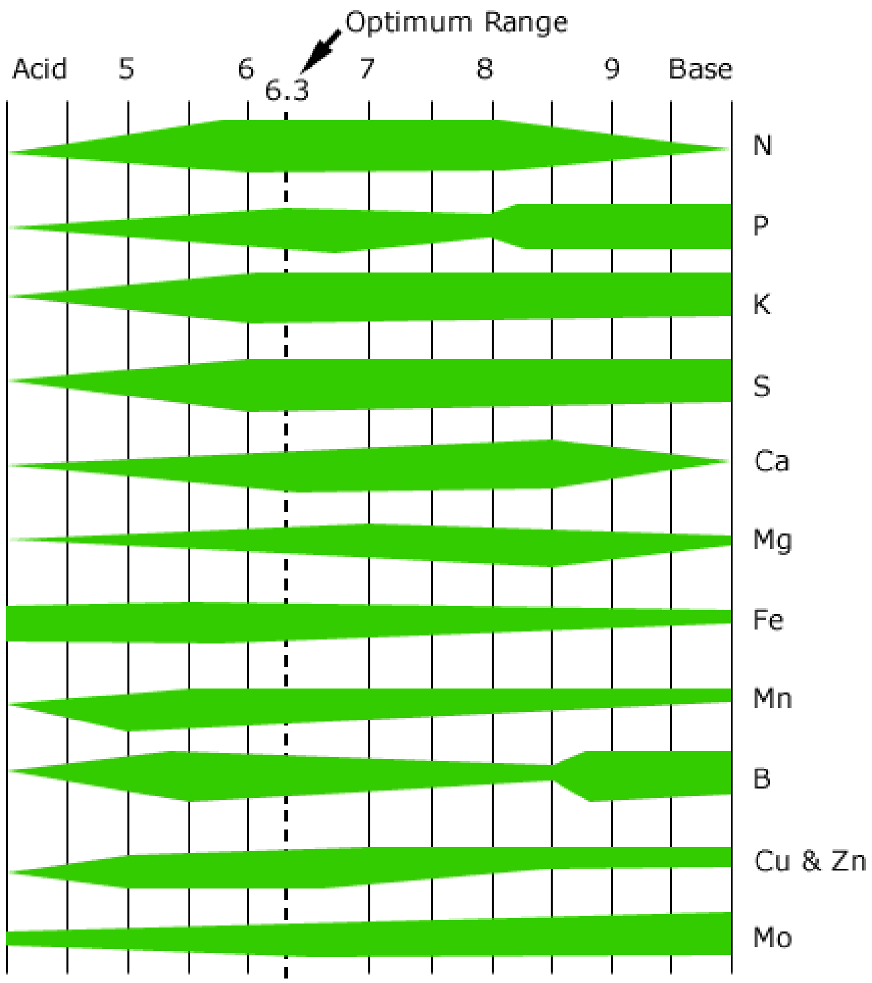
In hydroponics: use PH UP, potassium silicate, provides silicon at an effective dosage.

In bioponics/hydro-organics: add small amounts of sodium bicarbonate or lime.

Lowering hydroponic pH: (to make it more acidic)

In hydroponics: use PH DOWN, nitric acid during vegetative; phosphoric acid during flowering.

PH Nutrient Availability Chart



Temperature

The nutrient assimilation rate is further enhanced by the reduction in solution TDS/EC, which reduces osmotic pressure and allows the roots to draw the nutrients "easier". Young, established seedlings or rooted cuttings are started at 500-600ppm. The TDS is increased to 800- 900ppm during peak vegetative growth. During the transition from early to heavy flowering, TDS is further raised to 1000-1100ppm. It is then reduced to 400-500ppm during the final 2 weeks of flushing. The plants demonstrate their preference for a lower

TDS/EC when running a lower pH by clearly sustaining higher growth rates. The optimum temperature for hydroponic solutions to be is 75°F (23.8°C). At this point, most elements are assimilated highest and atmospheric oxygen is most readily dissolved. Although increases in temperature increase the rate of photosynthesis, avoid exceeding the maximum listed of 78°F (25.5°C). Elevated temperatures make some elements more available, but reduce the solution's dissolved oxygen capacity, increasing root disease likelihood.

Cold weather below 50°F (10°C) can lock up phosphorous. Some varieties, like equatorial Sativas, don't grow very well in cold weather. If you can keep the roots warmer the plant will be able to handle cooler temperatures than it otherwise could.

If the lights are too close to the plant, the tops may be curled, dry, and look burnt, mimicking a nutrient problem. Your hand should not feel hot after a minute when you hold it at the top of the plants.

Raise the lights and/or aim a fan at the hot zone. Room temps should be kept under 85°F (29.4°C) or 90°F (32.2°C) if you add additional CO_2.

The optimum temperature for hydroponic solutions to maintain is 75°F (23.8°C). At this point, most elements are assimilated highest and atmospheric oxygen is most readily dissolved. This part can get tricky. Increases in temperature increase the rate of photosynthesis and might make some elements more bioavailable, but exceeding the maximum listed of 78°F (25.5°C) will reduce the solution's dissolved oxygen capacity, increasing root disease likelihood.

Monitoring and Maintaining your Recycle System

As you have learned by now, depending on which hydroponic setup you are using, your nutrient solution goes through a system that recycles and reuses the nutrients in the reservoir over and over. As the plant extracts the minerals and nutrients from the solution it will become more and more depleted & empty of it's nutritional value to the plant. Remember, the pH of your water should always be around 5.0 – 7.0.

Reservoir maintenance is the routine task of keeping the hydroponic nutrient solution in the reservoir from becoming too strong or toxic as the water is being evaporated and the nutrients within the solution are taken up by the plants.

Simply put; Top off daily with half (half the strength of your current new reservoir starting strength) strength nutrients, alternating days topping up with plain water. Change the entire reservoir with fresh solution every ten days to two weeks.

One problem in hydroponics solution maintenance is that as water is being taken up by the plants (as well as evaporating out of the solution), the concentration of nutrient salts in the solution becomes gradually stronger, sometimes to the point of certain elements becoming toxic to the plants. The TDS will always become stronger as water is taken away from the solution.

Another common problem is that hydroponically grown plants will take up what they need as they need it from the nutrient solution. This means a nutrient solution left alone will end up lacking key nutrients, with a build-up of toxic levels of other key nutrients.

The only way around these problems for the average hydroponic grower is to practice sound reservoir topping off procedures. The most widely accepted maintenance method involves daily topping off and routine reservoir solution replacement.

An example of this would be topping off the reservoir daily with a nutrient solution (which is half of the current new reservoir strength), alternating days by topping off with plain water and finally; changing the entire reservoir solution at least every two weeks.

Changing the reservoir solution every two weeks will give the plants a fresh and well balanced nutrient mix which has not been altered by the plants nutrient uptake.

Many scientific studies have been performed which demonstrate these facts by

GCMS testing of the nutrient solution contents and the nutrient salts contained within the actual plant tissues, as the plants "take-up" the specific nutrients in the solution. Plants will take up excessive levels of some nutrients, leaving the solution lacking in certain key nutrients. Plants grown hydroponically can harm themselves with nutrient deficiencies, lockouts and overdoses, if allowed to continue feeding without some control over whats available in the reservoir.

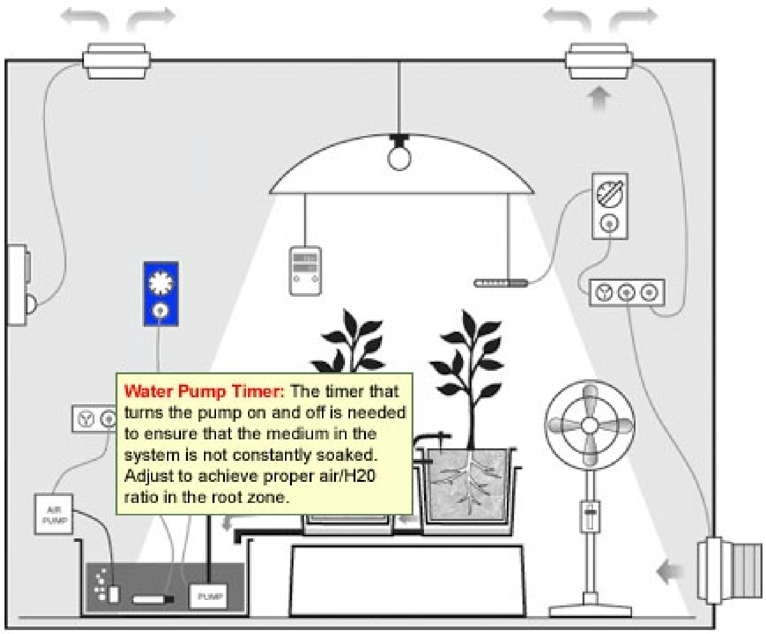
Therefore it is critical you learn how to properly monitor your reservoir's nutrient levels. A TDS meter will allow you to see how much of your nutrients have been used up and how much more you need to adjust in order to reach your optimal nutrient level. There is no way around it, over time your reservoirs will become depleted and will need replenishing. The more dissolved solids you put in the water, the better it conducts electricity. A PPM or EC reader is extremely accurate and recommended for this purpose, but it is quite expensive. Over time it balances out though because you will save lots and lots of money on the cost of hydroponics nutrients and burned plants.

Note: Burned plants, commonly referred to as a *chemical burn*, is what the plant suffers from due to over-feeding. No “burning” takes place, the outer edges of your plants just slowly deteriorate and flake away withering and dying.

Changing Your Solution

As water evaporates and is absorbed by the plants, your water reservoir level will drop. Every 2 weeks you need to change the nutrient solution. Be sure to clean out the reservoir and discard the old solution. Clean out the reservoir, pumps, and any other equipment that is used with HOT WATER. Then add tap water that has been aged 3 days or longer to the reservoir then add your nutrient solution. And don't worry just yet about the cups and tubing the plants are in, you generally only really need to clean them out before you start a new crop.

The timer that starts to pump the nutrient solution should turn on and the solution should submerge the plants roots every X minutes ('X' is dependent upon your system). As soon as the roots are submerged, the pump can shut down.

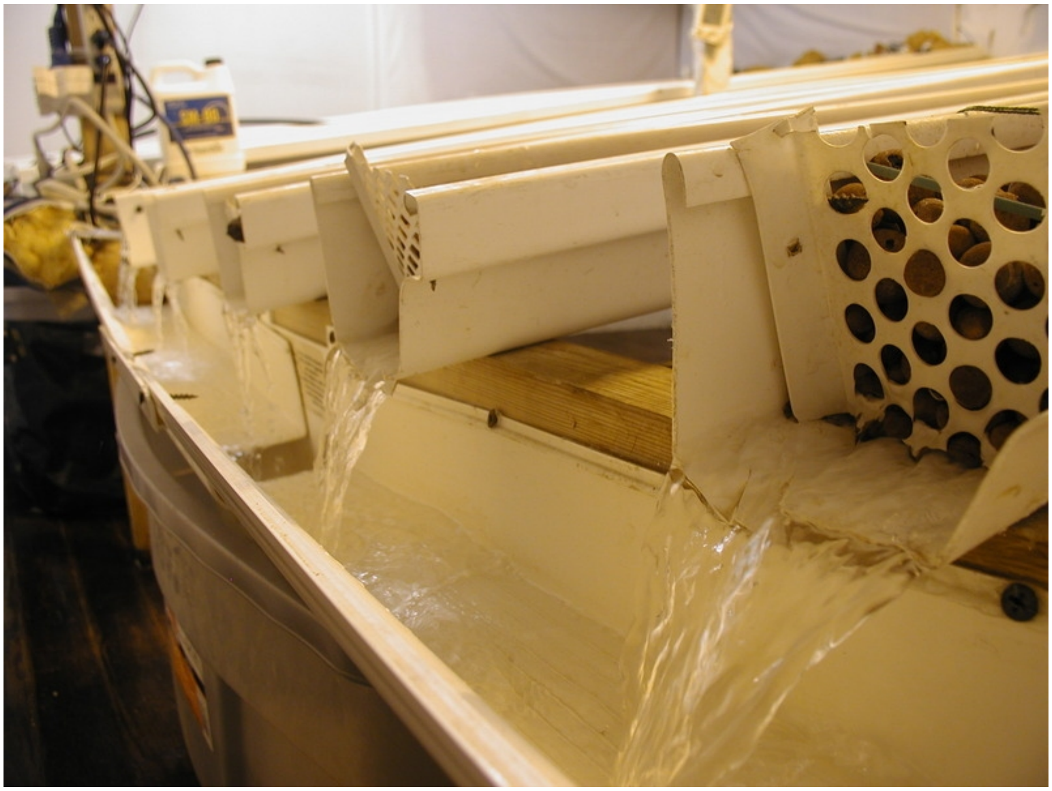


Note: If it takes longer than X minutes for the roots to get water, the roots will tend to grow long, They usually grow very long because they are looking for the nutrient solution source.

In fact, if this happens they can grow so long and thick that they prevent the solution from reaching all the way up your grow medium. This will also raise the chance of root material being ripped out and clogging the system. Once the flow is clogged by root or any other kind of material inside, you will have to take the garden apart and clean it. Not cool dude.

To make sure this doesn't happen, check the root length every few weeks. If it is hard to remove the grow medium the plants are in because the roots are anchored to the internal channel, the roots are too long. The root should be short enough to not touch the narrow point where the solution enters the cup holder. If they are too long, trim them down with scissors. Make sure they are not going too far, but don't cut them down unnecessarily. If you need to trim the roots, it has been reported that trimming the roots 6 inches down will not hurt the plant.

There are several ways to drain your tank. One is by adding the drain plug or faucet. Or you can obtain a plastic hose like you can get at the aquarium store to drain your aquarium, and siphon the water out. Another way is to attach the hose to the submersible pump, using your fist as a coupling, and simply allow the pump to pump it out into a bucket.



Since the plant will not absorb nutrients in the same proportions you are adding them imbalances will result over time. To correct this you will periodically need to drain and fill your reservoir with fresh nutrient solution. To begin with do this at least once a month and just before you start flowering. During flowering change the reservoir every two weeks. How often you actually need to do this depends on the plants, the nutrients, the size of the reservoir, etc. Luckily the plants will let you know how often you need to do this. They will start exhibiting signs of nutrient deficiency when there is an imbalance and you will know that you can't go longer than that before changing the reservoir. Especially with clones you will be able to get reservoir changes down to a system of clockwork since the clones will generally all have the same nutrient preferences.

About every month, replace the water nutrient solution. Every other time you change the water, rinse the medium with clear water to wash away any salts that have been left before adding a new nutrient water solution.

Keeping Your Reservoir Cool

Maintaining a highly aerated root zone at optimum temperature is key to achieving high potent yields and problem-free grows. High root zone temperatures often plague indoor growers running water culture (aero/bubbler/dwc/hydro) systems. These systems are subject to rapid heating by intense HID lighting which increases root zone temperatures, which decreases Dissolved Oxygen(DO) levels. Rapid plant growth combined with low DO levels can cause oxygen deprivation which in turn can result in infection by opportunistic pathogens such as pythium (root rot).

The key to maximum growth is to keep the air temperature at 75-80°F (24-27°C), but the root zone at 68°F (20°C) or less.

Note: The reservoir should be kept slightly cooler than the rootzone - irrigation and system heating will warm the water by the time it reaches the roots.

Optimum root growth occurs at 70-75°F (21-23.8°C); however, destructive root diseases also grow and reproduce rapidly at these root temperatures. Maintaining nutrient temperatures at or under 68°F (20°C) maximizes root growth and DO, and also prevents root rot.

Warm summer temperatures often require aggressive cooling measures. Bubblers and DWC systems are difficult systems to temperature regulate due to their (usually) small volumes and lack of external reservoir.

Make sure and spray, drip, mist, or circulate nutrients on a frequent basis to equalize reservoir and root zone temperatures. Intermittent spraying may require a slightly lower tank temperature to compensate for system heating occurring during the "off" spray cycle. For example; keep tank temp around 64°F (17.7°C) for intermittent spray cycles, 68°F (20°C) for continuous spraying.

Note: Submersible pumps add heat. Use an external/inline pump to minimize heat transfer. High quality digital thermometers are recommended.

14 Easy Ways to Keep Your Reservoir Cool:

- Add cold water when topping up. But be careful; abrupt changes in temperature may shock roots.
- Use frozen pop bottles/milk jugs. Keep extras in the freezer to replace thawed bottles with new frozen ones, replace as necessary.
- Increase the size of reservoir. Larger volumes are slower to warm up, pH/ppm is more stable and tank changes are less frequent.
- Put reservoir/bubbling buckets onto floor, or set on concrete blocks to conduct heat away from the water.
- Insulate. Paint all exposed system surfaces white or use reflective material (such as mylar). Wrap insulation around tank. Use a camping cooler for a reservoir (pre-insulated and comes with a drain!).
- Use a swamp cooler. Blow a fan directly across the surface of reservoir for excellent evaporative cooling. This method works well (expect a 10°F (-12.2°C) drop in reservoir temperature), but humidity and TDS will increase, and more frequent topping up will be required.
- Add a computer fan to a duct blowing into your tank (cut air exit holes). You can run it on a timer (i.e. 1 hr on, 1 hr off).
- Remote reservoir. In-room reservoirs will quickly heat up to room temperature. Put the reservoir (and ballasts) outside of the grow room to minimize tank heating.
- Airstone / Power head / Venturi air supply should be drawn from a cool source (ie. Cool outside air).
- Peltier coil (Thermoelectric chillers). You can purchase an Ice Probe and it works well. It uses 50 watts and pulls the temperature down 4 degrees under ambient. Cools 10 gal or less.

- Use cooling coils.
- Blow air through the root zone. Divert small amounts of cool intake air directly into the root zone.
- You can custom build a heavy box with fan and compressor coils, with a 5 foot refrigeration line with a titanium coil at the end. All you do is plug it in, set the controller and put the coil in the reservoir. Circulate nutrients for the best cooling. Get a bigger model than you need.
- Reservoir chillers - These are electric A/C units made specifically for cooling water. Also known as “Aquarium Chillers”.

Sterilizing and Disinfecting Your System

Sterilizing and maintaining clean conditions inside your hydroponics/aeroponics systems is extremely important. This cannot be stressed enough! Keeping cloning, vegetative and flowering systems clean gives your plants a fighting chance against pythium (root rot) and other harmful diseases, ensuring healthy, vigorous, potent crops.

Cleanliness is particularly important in closed (recirculating) hydroponic / aeroponic systems due to the favorable conditions these systems present to water and airborne diseases. Failure to periodically clean a system can result in stressed plants becoming infected and rapidly spreading disease throughout the entire system. Once infected, the entire crop will experience reduced vigor and yield, and possibly die.

Prevention is the best cure for disease. Sterilization between crops, adding anti-pathogen additives, and attention to system design can help combat disease.

Materials Needed:

-Hot water
-35% hydrogen peroxide (3% and 17% available at pharmacies, 35% at hydro stores). Oxidizes, then quickly (24 hrs) degrades to water (Sterilizing strength for 1-4 hours).
-99% Isopropyl (rubbing) alcohol. Kills bacteria and viruses on contact.

Note: bleach is not recommended. It leaves a toxic residue.

System Sterilization

Wear gloves when handling concentrated peroxide. Do not use bleach. Strong h2o2 will not burn off slime and salt buildup by itself.

Remove all plant matter from system. Pre-flush netcups/pots with water and inspect to ensure all roots have been removed. Put netcups/pots in dishwasher, then remove and soak in strong h2o2. If infection was present, replace any grow medium; soak gro-rocks in strong h2o2. Remove and replace all irrigation. Biologically-resistant poly tubing is can be cleaned and re-used. Soak all accessories in strong h2o2 (misters too, if possible).

System Cleaning

Remove and sterilize reservoir by initially flushing with water and wiping with a clean cloth, then spraying 50% h2o2 with a spray bottle on all surfaces.

Wait for one hour, then thoroughly flush with water twice. Flush system with water and do a pre-wipe (hot water + h2o2) to remove salt and slime buildup on all system surfaces.

Mix up a very strong (ie. 20%) H2o2 solution and spray it onto all system surfaces and allow to dry. Run re-connected system with 10% h202 + hot water for several hours, dump, and flush again thoroughly with water. Don't plant right away!

Tips

Do not share tools and other equipment between systems or reservoirs. Isolating systems will contain any problems. Keep separate and dedicated transfer buckets, measuring cups, trays and other equipment; do not share between systems. Keep your moms healthy and vigorous! Pythium (root rot) will pass systemically to clones.

(For the complete root rot remedy please refer to the Cannabis Care Manual.)

Inspect and remove unhealthy, slow growing plants early. Use a pond strainer to keep leaves and debris out of tank. Tap water often contains elevated levels of chlorine to inhibit bacteria, but it also contains a lot of other nasties.

System Design Considerations

- Isolate systems with separate tanks, irrigation and pumps.
- Use reflective surfaces (mylar, white poly or titanium paint) to keep the root zone cool between misting periods.
- Keep system light-tight. Cover tank (but do not seal).
- If possible, use low-cost UV / biologically resistant poly irrigation hose to minimize residue buildup. PVC plumbing is difficult to inspect and clean. Maintain nutrient temperatures in the 65-70F range for optimum growth and o2 saturation.
- Maximize o2 levels in your system: waterfall-drop your nutrient return, use airstones/venturis/skimmers.
- Be sure to frequently circulate nutrient solution to avoid stagnant water.

Mixing Your Nutrient Solution Step-By-Step

Properly preparing a nutrient solution is important. Take your time and do not rush. You'll probably want to get a container that will be able to hold the same amount of water as your reservoir. That way you can prepare your mixture in the mixing container, then empty your res and immediately pump the fresh solution into your system so that they will be out of the water for a minimal amount of time to reduce shock. Oh and it is essential that you use high quality water. Reverse Osmosis is best.

Step 1) Add all of your "extras" to your reservoir. In flowering for example, you could add 80ml of Bcuzz Bloom Stimulant (Bcuzz's suggested strength for 25 gals), or a similar "extra"; and a small amount of Epsom salts - about 2 TSP (10ml). You must mix your Epsom salts in warm water or they will take forever to dissolve and consequently throw off your readings. This little trick will help you whenever you need to mix something solid into your nutrient solution. Make sure you dissolve it first.

Step 2) Mix your nutrients. What you can do is get a gallon of water, and mix your nutrients ratios into that container, then simply add that solution to your reservoir until you reach the desired ppm. You CANNOT mix them together in their pure form, they must be diluted or nutrient lockout can occur. I've never heard anyone speak well of pouring their nutrients directly into the reservoir.

Step 3) Use a submersible water pump to keep everything mixing in your main reservoir. You can then add stuff like a GH (Growth Hormone) mixture slowly to the mixing container (if you're going to be using them) until you reach your desired ppm.

Step 4) After you have the ppm’s set, adjust your pH until your mixture is perfect. Then quickly dump your res and put the contents form your mixing container into your reservoir. Be sure your nutrients are fully mixed before trusting your readings. pH usually will take longer to stabilize than ppm's, so allow the tank to really mix up well before you count on a pH reading to be true.

Mixing Nutrient Solution Tips

- If you have a nutrient deficiency, or some other problem that you think might be nutrient related then change your nutrients!!
- Nutrients strengths should be qualified with the ppm/us conversion factor used (such as 0.5, 0.6 or 0.7), which can make a significant difference to the actual strengths.
- Another mix-up procedure is to mix the nutrients directly into the main reservoir. This method takes longer, as adjustments require additional mix-up of separate nutrient components.
- Keep your nutrients at a pH between 5.2 – 5.8. If it is in this range DO NOT try to get it “perfect” by adding pH up and down. If you mix up your solution and you don't HAVE to use the pH up or down DON'T. When you do adjust try to hit 5.5 but once again don’t be too picky. If

it’s a little higher or lower let it go. You’ll just mess things up by trying to mix it exactly, over-analyzing is a mistake.

- If system heat is a problem, you can use a silicone solution to raise pH and give the plants a little something to help them out in hot weather. Use it sparingly. I wouldn’t add more than 1 ml per gallon into your reservoir. It may slow down growth if used in excess.
- Some growers prefer to add main nutrient components first, additives later. Anything organic will throw your EC/PPM measurements off and it will be harder to judge how much salt fertilizer you've added. It is best to put the additives in last after you're happy with the chem levels.
- Be careful when mixing highly concentrated nutrients, as lockout *can* occur when adding pH UP (As may occur in a smaller volume). K can precipitate out of solution so make sure pH UP or DOWN is added to the nutrient solution with additional water.
- When you give a range of ppm, start off low and mix a little extra GH (growth hormone) to slowly bump up the PPMs as the days go on to make sure the plants can handle it. Every strain will grow a little different.
- Don’t try to add all kinds of stuff to your res, the simpler the better. That is why I recommend adding so little Epsom salts. If you start having Mg issues you would then bump it up.
- You will not need H_2O_2 (hydrogen peroxide) unless you have an improper nutrient solution. If you keep your reservoir temps at 68-72°F (20-22.2°C), and it is light tight, you won’t have algae problems and your plants will be the happiest. The higher your nutrient temperatures go, the less O_2 the water can hold. It is a property of water itself and no amount of bubbles will help.

Nutritional Lockout

One of the most frustrating difficult common problems growers encounter is Nutritional Lockout. Nutrient Lockout basically occurs when the optimal nutrient levels are not pH and nutritionally balanced so your plants cannot get access to a specific nutrient or group of nutrients it needs, and consequently it develops a deficiency. After being in your tank for 5 or 6 days, and being eaten for 5 or 6 days, the nutrients become imbalanced. Perhaps you are growing plants that ate all the nitrogen first and just snacked around the iron, magnesium and calcium, or vice-versa. It can also be caused by a chemical reaction in the medium/solution that causes a toxic substance to block the roots, or causes a chemical reaction that creates another substance that changes the chemical properties of the other nutrients. There can be many causes, but almost always the results are discoloration in the leaves, yellowing or rust spots, or curling up of leaf tips. It also becomes apparent when your plants were consuming a gallon or half gallon of water every day, and then suddenly when you check the levels the next day, they did not drink any water at all. This is a classic case of Nutritional Lockout.

(For the complete remedy, please refer to the Cannabis Care Manual.)

Daily/Weekly Hydroponic System Maintenance Checklist

Daily:

[ ] Dip your portable ph/tds/temp tester(s) in Isopropyl alcohol, then rinse with water before testing solutions to minimize contamination between reservoirs. When taking a reading, submerge only the sterilized portion of the tester into the reservoir.

[ ] Periodically inspect roots for signs of pythium. Consider pulling any plants with these symptoms.

[ ] Optional: Add 1.5ml 35% h2o2/gallon. H2o2 can attack beneficial bacterial; H2o2 use is not recommended when using these enzymes. H2o2 at low concentrations can add beneficial oxygen to the reservoir without killing these enzyme additives.

Weekly:

[ ] Mist all tools, transfer buckets, etc with isopropanol alcohol in a spray bottle, then rinse with water before use.

[ ] Weekly or bi-weekly nutrient changes are recommended. (Go longer if using enzymes to maintain).

[ ] Remove and soak all pump filters/gaskets, thermometers, strainers, air stones, etc in strong h2o2 + hot water.

[ ] Wipe away salt and slime buildup.

[ ] Add pythium-inhibiting enzymes to tank (weaker h2o2 strengths are recommended when used in conjunction with these biological additives.) It is important to maintain enzyme strengths.

8

YOUR GROW AREA

Your Grow Room

Setting up an optimal growth environment for your cannabis is crucial for reaping a big potent harvest. Your plant's healthy productive growth cycle is a direct result of the quality and care put into setting up your grow area, so take your time! Hydroponic gardens and soil gardens can both be set up outdoors, but for the purposes of this section we are (obviously) focusing primarily on indoor growing. So where is an ideal location to grow indoors?

An attic, closet, or similar grow area will suffice but a spare room dedicated to growing is preferred and will reap you the most reward. An attic is great not only because of its stealthy qualities, but it is also extremely insulated so controlling temperature year-round becomes easy. The downside to this is due to most locations attics are in, heat buildup is a concern if not ventilated properly.

WARNING: Any separate unit from your house such as a garage, barn, or shed; are highly risky areas to grow cannabis. Refer to the Marijuana Security Blackbook for more information.

Ideally a section of a basement or large room with with surrounding walls makes a very good grow area to set up in. Most growers use a spare bedroom or a closet. Also, you will want the entry point to have a lock on it. Some growers conceal the entrance with a custom-fitted bookshelf door, large painting, or mirror.

Before you make a final decision on your grow area's location be sure to consider that it MUST contain these elements to guarantee potent plant growth and maximum yields;

- **Electricity** – Enough power to run everything and safe and properly wired so no fires are started!
- **Air** - Fresh, and clean.
- **Water** – Easy access to water.
- **Hidden** – Minimizes the chance of theft or unwanted discovery.
- **Ventilation** – Has to be good.
- **Temperature** – Cool area that stays above at least 60°F (15°C).
- **Surrounding Walls** – For reflecting and focusing "lost" light properly.

If you're opting for farming marijuana aka needing MASSIVE indoor yields, your expert light proof grow room would probably consist of a 14ft x 24ft x 9ft grow area (L x W x H) containing several lights suspended from the ceiling. All the walls, flooring, and roof would be covered in reflective material such as Flat white or Mylar. Your ballasts would be attached to the wall. Your plants would be placed on the ground in large container buckets spread between the lights.

As far as ventilation goes, multiple air ducts and extraction fans would cycle in fresh air and suck out hot air. In order to eliminate the strong smell you would have an Ozone Generator as well. You would also have all the extra goodies like a CO2 Generator, Humidity controller unit, and a Light Rail. A Light Rail is a light mover that is suspended from the ceiling, your lights hang down from it, and it rotates the lights in a circular pattern over your plants. This allows fewer lights to be used in covering a large grow area such as this.

Note: If you plan on using a light mover it is strongly recommended that you use either 1000W or 600W lights. A 400W or 250W will under-light the environment when the light is tracking back and forth over a distance of 6 feet. A 1000W light is best when using a light mover.

Or maybe you are content with a small cabinet in your room, or desire starting off in a closet. Either way, I don't want to limit you so now you see what is possible.

Your grow room is your room of possibilities. As you further refine your favorite hobby, you will learn to make the best of your grow space. Perpetual grow cycling is born. This is when you keep most of the room flowering at all times. This can be accomplished by having an equal number of plants flowering and in the vegetative grow stage. As you begin to learn more and more about plant genetics you can start to develop your own breed and stock. Soon you can find yourself entering competitions and producing fine quality seeds. Seeds sell for around $30 - $150 per 15 seeds. Your favorite hobby can realistically become a great source of a rich income for you (be sure to check your area for regulations and laws regarding the possession or selling of cannabis seeds!) The possibilities are endless! The sky is the limit!!!

Two Grow Rooms

Productive growers have two grow rooms/sections! One for vegetative growth/cloning and the other dedicated for flowering. This alternative to growing under a HPS or MH during vegetation is to set up a dedicated vegetative area, and a dedicated flowering area.

The vegetative area would use a cloning hardware or something similar that would allow seeds or clones to grow and two standard 48 inch fluorescent tubes, turned on 24 hours a day.

The flowering area would use a standard hydroponic garden set up with HPS and/or MH fixtures turned on for 12 hours a day.
The cool thing about this method is that while the flowering plants are going through their growth cycle [inside the hydroponic set up], the germinated seeds or clones will have a few months to develop inside the clone setup. Then after the flowering plants have been harvested, the plants in the vegetative area are ready to move to the flowering area. New seedlings or clones can then be started in the clone hardware (such as a cloner or something similar).

If electricity costs are a concern than you will probably want to go with this dual-room set up as electricity use will be about 25% to 35% less because the MH or HPS light is only on 12 hours a day. Since the flowering plants need absolute darkness during the dark phase, the light from the vegetative area can't reach the flowering plants. So they need to be isolated, either by using curtains, a thick lightproof black cloth (or something similar), or by being located far away from each other.

Note: The longer a plant has been growing in the vegetative phase, the faster it will flower.

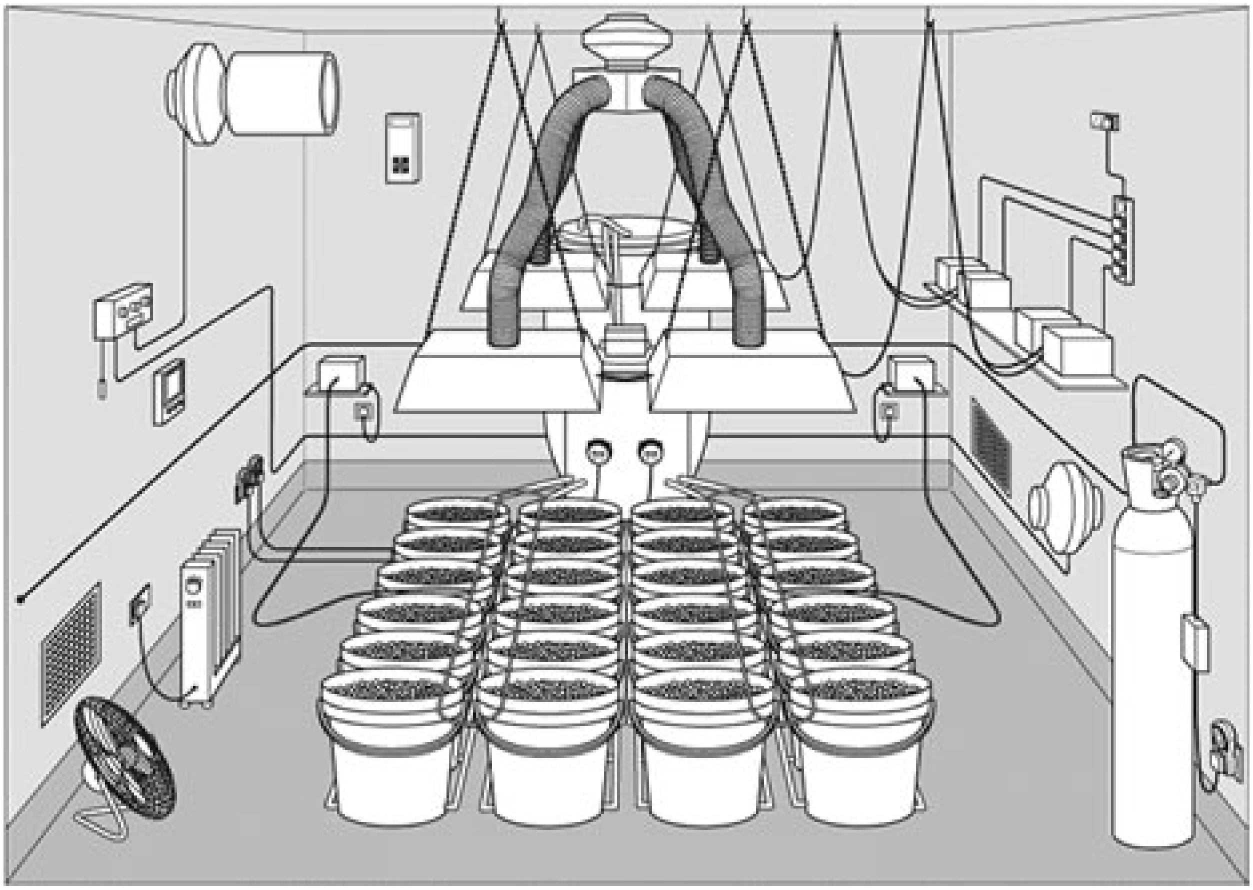
The only problem with this grow room setup is the extra space needed for two different grow areas...

Opting for two grow areas, one for vegging and one for flowering (this can also be accomplished by placing a light barrier dividing your room in half), results in quick heavy potent yields. Black plastic works very well for a light barrier, just make sure you staple it and seal it properly. It cannot be stressed enough that when utilizing this grow setup to make sure the light from the vegetative room does not disturb the sleep from the plants in the flowering room!!!

Note: When stapling any type of plastic to flooring, walls, or ceiling, we recommend that you use a little piece of square cardboard between the plastic and the staples so that the plastic doesn't rip.

Setting Up Your Grow Room

Now that you have decided upon your ideal growing spot, it is important to take care of it and keep it as clean as you possibly can. Design your indoor garden with care and planning. Decide beforehand how many plants you will have, how big you will grow them, the dimensions of your room, and how you will position the lights.



You're going to need easy access to each plant, so leave yourself room to work. Also remember you will be using lots of water. And it is imperative that you keep any light leaks from the outside out. Cover up interior windows, cracks, or anything else that will show light from the outside. Having light leak is like inviting people to come into your grow room. Light leaks are unacceptable and greatly reduce security.

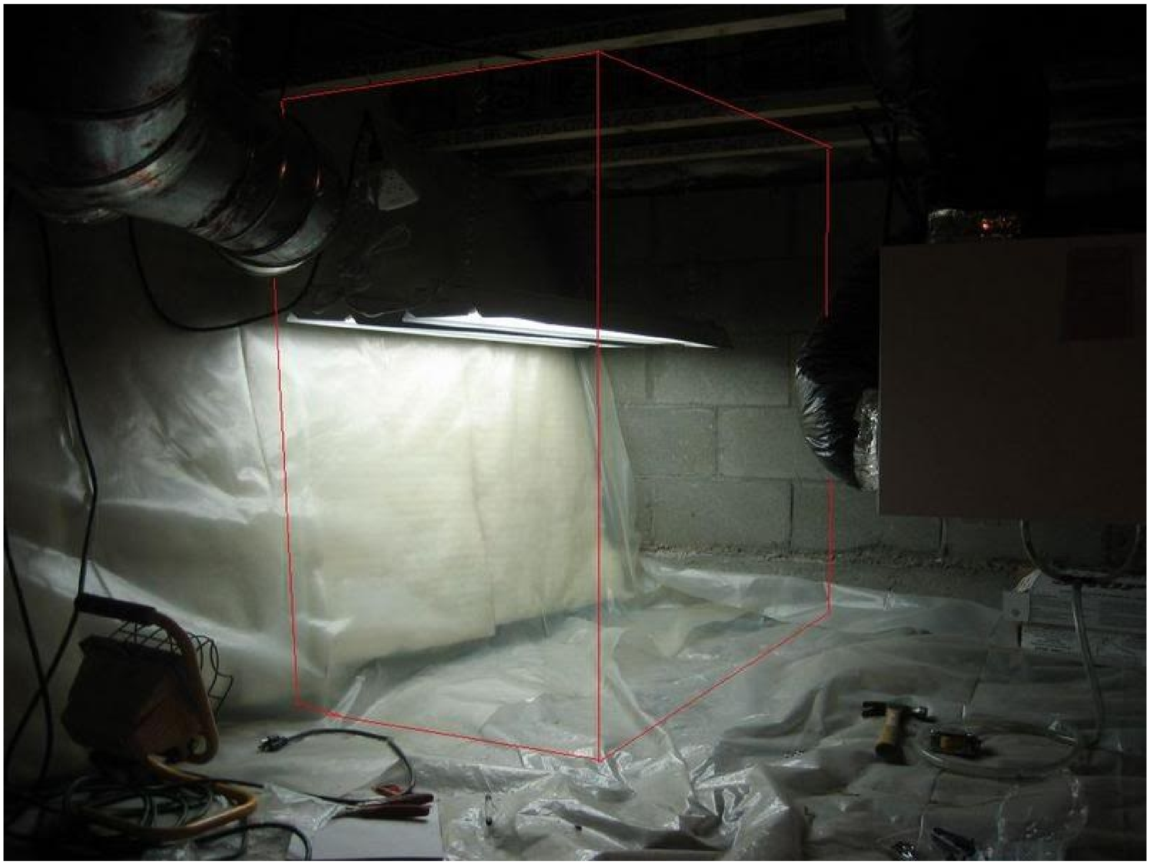
Cleaning

Plants a VERY susceptible to infestation and disease. Indoor gardens should contain only items that are absolutely essential for growing. Properly cleaning your grow area before beginning growing is a critical step to ensure long-term success. Do not overlook this section.

The first step is to clean your grow area before use. If you don't clean your grow room, bugs and germs will invade it and sabotage your plants. This means you'll need to scrub the walls, vacuum, clean all the equipment, and wash the floors etc etc etc. It is advisable to remove the carpets if you can. Remove ANY residue or debris that might include any form of insects, parasites or disease.

It is absolutely CRITICAL that you clean everything in the growing area then sterilize it with something like Lysol, bleach, or some other strong germ killer to prevent the marijuana plants from being harmed by germs, bacteria, molds, etc. Any dust or mildew is UNACCEPTABLE. Any carpets, drapes, or other fabrics can harbor dust, germs, and mildew so they must be removed.

Begin by cleaning the walls and floors with bleach and water very thoroughly. Scrub them until they are sanitary and clean. Pay specific attention to corners and any holes. You want your grow area to be like a factory where they manufacture microchips; a completely sterile clean germ-free environment.



Now this step is optional, but depending on where you live and where your grow room is (especially if it is an old attic) you may want to bomb the room with a pesticide smoke bomb depending if you have a pest or insect problem. These are available at most hardware stores. Follow the instructions very carefully on your product's label and bomb the room accordingly. This will wipe out all pests, bugs, larvae, algae, eggs etc and any other nasty critters that will threaten your precious marijuana plants. After bombing clean the walls, floor, and ceiling once more to ensure a clean healthy environment for your plants to grow in. Air quality is a crucial factor in growing marijuana, you want to make sure no residue from the pesticide has been left on your walls, floor, or ceiling.

Never to bring anything that has been sitting outside into your clean grow room as you can bring in pests. Be sure to properly clean it with bleach first. Anything that enters your garden should be considered a potential threat to your plants. Fungus, bacteria, and bugs can come in on tools, equipment, clothing, and pets. Always wear clean clothes when entering your garden. Washing the walls with bleach weekly will help the prevention of fungus and bugs.

WARNING: Never enter your garden when being in contact with houseplants; as this the perfect, *most common* way to introduce the deadly parasite, "spider-mites" right into your garden.

Flooring

Next step after properly & thoroughly cleaning your grow room is to lay down plastic drop sheets (the ones used for painting, available at most hardware stores) on the floor. This will protect your floor from water. Watering your plants will create lots of spills. Cover up the bottoms of your plants with trays to catch excessive runoff water. Mop the floor frequently. Also if growing using soil, in order to keep the plants from touching the cold cement floor you can use cinderblocks/bricks with wood for raising up a stable surface to place the plant containers on.

Note: You may wish to cover your floors with a white plastic or similar material for maximum light reflection, this is discussed in detail in the following section.

Reflective Surfaces

It's time to set up the surrounding walls, ceilings, and floors for light reflecting.

This will ensure your plants get as much direct light as possible, fueling their maximum possible growth. All areas of the grow room should be set up with reflective material. This is accomplished by painting a 'flat white' or setting up reflecting material such as Mylar. Mylar can be found in most hardware stores. The more reflective the walls, ceiling and floor are the better. Non-reflective surfaces will waste your light by turning it into heat. Mylar works the best for reflecting light!

WARNING: Do not use mirrors, as they absorb light!

Don't use tin foil either. A good quality reflector will ensure all your precious light is being directed right at your plants for optimal absorption producing the highest quality potent big yields as possible. And remember, if you are going to paint the walls be sure to use FLAT white, as this is the most reflective. Regular white will NOT reflect as much light as flat white will, resulting in lower yields due to lack of sufficient concentrated light exposure.

Also to make sure light isn't visible from the outside seal the inside of the windows with fire board and glue. Seal any cracks or unnecessary light leaks to keep the room as airtight as possible and to avoid any mold, fungus, or pests from getting in.

Choosing A Reflective Surface

Choosing the right surface for the walls of your grow room is very important, as up to 40% of your total yield comes from the edge - the right wall surface can increase the amount of light those plants receive by up to 30%! Artificial lighting diminishes exponentially with distance, so it is important to “contain” as much of this light as possible and direct it correctly. Reflective surfaces also help illuminate the lower portions of the garden, providing lower buds with light. This means big tasty yields as all your plants surfaces are getting concentrated light exposure.

To get the best results with your light and walls, it is important to get the walls as close as possible to your garden to ensure the least amount of light is wasted. The percentages provided are only useful as a general guideline, as they present the range of reflectivity of the particular surfaces. The high percentage presents the best possible circumstances for that material (for example a 99% reflectivity rating for mylar sheeting would be under ideal conditions - no creases, completely flat, no discoloration, etc).

The absolute best way to determine how well your grow room walls reflect light would be to purchase a light meter and measure your light directly; then take an opaque board and hold it a few inches off one of your walls with the light meter below the board in such a fashion that the light reflects off the wall and onto the light meter. You can then compare the difference between the two and determine a percentage from those numbers. The closer the two numbers are, the better your wall reflects light. It is important that in both measurements, your light meter is the same distance from the light, otherwise your results will be skewed.

Here are some of the most commonly used materials used for grow room walls:

Foylon:

A great solution for growers who are interested in long term use, and though it may be slightly more expensive than mylar, its durability will more than make up for its cost. It has the ability to reflect about 95% of the light (and approximately 85% of the heat energy, so a good ventilation system should be used in combination).

Foylon is a much more durable version of mylar, made of spun polyester fabric and reinforced with foil laminate. Foylon is resistant to most solutions, won't tear or fade, and can be wiped or washed clean.

A recommended method to attach Foylon to the walls would be using Velcro, as it makes taking it down for cleaning much easier and reduces the risk of tearing, creasing or bending it. If this is used for your walls, making sure you get it flush with the wall with no pockets of air between it and the wall to prevent hotspots.

Mylar:

Mylar is a highly reflective polyester film- it is one of the best materials on the market for light proofing. It acts as a moisture barrier as well as a light reflector. It comes in varying thickness, the most common being 1 and 2 mm thick. The 2mm thick mylar while not quite as durable as the foylon, is still pretty rugged. The 1mm thick mylar tears fairly easily, so taking it down for cleaning is quite difficult without accidentally damaging it in the process. Both types of mylar are able to reflect approximately 92-97% reflective, giving it the potential to be more reflective than foylon. Foylon is more easily cleaned as well as it being harder to crease, foylon usually ends up being slightly more reflective.

Mylar reflects radiant heat energy just as well as foylon(around 85%), so proper ventilation is also necessary if mylar is used in your grow room. Attaching this to walls can be done in a similar fashion as foylon, and the same caution should be used to avoid creating hotspots in your room. The 1mm thick mylar stands a fair chance of being creased or ripped in the process unfortunately, even if Velcro is used to attach to the walls.

Mylar comes in several different types; White, Black, Metalized, Aluminized, Dimpled Metalized, and Threaded Aluminized (reinforced).

When choosing a lighting surface a grower is interested in the obvious, he/she wants to wrap their grow space, large or small, with the best reflective material available. Aluminized or Metalized Mylar is an ideal choice. Mylar can withstand temperatures of up to 392°F (200°C), Mylar is also electrical resistant and fire retardant.

Unlike foil, mylar lays flat without the crinkles and creases if handled with care. Mylar will not create concentrated hot spots.

Mylar comes in many material Gauges. Most Hydroponic shops only carry 001" and 002" mil(which is all you need if your using as a grow room reflector). Mylar can be cleaned with Windex, alcohol or any other mild household cleaner. An antibacterial hand soap with warm water is perfect.

C3 Anti-Detection Film:

A specialized type of mylar that exhibits the same properties as the 2mm thick mylar, but in addition to reflecting approximately 92-97% of the light, it also is 90% infrared proof, making your grow room all but invisible to IR scanning. This can also be attached in the same manner as foylon or mylar, and the same caution should be used to avoid creating hotspots in your room.

Flat White Paint:

As aforementioned, flat white is a great option for large grow rooms or for people who are interested in a low maintenance reflective wall surface. FLAT white paint has the ability to reflect between 75-85% of the light, and does not create hotspots.

Note: Adding a fungicide is recommended when painting in your garden.

Glossy, plain, and eggshell whites will not reflect light as efficiently as flat white. Semi-gloss paint for example, only has the ability to reflect between 55-60% of the light. Also important to remember when using paint is that any smears or blemishes on the surface take away from how reflective the wall is - extreme care should be taken to avoid marking or staining the walls. Titanium white paint is very reflective; however it is usually only used on reflectors due to its high cost.

Elastomere Paint:

A rubberized roofing paint with 90% reflection. Good for growboxes. Mildew resistant. Highly reflective.

"Poly" White/Black Plastic:

Poly plastic is useful if you are setting up a temporary grow room or don't want to damage the walls. Plastic is easily cleaned. Black & white poly (6mil) is very tough, reflective(the white side reflects 90% of all light) and can be handled on a daily basis without damage or tearing. It is also a good choice for partitioning off spaces ensuring maximum efficiency of your lighting.

The purpose of the black side is to not allow any light to pass through the plastic, which ensures your dark cycle remains dark. The white side is 75-90% reflective. Choose a 6 mil thickness of poly for maximum light blockage and durability.

WARNING: If plastic is put too close to the light it will melt!

Poly can be attached to the walls by using carpenter's nails or using tape glue or any other similar means. This can be used as a cheap alternative to mylar or if painting your grow room is out of the question.

Styrofoam:

This is excellent for harsh environment growrooms such as an attic, provided you have a good ventilation system and a way to keep the temperatures from rising too high (an A/C unit or similar) as it is an excellent insulator.

It is also a great material for use in a temporary setup or for use as a "traveling reflector" on a light mover, where weight is a concern. It is approximately 75-85% light reflective so it is comparable to using a flat white paint. Foam will not create hot spots. Rigid foam can be purchased in sheets, and can be used as a free standing wall or can be taped, glued or nailed to the wall, the last generally being the most successful method.

Emergency Blankets:

Emergency "Space Blankets" are ultra thin polyester blankets that are sold in most camping stores and are constructed of a single layer of polyester film that is covered with a layer of vapor deposited aluminum.

It is not very effective at reflecting light because it is so thin. Holding it between you and a light source, many small holes are noticed at the intersections of creases and the entire blanket is translucent to begin with, this coupled with the many creases that are in it when you purchase it takes away a significant amount of it reflectivity. It is very easily creased which detracts from its ability to reflect light. And while it reflects nearly 90% of radiant heat energy, it is only able to reflect around 70% of the light.

So why use it? The largest advantage of using this type of material is that it is very cheap and therefore easily replaced. But, emergency blankets can create hotspots if not attached flush to the wall so it is important that no air gaps exist between it and your supporting wall. The easiest way to attach this is to use tape (aluminum or metal tape is the best), as it tears very easily once it is cut or punctured.

Aluminum Foil:

Aluminum foil is no more than 55% reflective when it is flat. When it becomes creased its reflectivity is even lower (around 35%.) It is also very dangerous to use because it creates hotspots easily, is electrically conductive, and is a fire hazard when it is in close contact with HID lighting. This should only be used as a last resort.

….DO NOT USE FOIL UNLESS YOU ABSOLUTELY HAVE TO!

Watering Unit

An optimal method for watering is to place a 150 liter water barrel in the corner of your grow room. Fill it about 1/3 full of fresh water. You will want to add a water pump inside the barrel connected to a hose with a spray nozzle for watering your plants. Next add a circulation pump that you will provide a good mix of water and nutrients. This will plug into your garden hose and on the other end of it attach a water wand. Add also a breaker head to the end of your water wand, this will add air to your water mix, oxygenating the water just before it is supplied to your plants.

You may also want to add a heating device that will keep the water at a constant approximate 73.4°F (23°C). Make sure the barrel has a LID on it, as this will prevent any water from evaporating unnecessarily increasing the humidity of your room. This will also ensure that no unwanted debris falls in your water supply.

The concentration of calcium and magnesium indicate the “hardness” of your water supply. Water containing 100-150 mg of calcium per liter is fine. Reverse osmosis machines are the easiest most efficient machines available to clean raw water. This machine allows pure water to pass through it, and in effect it will filter out the dissolved solids from your tap water. This is the ideal water for your plants.

Note: Most of these materials are available at any hydroponic shop or local hardware store.

Setting up a Closet Grow Space Step-By-Step

Setting up a closet is a little bit different than setting up a large grow room, but, similar principles still apply:

Step 1) To start you need a small space - a closet roughly 2x5x6 (LxWxH) feet. Clean and empty it out as mentioned above.

Step 2) Cover the walls, ceiling and doors with aluminized mylar, shiny side out. This saves light for the plants, ideally, the only light absorber in the room will be the plants.

Step 3) Next step is to put your lights in the room. Fluorescents are the cheapest and most readily available. This is the real advantage of fluorescents for the closet grower. For the professional, expensive metal halide and high-pressure sodium lights give more light for less electricity. But these lights are overkill, and too damn hot for the amateur closet grower.

Step 4) Put either your hydroponic system in, or set up your containers (if growing using soil). Keep good air circulation using a ventilation system (check below).

That's all there is too it!

Cabinet Growing Step-By-Step

Cabinet growing is a great method, the goal being to keep a cycle of plants growing at all times. You can use anything ranging from a small closet, a hot press, and old refrigerator, a box, a press, or simply a cupboard or cabinet. Typically your grow area will be small accommodating 1 to 5 plants at a time.

Step 1) To get started you will want to get ahold of the cabinet, a light, and an air vent with a fan. Set up your light to be adjustable, you can use chains or some other type of non-flammable cord. Make a large hole in the unit to allow

air to enter the unit, and another hole is created to allow air to escape. Place your fan in one of the holes that will serve it's purpose of extracting the hot air generated by your bulb. It's good to put the vent and fan at the top of the cabinet near the light. This is due to hot air rising and collecting at the top. You can also place a fan on the intake hole as well. Set your intake fan speed higher than your hot air removal fan so that constant fresh air is being pumped into the unit and stays longer.

Step 2) As described in the reflective surfaces section, paint the walls a Flat White or use Mylar for reflective maximum plant light absorption purposes.

Step 3) Your plants (in separate pots) are placed inside the cabinet and will go through their entire life grow cycle inside the cabinet growing environment. Clones can be taken and placed on a second shelf inside the cabinet. Some people like to create a small compartment inside their cabinet for clones and germination. This compartment must be kept small, you only need enough room to keep the clones alive. Unless you are using a very big setup then you will not need an intake fan for the clones. All you'll need is a hole in the side to allow the clones to breathe.

After harvest, place the clones in the grow room and repeat the process. This puts you up in a perpetual growing cycle. If using the right strains you are able to harvest 4 ounces of bud every 30 days. It really depends on how big you want to create your grow room.

We have seen 5ft x 5ft setups that have yielded 40 ounces of marijuana every 2 months. This can easily be achieved with careful maintenance and optimal grow environment conditions (mentioned throughout this guide).

Stealth Growing

Many modern growers find it difficult to grow in large closets or huge grow rooms. But they still want to experience the incredible benefits of growing their own delicious supply of potent healing herb. So what do they do?

The answer is to grow in a stealth setup of course!

There are two options growers face, they can either spend lots of money, time, and effort and build their own homemade stealthy drawers / cabinets / whatever, or, they can purchase a pre-made professionally designed stealth growing box. There's only a few companies who make good one's right now.

(Pictured above: the stealthy Sun Speaker by SunLight Sheds, now out of business.)

This turn-key PC Planter prototype is one of the most *awesome* stealth grow setups available to the 420 community today.

This box utilizes Sea of Green so you can grow TWO plants in it from start to finish! It's incredibly easy to operate, light-proof, and super discrete. This particular setup includes its own HID & odor eliminator!

PC Planter Benefits:

- Light Proof and completely discrete.
- Dimensions: 8.1" x 20.6" x 18.6" (WxHxD)
- Secure turn-key locking system means only you get access to your plants.
- Custom made interiors have a 99% reflective surface for maximum light absorption by the plants.
- Includes ventilation system (100+ CFM of air cooling).
- Includes reservoir with 2 plant capacity.
- Grows over 1lb. of plant matter annually.

It may seem difficult, but it's quite easy to build your own, you can create one from an old used computer case!!!!

Some growers utilize garage, shed, and similar units too.

(Pictured here: the Cool Cabinets.)

Finally, options for those growers who feel that lack of privacy is the only thing keeping them from harvesting pounds of their favorite greens.

Making Your Own Effective Carbon Filter

A Carbon filter is great for reducing odors. They are attached to your ventilation system. Here is how anyone can make a carbon filter to remove odors for cheap. This is a very simple and effective unit that will work just as well as a commercial unit that costs $400+ USD dollars.

Supplies:

-6" pvc clean out cap available at any hardware store.
-4" to 6" adapter (available at any hardware store) - you could substitute this with a 4" to 6" pvc adapter.
-a roll of aluminum screen (aluminum is better, not fiberglass; you need the strength of the metal to make it retain it's shape).

-a roll of duct tape.
-a clothing hamper (you can probably find other suitable containers of varying sizes).
-roll of high loft quilt batting.
-a length of 4" dryer vent hose.

Virgin Activated Carbon:

You can get carbon at most aquarium supply web sites - the bulk containers are best here. Kent marine or Esv brand is pretty good. Pelletized activated carbon in the 5 gallon bucket - 5 gallons should do at least a couple fills, which should last for years. You can use lignite-based carbon, but be sure to find "activated" and "pelletized" - it is much more effective than the crushed carbon.

Pelletized activated carbon has been crushed and formed into pellets, then washed in an acid solution to create millions of charged pores in the pellets. As air passes through the pellets, it attracts odor ions and particles. The carbon becomes “exhausted” when all the pores are clogged. Pelletized carbon has more available surface area than the crushed stuff, and becomes exhausted much more slowly. It can be found and most online aquarium supple outlets

Construction:

Wrap open the roll of screen around the PVC cap, then duck tape the cap in place. This serves to hold the screen open to the appropriate size for use.

Trim the screen roll down to the appropriate length for the size hamper you are using. Just eyeball it to be even with the top of the hamper rim - just be within and inch or two.

The next step is to insert the 4" to 6" adapter and tape it in place.

Now we need to wrap the tube we just built in some of the quilt batting. Unroll the roll of batting and double it over until it is the same length as the tube we have built.

Here I show and the appropriate batting length for the hamper we are using - this means unfolding the batting one time after unrolling it; it is then conveniently cut to the right length.

Now tape the end to the screen roll the tube around till the batting overlaps just a bit and trim her off, then tape the batting up nice and clean.

Ok, now we need to line the inside of the hamper with the batting - the same fold size will work here also. Just wrap the inside and then tape it to the top rim so that it wont move around or drop down into the hamper during filling.

Now we can insert the tube we have just finished building inside the batting-lined hamper basket. Hold the inner tube as you pour in the carbon between the two layers of batting. You can change the amount of carbon by simply wrapping the tube with more rounds of batting. This filter would probably use 7 pounds or so.

Note: a 26mm thick layer of carbon is considered an optimum thickness for smell removal and blower backpressure.

All we need to do is add a roll of batting to the top to close things off nicely.

Now we can cut out the top so that we can get the lid over the tube end. Stick the lid on and maybe tape it down if you need to.

Now we can attach out 4" dryer vent hose and tape it in place. Attach the other end to a suitable air blower, and wha-la! - a clean fresh smelling room!
Here is an example of taping a dryer hose to the output on a blower, but you can get blowers with flanges at most grow shops.

There you have it. Commercial-grade effective homemade carbon filter for eliminating ALL exiting odors in your grow room.

Environmental Conditions For Explosive Growth

Your plant should live in a stable temperature and optimal growth environment all day and night, in order to ensure highest possible quality smoke.

Oxygen

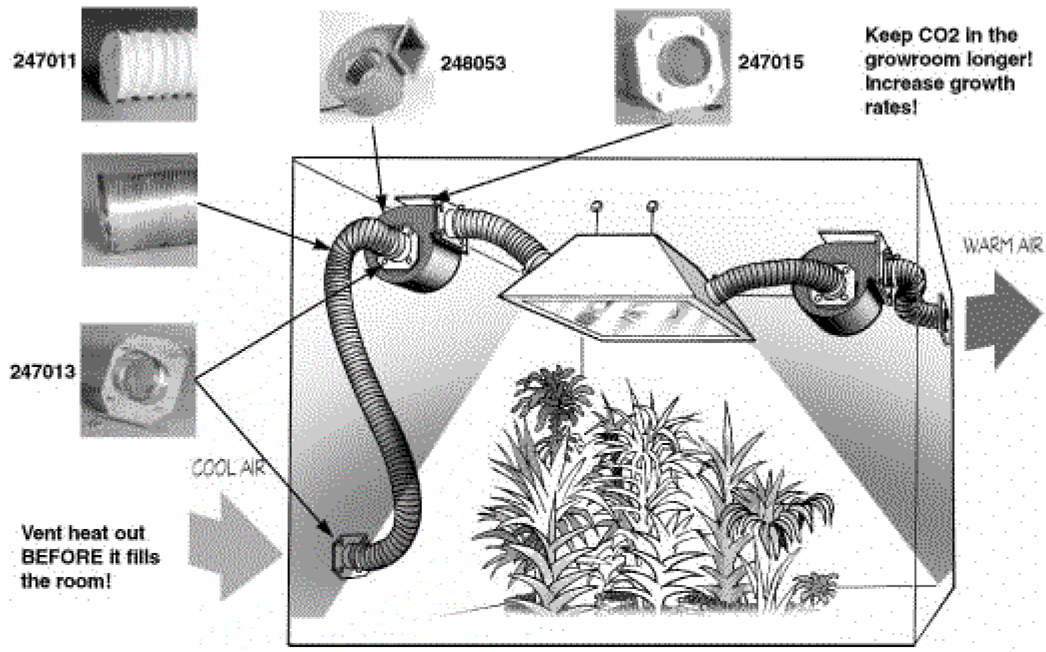
During your marijuana plant's vegetative and flowering stages plenty of oxygen-rich fresh air is required for vigorous growth. Always keep a window open to refresh the air quality in your grow room each day. Between watering (dry periods) your plant's roots need to breathe. If you're growing in winter time the cold air can inhibit growth, so keep the air recycling exposure time to an absolute minimum.

If your grow area is enclosed then you will need to get some sort of fan / ventilation system to suck out the old stale air and pump in fresh air. Fresh air surrounding your plants also tricks them into thinking they are in an outside grow environment, so consequently your buds will grow bigger and faster.

Air Ventilation

No indoor garden can be without a ventilation system. Heat is the biggest problem for the indoor grower; that is, maintaining the proper temperature for the plants. In order for plants to thrive they need a constant supply of fresh air. Each average 1000w light increases the room temperature by 10-15°F (-12.2 to -9.4°C). Proper ventilation is essential for healthy thriving plants. Make sure your vent fan is strong enough to produce a pronounced suction effect in your grow chamber. A room with an exhaust fan on the ceiling is a good choice (if that is available to you). The exhaust fan on the ceiling will help keep the temperature cool, and if needed, you can upgrade to a stronger fan to remove a larger volume of hot air created by the grow-lights. This will keep your room nice and cool – the ideal growth environment for growing dank buds.

You can install a thermostat and a ventilator system so as soon as the grow room gets too hot, the thermostat will switch on the ventilator to cycle out the hot air. A constant flow of fresh air must be available to the plants. All hot, stale air should be ejected to outside the grow area and not be immediately recycled (hint: vent it outdoors, preferably high up!) Make sure your fan is up, over the plants to collect the hot air that rises. If using an air intake, it should be positioned low to the ground to pump cool air into the chamber.



Note: It is advisable to place filters on your ventilation system, as this will block out any unwanted odors from escaping. Carbon coal filters are very good.

You can also position an oscillating (rotating) fan so that it is blowing directly over the tops of your plants, cooling the area between them and your light. You may also want to have an additional fan blowing air below the buds. Both fans should be positioned so that they receive incoming air from outside the chamber and blow towards the ventilation fan. The oscillating fan will also assist in the buds developing thicker stalks and stems when a constant gentle breeze is applied.

The reason fresh air and good ventilation is a MUST, other than heating removal reasons, is it is required to replace the oxygen supply to the plants due to their constant carbon dioxide expulsion. Cycling clean air into the grow area is an absolute necessity if you want to ensure maximum yields. Every grow room will need some sort of exhaust fan to move hot stale carbon dioxide-saturated air out. Intake areas should be clean and dust free. Air intake and outtake areas should be as far away from each other as possible to promote maximum air circulation. Place intakes as low as possible and outtakes as high as possible. This is the best way to cycle air and remove the heat buildup caused by lights. (A squirrel cage fan attached to a dryer hose makes for a good cheap ventilation system.)

Note: If grow lights heat is a major concern, you might want to consider checking out Cooltubes.

How Much Ventilation Is Needed In a Grow Room

Each fan has a rating that tells you how many cubic feet of air per minute (CFM) it will move. When dealing with average temperatures you will want your fan to exchange the grow room air 3-5 times in one minute, so for a room that is 40 cubic feet, a fan that is capable of moving 120-200 cfm (cubic feet per minute) is recommended. If you only want to replace depleted levels of CO2 and are growing in a closet using fluorescents, one room change per five minutes (divide room size by 5) will be adequate.

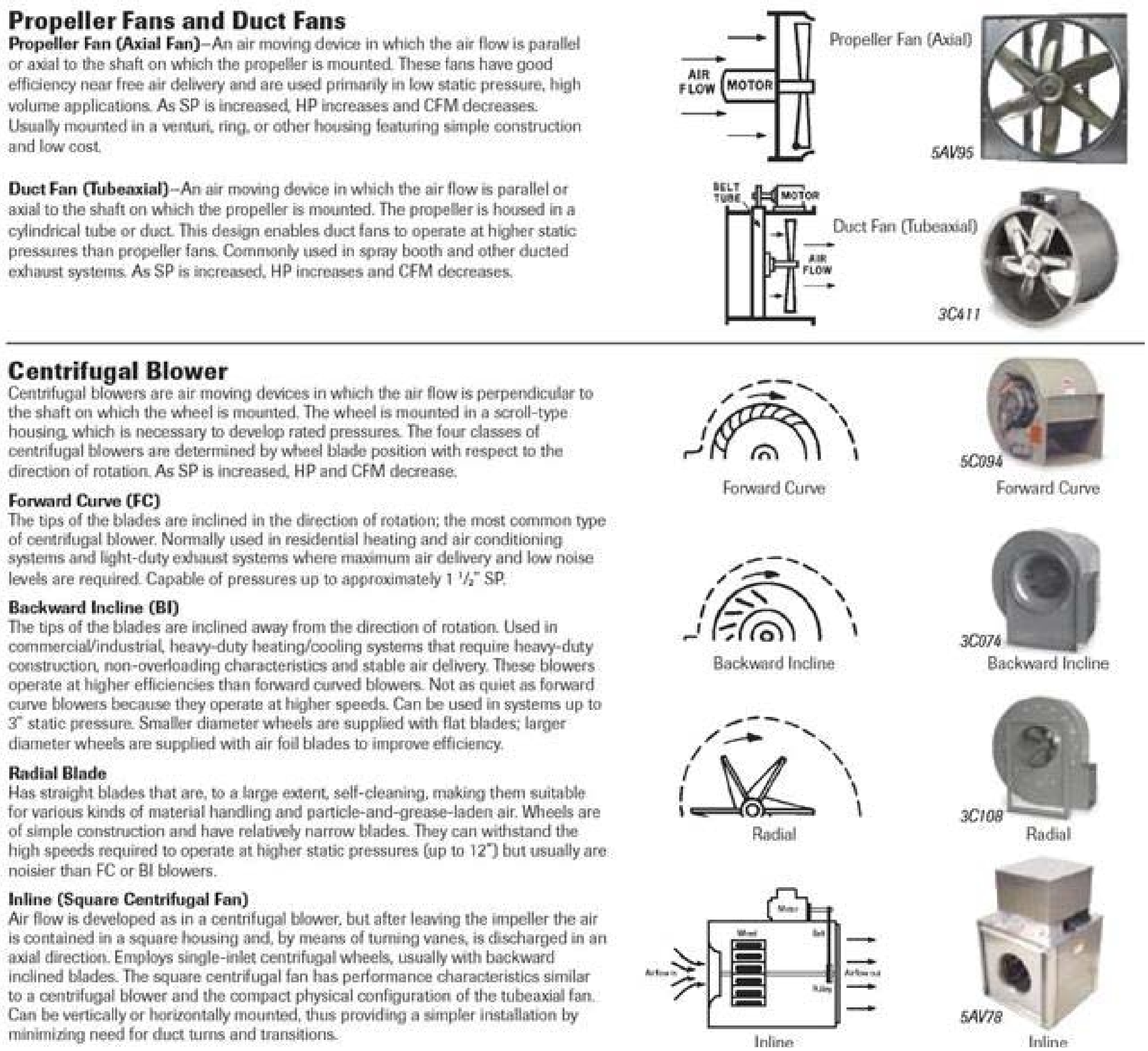
To calculate your room size, multiply Width by Length by Height, this will give you the CFM rating required for one room change per minute.

Air that's exhausted will be replaced by fresh air, which is drawn from Passive Intakes - located opposite the exhaust at the floor of your grow room(recommended for closet grows) or forced in using another blower (recommended for larger grow rooms). For internal circulation oscillating fans are the most efficient devices for circulating air in a room. The gentle back and forth sway of the fan is very beneficial for the developing plants. These fans keep mold down. Home improvement centers carry a large array of various types and styles of air-moving fans, there are wall-mounted styles available and most are relatively inexpensive.

So make sure that you have a highly effective exhaust system. You will want to make sure your exhaust fan is rated for high CFM under pressure. All fans will have a CFM rating, this rating is how many cubic feet of atmosphere the fan moves per minute. Your exhaust fan should be capable of evacuating your grow room at least once every five minutes. Multiply the width, height, and depth of your room to determine the total cubic feet, divide this number by five and you will have the minimum CFM fan rating needed. Of course this assumes the fan maintains its CFM under pressure and actually performs to specifications. In practice this doesn't happen.

It is best to overshoot this rating as much as your budget will allow. Even if your fan does perform to specifications pulling more air through will help keep the temperature of the room down and exhaust the heat from powerful fans. Generally squirrel cage and duct fans are used for exhaust systems. These fans can be connected to 4 inch and 6 inch flexible ducting that can be used to route the air where you want it and to pull air through a carbon filter. In addition to your exhaust system you will need an air intake. For many systems a passive intake is used, simply providing a channel for fresh air to enter the grow room to replace the air being exhausted. For a larger area or longer intake line you may need an active intake. Providing an active intake relieves pressure to allow the exhaust and intake to share the workload of air exchange. Otherwise the exhaust fan must provide the force required to pull air into the room as well as the force required to exhaust.

To convert CFM to CMH use the following formula CFM X 0.03 X 60 = CMH.



Propeller Fans and Duct Fans

Propeller Fan (Axial Fan)–An air moving device in which the air flow is parallel or axial to the shaft on which the propeller is mounted. These fans have good efficiency near free air delivery and are used primarily in low static pressure, high volume applications. As SP is increased, HP increases and CFM decreases. Usually mounted in a venturi, ring, or other housing featuring simple construction and low cost.

Duct Fan (Tubeaxial)–An air moving device in which the air flow is parallel or axial to the shaft on which the propeller is mounted. The propeller is housed in a cylindrical tube or duct. This design enables duct fans to operate at higher static pressures than propeller fans. Commonly used in spray booth and other ducted exhaust systems. As SP is increased, HP increases and CFM decreases.

Centrifugal Blower

Centrifugal blowers are air moving devices in which the air flow is perpendicular to the shaft on which the wheel is mounted. The wheel is mounted in a scroll-type housing, which is necessary to develop rated pressures. The four classes of centrifugal blowers are determined by wheel blade position with respect to the direction of rotation. As SP is increased, HP and CFM decrease.

Forward Curve (FC)
The tips of the blades are inclined in the direction of rotation; the most common type of centrifugal blower. Normally used in residential heating and air conditioning systems and light-duty exhaust systems where maximum air delivery and low noise levels are required. Capable of pressures up to approximately 1 ½" SP.

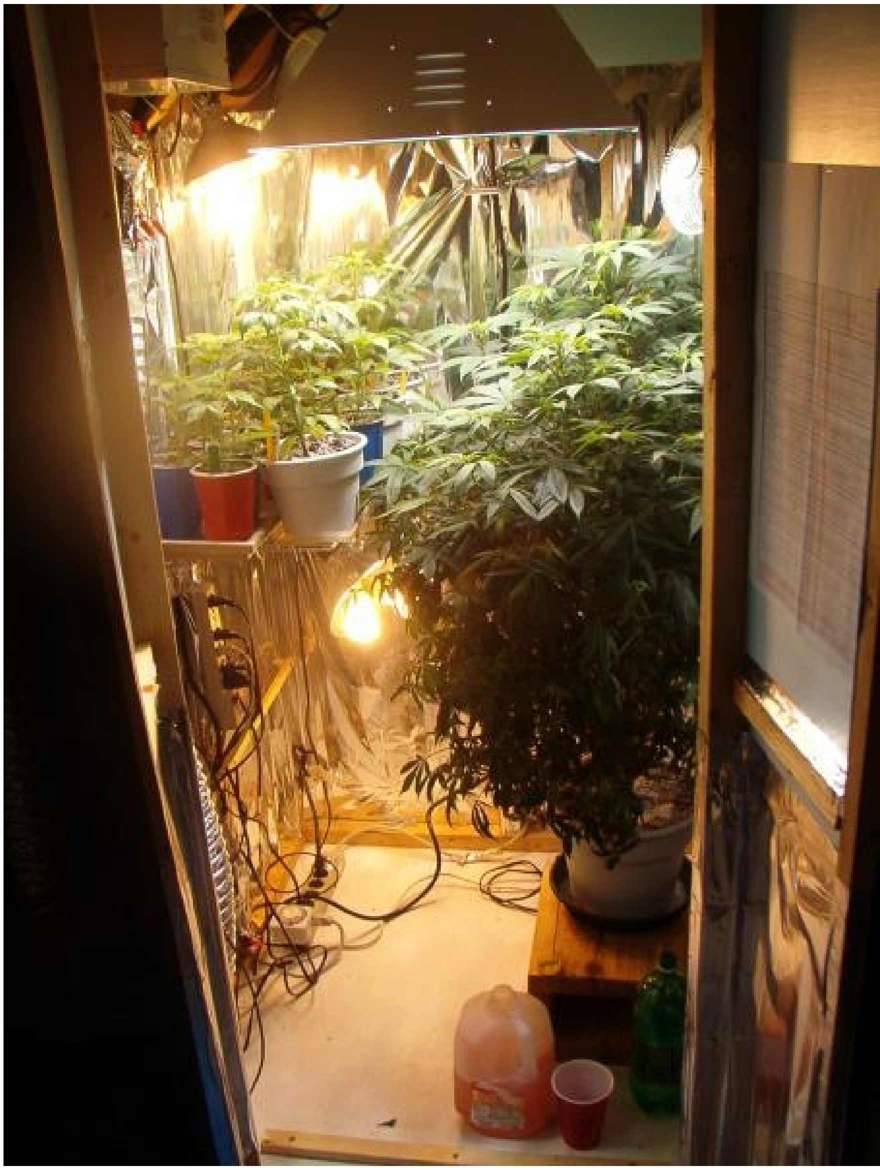
Backward Incline (BI)
The tips of the blades are inclined away from the direction of rotation. Used in commercial/industrial, heavy-duty heating/cooling systems that require heavy-duty construction, non-overloading characteristics and stable air delivery. These blowers operate at higher efficiencies than forward curved blowers. Not as quiet as forward curve blowers because they operate at higher speeds. Can be used in systems up to 3" static pressure. Smaller diameter wheels are supplied with flat blades; larger diameter wheels are supplied with air foil blades to improve efficiency.

Radial Blade
Has straight blades that are, to a large extent, self-cleaning, making them suitable for various kinds of material handling and particle-and-grease-laden air. Wheels are of simple construction and have relatively narrow blades. They can withstand the high speeds required to operate at higher static pressures (up to 12") but usually are noisier than FC or BI blowers.

Inline (Square Centrifugal Fan)
Air flow is developed as in a centrifugal blower, but after leaving the impeller the air is contained in a square housing and, by means of turning vanes, is discharged in an axial direction. Employs single-inlet centrifugal wheels, usually with backward inclined blades. The square centrifugal fan has performance characteristics similar to a centrifugal blower and the compact physical configuration of the tubeaxial fan. Can be vertically or horizontally mounted, thus providing a simpler installation by minimizing need for duct turns and transitions.

Figure 1. Fan Sizing Guide

In a small closet where there are only a few plants you can probably create enough air circulation just by opening the door to look at them. Although it is possible to grow healthy looking plants in poorly ventilated rooms, they would be larger and healthier if they had a fresh supply of air coming in. If you spend a lot of time in your growing room, your plants will grow better because they will be using the carbon dioxide that you are exhaling around them. It is sometimes quite difficult to get a fresh supply of air in to your growing room because your room is usually hidden away in a secret corner of your house, possibly in the attic or basement. In this case, a fan will create some movement of air. It will also stimulate your plants into growing a healthier and sturdier stalk. Often times in an indoor environment, the stems of plants fail to become rigid because they don't have to cope with elements of wind and rain. To a degree, though, this is an advantage because the plant puts most of its energy into producing leaves and resin instead of stems.



Temperature

Correct temperature is extremely important. Carelessness when monitoring and maintaining temperature levels can cost you ounces of bud. Ideally place a thermometer near your plants (on the containers) and one on the wall of your grow room. Night temperatures should be kept properly to prevent stress. It is preferable during flowering to have a night temperature drop to stimulate flowering hormones and reduce stem elongation. Remember that you always measure the temperature in the shade, and not in direct light.

Temperatures should be between 70-80°F (21-26.6°C) when the light is on. When the light is off the temperature can drop to the low 60's°F (15°C) and have no negative effect on the plant. The temperature should never go below 60°F (15°C) or above 90°F (32.2°C) (even for short periods) or growth will slow down. If these extremes are exceeded the plant may be permanently damaged or killed. Your goal is to try and keep your grow area temperature around 70-80°F (21-26.6°C), as this is the ideal growing temperature that marijuana plants thrive in.

Either too hot or too cold and your plant's growth will be stunted. If it is too cold then crank up the heating, if it is too hot then open a window and use the above mentioned methods such as fans/ventilation systems to cycle in fresh new air.

Keep daytime temps below 85°F (29.4°C), ideally about 75°F (23.8°C). Nighttime temperature should drop a little to about 68-72°F (20-22.2°C). If larger temperature drops are a problem, run your vent fan all night or intermittently throughout the night to expel moist air. If you don't have to run your vent fan all night, don't allow it to come on until about ½ hour after the light so that the plants can absorb all the CO_2 they released at night. This will accelerate growth a bit.

In some situations, a heater or air conditioner may be required to keep temperature levels in check.

Raising temperatures will cause faster photosynthetic processes(to a point). However, temps above 72°F (22.2°C) will also cause the unwanted stretch, which significantly lowers productivity later down the track. If you are growing a seedling for the purpose of checking the sex, it will however be a good thing to keep the temperature up a bit. But make sure you do not burn the plants in the process (and you probably will if you go over 82°F (28°C)). It is preferable during flowering to have a night temperature drop of 10-20°F (-12.2 to -6.6°C) to stimulate flowering hormones and reduce stem elongation.

Humidity

Low humidity causes stress on plants. Keep humidity levels at 50-60% humidity until the final 2 weeks of flowering. At this point, the humidity should be lowered as much as possible to encourage the plant to seal and protect itself with additional resin (some growers are able to get the humidity to go as low as 32%). Utilizing this method you can be sure to frost your buds up considerably this way. The higher humidity levels prior to final ripening reduce salt levels within the plant tissue and encourage healthy, more lush growth.

If the temperature in your grow room raises too much, the humidity will increase and the plants are susceptible to mold. The lower the temperature the less moisture the air can hold. When temperature drops, humidity rises. It really is that simple. Low humidity cause stress on plants. Low humidity causes stress on plants. Humidity should be between 40-60 percent relative humidity(rH). Humidity is simply the amount of water in the air. This is the range that marijuana grows best in. Use a hygrometer to measure humidity if you think your grow area is out of range. A humidifier can increase humidity and a dehumidifier can be used to lower *humidity*. You can also use fresh air to regulate humidity levels as well. To measure humidity you will want to use a Hygrometer (an extremely important essential instrument for your grow room). This will save you plenty of money and frustration from fungi destroying your plants. Some hygrometers have built in thermometers to measure the temperature.

Ideally you will want rH (relative humidity) to be kept at ~50% during flowering and at approximately 60-65% during vegetative growth.

Increasing Humidity: To increase the humidity in the air, simply spray the air with a spray bottle, or you can let a bucket of water evaporate in the room (place it near your lights). One of the survival adaptations the cannabis plant has when grown in a dry climate is that it will actually increase the resin all over the plant in order to keep it from drying out. This is why it is important to maintain proper atmospheric humidity levels in your grow room to ensure potent bud.

Decreasing Humidity: Humidity can be reduced in three ways.

- **Dehumidifier/AC:** this is the best option as it's completely controllable. The downside is that dehumidifer's create heat, use lots of electricity, and take up space.
- **Desiccants:** these are hygroscopic substances that absorb water. For your purposes, a desiccant will be absorbing the humidity in the air. Desiccants are a poor choice because they need to be replaced often and the rate of absorption is only a function of exposed surface area of the desiccant rendering the use of desiccants in the growroom largely uncontrollable. While desiccants are cheap initially, repeated usage and purchases will eventually become expensive. Silica gel, calcium sulfate, and montmorillonite clay are commonly used desiccants.
- **Air Movement/Ventilation:** Air movement is a great choice to reduce humidity especially if the relative humidity outside your grow room is low. If this is the case, adding active intake and exhaust (if you do not already have this) will reduce your humidity relatively cheaply and effectively. In addition, most growers must use ventilation irregardless of RH issues to control temperatures. The only downside to ventilation occurs in sealed environments where direct ventilation is not feasible because of the use of CO2 enrichment.

Measuring Humidity

To measure these levels, be sure to keep a hygrometer and a thermometer in the the drying area very close to the plants. A hygrometer allows you to keep tabs on the relative humidity level in the room and a thermometer will display the temperature. Some hygrometers have built in thermometers so you can measure both temperature and humidity at the same time.

Depending on the time of year and your current location, a heater or an air conditioner might be necessary to adjust the temperature. To control the humidity levels a dehumidifier can lower the humidity and a humidifier can be used to raise it. There are two types of humidifiers – warm mist and cool mist.

A warm mist humidifier raised the temperature while a cool mist humidifier doesn't affect the temperature at all. There are also humidifiers that allow you to switch between a warm or cool mist. If you're going to purchase a humidifier, be sure to take your climate into consideration and then go ahead and buy an appropriate humidifier to suit your individual needs.

Warm mist actually heats up the water and releases warm humidity. Cool mist water isn't cooled, it just means that water is not heated. In most cases a cool mist works best. If you're not sure and want to be safe then go ahead and grab a humidifier that lets you switch between warm and cool mist.

Your Grow Room Checklists

Be sure to print the following checklists out (and follow them) to ensure a successful, abundant, healthy harvest!

Daily Grow Room Checklist:

Light

[ ] Check all your lights, timers, and power. Make sure everything is working properly and safely.

[ ] Make sure your bulbs are burning bright and do not need to be changed out (every 4-6 months is best). Check to see if your bulbs and hoods are clean and clean them accordingly.

[ ] Check your light's distance from your plants so they are getting proper amounts of light but not getting burned.

[ ] Make sure all electrical cords are all plugged in completely.

Water

[ ] Check your hydroponic system (if using) to ensure the pumps are working and your plants are being fed. Check timers and powerheads.

[ ] Check the H_2O levels in the reservoirs. H_2O evaporates, not the nutrients. To maintain a consistent mix add only H_2O.

[ ] Completely change out water and nutrients every 2 weeks!

pH levels

[ ] Check pH levels in the reservoir/nutrient solution, making sure it is as close to 6.0 as possible.

[ ] Monitor the EC (or ppm in North America), aka the strength of your nutrient solution to make sure it is correct.

Temperature

[ ] Keep daytime temps at 75°F (23.8°C). Nighttime temperature should stay between about 68-72°F (20-22.2°C). Too cold or too hot can severely stunt growth, or even kill your plants! Keep these ranges will ensure your fastest, most abundant growth with the least problems. At night your temperature can ideally drop by 15°F (-15°C), and even up to 10°F (-12.2°C). BUT NO MORE THAN 10°F (-12.2°C), EVER! This will slow your growth greatly. So daytime keep the temperature 70-75°F (21-23.8°C), and at night 60-70°F (15.5-29°C).

Air

[ ] Airflow. Make sure all fans are working correctly and air is being pulled properly.

[ ] CO_2/other. Make sure your system is running properly at the proper environmental levels, regulate if needed.

[ ] Check any air fresheners/odor elimination systems.

Humidity
[   ] Too much humidity causes moldy bud rot! Keep it at 40-50%

Circulation
[   ] Make sure the plants are moving a little bit and getting a nice oscillating breeze.

Other
[   ] If growing in soil, rotate (turn) your plants each day. This will ensure they get maximum light exposure. Also check for dry pockets and water accordingly.
[   ] Check for pests and fungus or any other plant diseases/abnormalities and handle accordingly. Check the the leaves surface as well! Especially check for spider mites under your leaves. These will make little webs.
[   ] Cleanup your grow area! Remember, act as if you were manufacturing microchips in there.
[   ] Make sure everything is working.

Your Weekly Grow Room Checklist:

(Including everything you should be doing daily)

[ ] Make a supplies list so you never run out of important supplies.
[ ] Fill your reservoirs (filling may need to be done more than once a week).
[ ] Air Ventilation/Circulation.
[ ] Check soil for dry pockets, water as needed.
[ ] Rotate (turn) plants.
[ ] Check pH.
[ ] Check for fungi, nutrient deficiencies, and other plant problems (especially spider mites under leaves).
[ ] Check grow area for mold.
[ ] Clean!

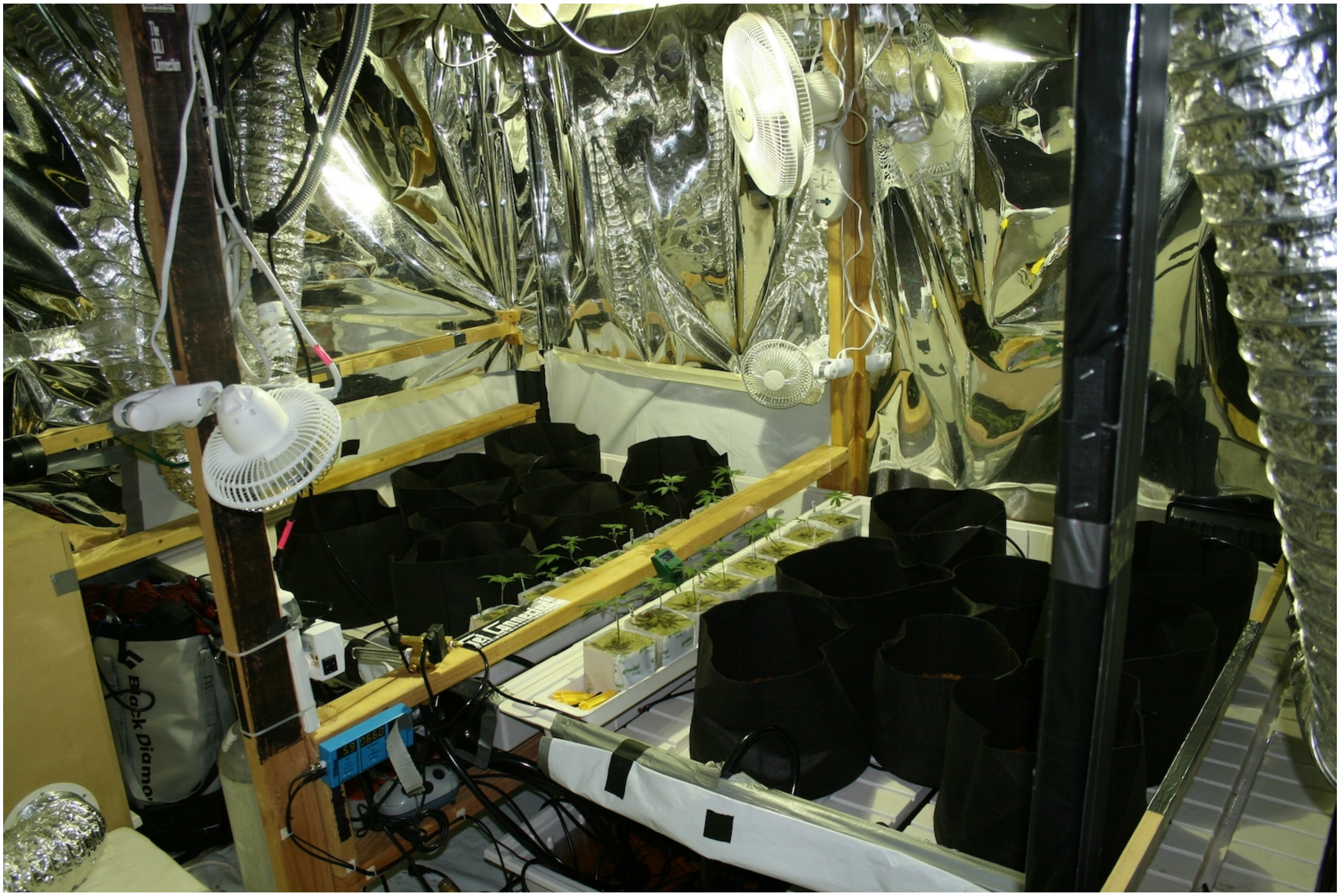
Your Monthly Grow Room Checklist:

(Once a month schedule a thorough cleaning. This is the time when you should clean up and sterilize your equipment and grow room.)

[ ] Vacuum
[ ] Organize and clean your room, pick up any loose tools or anything else
[ ] Clean your trays, pots, etc to avoid nutrient buildup
[ ] Change reservoir formula
[ ] Flush your moms with a gallon of plain water
[ ] Dust light covers

Advanced Grow Setups

So now that you have a good handle on the critical foundational elements required when growing marijuana I would now like to show some “advanced” grow setups I have discovered for improving your plant's yield and quality.



In order to achieve this, our primary objective is to implement advanced growing methods that allow us to grow really really big top colas (a cola is a group of buds). The basis of this theory is that the bottom branches of an indoor cannabis plant do not absorb much light from the HID, & they're also a crappy smoke primarily due to them being fan leaves. So with the methods below this allows us to focus on maximizing the growth of the top part of the plant. The top cola is the part of the plant that produces the most bud, so here we are going to use the following methods to get that part of the plant to grow really big.

How far you take the below methods are completely up to you. We have seen some growers fill entire grow rooms with these advanced growing methods outlined below. Build your own garden to satisfy your heart's desire and to accomplish all your marijuana growing goals and dreams.

Sea of Green (SOG)

Sea of Green (SOG), originally developed in Holland, is the method of harvesting lots of small plants, matured early to get the fastest production of buds available. It is a technique whereby you grow a far greater number of smaller plants rather than a small number of large plants. Usually clones are used for uniform growth characteristics and each plant is trimmed so that only the main stalk grows. The sea of green method was developed to maximize the speed of cannabis growing in limited height situations. In a typical sea of green setup of this type, clones are planted at densities as high as 9 per sq. ft. Instead of growing a few plants for a longer period of time in the same space, many smaller plants are grown that mature faster and in less time. Thus, less time is required between crops.

Figure 1. The Large Top Cola – a SOG Grower's Goal.

One crop can be started while another is maturing, and a continuous harvest year round can be maintained. 4 plants per square foot will be a good start for seedlings. 1 plant per square foot will allow plenty of room for each plant to grow a large top cola, but will not allow for much bottom branching. This is OK since indoors these bottom branches are always shaded anyway, and will not grow very well unless given additional light and space. The indoor grower quickly realizes that plants that are too tall do not produce enough at the bottom to make the extra growing time used worthwhile. An exception to this rule would be if it is intended the plants are to go outside at some point, and it is expected that the light or shading issue will not be a factor at that point.

The plants, if started at the same time, should create what is called a "green canopy" that traps most of the light at the top level of the plants. Little light will penetrate below this level, since the plants are so close together. The gardener is attempting to concentrate on the top of the plant, and use the light and space to the best advantage in as little time as possible. Use of nylon poultry fence or similar trellising laid out over the green canopy will support the plants as they start to droop under the weight of heavy fruiting tops. Stakes can be used too, but are not as easy to install for plants in the middle and back of the room, where reach is more difficult. It's easy to want big plants, since they will produce more yield per plant, but it's usually better with limited space to grow smaller plants that mature faster and pack into much more smaller spaces.

Instead of fitting 4 large plants in that small room, you can fit 12 small ones on a shelf above 12 other small plants. These plants take only ~3 months to mature from germination to ripe buds, and harvesting takes place constantly, since there is both a vegetative and flowering area devoted to each, with harvests every 45-60 days. It's not the size of the plant, but the maturity and quality of the product that counts. Twice as many plants grown half as big will fill the grow space twice as fast, so harvests take place almost twice as often.

You'll need to get good at picking early flowering plants, and propagate only those that are of the best quality. 6" square containers will allow for 4 plants per square foot. You may also gauge by the size of your growing tray (for passive hydroponics).

Planted 4 per square foot, (for vegetative seedlings) a 12 sq. ft. closet will hold 48 seedlings on one shelf. For example you can use 4" rockwool cubes that fit into catboxes @ 12 cubes per box. You can get 5 boxes onto a 12 sq. ft. closet upper shelf, so that is 60 seedlings on one small shelf!

For flowering indoors, 1 plant per sq. ft. is a good rule of thumb for SOG. If less plants are grown in this size space, it will take them longer to fill the space, thus more electricity and time will be used to create the same amount of product. If more than one plant per square foot is attempted, the grower will soon find that plants crowded tend to be more stem than bud, and the total harvest may be reduced, so be cautious.

Also, "training" plants with twist-ties is a great way to get them to bush out a bit. Just take any type of plastic or paper twist tie and wrap it around the top of the plant, then pull it over until the top is bent over 90-180 degrees and then attach this to the main stem lower on the plant. Do this for one week and then release the plant from it's bond. The plant can be trained in this fashion to take less vertical space and to grow bushier, to fill the grow space and force lower limbs to grow upward and join the green canopy. This technique takes advantage of the fact that if the top is pulled over, it creates a hormonal condition in the plant that makes it bush out at all lower internodes. Sea of Green entails growing to harvest the main cola (top) of the plant. Bottom branches are trimmed to increase air flow under the "blanket" of growing tops. Use these cuttings for clones, as they are the easiest part of the plant to root. It's also the fastest part of the plant to regenerate after flowering has occurred.

What happens to the planted clone?

The clone could just sit there, stretch a bit under the light regime, and flower, producing a tiny little bud with a couple of seeds. But that rarely, if ever, happens. Instead the clone takes off in a rush of growth, forming a woody main stem and branches. If the plant is suitable for sea of green growing, it will stop short of the lights and flower. Most indica dominated plants stop short enough to be grown using this method. That process is at the heart of the sea of green method, as it results in the smallest possible plant flowering in the quickest possible time.

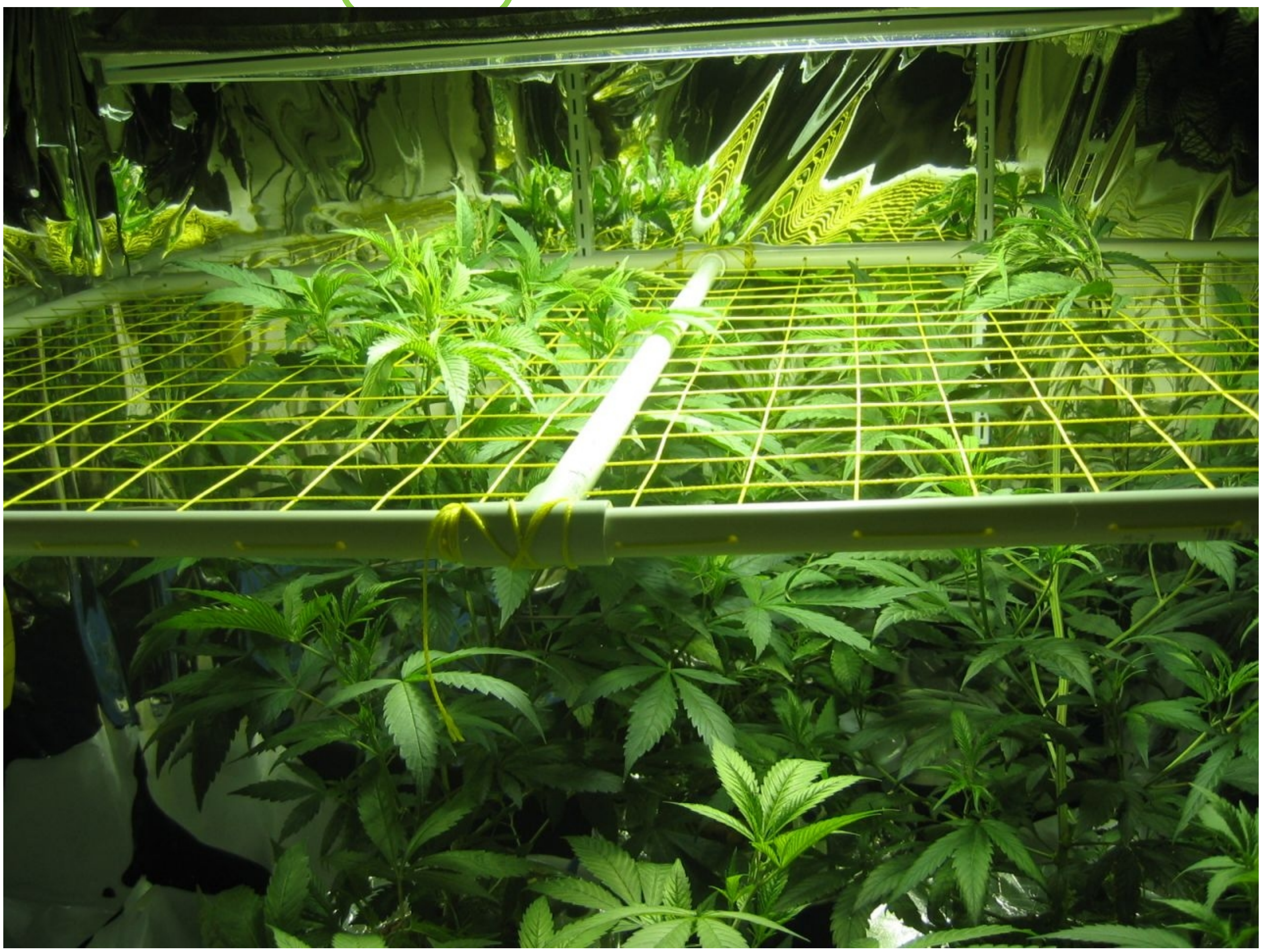
Note: SOG plants are really just "an apple on a stick," that is, the main cola, and perhaps a side bud or two, are cultivated.

This image is of a standard SOG grow:

Figure 1. Generic SOG Grow.

Conclusion: The Sea of Green method was developed to maximize the speed of cannabis growing in limited height situations. You won't get that much marijuana out of each plant. The SOG grow is one which presupposes mother selection, and is not suited for seed grows since height variations, and variation in general will be detrimental to yields. Ideal strains for SOG setups are top-cola-dominant strains that do not have heavy side branching and tend to dedicate most of their energy to a top shoot. Heavy branching will end up interfering with the neighboring plant, and ultimately, will effect and reduce your yield amount. In order to avoid this, you must use clones from a mother plant that has proven to produce uniform cuttings and whose growth pattern is optimal for a SOG environment. In other words, a SOG setup is not something you can pull off on your first time around with seeds. Select a mother carefully, and your SOG will do VERY WELL this way.

Screen of Green (SCROG)



ScrOG is like a SOG grow except that fewer plants are used in conjunction with a screen to fill the grow area with heavy top colas, hence its name; ScrOG or *Screen of Green*. The screen is simply a large wire mesh placed between your light and the plants. Again, clones from a female plant are used, but we allow at least one square foot per flowering plant in the ScrOG method. The plants aren't flowered until they have covered the entire mesh with green. As the plants grow up through the wire mesh they're trained and worked around the netting to form a very even canopy. The top colas and side branches are all trained under the screen.

You can use 2″ chicken wire or 2″ nylon poultry fencing for the screen. Placement of the screen depends on the size of the light you are using. The height placement can range from 8″ to 24″. The light needs to be hung by chains so it is adjustable.

The plants then are not flowered until they have covered the entire mesh with green. As the plants grow up through the wire mesh from their tray they are trained and strategically worked around the netting to form a very even canopy until they are 2 weeks into the Flowering cycle. The top colas and side branches are all trained below the mesh. This setup using HID lighting seriously pushes your buds to the limit. I have seen other growers grow top colas the size of large 1 Liter soda bottles!

After 2 weeks into the Flowering cycle, allow the tops to grow vertically through the mesh screen. As the tops grow vertically, make sure to push away the fan leaves down under the mesh. This allows light to reach the developing bud sites. If your leaf growth is dense, cut the finger in half making a shorter leaf and allowing light to reach the bud site. DO NOT FULLY CUT THE LEAVES, leaving half the leaf on the plant allows it to still absorb light and make energy for the plant to grow and flower at it's maximum potential. If you remove an entire fan leaf right away you can severely stunt your plant's growth. Now you should be at the exciting stage of growth when the flowers are forming and growing vertically, creating a canopy of bud above the screen, or in other words, a Screen of Green.

Now it's time for some maintenance. Head below the screen and remove all the lateral branches (hopefully not many!) and stray bud sites. The canopy should be so thick at this point that it blocks most, if not all, the light from reaching the lower growth. The lower growth is only leeching your plant's precious energy from the buds growing above (getting lots of light). The goal here is to get all the plant's grow energy concentrated on developing the flowers above the canopy for MASSIVE yields and MAXIMUM THC CONTENT.

There are other variations of Screen of Green and Sea of Green, but the above is the most commonly used, and is generally the backbone to all other variations.

A good Screen of Green grow will produce 2 ounces of bud per square foot of screen, possibly more! It takes the right kind of strain and environment to do this in though so don't be discouraged if your yields aren't close to this, if you have been following this guide you will be able to grow this much in no time! The #1 strain I recommend you use for Screen of Green is C99. There are other great ones too. Aim for a pure Indica or Indica dominant cross, this will grant you the most yield in a Sea of Green.

When a length of poultry netting is stretched over the grow area, it eliminates the need for conventional training. Tying, bending, and crimping are replaced by using the netting as anchors to keep shoots in position. It can also be perfectly shaped to make best use of the light. The netting is known as the screen, hence the name Screen Of Green.

Plants are topped to promote branching, as the plants grow into the screen and their shoot tips start to grow through the holes in the screen, they are pulled back under the screen and guided to the next hole to continue their horizontal growth. All the time maintaining the profile of the screen to maximize light use. Growth is very robust. While now getting the same light intensity as the primary shoot tips, secondary growth seems to blossom, and from the secondary growth comes tertiary growth, etc. All at the top of the canopy, and all receiving maximum light intensity. How many plants are used depends on how much time the grower wants to take to fill the screen to a point where it will be full with buds at harvest. This will largely depend on the growth traits of the variety he uses, but one can fill a canopy with only one plant if desired.

When flowered, only the slow growing buds are allowed to grow through the holes in the ScrOG. The resulting harvest profile is indeed a Sea Of Green but with much fewer plants and the increased yields gained from making use of the void spaces found in a conventionally trained, non-SOG canopy.

There are many variations of the above method, yet they all utilize the same principles. SOGs and ScrOGs were originally developed to get the most out of poor quality fluorescent lights. The grower would line the roof of the shelf or box with fluorescent tubes to try and get the most out of their grow. Today's growers, using good HID bulbs, have taken these setups to a new level: pushing their buds to the limit. Some people even grow top colas that are the size of large corncobs or soda bottles!

Here is an example setup; it is like a SOG growing, but a screen is used to train the plant to grow horizontally, creating a canopy of buds beneath the light. The screen is simply made from chicken wire or nylon poultry fencing, or you can use hooks and 20 lb. fishing line to make the net.

This picture shows another ScrOG variation:

The screen is installed at a fixed height above the plant medium. For Indica varieties the screen does not need to be much more than 8 inches above the pots. Indica Saliva hybrids need about 12 inches white Sativa plants tend to have longer internodes so you may have to use a screen that is about 18 inches above the pots. If your strain is a pure Sativa variety, like Haze or Thai, you may have to raise your screen to around 24 inches. This space allows the base of the plant a certain amount of vertical growth before branching occurs on the clone.

The clone should start to branch just under the screen but if it does not do not worry because you are going to be training them anyway. The light should be suspended by adjustable chains so that it can be raised if necessary.
ScrOG growing doesn't require as many plants as SOG (allow at least one square foot per flowering plant), but takes anywhere from one to three weeks longer per grow because we will be in the vegetative growth stage longer than

a SOG grow to allow the plants to fill out. The plants are trained to grow horizontally under the screen until they're two weeks into the flowering cycle, at which point you let the tops grow vertically through the screen. You should always train the main growing tops from the outside of the screen moving inwards so that the colas are focused as closely as possible on the light dispersed from the bulb. You will not be able to get all of them centered under the light, but you should aim for this shape. As the tops grow vertically, push the large fan leaves down under the screen, allowing the light to get to all the developing bud sites.

If leaf growth is excessive, you can first cut fan leaves in half making a shorter leaf and allowing light to get to the bud site. Leaving half the leaf on the plant still allows it to make energy for the plant to grow. Taking a whole fan leaf away in one go can stunt growth. In about a week, you can take off the rest of the leaf. Some people don't remove the leaf at all, but I do it to help with air movement, reduce the chance of mold or fungus and to allow more light to penetrate the bud sites. Just remember to remove a little at a time if you do remove leaf mass.

At this point flowers are forming and growing vertically, creating a carpet of bud above the screen. Now we go below the screen and remove all the lateral branches and stray bud sites. The canopy has thickened enough that light is blocked from reaching this lower growth. It’s only diverting your plants’ energy away from the buds. You can remove all branches that haven’t made it to the screen and the stray bud sites but you may experience stunting. Although you want the plant to concentrate all of it's grow energy on the developing flowers above the canopy, removing too much leaf mass and branching can prevent additional flowering.

The three main differences between a SOG and ScrOG grow are the number of plants grown, the use of a screen and the slightly longer grow cycle of the ScrOG. Both methods can be done under the same light and in soil or with hydroponics. There are many variations of the ScrOG grow including V-ScrOG, Stadium ScrOG, Flat ScrOG and Cylinder ScrOG but they are all based on the same principles. They work essentially the same way but use different shapes.

One of the best strains available for your ScrOG garden is C99. You will find that a pure Indica or Indica dominant cross will produce the best in a ScrOG grow. A good ScrOG grow will average two ounces of bud per square foot of screen, but you can't expect this the first few grows, because it takes proper timing and the correct strain to accomplish this.

ScrOG was originally designed for grow areas limited in height and lit by fluorescents. Today's growers are using HID lights for growing ScrOG. They've taken it to the next level with these lights and are generating far greater results. Today's grower is always trying something new to improve the production of their favorite plant. With experience, practice and experimentation, you too can create your own customized grow.

Notes on SOG and ScrOG Growing

Now that you have a firm grasp on what Sea of Green is and how to get a started, let's go into more final details...

Spacing: Spacing is the most controversial subject when it comes to SOG. It is also one of the most important factors in determining yield amount. It's quite tricky and there isn't one single rule to follow. Your SOG's spacing is ultimately determined by the clones you have selected for your grow. Specifically their growth pattern. If your clones grow straight up when flowering is initiated, concentrating all of their energy on a top cola, you can position your cuttings between 4 per sq. foot and 3 per sq. foot, and veg for between 4 days and 7 days. On the other hand if your clones happen to branch out a bit, or they demonstrate having an uneven growth pattern, then you should probably stick to a SCROG grow, but otherwise space your cuttings further apart, and veg for longer. But keep in mind this defeats the purpose of a SOG grow entirely.

Due to the plants being spaced so closely together, any heavy branching and large shade-producing leaves will interfere with the other plants light. Weak cuttings which do not grow as vigorously as others cause this by lagging below the canopy when the others take off after you switch the light back to 12/12. In order to prevent this all too common problem, you should take a few more cuttings than you need, and be sure to only use the most healthy, fastest rooting clones in your grow chamber.

Also any cuttings that are growing too fast should also be removed from the garden. This is because they will outgrow the others and cause the same exact problem. Once plants become blocked from the light, their growth will be stunted indefinitely.

Keep in mind choosing uniformly healthy clones is not the only factor. Some mother plants will produce clones that just don't grow uniformly. This has been reported before with c99 which is also a heavy brancher and thus not an ideal SOG plant at all (and not to mention the fact that her tops aren't as heavy as others).

Only a couple simple tricks to avoid overcrowding exist and they are not that effective at all. The only real way to prevent overcrowding is to grow a batch of clones you at medium density of 2 - 3 per square foot to judge how they perform(that is if you are not already experienced with cuttings from the same mother plant). That is why it is a good idea to keep more than one seed parent as a mother until you know which one has the superior cuttings. Sometimes seedlings that seem perfect for one type of setup go quite wrong in the cutting stage.

If overcrowding does occur, here are some helpful tips and tricks:

- Keep lower branching well trimmed from day 1 of vegetative growth until 3 weeks 12/12. It is important that you don't trim every day, rather every 5-7 days. This will allow the plant to fully recuperate. You can refrain from trimming any branches which are not interfering with a neighbour and are getting good light coverage. The top cola and the few short branches below it are all that should remain. This is approximately 1/2- 1/3 of the plant.

- Tuck and trim shade leaves that are obstructing neighbors and those juicy bud sites. Try not to go bananas on the trimming! If anything, try trimming only a few blades, or half of each blade. The leaves will still photosynthesize. Still, do not overdo it!
- Install enforced chickenwire like in a SCROG to keep plants from leaning on their neighbors. Bamboo poles work decently, but chicken wire will be much more effective. It will also allow for greater overall control of your garden's profile. You can start with bamboo poles until your plant's finish stretching, then apply the chicken wire accordingly.
- Install enforced chickenwire like in a SCROG to keep plants from leaning on their neighbors. Bamboo poles work decently, but chicken wire will be much more effective. It will also allow for greater overall control of your garden's profile. You can start with bamboo poles until your plant's finish stretching, then apply the chicken wire accordingly.
- Don't grow sativas in a SOG.
- If you insist on using seedlings for your SOG, keep your spacing to 1 psf.

Lighting: Even though MH and HPS lights can be used in conjunction with ScrOG and SOG grows, most ScrOG and SOG growers will use HPS because of the short vegetative period before flowering. Sometimes growers use smaller wattage HPS lights like the 250W and 400W series to keep the cost of electricity down and bud production within an acceptable range. In fact, ScrOG grows are so dense that smaller lights are sometimes more cost-effective than lights in the 600 to 1000W range, but again this depends on your strain and level of experience. If you get it right you can effectively direct 95% of available light onto your bud. The end result is like a canopy of pure bud with the light belting down on top of it all for 12 hours a day.

SCROG Advantages for Larger Lights:

- More even canopy.
- Can be trained into an bowl or V-shape to match the light falloff.
- More consistent bud size across your crop.

Disadvantages:

- Lots of work training a large screen every day.
- Need access to all corners of the garden.
- Must time the flowering switch correctly so that the screen is full and you have enough height above the screen to make full use of your light penetration.

Screen Control: Some ScrOG growers like to tie the center of the screen down to avoid it being pushed up by the center of the bud production, which should be the most vigorous since it is directly under the light. If the plants were to push the screen up it would affect the overall results because the light would not be able to reach all the bud areas. The pushing effect could also cause stems and branches to break.

Branch Development: You should not leave your plants growing in vegetative growth for too long because this causes more leaf matter to develop than bud which will make our SOG or ScrOG grow less effective. Also watch out that you do not crush or pinch the stems as this will cause branches to develop at those areas or close to them. Branch development means that plant energy is being used in leaf and branch promotion rather than bud production.

Weight: It is totally possible to reach around 2 oz. per ft. with a suitable plant and enough light density. 400 watt growers have reported up to 2.4 ounces per foot in a flat scrog. In a compressed grow, using shielded lights in a box of screen, I've read about growers who have gotten nearly 2.6 ounces per foot, measured by canopy area. I suspect that 75 watts per sq. ft. is about the minimum to reach that kind of production, but I don't know for sure. Understand, that the HID scrog method has not been around very long, and results are sketchy. Your results may vary, but certainly you will do better using scrog than small-scale sea of green at any light density.

Shape: You can experiment with different shapes of ScrOG to see how it affects your overall yield. Some ScrOG growers even advocate a dome shaped screen to match the curvature of light dispersal patterns, however, the differences between shapes in the final yields is not always significant and the overall effect is more exciting looking than anything else.

Plant Height: The worst thing you can do is to allow the plants to grow too long. You would think that excess growth could be cut out or moved to vertical screens, but in practice you'll find it's difficult to recover from a badly overgrown screen. Plants that grow into and fill the screen seem to put on better bud weight than overgrown plants that are tied down and whacked back to fit.

Pre-training for ScrOG

So you've decided to grow ScrOG? Well, get used to training your plant, you will spend a lot of time shaping and positioning for better light distribution. One of the main advantages of ScrOG, is when the main growth tip is redirected horizontally 90 degrees to the screen, it opens the main stock to more light, which generates growth tips, and increases vigour.

You can give your plant a head start by pre-training the main stock horizontally. This has two real benefits, the main stock is not affected by the installation of the screen (training your plant horizontally to 90 degrees, really helps when you have a real fat stock), and the growth tips start growing/stretching upwards so they are very close to, or are penetrating the screen when the screen is installed (normally the growth tips wouldn't start to stretch up until the initial main growth tip was trained horizontal to the screen, this causes you to veg more time under the screen to allow for the growth tips to penetrate).

All you need is a twisty tie, a container, a sharp pointy object, and some string. First take the string and at one end make a loop, leave the other end alone for now. Next, take your container and pop a hole at the top of the container, then slip the loop through the hole (So the loop would go through the hole towards the centre of the pot.) Next, at one end of the twisty tie, secure your stock where you want it to bend horizontally, at the other end twisty tie around the loop. Carefully take the string hanging out of the hole you made and pull on it, the plant should start to bend where you have it secured at the main stock. Pull the string till you have your desired angle then tie a knot that won't fit through the hole you poked in the container, and let go of the string.

Veg like this for 3-5 days; you should now have a pre-trained plant, ready to be installed into the screen with ease.

Note: Your plant may not be able to bend horizontally on the first train, so to prevent snapping the stem; train progressively.

SCROGGING in Soil or Hydroponics?

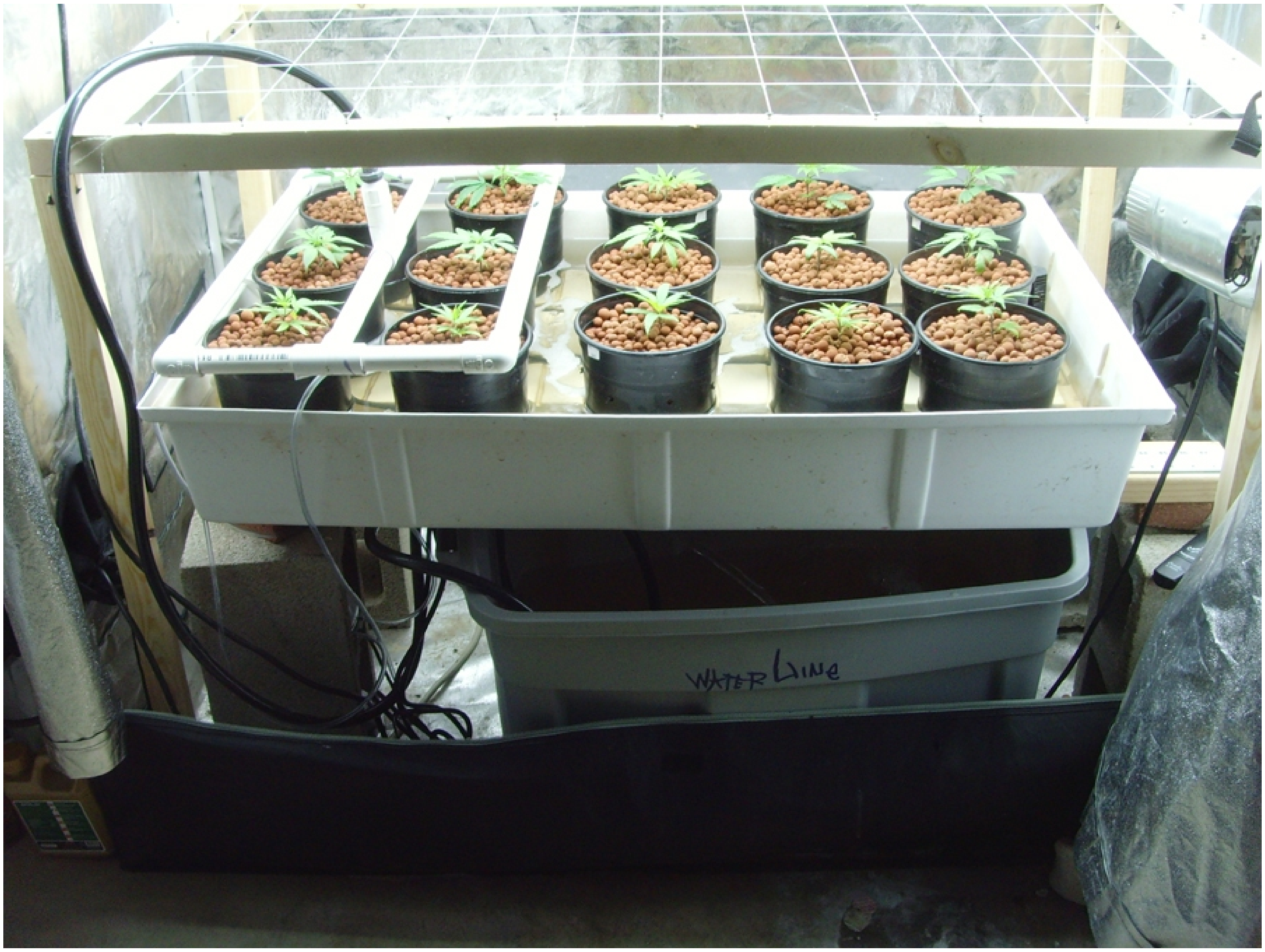
A successful ScrOG can be done using plants in pots as well as with more exotic hydroponic systems. But there are a few elements of ScrOG growing that tend to favor an active hydroponic setup.

Once you get past a small, flat scrog grow, it becomes very difficult to train a more complex grow by reaching into the cabinet space. Never design a ScrOG system without the capability of rolling or sliding out the plant container and screens as a single unit. Obviously that means that the screen should be connected to the plant container, or possibly to a common substrate, like a plywood base. The screen does not need to be sturdy, it's just a guide, so there are many ways this could be done. But obviously it is much easier to slide out an empty container than one full of water (as in DWC) or soil.

Active hydroponic systems allow freshly rooted clones to have direct access to very high levels of nutrients immediately. That may mean that active hydroponic ScrOGs will evolve quicker than soil or DWC grows.

Hydroponic Sea of Green Setup

An important thing to understand about creating a Sea of Green setup is that it can be any size, it's only the shape that must remain a constant. The highest yielding, easiest to maintain SOG garden is a simple slated Ebb&Flo tray.



The tray is simply a 4" deep plastic tray of varying sizes with 1" deep grooves on the bottom for root growth. There is also two holes on the far end which hold the tube from the water pump (which administers the nutrient solution from the reservoir), and the siphon valve which drains the water back into the reservoir once the water level reaches a certain mark during flood time.

Next, 4" rockwool cubes are placed on this tray, and a sheet of opaque plastic (you can find these at a hydroponics shop, it is black on one side and white on the other) is draped over top of the tray, so the cubes sit in total darkness.

When the cuttings have rooted in 1" cubes, they are transplanted into the 4" cubes by making X shaped cuts in the plastic You do this so that minimal light reaches the root area below the plastic, and roots can grow freely after they have outgrown the cubes. Remember that roots need moisture AND darkness to thrive and grow! Without the plastic covering, the roots are exposed to light, and all the moisture from the root area is allowed to escape into the air. Also, without light, algae and mold growth are reduced if not retarded completely. Keep these essential tips in mind for all your grows. Growth will drastically improve if there is darkness at root level.

Now the cuttings are then vegged until thriving growth resumes. Bamboo shafts are inserted into the rockwool cubes through a small cut in the plastic to support the large top colas. Be sure to do this early to avoid root damage when you jab the pole through the rockwool cube.

Flowering is induced while the plants are less than 10" tall so that, ideally, the plant finishes between 24" and 36" inches MAXIMUM, complete with a large top cola and minimal side branching. Golden.

The great thing about the clones is that since we took them from a mature mother female plant, the age carries over. This means that as soon as we begin the 12/12 lighting cycle they will immediately start to flower. I strongly recommend you trim all of the undergrowth from your girls within the first 3 weeks of 12/12. Trimming all the side branching about 1/3 to 1/2 way up the plant is best.

If all goes well according to plan and your mother selection was good, you will finish your Hydroponic SOG grow with an even canopy of buds that looks something like a corn field massive bud canopy(or in other words a Sea of Green ;), and yields up to 2 pounds per 1000W light!!(when growing conditions are optimal). Since you are only using clones in the setup, all you have to do is grow them out for the remainder of their Flowering phase. This allows you to have a massive bud quantity yield turnover every 2 months.

Equipment: Good quality Ebb and Flo systems are available from many different outlets, but don't even bother. They usually tend to be way too expensive and more complicated than they should be. For a 1000W Ebb&Flo system (ebb&flo system only, not lights, etc) you should pay no more than $400 USD. You can ind lots of ebb&Flo systems in the marketplace today for like $800 USD and most of them either just plain suck, or are not nearly as productive as the tray. This system is so simple!

Here is a list of all the equipment you will need:

- A simple Ebb and Flo tray (a plastic, black 5" deep unit of varying shapes and sizes. It should also have 1" deep slats that accommodate root growth as mentioned before).
- An appropriate-sized length of plastic tubing (this will act as your syphon valve).
- A water pump, and digital timer (to flood your table with).
- 1" and 4" Rockwool Cubes.
- A sheet of opaque plastic (described above).
- An airstone of appropriate size.
- A 12 gallon reservoir per 4'X4' table.

Running Your System: In order to operate your SOG system, simply transplant your cuttings after they root as per directed, set your digital timer to run your waterpump once a day (approximately ½ hour after the light comes on - once a day in 4" cubes is fine when they're young). The water should reach approximately 2/3 up the cube before the syphon valve begins to drain completely. Another two minutes of flood time should suffice, then the timer can turn off (about seven minutes total). When the cuttings begin to grow more vigorously, and have grown to 6" or more, the timer can be set to flood twice daily; the second time should be about three hours before the light goes off at night (during 12/12). Nutrient levels in the reservoir are increased from 1000EC to 1800EC from transplant to maturity stage, and the harvest will ultimately be AMAZING.

Strains suitable for SOG growing are:

- Afghan.
- California Orange (When untopped the CO puts most of it's energy into growing one large, main cola and does NOT branch out much at all.)

V-SCROG

V-SCROG is a version of ScrOG, where you place the screen vertically instead of horizontally. The principle is however the same in V-SCROG as in ScrOG.

One problem with V-SCROG is top dominance. Top dominance is that buds located higher up will grow larger then buds located further down. This problem can however be solved by sideways-upwards training of the plant; spiral-training. If you train the plant to vertical the top dominance will have effect, so you have to be precise.

Vertical screens extend from the plant medium all the way up to the top of the growing space. The light is not in a reflector at the top of the space, but is suspended vertically in the middle of a tube of foliage. Note that the entire light field is used, not just from the bottom half of the lamp and what comes off the reflector. The foliage area is stunning. Imagine a 2 x 2 cabinet with a v-scrog screen held 4" from the walls, with a gap in the front screen for maintenance. Suppose the buds fill up about 3' of the vertical screen. We're talking 4 screens, each 4' in area (16" x 36"). Take off a couple of inches for corner overlap and a gap in the front for access, and that's nearly 14 sq. ft. of screen in the same space that supports 4' of flat screen. Even if the production per foot were half, and it would be less due to the loss of the 3D flat scrog field, you're still talking 3 ounces per foot!

Even if production isn't dramatically better than horizontal methods, v-scrog is a promising solution to growing in very restricted height conditions. It might be possible to grow a productive crop in as little as 2', maybe less. Since the light-to-foliage gap is horizontal, the only absolute vertical needs are for the plant container and a gap between the end of the downward-pointing bulb and the planting medium. Plant growth could be controlled by training it across the vertical screen, which could be any reasonable height.

Box of Green (BOG)

Lots of enthusiastic growers have been super excited about the ScrOG method and have created up all sorts of ways to expand production. One of the coolest most noteworthy common variation is known as the Box of Green (BOG) method.

Added to the horizontal screen are vertical screens around the perimeter. Either additional plants are used at the edges, or the ScrOG field plants are grown longer, but either way, the additional foliage is allowed to grow up the outside of the vertical screen, taking advantage of wasted air space above the field. It also allows plants at the edge of the field to get into the circle of intensity from the bulb.

Imagine the light field as a circle sitting tangent to a horizontal line. Imagine your plant as a point on the line outside of the circle. How can the plant get inside the circle? By going up. You might equate this method to an "arena" grow in this regard. This method allows all the screen area to be densely filled with bud sites.

There are two ways to fill the vertical BOG screens. The first is to use more plants, which are added to the edges of the grow. When the horizontal ScrOG field plants are forced to flower, the plants on the edge are allowed to grow vertically like sea of green plants, the resulting growth being trained to the vertical screens. If the growth is too tall for the screens, it can be laid down at an angle. The advantage of this type of BOG grow is reliability and speed, since the horizontal field is filled in exactly the same manner as in a normal scrog grow. The disadvantage is that the number of plants is increased to near plantlet-method Sea of Green levels.

The second method is use the same number of plants as in a standard scrog grow, or thereabouts, but to allow them to grow longer before forcing, around another two weeks of growth seems to be about right. This process is a bit tricky, but other growers are having success, and the method is superior in theory.

The quickest and most successful approach to train a bog grow is to lower the horizontal screen to within 6" of the soil and grow 2 plants per sq. ft. straight up to the vertical training screens. As it's a box driven by a 70-watt bulb, the height from the horizontal screen to the roof is only 12". The plants grow unhindered 18" from the soil up through a narrow band of the horizontal screen and onto the verticals until they touch the roof. Then they are laid down horizontally and trained in a spiral fashion around the vertical training screens (SBOG). The cabinet is small; spiral training is the only way to direct the shoots so it just happens.

The spiral training can go one of two ways. The entire plant can be bent over in one direction and trained along with the rest of the plants in a clockwise or counter-clockwise fashion around the vertical training screens. Or the plant can be trained as it naturally branched, trained in opposite directions along the vertical training screens.

Any method of growing should be analyzed not only for production over the space used, but also for production over time. Just for the sake of argument, let's suppose a plantlet-method sea of green method produces 1 ounce per ft., and the subject plant takes 60 days to complete its life cycle. That would be .017 oz. per ft./day.

Let's suppose a ScrOG grow takes two weeks longer, 74 days, and produces 1 1/2 oz. That would be .020 oz. per ft/day, advantage ScrOG. Let's suppose than an extended BOG grow takes two more weeks than a ScrOG grow, 88 days, and produces 2 oz. That would be .023 oz. per ft. day., advantage extended BOG. Note that it's possible to shorten the cycle by growing plants in a separate area for about three weeks and then adding them to the scrog setup. But most micro and mini growers don't have room for a separate growing area.

Hollow screen forms do not have to be in the shape of square-cornered boxes. I've seen online one grower using small HPS lights who shaped his screen into a deep bowl shape, with the light suspended in the middle. Some have utilized inverted V shapes. A single "correct" way to do this probably doesn't exist.

For those new to the scrog method: get a few fast, flat scrog grows under your belt first to get used to the process. But do add the vertical screens regardless, and capture whatever excess growth you can on the verticals, as there is no reason not to handle as much growth as you can.

Jungle of Green (JOG)

“Jogging”, also known as the Jungle of Green or JOG technique is a useful way to maximize the yield from your crop. It is very effective in a low or confined grow space.

With the JOG technique you will use wires shaped into "U"'s to hold down the stem into the desired positions as you gradually shape it around the perimeter of the pot. The goal is to make the plant entirely fill the pots space with top buds. No matter how much training you do a plant will have a genetic maximum bud capacity that can not be exceeded. Training will help you reach that potential.

(To find out more about training please review the Training portion of this eBook.)

Setting Up a ScrOG Cabinet

Some growers can grow in a 10' room under 1000 watt lights, but many can't devote that much space and effort to pot growing. For those interested in some real production (½ pound to a pound or more every crop) here's how to do it easily in 2-4' of wall space.

Your Space: Start with a wall. You need airflow through the cabinet, so an outside wall is best. You need to be able to get air into the cabinet, so if you can punch holes through the wall with a hole saw, all the better. You need to get air out of the cabinet as well, so if the eave / soffit line is accessible, that's a great place to dump air.

It helps if the cabinet is not the only thing on the wall. A wall of cabinets, with your cannabis factory just being one of the bunch, is perfect; hidden in plain sight. But a couple of cabinets standing by themselves will not look out of place in a garage or storage room, particularly if they are surrounded by tool racks and other normal clutter of a working space.

Each cabinet takes up 2' of wall space. Why 2' and not some other dimension? Because the engine of this factory will be the 250 watt HPS, and that is a light that can best handle a space about 2' square, 2 1/2' tops. Further, standard size storage containers, which are used for growing and for reservoirs in this system, fit right snuggly into a 2' interior space.

Cabinets and Utilities: The incoming power source should be on a GFCI circuit. If you wire up wall sockets around the cabinet, only the first one need be a GFCI. All the other power outlets can take off from the first GFCI circuit. Never gang up GFCI circuits. If you are using power cords, buy a GFCI stub cord and put it in the main line. Transformers, motors, submerged pumps, HID lights; a recipe for fire or shock.

Each cabinet system occupies a footprint of just about 2' square. A standard floor to ceiling height of most finished spaces is 8', which is just right for this setup. Plywood is great for the walls, as insulation is not necessary, and the thinner the walls, the more room for buds. You can design hollow spaces in the cabinet walls to carry electric power if you like. You might run a power supply wire into the hollow walls of the cabinets and install standard wall switches and outlets to supply power to the various systems.

You can supply electricity with cords snaked up through the floor or from a nearby wall plug, so long as the wire is sufficiently thick; at least the same gauge as the wall supply, and you will need at least a 15 amp circuit with little or nothing else on the line (like maybe a garage light).

The doors need to fit nearly airtight, but not perfect, as the fan blowing air out of the space creates a slight vacuum that sucks the door in. It would be better to create an overpressure in the space, but that complicates sealing the doors quite a bit, so the ventilation fans suck air out of the cabinets rather than blowing in. You can seal the door in your unit with foam weatherstripping, using strips of 1 x 2 boards to frame the opening and mounting the foam along the 1 x 2's. The board strips can be mounted on the interior walls so that the foam stands slightly "proud" of the outside of the cabinet, allowing the door to crush the foam slightly as a seal. The foam also effectively seals the light inside the cabinets. You can stand next to the cabinets in the pitch black darkness and see no light.

The Layout: Focus on a single cabinet, taking up 2' square of space, 8' tall. You'll need three separate compartments in the cabinet, each with its own door to allow working in one compartment without blowing a dark period in another. The top compartment is for flowering, and should be 4' tall. Why on top and not in the middle? The heat will be generated by a 250 watt HPS light in the top of the cabinet, and that heat needs to be removed. If the light was up against the floor of an upper cabinet, it could roast the roots of the plants above. Heat rises, so put the biggest heat source as high as possible.

Why should the flowering cabinet be 4' tall? Because if you follow these plans, the relationship between the height of the container, the stem length to the scrog canopy, the thickness of the ScrOG canopy, the distance between the lights and the canopy and the thickness of the light hood fits almost ideally in a 4' tall space. It would be difficult, in fact, to change the relationship between the elements of the scrog system with a 250 HPS light. 4' is not the minimum space required; you can get by with 44" in one cabinet be stealing an inch or two from the stem length and the light gap. But more than 4' is probably wasted.

Next is a mother compartment, to be lit by a single 70 watt HPS bulb. You can maintain 8 mothers under the one small bulb, more than adequate. The 70 HPS runs very cool, but even so, this mother space needs to be ventilated.

The height of the mother cabinet is negotiable. First subtract 4' for the flowering cabinet (no less than 44"). Then figure the space needed for the reservoir on the bottom. Include some air space above the reservoir for access to mechanicals. The leftover height goes to the mothers. They don't need much. Probably the minimum height would be 2' or so.

Cloning can also be handled in the mother compartment by installing a small shelf on the upper part of the wall; nice and warm up there, good for rooting. You could mount a 20 watt stick fluorescent above the cloning shelf. It'll work OK just with the side-lit HPS. Cloning only happens every two months, so the shelf could even be made to fold up against the wall when not in use, allowing more space underneath for another couple of Bonsai Mothers.

Finally, heat rises, so the lowest compartment holds the reservoir. An 11 gallon Rubbermaid storage container is the perfect size.

There you have it, an integrated system of mothers, clones and flowering plants, all in a 2' footprint. You can get about 2 ounces per foot of ScrOG canopy with a 250 HPS, so we're talking 1/2 pound per crop here on a good day.

But, let's take this a little further. The mothers only need to produce 4 clones per crop, and are obviously capable of making many more. So, how about another 2' cabinet next door? Two more 4' tall flowering cabinets could easily be supported by the mothers, and now you're talking 1 1/2 pounds per crop. That's 3 ounces per foot of floor space, mothers and reservoir included!

You can have a second cabinet, but three crops at once is more work than you probably care for, and the electric load of the lights and fans probably is excessive for a 15 watt circuit, so you're probably better off modifying the plans a bit and building three compartments. The bottom compartment holds a second reservoir and pump, which allows more time between topping off than if one reservoir was servicing the whole unit. The middle compartment is another 4' flowering cabinet, but note that it overlaps the mother cabinet next door and shares part of the wall of the upper flowering cabinet in the first stack.
Cut out a passage way in the shared wall, so that the two flowering cabinets

both share the same air system, a 200 CFM Dayton pancake mounted in the top of the upper flowering cabinet. To help the airflow along, mount two 100 CFM axial fans in the passage way. You can light proof the passage way by mounting a darkroom air grill, a special plastic baffle that allows air to pass through but blocks light. The damn things cost a fortune, but they work well. That allows you to flower in one cabinet while the second cabinet is working vegetatively. Usually the two cabinets are in flowering mode, and you'd remove the darkroom grill to assist airflow.

That leaves 2' on top of the second cabinet; guess what goes there? How about the ballasts for all the lights? This keeps the heat from the ballasts out of the plant spaces, and eases the load on the fans.

By using two flowering cabinets, you only grow about two ounces per square foot of floor space, including all reservoirs and mothers. I don't think most room growers include the mother area in their yield reports, so I bet this blueprint stacks up pretty well even against the 1000 watt crowd, except for the real pros getting 3-4 ounces per foot.

Ventilation: If you can punch holes right through the outside wall to bring fresh air into the space. You could drill two 3" holes with a hole saw in the bottom of the lower flowering cabinet, and install a short section of 3" PVC drain pipe through the wall. On the outside of the wall mount dryer vents with the air inlet pointed down, and a screen mounted to keep bugs out. You could then paint the PVC tube and the inside of the vents with flat black paint to limit reflected light.

On the inside, clamp fabric shop vacuum bags over the ends of the PVC tubes, which protrude into the cabinet a bit for that purpose. The vacuum bags keep the mites out.

Moving over to the first cabinet stack, the mother compartment is serviced the same way, but you could only use one 3" opening. Airflow from the lower flowering cabinet next door is sufficient as an inlet in the upper flowering cabinet, but add one 3" inlet for use in summer, when some additional cool air is needed.

Use 200 CFM Dayton squirrel cage fans both in the mother compartment and the upper flowering compartment. If you were designing a system with three flowering cabinets, I would use one in each. These fans are compact, easily mounted with integral tabs flat on a wall, and they are efficient and quiet. The big Dayton may be a bit of an overkill in the mother compartment, but it's easier on the mechanicals to use a large fan on now and then vs. a smaller fan huffing away all the time.

CO2? There is little room for the mechanicals, the scrog blanket will already get as thick as it can be, and the fans are on quite a bit with the hot lights in the enclosed space, and would blow out the CO2 regularly (every five minutes or so). So, I doubt it would be useful in this limited growing situation.

The outlet can also be a 3" PVC pipe punched through the wall. The inside will protrude into the cabinet as a place for the flexible dryer conduit to be clamped. The outside outlet is another dryer vent, with the flap pieces left in place to prevent insects and debris from floating in through the outlet tube. You can run the outlet right out through the eave line in the soffit, where it exhausts into the outdoors.

What if you don't have the luxury of being able to tap the outside air so easily? Well, you can draw air from a crawl space if there is one below the cabinet, by running 3" PVC tubing up inside the cabinets to the desired compartment. If you use Rubbermaid 11 gallon containers mounted sideways, there will be enough space in back to run several such conduits. The same holds true for the outgoing air. The fan can exhaust down a 3" PCV pipe into the crawl space, and flexible tubing can carry the air to the nearest available hidden outlet. You can't run air through tubes that are too long, or the fan won't be able to push the air needed.

Controls: The fans need to be wired up to thermostats as controls, a humidistat too, if you can afford it. When selecting a thermostat, I recommend you avoid cheap units and get something decent.

You'll want to mount the thermostats up high in the cabinet, where the buds will be growing, as that is the airspace that is critical. Generally a temperature of

70-75°F (21-23.8°C) is recommended.

All the lights and pumps can be controlled by cheap hardware store dial timers, which you'd plug into wall sockets you can build into the cabinet walls. Ballasts should be by themselves in a separate compartment. That means you'd have to run some power cords from the timers through the walls into to the ballast cabinet, but it wouldn't look too messy; there would already be cords coming from the ballasts to the light hoods.

The reservoir cabinet will have its own outlet and timer. You could run the pumps for both reservoirs and the air pump from a single timer.

Water: The bottom compartments should hold the reservoirs, and 11 gallon Rubbermaid storage containers work great. They will be in the dark, but it's not a bad idea to wrap them in black plastic to keep all light out, which prevents the growth of algae. Cut out a window to check for water level of course. The 8' compartment stack requires a pretty hefty pump, as there is quite a vertical distance for the water to climb.

1/2" drip system tubes work fine to deliver the water up into the cabinets, but you can also use hard-wired PVC plumbing bits and pieces, and there are adapters to mate the two. If you use PVC, go 3/4" to allow the water to mix with air on the drain leg.

The water needs to get from the plant containers back down into the reservoirs, and gravity handles that. There are myriads of ways to plumb the system. One method is to open drain holes cut into the floors of the compartments. You'd use Rubbermaid containers to grow in, and mount a cheap chrome sink drain in the bottom of the containers. The chrome drain piece will sit in the hole in the floor and drain into a large PVC adapter fitting that is plumbed into the drain system, all would be connected together and flowing back into the reservoir below. Add a good quality aquarium air pump connected to an airstone in each reservoir.

Every couple of weeks the reservoirs need to be drained, and while you're plumbing away here, add a fitting to the cabinet to connect a hose, plumbed into the pump outlet line. That way you can connect the hose, turn on the pump and allow it to drain the tank to the outside. The hardware store is an endless source of valves and connectors to fulfill any elaborate design you like, to get water in and out of the reservoirs.

Water is added to the reservoirs with a 1/2" drip tubing piece connected to a quick connect hose coupling. The drip tube piece pokes through a hole drilled in the container top (yes, another hole saw to buy). Filling up is clean and easy. Nutrient mixes are added from a jug with a piece of the same 1/2 drip tubing mated to the top.

Lighting System: The main lighting in this setup is a 250 watt HPS.

You can find a standard hood for sale at the local growstore just about 2' long, a perfect tight fit, covering the area completely with reflected light. There is no need to mount the hood on chains or anything like that. The vertical distance in scrog growing is fixed, so the hood can be screwed right into the top of the apartment – you can mount the hoods using wingnuts (in case of maintenance, etc).

The light could be mounted to run into the cabinet rather than side to side, but it's easier to maintain the plants if the container is in front of the cabinet, with the air and water supplies running up the back wall.

To allow the hoods to be removed for maintenance, connect the light socket to the ballast outlet cable with three-prong plugs and sockets. Unplug the light from the ballast cable, spin off the wingnuts holding the hoods to studs mounted in the ceiling of the compartment, and the whole light assembly will come out in one piece.

While the 250 HPS does a great job in this space, they tend to sit offset on one side of the hood, favoring the ScrOG canopy nearest the socket. To remedy this you can supplement your hoods with a 70 HPS light mounted on the other end.

Plant Containers and Medium: You don't have to grow this way, but it works, and it works as well as it needs to work. You will grow thick ScrOG canopies.

Use 11 gallon Rubbermaid containers to grow in. The Rubbermaid containers solve many problems. The drip system doesn't have to be water tight, because leaks are confined in the container. The ScrOG net can be attached to four poles attached to the corners of the container. The Rubbermaid container has a lip around the edge. Drill a hole in each corner, insert one of those plastic plant stakes in each corner, and run duct tape around the outside of the container to hold it all together. If the compartment needs maintenance, the drip system inlet can be disconnected (quick connectors again), and the whole plant mass, scrog net and all, can be lifted out of the cabinet in one move. If you connect the scrog netting (chicken wire) to the walls of the cabinet, well, you can't do that obviously.

Use rockwool, but it wont act as the primary nutrient carrier. Four plants adequately support the scrog canopy, each started in 4" cubes. The cubes sit on a slab, but the slab is first sliced in half, just a thin layer. The purpose of the slab is only to spread the roots out horizontally, as the grain of the slab runs 90 degrees to the cube.

The thinned slab sits on top of an open plastic grate, an eggcrate grill for a fluorescent light fixture is perfect. The plastic grate is set up off the floor of the container on blocks, allowing a 1-2" air chamber for the roots to grow into. The roots quickly grow through the cube into the slab, spread out and then grow through into the bottom of the container, pooling up into the indentations molded into the Rubbermaid bottom. It is the flow of water over the roots in the container bottom that primarily supply the root mat.

Accordingly, I don't recommend a drip system, but an open flow, using spaghetti tube connectors as emitters. I recommend five half hour cycles per day, three during the light period and two during the dark period. The rockwool gets saturated with water, but the solution drains through the wool very quickly, flowing down the drains back to the reservoirs. There is never any build up of salts in the wool to worry about, and the roots will be very happy.

Mothers are also grown in the same fashion, but skip the half slab. You can cram many mothers into the Rubbermaid tub, as they are never allowed to get very tall or big. In order to keep a mother small over an extended period of

time, it is necessary to avoid giving it a "haircut", as that would encourage it to become bushy and top-heavy. Instead, remove whole branches from near the bottom of the plant, oldest branches first. Eventually a mother will get tired and will start to fail due to the many prunings, but she can always be replaced with a clone.

Conclusion: I could discuss many other bits and pieces of the system, but hopefully this has been sufficient for you to get the basic idea. I don't think you can design any other system that will produce more weight of buds from 250 lights in this space. If you are new to this hobby and you want to go first class in a minimum of space, you can feel confident that your efforts will succeed in a big way if you duplicate this system. If you choose to do something different, at least I hope my experience will provide some ideas for your dream cabinet.

9

GROWING OUTDOORS

Growing Marijuana Outdoors

Growing marijuana outdoors can grant you MASSIVE yields (some plants can reach up to 20 feet tall!), but it can also be quite risky depending on your grow area. Natural sunlight and fresh air does wonders for cannabis plants. The male dies around the 12th week of growing and the female will live another additional 3 to 5 weeks. Females can weigh twice as much as males when they are fully mature.

The cool thing about cultivating cannabis outdoors is that you save tons of money on lighting - natural sunlight is available year round and is free! And outdoor plants do not require ventilation systems.

Outdoor growing can be risky because of thieves, pests, and other factors that can ruin your dreams. Tight security and privacy is essential to general outdoor growing success. If you're contemplating whether or not your climate is sufficient to grow good weed in, don't worry as long as it is a fairly warm climate that you could grow small fruits or vegetables in you should be alright.

There are two types of outdoor growing methods known as Outdoor Growing and Guerrilla Outdoor Growing. Outdoor Growing is when you grow on your own property. Guerrilla Growing is when you grow on someone elses' or public property. Guerrilla Growing has advantages if you don't want to get identified with marijuana growing on your property then it's a satisfactory option. Regular outdoor growing is the method used when you have your own plot of land to grow on.

Guerilla growing is when you grow on property that is not your own (usually somewhere out in the wild). When guerilla growing the most important thing is to have a cover story. Take along with you a bird watching book and binoculars, or a fishing pole and fishing license etc so if stopped by any nosy people asking what you are doing out there, you will be safe.

Note: If you were hoping to just plop your seeds in the soil and come back 3 months later then sorry to disappoint you but some maintenance is required in order to get outstanding yields from your crop.

Outdoor pot tends to be the strongest, since it gets more light. Growing outdoors means no light leak problems. No dark periods that keep you out of your grow room. No high electricity bills. Sunlight tends to reach more of the plant, that is, if you are growing marijuana in the *direct* sun. The bottom of the plant will be almost as developed as the top.

There are disadvantages to cultivating cannabis outdoors however; there are many factors that can kill your crop. Deer will try to eat them, and rodents too. Nasty bugs will inhabit them. The wind and rain can tear your little buds to shreds if they are exposed to strong storms. Due to these harsh external conditions many outdoor cultivators turn to a greenhouse, or choose to grow indoors.

This is why it is imperative you buy an outdoor marijuana seeds strain. Those specific cannabis seeds are breed especially for difficult outside weather conditions, optimum natural sunlight absorption, increased pest resistance, and much more bushy plants. It is important to start your outdoor garden with quality genetics, preferably high yielding cannabis seeds strain, pest and cold resistant if you plan to plant early in the season. Most reputable seedbanks carry marijuana seeds varieties for early spring outdoor growing.

Try a few different outdoor marijuana seeds varieties during the first year of your outdoor cultivation, compare growing properties and the yields of your cannabis seeds strains to find the one that suits you, your climate and location as well as security circumstances. If you are growing in your back yard avoid high Sativa marijuana seeds varieties that could grow higher than your fence.

For higher marijuana seeds germination rate, do not plant the cannabis seeds directly in soil. Germinate your seeds at home using the paper towel germination method. After the white roots can be seen coming out the marijuana seeds move them to small pots and grow the seedling indoors until they have 2 adult leaves. Replant outdoors, avoid indoor / outdoor temperature shock. More on this “starting indoors” method later.

Put up a fence and make sure it stays up. Visit your plot at least once every two weeks, and preferably more often if water needs demand.

You may want to keep outdoor plants in pots so they can be easily moved. A big hole will allow the pot to be place in it, thus reducing the height of the plant, if fence level is an issue. Many growers find pots have saved a crop that had to be moved for some unexpected reason (repairman, appraiser, fire, etc.).
It's a good idea to use soil if you don't have a green house, since hydroponics will be less reliable outside in the open air (due mostly to evaporation).

Light Exposure

When growing outdoors it is critical you plan BEFORE you plant. The first important major factor to take into consideration is the angle of the sun over the entire year aka the light exposure your plant's are getting.

In order to grow a successful bountiful outdoor harvest with the best plants you are going to need a minimum of 5 hours of mid-day sun. An easy way to do this is go out in the Spring to the area where you wish to plant and see what the angle of the sun is at different times throughout the day. As the seasons change the suns orbit will change slightly as the planet rotates. Go out in midday and follow the sun around in a 360 degree circle. Imagine its rotation being in this spot at different times of the year. It sounds complicated but it is really simple, just make sure your plants are in a good spot and no light is blocked from them from any possible angle the sun may take on during the year later.

Light exposure is all important when locating a site for a greenhouse or outdoor plot. A backyard grower will need to know where the sun shines for the longest period; privacy and other factors will enter in as well. Try to find an secluded spot that gets full winter sun from mid morning to mid afternoon, at least from 10-4, preferably 8-5. This will be really asking for a lot if you live north of 30 degrees latitude since days are short in winter. Since most gardeners will not want to use the greenhouse in the middle of the winter, you can still use winter sun as an indicator of good spring and fall lighting exposures. Usually the south side of a hill gets the most sun. Also, large areas open to the sun on the north side of the property will get good southern exposures. East and West exposures can be good if they get the full morning/afternoon sun and mid-day sun as well. Some books say the plants respond better to morning-only sun, verses afternoon-only sun, so if you have to choose between the two, morning sun may be better.

Another great tip is if your plants are near any kind of wall to paint it a flat white. This will help greatly with reflecting light onto your precious buds (this single tip alone is said to help increase yields by up to 10%!)

Frost

Frost occurs when air temperatures drop below 32°F (0°C) and ice crystals form on leaves, injuring, and sometimes killing, tender plants.

Clear, calm skies and falling afternoon temperatures are usually the perfect conditions for frost. If the temperatures are falling fast under clear, windy skies-especially when the wind is out of the northwest-it may indicate the approach of a mass of polar air and a hard freeze. A hard or killing frost is based on movements of large, cold air masses. The result is below-freezing temperatures that generally kill all but the most cold-tolerant plants.

Cloudy Skies: If the temperature is cool, but clouds are visible, your plants may be protected. During the day, the sun's radiant heat warms the earth. After the sun sets, the heat radiates upward, which lowers the temperatures at or near the ground. However, if the night sky has clouds, these clouds will trap the heat and keep the warmer temperatures lower, closer to your plants, preventing a frost.

Wind: Wind also influences frost. If the air is still and windless, the coldest air settles to the ground. The temperature at plant level may be freezing, even though at eye level it isn't. A gentle breeze, however, will prevent the cold air from settling and keep temperatures higher, protecting your plants. If the wind itself is below freezing, frost may be very damaging.

Moisture: Humidity and moisture are good things when talking frost. When moisture condenses out of humid air, it releases enough heat to sometimes save your plants. When the air is dry, the moisture in the soil will evaporate. Evaporation requires heat, which removes warmth that could save your vegetables.

Location: The location of your garden can have a tremendous influence on whether or not an early frost could wipe out your garden, but leave your neighbor's alone. As a general rule, the temperature drops 3-5°F (-16.1 to -15°C) with every 1,000-foot increase in altitude. The higher your garden the colder the average air temperature and the more likely your plants will be hit by an early freeze.

However, lower isn't always better. Cold air is heavier than warm air and tends to sink to the lowest areas, causing frost damage. The best location for an annual garden is on a gentle, south-facing slope that's well heated by late-afternoon sun and protected from blustery north winds. A garden surrounded by buildings or trees or one near a body of water is also less likely to become frost covered.

Soil: The type of soil your garden is growing in also affects the amount of moisture it holds. Deep, loose, heavy, fertile soil releases more moisture into the surrounding air than thin, sandy, or nutrient-poor soil. The more humid the air is, the higher the dew point will be, and the less likely that frost will form on those plants. Heavily mulched plants are more likely to become frosted since the mulch prevents moisture and heat from escaping out of the soil and warming the surrounding air.

Know your plants: The plant itself determines its likelihood of frost damage. Immature plants still sporting new growth into the fall are most susceptible-especially the new growth. Frost tolerance tends to be higher in plants with maroon or bronze leaves, because such leaves absorb and retain heat. Downy- or hairy-leaved plants also retain heat. Compact plants expose a smaller proportion of their leaves to cold and drying winds. By the same token, closely spaced plants protect each other.

If frost is on its way: If a frost is predicted, cover your plants, both to retain as much soil heat and moisture as possible and to protect them against strong winds, which can hasten drying and cooling. You can use newspapers, baskets, tarps, straw, and other materials to cover your plants. Cover the whole plant before sunset to trap any remaining heat. Be sure to anchor lightweight coverings to prevent them from blowing away.

Keep the soil moist by watering your plants the day a frost is predicted. Commercial fruit and vegetable growers leave sprinklers on all night to cover plants with water. As the water freezes, it releases heat, protecting the plants, even though they're covered by ice. To prevent damage, the sprinklers need to run continuously as long as temperatures remain below freezing.

Cold Temperature Effects On Plants & Vegetation

Frost Damage: Depends upon length of frost duration.

Light Freeze: 29-32°F (-2 to 0°C). Tender plants killed with little destructive effect on other vegetation.

Moderate Freeze: 25-28°F (-4 to -2°C). Wide destruction on most vegetation with heavy damage to fruit blossoms and tender semi-hardy plants.

Severe Freeze: 24°F (-4°C) and colder. Heavy damage to most plants.

Color Changes: Cold temperatures can cause your plant to turn purple/red.

Whens the best time to Grow?

Marijuana plants can grow anywhere corn can grow. All it needs is about three growing months – from seed to harvest. Two if started indoors! Many seasoned (no pun intended) growers agree, an ideal time to start growing your plants is the months of March and April/early May. The reason is your plants start to mature and flower around August & September, which is when daylight hours begin to decrease. If you live in the Northern Hemisphere be sure to ask growers around you when the last frost is. Anytime after the last frost is OK.

Definitely plant them after the last frost of the year. If the cold climate is a concern you could start them inside, and put them outside during the day, then bring them in at night. If you start a plant indoors you should do this anyway, because the plant needs to "harden off", or in other words get used to the elements. If you just toss an indoor plant outside it will suffer some shock. Giving it a few hours of outside a day will ease it into the outdoors.

Remember that starting your plants off indoors is probably the easiest way to begin. The plant's initial growth can be spurred by utilizing a CO2 enriched atmosphere and by using metal halides.

Starting Indoors

Do not plant your precious marijuana seeds directly in soil. Germinate the cannabis seeds at home and replant seedlings outdoors. One popular method of doing this is to start off by planting your seeds in small plastic pots indoors (or by using clones). Once the seedlings have been allowed to develop for a little bit, you then cut off the plastic bottoms and tape a small piece of shoebox or cardboard to the bottoms. Then go to your grow patch to transplant them. Start off by digging a little hole, remove the cardboard, and carefully set your plant in. This method is liked by many because you don't have to worry about germinating (since it is already taken care of indoors). You can also clone all females and do the above method to have all female outdoor plants.

Pretty rad, yeah?

Note: You can use a commercially-available transplant chemical in order to help them overcome the initial environmental shock.

Transporting vegetative starts to the growing area is a most tricky aspect of growing outdoors, but germinating your marijuana seeds in spot is out of the question. Usually, you will want to germinate the cannabis seeds at home, keep seedlings indoors, or outside in your garden, then transport them to the grow site once they are firmly established. It may be desirable to first detect and separate males from females so that no effort of transporting / transplanting / watering males is incurred. Male or female plants cannot be identified by looking at the cannabis seeds, so you have to wait for seedlings to show sex signs.

Another method is to use 3" rockwool cubes to start seedlings in, then put 20 of them in a litter pan, cover it with another pan, and transport this to the grow site. The cubes can be planted directly into soil.

Guerilla Growing

Guerrilla growing basically means farming outdoors, away from your own property, or in a remote location of your property where people seldom roam around. It is possible to find locations that for one reason or another are not easily accessible or are privately owned.

Security: When guerilla growing it is critical to make sure your cannabis plants are out of sight. Take a different route to get to them if they are not in a secure part of your property, and cover the trail to make it look as if there is no trail. Make cut backs in the trail, so that people on the main trail will tend to miss the cut-back to the grow area. Don't park on the main road, always find a place to park that will not arouse suspicion by people that pass on the road. Always have a good reason for being in the area and have the necessary items to make your claim believable.

When planting, try to plant under trees, next to bushes and keep only a few plants in any one spot. Train or top the plants to grow sideways, or do something to prevent the classic Christmas tree look of most plants left to grow untrained. Tying the top down to the ground will make the plants branches grow up toward the sun, and increase yield, given a long enough growing season.

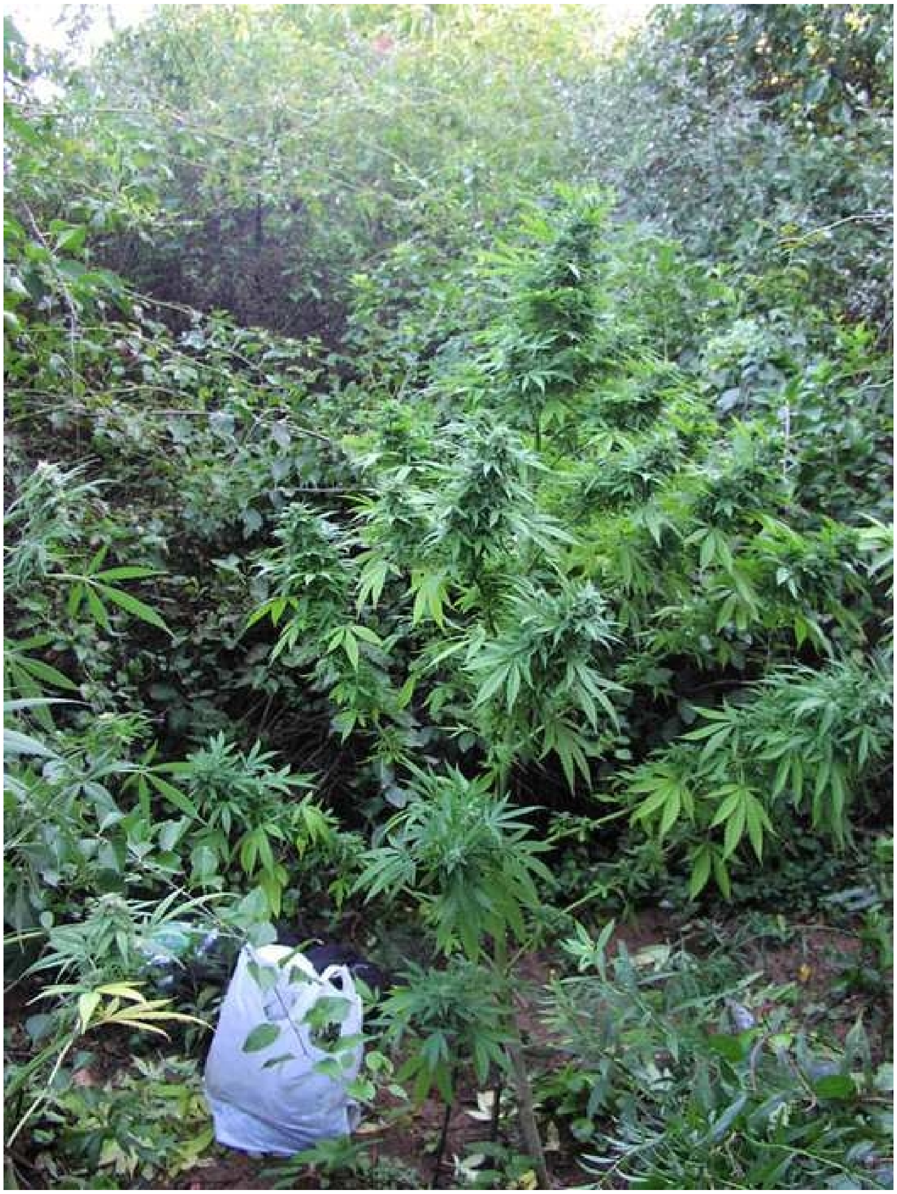
Plants can be grown under trees if the sun comes in at an angle and lights the area for several hours every day. Use shoes that you can dispose of later and cover your foot prints.

Fencing: Put up a fence, or the chipmunks, squirrels and deer will nibble on your crops until there is nothing left (mmm...cannabis). Green wire mesh and nylon chicken fencing net work great and can be wrapped around trees to create a strong barrier. Always check it and repair every visit you make to the garden. A barrier of fishing line, one at 18" and another at 3' will keep most deer away from your crop. The best fence in the world will not keep rats away from your plants! Put the poison grain in a feeder than only small rodents can enter, so that birds and deer can't eat it. Set out poison early, before actual planting. The rats must eat the grain for several days before it will have any effect on them. Ultimately, you may find it's easier to grow in a greenhouse shed in your own backyard rather than try to keep the rats from eating your outdoor plot.

Water: When growing away from the house, in the wild, water is the biggest determining factor, after security. The amount you can grow is directly proportional to the water available. If you must pack-in water, carry it in a backpack in case your seen in-route to your garden; you will appear to be merely a hiker, not a grower. Water must be close by, or close to the soil surface, or you will have to pack water in. Water is heavy and this is very hard work. Try to find an area close to a source of water if possible, and keep a bucket nearby to carry water to your plot.

A good idea is to find high water in the mountains, at altitude, and then route it down to a lower spot close by. It is possible to create water pressure in a hose this way, and route it to a drip system that feeds water to your plants continuously. Take a 5 gallon gas can, and punch small holes in it. Run a hose out of the main orifice and secure it somehow. Bury the can in a river or stream under rocks, so that it is hidden and submerged. Bury the hose coming out of it, and run it down hill to your garden area. A little engineering can save you a lot of work, and this rig can be used year after year.

Harvesting: When it's time to travel back to your home with your rewards, be sure to do it very early in the morning (preferably before the sun rises) in order to avoid unwanted attention.



Choosing A Grow Site

Before you can sow your marijuana seeds you must find a suitable location to grow your plants. The garden should be located in an area where people are unlikely to stumble across it.

Try to grow away from roads, trails, railroad tracks, power lines and any man made structures. Pricker bushes, mud, water and steep hills are all people deterrents. Growing near small pine trees also helps hide your plants in the fall when other plants are turning brown and marijuana remains green. Also, find out when and where hunters start to roam the woods in your area.

Light: A very important consideration when making your choice is sun exposure. The more direct sunlight the better (preferably a southern facing slope). North facing slopes are also a good choice. Marijuana likes a lot of sunlight. Your grow site should have at least three hours of direct sun every day. Marijuana will grow the fastest with around five hours of light every day. The less light the plant receives the slower the growth and smaller the yield. If there is less than three hours of direct light at the grow site then tin foil can be put around the plants to reflect more light on the leaves. If you are in a low light area this will make a big difference. Marijuana also seems to respond better to morning sunlight than afternoon sunlight. Keep this in mind when selecting a site.

Soil: Soil is obviously an important factor when determining a grow site. Marijuana likes a soil that drains well and has a pH of about 6.5. Marijuana soil should compact when you squeeze it and break apart easily when you poke it. Sand, perlite or vermiculite can be added to soils that drain poorly. The pH of the soil must also be kept around 6.5. If the pH is too extreme then the plant will not be able to absorb nutrients properly. Low pH also causes more males to develop. The pH can be raised by adding hydrated lime. The lime is slow acting so add it during the fall or at least one month before planting. pH can be lowered by adding sodium bicarbonate to the soil.

The level of the water table at the grow site is also important. If the water table is too high and the soil is too wet the roots will not receive enough oxygen and die. If the water table is too low then the soil will dry out quickly and you will have to water often. If the ground is too wet then the plants must be grown in pots. The larger the better. The pot should have a one inch layer of gravel for good drainage. The rest of the pot should be filled with potting soil.

Water Source: A nearby source of fresh clean water is also helpful. If no water is available in the area for watering then large buckets or barrels should be partially buried. These will collect enough rainwater for watering. If you have to bring water to the grow site then do it at night and water the following morning. Watering at night or late evening will increase the chance of developing a mold problem. Any equipment needed for watering or garden maintenance should be left hidden at the site.

Choosing a marijuana grow site near a water source saves the major hassle of having to haul water in by hand. A nearby water source allows irrigation (with pumps and hoses), making watering easy. A drawback is that people are also attracted to rivers, streams, etc and may be nearby. Having a water source near by is great, as it usually means the tap roots of the plant will penetrate deep enough though the last 1/2 or 1/3 of the season and will not require much, if any, supplemental watering.

Marijuana fertilizing will still be required periodically.

Pests: Wild animals love to eat young marijuana plants and if you don't want your plants to be food then you must keep them away. Human hair and blood works well. Hair from predator animals such as bears, foxes, lions and wolves also works well. If you would rather put up a fence then fishing line hung at eight inches and 3 feet off the ground will stop deer. When the plants are small a drinking glass can be placed over them to act as a humidity tent and to keep rodents and deer out.

Security: Do not grow marijuana outdoors on your own land(unless it is remote), so that you can show that someone could have easily trespassed on your property, and violated your land by planting marijuana. A few marijuana plants should be fine, but be careful. There is a constant threat of suspicious neighbors, hunters/hikers when growing weed.

Find a secure location where your marijuana plants won't be stolen by rippers/hunters/hikers. Avoid heavy traffic areas, popular hiking trails, and recreational roads.

At all costs, avoid making paths to your outdoor marijuana grow location. What seems invisible on the ground may be very apparent from the air.

Try a new path each time you enter or exit your marijuana site; walking along fallen logs, in dense areas and through streams, etc.

Heck, wear snowshoes.

Try to have several outdoor marijuana grow locations. Do not plant all your marijuana plants in one spot. If your cannabis plants do get eaten, ripped off, or destroyed it is nice to have marijuana plants in other locations to fall back on. These separate marijuana grow spots can be close (5-20 min hike away) or distant (completely different areas in driving distance). Planting inside a dense field of brush is very stealthy.

Camouflage: Pot plants tend to blend in with other plants to the point that they are unidentifiable by all except those actively looking for them (and even then it's still tough!). Plants started outdoors late in the season never get very big and never attract the least bit of attention when placed next to plants of similar or taller stature. Even tall plants grown among several trees will be almost invisible in their camouflage.

Outdoors the object is to control access to an area, and not to arouse suspicion. Tuck them here and there, never in a recognizable pattern. Space them out, and fit them in to the existing landscape such that they get full sun, but their hidden or blend in. Fence lines and groups of several together are best. Try to find strains that seem to match the surrounding plants.

Feed nitrogen to your plants if they need to be greener to blend in. Some growers even use plastic red flowers, pinned to a plant, disguising it as a flower bush. Visit the plants at night on full moons, and if your visible to neighbours, appear to be pruning a tree, mowing the lawn, or doing something in the yard that makes you invisible. Dig a hole and put a potted plant in it. The plant's height will be reduced by at least a foot. Some growers top the plant when it is 12" high, and grow the 2 tops horizontally along a trellis. The plant will never be over 3 feet tall, and never arouses suspicion from neighbours. This type of plant can even be grown in your yard in full view.

Fertility & Sun Exposure: Once you have chosen a secure location, check the area is fertile, with lots of green vegetation. Dark or black topsoil with lots of bugs/worms within the first few inches of soil is an indication of a healthy location. Be prepared to prepare the soil before planting. This would include hauling in marijuana fertilizers to improve the soil conditions. Use marijuana fertilizers throughout the marijuana growth cycle for optimum growth.

Valley bottoms tend to be ideal locations for marijuana plants because rich topsoil often washes downwards and accumulates. It can be challenging to find good sun exposure at the bottom of a valley. Valley bottoms are also the first areas to have frost in the fall.

Note: Scout a marijuana grow location during the summer and fall to prepare for planting the following spring. The site needs to have brush removed, and a suitably sized area needs to be cleared for cannabis planting. Preparing the holes the previous fall allows soil time to compost and grow beneficial bacteria. Add valuable compost and return in the spring to healthy enriched soil ready for marijuana plants.

Preparing Your Grow Spot

Once you have found a suitable safe location to grow your outdoor stalks of delicious greens, you must prepare your grow spot. First things first, make sure you remove as many weeds as you possibly can. The best method to remove those pesky weeds is by hand.

WARNING: Do not use generic weed killer!

Stay away from commercial weed killers. Some weed killers react very negatively to marijuana plants. If you are adamant on using a weed killer, then I suggest you test it on a clone first to make sure it doesn't hurt your plant's growth in ANY WAY. It is ideal to find one that reacts with cannabis plants in a favorable way, or if you can find a specific cannabis-friendly weed killer all the better. If you want to be safe, do all your weeding by hand.

Preparing Soil

Dig a big hole, don't depend on the plant to be able to penetrate the clay and rubble unless your sure of the quality of topsoil in the area. Grassy fields would have good top soil, but your back yard may not. This alone can make the difference between an average 5' tall plant, and a 10' monster by harvest time. Growing in the ground will always beat a pot, since the plant will never become root bound in the ground. Plants grown in the ground should grow much larger, but will need more space for each plant, so plan accordingly, you can't move them once they're in!

Preparing your soil and the spot you are going to plant in is very important. The first step is to dig a hole. About 1.5ft x 1.5ft deep is fine. Next, fill it with water and time how long it takes the mud to drain the water out.

If it...

- Drains in 10 minutes or less add coco, peat, compost etc to hold water.
- Drains in 10-30 minutes add peat, compost, coco etc to improve texture.
- Drains in 30-60 minutes add peat, compost, coco etc to improve texture.
- Drains in 60 minutes+ add sand, coco, perlite, to improve drainage.

Also be sure to remove any rocks or roots inside your hole as best you can. Now fill your hole with your mix. Your soil is incredibly important. Once you put it in that's that. It is the BASE of your entire garden. Mix a good soil and you will save yourself plenty of time, money, frustration, energy AND you will reap the benefits of MASSIVE yields and quality outdoor plants.

If using a clone, just simply drop your seedling in and surround the rockwool cube or other grow medium with your mix. You can add rougher objects like rocks on the surface around your leaves to act as a mulch. This will help retain water better. Fill up your mix up to your leaves.

A lot of growers like to add pre-made soil to their grow patch. This is fine, but make sure you only use a soil that has an N-P-K ratio containing higher levels of N (Nitrogen) than P (Phosphorus) or K (Potassium). Adding pre-made soil is a good idea. Even if you treat your patch it probably still contains seeds and spores of weeds and other wildlife that will leech your cannabis plant's nutrients, water, and most importantly – LIGHT. Make sure your plant has little-to ideally NO competition.

Note: A premium potting soil works fine for our purposes here. Stay away from soils with a lot of bark dust in them as these tend to be way too acidic. Also stay away from anything that is a heavy clay. A nice, light potting mix is what you are going for. Ideally you should mix your own though.

One secret trick used by growers that will tremendously help in increasing outdoor plant growth during the early stages is to spray the plants with carbonated water several times a day. DO NOT use club soda or anything like that as those products contain salt. Make your own with a home soda maker which used CO2 cartridges, or you can buy seltzer. These have zero salt added.

If the young plants are sprayed several times a day, it will speed up their growth considerably. You can continue this method to receive benefit throughout the plant's life cycle but it costs a lot of money.

If you are planting in a very dry climate, make sure to create a deep bowl shape so water is retained better.

Maintenance

First thing you will want to do on a regular basis is remove any of the leaves that aren't getting any sunlight as well as old leaves. Next shake off any excess water gathering on your buds.

Any time there is a heavy rain storm go out and shake your buds. This will prevent mold from forming.

Be sure to weed your outdoor grow area at least once a week after the initial weeding. Keep this up for the first 3 weeks, then only about once a month will be needed. But sometimes weeds here and there will pop up. Make it a habit each time you visit your plants to pull up a few weeds.

Planting Your Seeds

Before planting soak your seeds in distilled water overnight. There is no need to bury them too deep in Mother Earth, 1" is perfect. When you plant them, be sure to plant in the ground with the pointy end facing UP. Also note that the plants should be planted at LEAST three feet apart, do not get greedy and stack them too close. Stacking your plants too close will result in stunted growth.

A healthy seed will sprout in about five days. After planting your seeds sprinkle some water over them. That's all you need to do for now. There is no need to adjust the soil's pH level or feed your soil just yet. This is all that needs to be done to start your seedlings if you decide to take the root of planting them directly in soil. For another awesome method for starting off your outdoor cannabis plants right(indoors first), check the Guerilla Outdoor Growing section.

Watering Your Outdoor Plants

Most the water you will need will come from clean fresh rainwater. The plants enjoy some water during their growing season, but not too much or you can rot the root system. If no rain or any other natural source of water will get to your plants, then you will need to water and feed your plants when they need it. Be very careful during warm long summer dry spells, try to get water to your plants whenever you can. If your Guerilla Growing and have to travel over a long distance then you can get a backpack or duffle bag and fill it with water bottles.

Another option if you own your own property is to use a sprinkler system. Remember, the bigger your plant is, the more water it needs. Some large plants require a minimum of 1 gallon of water per day. Some factors to consider when watering your plants; sometimes deep pockets of water will be held inside the earth under your plants. The best method to determine if your plant needs water or not is by it's appearance. If it is wilting it needs water. If not, you're fine. Keep in mind some plants tend to wilt a little bit during hot summer months, not to worry as this is completely normal.

Note: When watering your guerilla grown plants a useful strategy is to take a large water bottle (about a gallon or two) and poke a hole in it. What you want is for the water to SLOWLY drip out. Then place it so it drips near your plant's soil, about 3 inches away.

In the hot summer water at least twice a week for the first two weeks. After that once a week checkups to see how it is doing is fine. If you get about 1 inch of rain a week you wont need to water at all.

Security

Keeping your cannabis plant safe is very important. There are several effective precautions we can implement to ensure a safe bountiful harvest.

(For complete detailed outdoor security and safety procedures please refer to the Marijuana Security Blackbook.)

Pests

You will encounter many outdoor pests that love to feast on cannabis and destroy your precious crops.

(Pest prevention and identification are provided in the Cannabis Care Manual.)

Tying Down Outdoor Plants

Tying down your outdoor plants offers many benefits. For one thing it vastly improves air exposure and sun, which reduce chances of mold and increase harvest yield weight.

The Benefits of Tying Down:

- Increases yield.
- More sun coverage.
- Greater air exposure(reduces chance of mold).
- Promotes branching(increases bud sites).
- Security

These are awesome benefits for such a simple practice. Tying down in the long run will distribute light to your plant/plants evenly(Instead of one side receiving morning light, and the other receiving the afternoon light). As you will observe - this will dramatically enhance growth.

The Procedure

The method is very simple and can be used whenever you want. It doesn't matter if you do it during vegetative growth or during flowering. It is dependent on the lower branches that you'll need to spread out. When tying the lower branches down you will get a better air circulation and that will reduce the chance for mold, also the yield will increase because the sun can penetrate the canopy better.

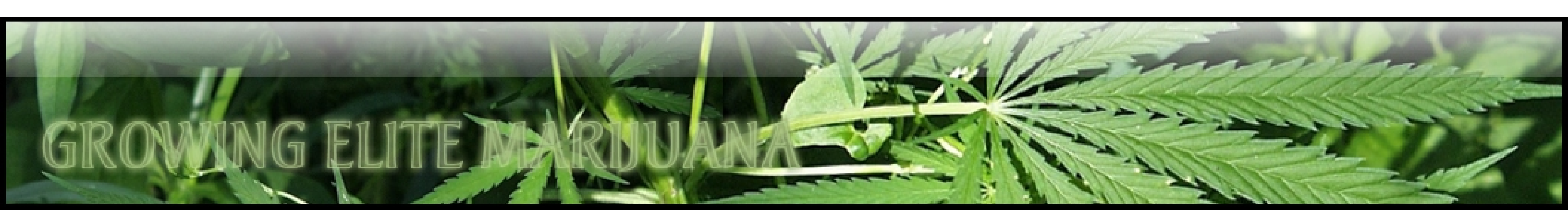
You can use strings or ropes or whatever you want to tie the branches. Don't tie them too hard because they could easily snap. Also, don't bend the branches all at once in one day, bend it more and more, day by day, this way the branch wont snap. After doing this you will notice a very large open area, Because all the lower branches have been spread open, don't worry, in a couple of days the improved sunlight penetration will fill it up again. Using this method, you will create a wider plant which will have several more productive bud sites and heavier branches than any plant that wasn't trained in this way. It's like ScrOG without topping the plant, but instead of doing it to a tiny indoor plant, you do it to a big tree. :)

Week 1: Start Lightly. Tie string or fish line approximately 1/3rd down from the top. Tie the other end of the line to an obstacle on the ground, making sure your plant isn't straining

After 5 Days: Inspect Growth. By now if your plant has received quality amounts of light, you will notice your leaves facing upwards (reaching for the sun). Your plants will try to receive as much sunlight as possible. Obviously it would have grown a certain amount as well; this is why you will need to attach more line to the middle of your plant, tying the rope down more than you did previously.

Several Weeks Later: Keep tying your plant down as necessary until branches start to pierce the canopy. Leave these branches to grow. When branches start to flower, you will have to be cautious. Branches that get too long will not be able to support the heavy bud it is producing. This is when you will have to start tying the branches either down, or pulling them up, depending on the circumstances.

Suggestions: Make sure you determine if your plant is female before you commence tying down! Figure out where the sun is casting its shadows before commencing. Remembering to tie down in the direction the sun is mostly cast upon through out the day.



First day(behind).

First day(front).

1 Week After(behind).

1 Week After(closeup).

2 Weeks After(bud sites showing).

Week 6(front).

Tying down has about the same effect as topping, although with much less stress on the plant. That said, tying down can be done during early flowering, but if you can you might want to do most of your tying during vegetative growth, and when you get to flowering, you can do some minor adjustments.

When you tie down, the growth hormones are relocated to lower branches, so you probably don't want to be doing too much to change the plant's focus during flowering. That said, I don't think it's going to change all that much, but in general, trying to keep your plants as unstressed as possible is always good for maximum bud size and quality.

Greenhouse Growing

A greenhouse is any structure with a covering (usually glass) which is used to control temperature and humidity in the cultivation and protection of plants. When you have a greenhouse, you effectively have your own little micro-environment that is totally in your control.

The Advantages of Greenhouse Growing

Greenhouse growing is like a "hybrid" between indoor and outdoor growing. There are many benefits to growing cannabis inside a decently-constructed greenhouse.

Temperature Control: The greenhouse design lets light in; and when this light is absorbed by objects inside the greenhouse and turns to heat energy, it is not permitted to escape. The air temperature in the greenhouse will exceed the outside temperature. If it gets too hot, all you have to do is open up some of the ventilation panels (or just open the door, depending on the design) and the temperature will drop. Greenhouses are able to regulate temperatures - temperature fluctuations can stress plants and slow growth.

Pest Control: As most greenhouses have a pretty good covering over all the structure, pests can't get in as easily as they could if your plants were just out in the open. This also applies to seeds and even pollen from unwanted plants (such as weeds).

Ability to control humidity: The air-tight covering on a greenhouse causes it to become quite hot and humid inside during the day time. The moisture evaporating from the soil, and the moisture given off by photosynthesizing plants (transpiration) fills the air. Once the air is very humid, it becomes harder for plants to lose water through evaporation, and likewise with the soil. This helps to keep everything from drying out on a hot sunny day. Therefore, it is essential to have air circulation to exhaust excessive humidity and regulate air exchange.

Stealth: Nosey neighbors will have their view obstructed by your greenhouse if you choose to use slightly shaded glass/plastic, which still lets enough light through for strong plant growth, but is opaque enough as to obscure vision from the outside.

Protects your plants from adverse weather conditions: Storms can't blow your plants over and tear them to shreds when they're safely inside your greenhouse! Also helps protect plants in areas where frosts are common. Excessive rain can cause powdery mildew and mold that can affect the final crop.

Other Advantages: Every plant is made up of cells. Every cell has hundreds of chemical reactions taking place inside it at every moment of the day. These reactions would be very slow, if it wasn't for enzymes. Enzymes act as catalysts for all the chemical reactions taking place in cells (including photosynthesis).

Enzymes work best in certain pH's and temperature ranges, depending on the type of enzyme. Too high or low pH, and the enzymes will work slower than normal, or might even denature (die). Too low a temp, and the enzymes will also not function to capacity, and too high results in them being denatured. Warm, but not hot temperatures, usually result in maximum enzyme efficiency (which means faster plant growth). Having perfect temperatures is like super-charging your plants!

Higher humidity helps slow the rate of evaporation from soil and plants, as the air already has a large amount of water suspended in it. Plants use water during photosynthesis; so they need a constant water supply during sunlight hours. Having to battle with high evaporation rates is something they don't want! By lowering this, it enables the plants to photosynthesize more without losing water to the point of their leaves wilting.

A greenhouse is a great idea for outdoor growers who live in cold climates, or areas where pests and security are major concerns. It also helps hide your crops from anyone who may be having a quick look over their fence. If you want maximum control of your outdoor grow, a greenhouse is an absolute essential part of your garden!

The Disadvantages of Greenhouse Growing

This is actually a trick section – there really aren't any disadvantages to greenhouse growing! Growing in a greenhouse is just like a regular outdoor grow, except you have much more control over it. The one thing I would say might be a bit disadvantaging would be the humidity. It may increase the risk of mold on your buds. This is easily fixed by opening the greenhouse up a bit and letting some more fresh air in. If you're paranoid about mold attacking your plants in a greenhouse, you can use Potassium Silicate to protect your plants, which is easily available at most gardening/hydroponic shops.

Greenhouse Construction

Greenhouses don't always have to be made out of glass. Many modern greenhouses are made of plastic, or specialized materials. These materials come in a variety of color, size and thickness. Choosing materials carefully will ensure you have the best greenhouse for your situation.

Greenhouses can be simple do-it-yourself jobs using some timber and a drill, or poly tunnels using poly tubing and some polythene sheets. They can also be large custom built structures, using metal and concrete. For most people, a small DIY greenhouse (about 10-20 square meters) will do just fine.

When growing in a green house it is important to conceal it. Disguise your greenhouse as a tool shed, or similar structure, by using only one wall and a roof of white opaqued plastic, PVC, Filon, or glass, and using a similar colored material for the rest of the shed, or painting it white or silvery, to look like metal. Try to make it appear as if it has always been there, with plants and trees that grow around it and mask it from view while allowing sun to reach it.

Note: Depending on the size, and construction of the greenhouse, you may or may not need permission from local authorities.

Filon (corrugated fiberglass) or PVC plastic sheets can be used outside to cover young plants grown together in a garden. You can buy the clear greenhouse sheets, and opaque them with white wash (made from lime) or epoxy resin tinted white or gray and painted on in a thin layer. This will pass more sun than white PVC or Filon, and still hide the plants. Epoxy resin coats will preserve the Filon for many more seasons than it would otherwise last. It will also allow you to disguise the shed as metal, if you paint the clear filon sheets with a thin layer of resin tinted light gray. Paint will work as well, but may not protect as much. Be careful to use only as much as needed, to reduce sun blockage to a minimum.

Final Words

With adequate sunlight, sufficient watering, pest protection, proper feeding, a secure grow area, and plenty of fresh air; your cannabis plants will grow through their entire life cycle beautifully with an abundant quality harvest. Once you reach the end of your plant's flowering season you will be ready to harvest your plant and enjoy it's tasty rewards.

(See the Harvesting section for more details on harvesting outdoor marijuana plants.)

10

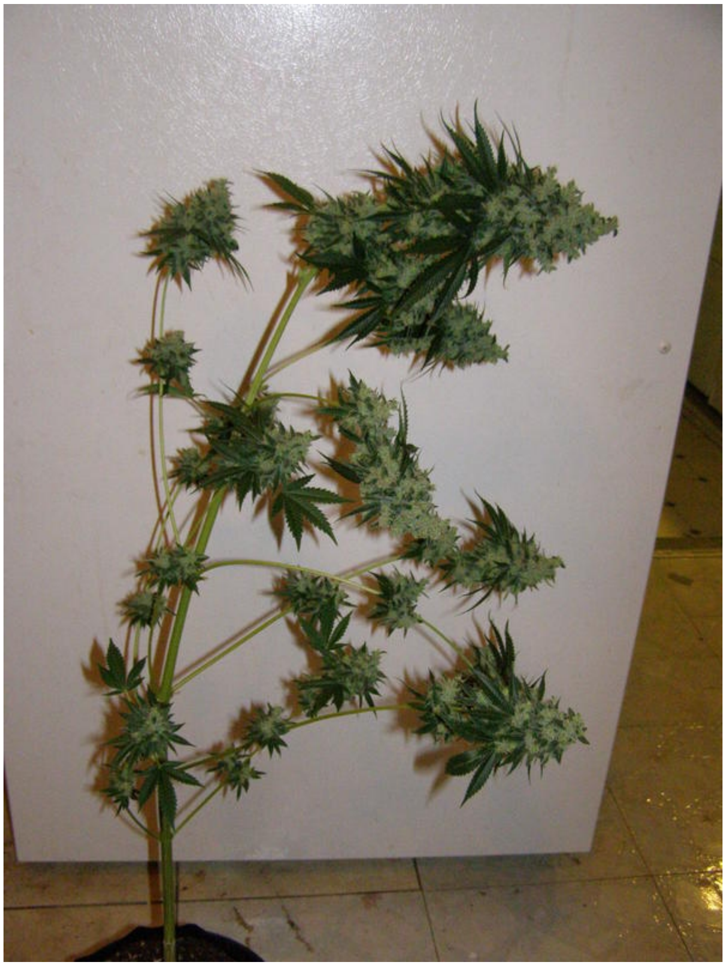
CANNABIS MAINTENANCE

Cannabis Plant Care

Growing marijuana isn't as simple as plopping a seed into a grow medium and sitting back and smiling. Proper maintaining of your crop is required through training, pruning, topping and more...

Plant Support

When your plants enter their flowering stage of growth, they will begin to get very top-heavy and may end up tipping over. Properly supporting them is important.



There are a couple things you can do. For one you can use bamboo support sticks. These are super cheap, durable, and do the job very effectively. Metal support sticks used for holding up large flowers work great too.

Get creative! Another method is PVC pipe:

Screen of Green(ScrOG) Works well in this regard as well. More on this technique later.

Plant Sickness, Stress, and Pests

(Please review the Cannabis Care Manual for information on how to properly prevent, identify, and cure any problems you may encounter with your plants.)

Training Cannabis

Over the years, many different techniques have been developed for training cannabis plants. The goal of training a marijuana plant is to optimize yield with the available light and space. Outside a plant in the middle of a clearing with a full year of vegetation can probably be left to do what it wants and give great yields. Indoors the light is more precious and and many growers are using small cabinets. Indoor growers must train their plants to utilize the space they have. Before getting started training there are couple things that any grower should be aware of. The first thing is that cannabis leaves are a lot like solar panels. You might be twisting and directing the branches but the plant knows better than you when and where it needs leaves, so leave them alone. If a gentle pull on the leaf doesn't cause it to give way immediately then it is healthy tissue.

Usually you will only want to removed browned leaves. With a thick canopy under indoor light the lower growth will yellow and die, this is because the plant isn't getting much light there and steals the nutrients from these now uneeded "solar panel" leaves. This is Mother Nature at work and not always a sign of too much or too few nutrients, as many newbie growers tend to wrongly think.

Another thing that is important to know is that the tops of the plant produce the most potent and largest flowers. Most training techniques focus on maximizing the number of these "top flowers". When removing smaller lower flowers the plant will direct all its energy to the larger tops. How much difference different training techniques make is debated but trimming lower growth that is far from the light is universally agreed to improve yield. Any time you bend a branch horizontally it will cause the plant to produce a hormone that encourages lateral growth.

When training plants you will occasionally snap a stem. It happens. Plants can usually recover from this. Just position the stem back together and tape it in place. Give the stem time to recover before applying more pressure to that spot. A small knot will develop at the break and in the end the plant stem will grow back healthier and stronger than before.

There are several cool techniques that one can use when growing cannabis...

Pruning

Why prune? When a cannabis plant is left to grow freely as it chooses, it usually has more branches than it has the energy to support. This means that a lot of energy is wasted on smaller branches, especially the lower ones. The energy need is so spread out that in extreme cases flowering takes a very long time as the plant tries to supply energy evenly to every location. By removing some of the less important and weaker branches, you can ensure that the larger branches produce a greater amount of high quality bud. The bud on the lower branches that receive less light usually end up as single "pop corn" buds that never truly mature, so it is best to remove them at an early stage.

Observe the growth and remove any branch that has long internodes(the space between the nodes) and any branch that stays significantly lower than the main shoots. These branches will get very little light and they will also have a hard time finding their way up to the well lit area. Many growers end up removing almost all the growth underneath the ScrOG net. They usually only leave the fan leaves intact until the plant drops them by itself after the energy has been recovered.

When it comes to removing leaves material opinions vary, some growers remove leaves and others, chose not to. There is no positive effect really from removing leaves. Keep in mind that fan leaves are the primary location for photosynthesis and that the plant also stores surplus energy in them. By removing the leaves you do double harm; you handicap the plants ability to produce vital energy and simultaneously you also remove the energy that has already been stored for future use. Furthermore, although it cannot be observed with the naked eye, light actually passes through the leaves and that is why some of the lower growth stay green throughout the entire grow. It is better to tuck or tie the leaves under the canopy so that light reaches more bud sites, or alternatively cut the leaves in half.

Another thing important thing you must understand is that there is a hormonal response in plants to being wounded. This includes a growth inhibitor called jasmonic acid. It tells the plant to favor defense over growth. The more you remove at any given time, the greater the response. It is therefore wise to trim the plants gradually all through flowering, instead of removing all the growth at once. This hormone also plays a part in regulating the formation of trichomes, and that is probably why a little bit of stress is thought to increase potency. There is however a difference between stress and torture, a healthy plant will always produce more bud than a plant that has been severely handicapped.

Since most of the photosynthetic activity takes place in the fan leaves, the buds themselves do not need light. In other words, bud sites are activated by light when it hits the node but the energy is produced and transported to the buds from the leaves. This is where a ScrOG net comes in handy; you can tie down the leaves without removing them and thereby allow more light to reach the buds while no energy is lost. Sometimes you do not have a choice and must remove some of the growth in order to ensure that you get a good harvest. It all depends, some plants respond well to rigorous pruning but in general I would advise that you keep it to a minimum(since there are optional methods to removing the leaves altogether). The rules of pruning are a bit different when it comes to SOG grows as you might have to remove some of the fan leaves because the plants are packed so close together.

The best advice is to watch your plants closely and adapt your technique and grow style according to the needs of the plant. Nothing is set in stone when it comes to growing. All grow rooms are different and so is each strain of cannabis. In fact every plant is different from the next so you will have to try out what works best for you and your plants.

In-Detail Pruning

So now that you have a general overview of pruning let's jump right into the finer intricacies of a proper cannabis prune. Pruning is probably one of the easiest, most effective ways to improve the quality and size of your harvest yield. When you prune your marijuana plants they produce fewer, but much bigger buds. Depending upon the genetics of your plants and your goals for harvest you should determine the type and style of the trim. A lot of hard work goes into pruning and stalking plants, but it results in bigger, higher grade buds that require less manicuring.

Some growers argue that pruning will stunt the plants growth and may even produce more males do to the stress of removing branches. However, pruning has shown itself to be a helpful technique in increasing yield and keeping plants short and out of sight. If you choose to prune use sharp, clean scissors to snip the branch. Where you cut the branch two new branches will grow from that point. Never take off more than six inches when pruning. If you follow the guidelines below you will ensure a safe, healthy prune for your plants that ensures nothing but benefit for your cannabis.

Before we begin, a few tips. Always use clean sterilized cutting tools for pruning. A pair or pruners, a razor, or scissors are excellent choices. It is always better to use a tool to prune your plants, than to simply pluck off the growing tips by hand. Sanitize your instrument in between cuts by dipping them in rubbing alcohol. During your pruning, the open wounds on your plant are VERY susceptible to diseases and pest infestations. Wash your hands before and after you prune every time.

WARNING: Do not use any tools that have been used outside for pruning indoors. Pruning instruments used outdoors have everything ranging from spider mites to fungus spores.

Do not prune up to a month before you trigger flowering. Pruning diffuses hormones, which interferes with and hinders the flowering process. Peak maturation is greatly delayed. It takes about one full month for hormones to build up again to their original pre-pruned levels.

You will want to keep an even top garden profile to ensure maximum light absorption. The size and shape of your plants can be changed by pruning and training. Not only will this optimize light exposure but it also maximizes side growth. Pruning is the process of trimming the stems back to change the plants shape. Here the grower will pinch the plants between his fingers. Training is the practice of bending the stems and tying them with twine in order to change their shape and growth pattern.

Also please keep in mind pruning depends solely on your plant's growth pattern and size. There are benefits to NOT pruning your plants. The hormones are allowed to concentrate in the tips of branches and leaves causing your buds to grow better. Most commercial growers do not prune at all when growing a short clone crop that at it's maximum height only reaches about 2-3 feet tall (61-91cm). The reason is because shorter clone crops don't need pruning for increased light exposure to bottom leaves or better air circulation. So if you're growing short crops, you most likely don't have to prune and your crop will benefit.

The bottom fan leaves of the plant are used to absorb and soak up light for your plants optimal flourishing growth. NEVER CUT YOUR FAN LEAVES!!!! Removing large fan or shade leaves doesn't make your plant more productive! They contain glucose and chlorophyll that is used in bud production. Cutting away fan leaves will greatly stress your plant and deplete it's food stores thus severely stunting your growth and bud size.

Note: The only time it may be acceptable to cut away a fan leaf is if it is blocking light from reaching a bud mass on another plant, or if the leaf is dying or burnt. Always throw away your dead leaves, never leave them near your soil or plants as they can attract pests.

Remember; keeping your sterilized cutting tools clean while pruning is *very* important. To easily do this just take a sharp razor blade and scrape off all the resin and excess. You may need to do this several times during one pruning session. After you are done scraping all the resin, take some alcohol and pour it on a paper towel. Then wipe down the instrument. This ensures clean, sterile, healthy precise cuts.

Lower Growth: The first most commonly used pruning technique is to remove lower spindly branches and growth that do not receive light, including burnt dead or dying leaves. A great benefit of pruning the lower branches is that it concentrates auxins into the upper branches which forces growth rapidly upwards. Doing this your plant will direct its energy into buds, producing quite a rich dense harvest for you to enjoy.

Clip any small buds and branches under the canopy, along with any less developed branches. The best way to make cuts when pruning is at a 45-degree angle. This will reduce any moisture that wants to sit and accumulate on plant wounds. Cut the lower branches off as clean as you can so no stub is left. Stubs rot and attract disease & pests. Buds under the canopy that are small do not mature well and leech energy from the upper buds.

Inside Pruning: Some more basic pruning methods include removing the spindly branches and growth inside your plants. This will allow for much better air circulation and light exposure for the deeper parts of your plant. Another technique is completely cutting off the top of the plant below the first set or two of branches. This will drive hormones to the lower branches and flowers.

Pruning The Tips: Another is to prune off the tip of plants, this will redirect hormones and cause the lower branches to grow more. Each and every time a growing tip is clipped, the stem branches into two shoots, which begin to grow from the nearest leaf axils. Pruning a growing marijuana plant is an easy way of controlling uneven growth without seriously harming the plant. Don't prune the growing tip of a young seedling until after the first five-bladed leaves have formed and the vegetative stage has begun.

Note: If you want to make your plant taller you can prune all the tips on all the branches.

Many growers prune the growing tips after four to five weeks growth to develop lower branches which will quickly fill all the horizontal space. The greatest potency of the growing plant is found in the growing tips, and by three months, they should make a high quality smoke. You can basically prune growing tips at any stage of the plant's development, but just make sure you don't overdo it. Severe pruning can harm the growth of the plant. It is always better to plan a pruning strategy for your developing plants rather than haphazardly clipping off growing tips on an irregular basis. Each time a growing tip is removed the plant takes a few days to recover before new growth resumes on that branch.

The amount of new growth formed with continued pruning is limited by the genetic structure of the seed and the environmental conditions. It is better to prune your plants at an early stage of their development, than towards the end of the vegetative stage or during flowering. It's always much better to prune growing tips in the morning than in the evening, as it gives the plant a full day to recover and heal the wounds.

It is not recommended that you prune every new node in a developing plant. Rather prune every second or third node to allow the plant time to recover. Wait for the new node to start growing before clipping the young branch a few millimeters above the previous node's newly formed leaves.

Do not prune any growing tips if you notice that your plant's health is declining and it has started losing leaves. This is a bad idea!

Although you could always smoke the pruned growing tips, plants should be pruned to develop their growth rather than for smoking purposes. Pruning all the branches or removing more than 25% of the foliage in a short amount of time greatly stresses your plants and will hamper your harvest.

While it may be tempting to prune female buds during early flowering, your harvest will be severely hindered by doing so. Cannabis Indica is a genetically smaller and more bushy plant than Cannabis Sativa and usually requires less pruning. *Never* prune more than the single growing tip, or upper-most node, from any branch on the growing plant.

To grow seedless marijuana, you should remove all the male plants as soon as they are discovered, by pruning the main stem right above the ground if grown in soil, or removing the plant from a hydroponic garden. Although it may be better developed, a pruned marijuana plant does not always produce more buds than an unpruned plant. Another good reason for pruning is to take cuttings from a strong growing, favorite plant for further hydroponic development. Marijuana growers often prune their plants in an attempt to limit their height and prevent unwanted detection.

Pruning For Hormones: Pruning your plant will redirect growth hormones.A great way to trigger this beneficial hormone redirection process is to cut the meristem (top growth tip, aka the central stem) of a cannabis plant it will cause hormonal balances to shift by causing greater concentrations of auxins in the lower branch tips. To do this you would remove this central main stem just above the four lowest (main) branches. Since this is the plant's main central growth leader, removing it will concentrate floral hormones into the four remaining branches exploding your growth there. When you have fewer branches on your cannabis crop, they become stronger, get plenty of light, and grow a larger quantity of dense heavy flower tops.

The upper-most growing tip of an unpruned marijuana plant will always be more potent that the top buds of a pruned plant grown in similar conditions. Pruning the tallest branches ensures that the lower branches grow upwards, forming a larger surface area for the light to cover. The clear fluid that often flows from the end of a newly pruned branch, contains substances which seal the wound and aid the healing process. Although it is recommended that you remove all dying leaves from the plant, you should resist the temptation to prune too many healthy leaves.

An alternative to pruning for developing growth, is to bend the tops of the branches over and tie the growing tips down with string or wire. Remember that by pruning a growing tip, you are removing the most potent part of the plant, thereby spoiling it's chance of reaching full maturity. By pruning all the buds at harvest time, rather than cutting the stem off above the ground, you could easily harvest your plant a second time. By severely pruning your marijuana plants you are lowering their resistance to harmful natural enemies such as insects, fungus and frost. You can make a great cup of tea, by chopping up some pruned growing tips and soaking them in boiled water for a few minutes. Cannabis is a very hardy and adaptable plant, and will endure serious harm to it's leaves, branches and stem before it dies.

If this is your first crop you'll understand much better what you want once you've watched a plant through its entire life cycle. Also keep in mind many growers who have a large amount of grow space and proper lighting might not even have to prune.

Topping

One week into flowering you can top your plants. Topping the plants allows you instead of getting one bud top cola, to get TWO big fat ones. This little trick is accomplished by pruning the main top cola in order to get it to split into two or more plants, but be warned, depending on your strain you may hit the jackpot and it'll split off into two huge big bud rich top colas, or two tiny little itty-bitty ones.

By removing the main shoot located on the central stem you will encourage the plant to grow into a bush with a lot of shoots, instead of one big main shoot that you get on the untopped "Christmas tree".

The reason why the plant behaves this way is because the centre of growth control is located in the apical meristem or main shoot. The main shoot sends suppressive hormones down to the lower or axillary shoots which stops them from growing. This is called apical dominance. This mechanism does not stop the lower branches from growing but as long as the main shoot is intact it will be largely favored. By removing the main shoot, the branches beneath it become free to grow at full rate in order to take its place.

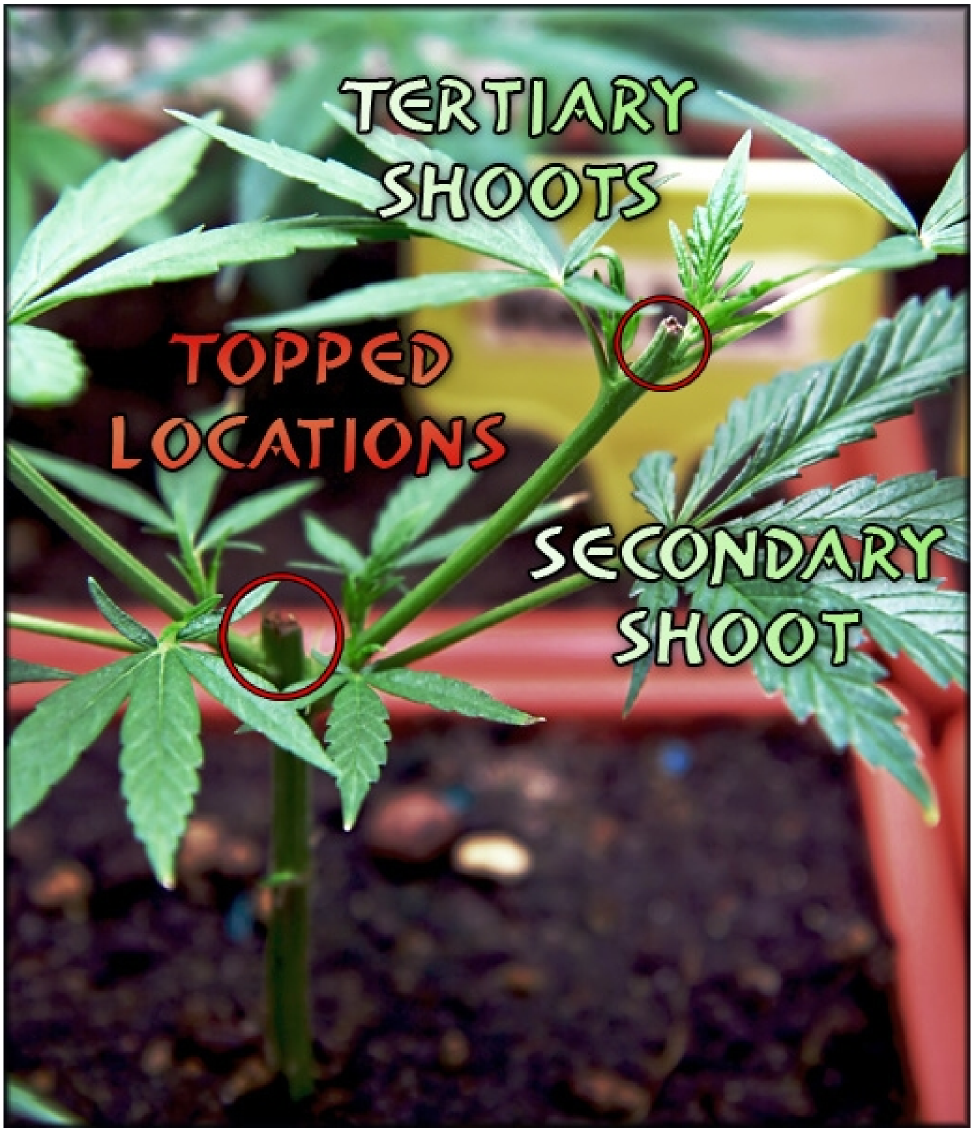
The main shoot also has other functions. It communicates with photosensitive pigments, called phytochromes which are located in the leaves. Flowering in plants is triggered by two things; the first part of the system is called the Circadian rhythm which is basically an internal biological clock. This biological clock is basically an evolutionary response to light and darkness and is closely linked with hormonal functions in the plant.

The second part involves hormone signaling mechanisms; messenger molecules and specifically encoded proteins that tell the plant to start budding based on the information that it receives from the environment. The plant knows when to trigger flowering because the sensory pigments keep track of the photoperiod (or the hours of daylight) and relay this information to the centre of growth control which is located in the main shoot. The sensory pigments also inform the plant of how much sunlight a certain part of the plant receives. This enables it to relocate energy and growth hormones to exactly where they are needed.

There are several types of hormones that regulate growth. One of the most important growth hormones is called auxin. It originates in the main shoot and is part of a mechanism called the auxin transport system. This hormone plays a big part in the internal signaling and growth control mechanisms of a cannabis plant. Auxin also serves to regulate the formation and behavior of other growth hormones that are responsible for everything from root growth to the formation of flowers.

By removing the main shoot, the communication between the leaves and the main shoot ends, effectively canceling the apical dominance. The result is that the plant assigns the next shoots in line to the job. This means that the smaller shoots on the branches beneath the cut starts growing faster and gain size.

Since there is no more apical dominance, the plant will grow into a bush because the newly appointed main shoots all have equal priority. These shoots usually grow very slowly when the plant is left untopped so it is probably best to top the plant at night when most of the hormones have been sent to the roots which means that there is a smaller chance of the plant being stunted after the main shoot has been removed.



There will be a short period of time when the plant is in something that could be called a state of confusion. It will stop all activity until it can figure out what is going on, so to speak. It will resume vegetative growth as soon as the hormonal functions are up and running again. It should take no more than a few days for this to happen, a week at the most.

Most of the time this transition is quite fast but some plants that respond poorly to topping might have stunted growth for a while. It is possible to top a plant many times, each time the number of main shoots will double. Give your plants some time to grow before you top them, if they are topped too early they might get stunted for a while. Many growers top them quite early. Go by your feeling, once the plants look strong enough you can start topping and training them.

This is a good way of training the plant if one wants to make the most out of the space available Topping is also a good way of slowing down plants that tend to stretch a lot, as each time the plant is topped it will redirect energy to a greater number of shoots. The new shoots will never grow as large as the untopped main shoot will but they will most likely produce a larger crop.

There is also a technique called FIM topping (more on this below in it's appropriate section). By leaving a small portion of the growth on the main shoot intact, the plant will assume that four shoots, instead of two, are the main shoots and they will grow evenly in height. The success of this method is usually up to the luck of the draw but in order to up your odds you should make the cut circular so that the remaining tissue forms a “cup”.

Note: The same result can however be achieved by topping the plant twice.

Topping is actually quite easy. Follow the main stem from the roots, all the way up to the top, and with a clean pair of scissors snip the top. No matter what you have heard topping is not clipping off bud tops. You're only removing about 3/4 of the top growth tip. This will cause the plant top to split into two tops. This technique can be used to produce up to about 4 tops on a plant.

You will also want to cut away any leaves that are growing too close that block the lower fan leaves from getting adequate light. In addition, cut away the lower unnecessary leaves to make for long stems, this will ensure maximum air circulation (a much better exchange of CO_2 and Oxygen).

Topping is essential when growing Sativa marijuana seeds strains in small closet or other limited indoor grow space.

Topping Step-By-Step:

Please refer to the diagram on the next page for further clarity.

Step 1) Locate the very top of your plant and cut through the main stem just below the newest growth. This should be done after the 3rd or 4th leaf set but can be done at any time after the 3rd leaf set.

Step 2) Shows Plant Top cut off and where the 2 new Branches that will form a "Y" in the main stem will grow from.

Step 3) Shows the newly topped plant after 2 days of growth, notice the Y in the Stem Forming.

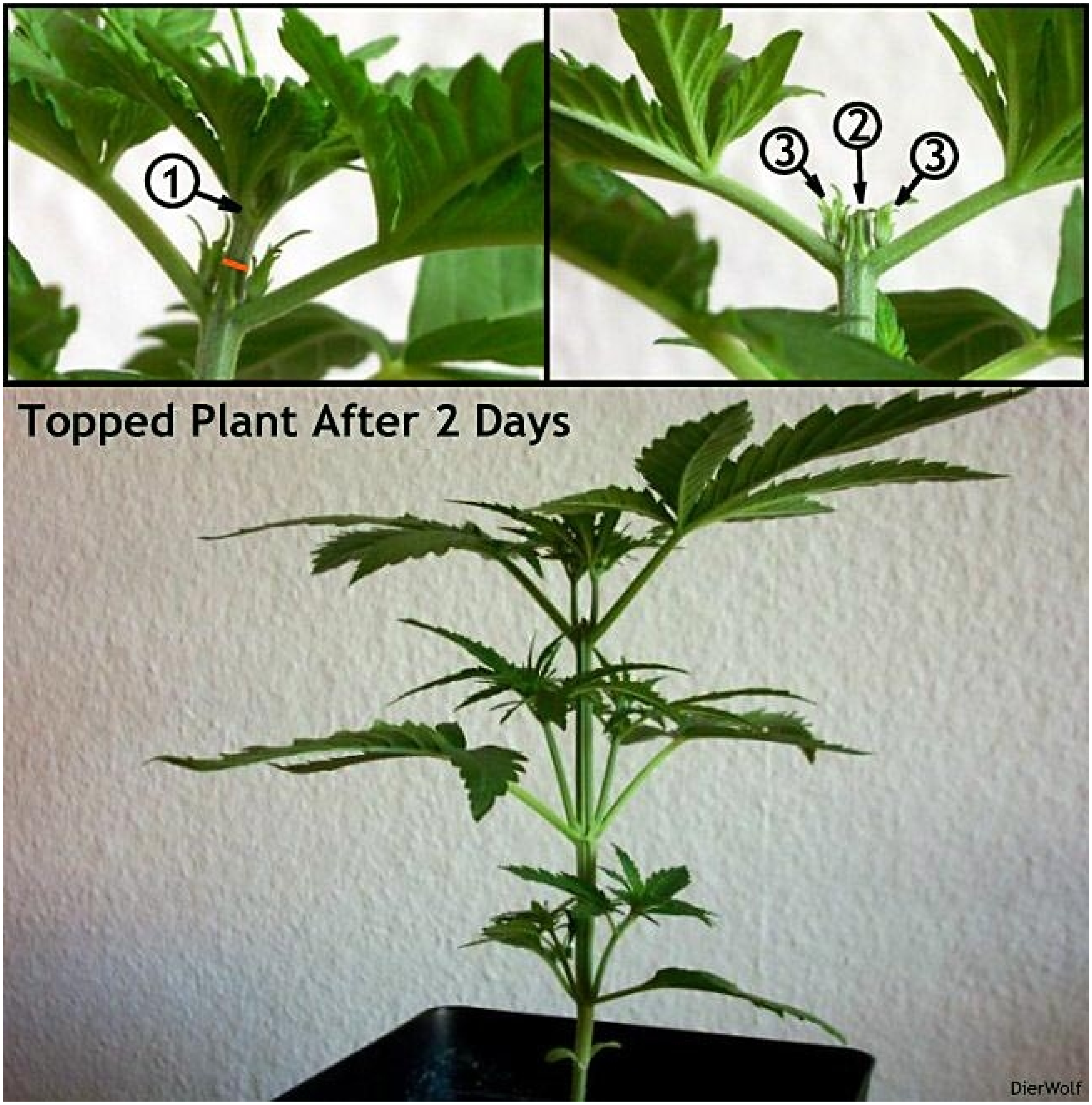


Figure 1. Topping Steps 1, 2, and 3.

Training/Pruning For a Lower Profile

If you're growing in a confined space most cannabis plants will overgrow the space within a few weeks. Here is a method to train and prune your cannabis for a lower profile.

Materials:
-A length of earthing wire.
-Side cutters or wire cutters.
-A number of self tapping screws.
-A Phillips screwdriver.

Earthing wire is available cheap at most electrical supply stores and hardware stores. This is thick copper wire used for earthing certain electrical devices. It has a soft rubber coating on the outside; the copper is malleable enough to be formed into whatever shape is required and doesn't lose it's shape very easily. The first step is to bend your wire to get it as close to the shape below as possible.

The stake can then be removed and repositioned to again train the main growth tip downwards. The lower branch growth accelerates and can also be trained using the stake method. This again reduces the overall profile of the plant.

Training continues into flowering until the males have been identified and removed to leave the females to be trained into a screen.

The plants can then effectively be controlled using Scrog techniques to maximize light efficiency and yield.

Example:

This plant has been vegging for approximately 20 days and is approximately 9 inches in height, on its eighth node.

This next picture shows where this crook is placed:

It is positioned above the first or second node with the other end of the wire laying against the top of the plant's pot. Where it touches the pot, a self tapper is screwed in as high as possible. This is to reduce the likelihood of a leak when watering. The wire can then be cut to length and wrapped around the self tapper.

This picture shows the trunk tie in place:

It's wrapped off to the self tapper to a length where the tie is tight against the main stem to keep it vertical.

In this image you can see the gentle bending of the main growth tip over in the opposite direction to the main trunk tie:

This must be done progressively to avoid snapping the main stem off. A small break in the stem isn't a problem as the plant will recover.

Note: If it does break off completely, leave the plant! It takes a week to get over this shock but they then react as any topped plant would.

This image shows the second length of wire, again with a crook in one end:

This time it is used as a stake to pull and hold the main growth tip in place. The crook is placed under the fan leaf stems of the upper most node, with the other end of the stake being pushed into the soil about an inch or two.

There must be sufficient distance between the top of the growth tip and the stake crook. This is to stop the main growth tip from popping out from the crook of the stake. The distance the stake is pushed into the soil determines how low the growth tip is trained. It must be trained to below the next node or further for maximum increase in lower branch growth and reduction in profile.

This image shows the trained main growth tip with the trunk tie and stake to hold it in place:

This effectively reduces the vegging plant from an eight to a four inch profile. The final pic shows the plants after 12 hours of HPS light:

They have all shifted the top half of their profile towards the light and exposed all the lower growth shoots. This gives them maximum exposure to the light and therefore potential for growth.

The Paperclip Technique

This next low stress training technique offers many benefits for your cannabis...

Benefits of the Paperclip Technique:

- Effectively controls the height.
- Allows more light to reach the centre of the plant.
- Shoots grow vertically off the stems.
- Stimulates stem growth by bending the stems (stresses the inner herd, causing it to grow thicker and stronger).
- Greatly increases overall plant yield.

The process starts early in your marijuana plants life cycle. Only begin paperclip training when you have either FIM, pinched, or topped your plants.

The first step is to bend some paperclips straight out - they will be about 3” in length. Next, bend the first ½ inch into a hook so you have what resembles a candy cane (yummm). Bend the stems down parallel with the medium. Carefully snip offending leaf out of the way. It's more important for the plant to spend energy growing new tips than larger leaves right now.

When the bent tip of the plant has made the turn and is growing vertically again, it's time to move the clip further up the stem to keep the tip oriented horizontally. Train the stems parallel with the medium until you want to initiate flowering.

When you do finally decide to trigger flowering, all this training will pay off. What would have normally been your tiny and airy bottom buds will now turn into nice heavy thick THC rich colas.

FIM (F*** I Missed!)

FIM is performed in order to limit plant height and encourage lateral branching. This technique and others like it (SOG, ScrOG, LST, Topping), are especially beneficial, when growing under artificial lighting; which has very limited penetration/capability. It's a good idea to keep your plant growth within the penetration area of your lamp for maximum potency and yields. For many modern growers, FIMMing is much more preferable to topping.

FIMMing isn't hard, it's simply pruning the growing tip of a plant(just like topping) but if you do it wrong, you'll soon discover why the cannabis community coined this little technique "F*ck I Missed!"

For Clarification: Topping is the removal of the growing tip at or above the 2nd or 3rd visible node, whereas FIMMing is the removal of the uppermost growing tip above the uppermost visible node - this growing tip is only visible, and accessible, if you part the tender new fan leaves. Clean fingers, a knife point, or a pair tweezers works well for this.

Note: When doing plant surgery always start with clean hands, and sanitized equipment.

FIM pruning needs to be done during the plant's vegetative cycle. FIM is a great way to prune the plant in order to get more branches. FIM is different than topping. When you top, you chop the whole node off cleanly hoping for the stalk to split in to two. When you FIM, you cut so that the vegetation that is left has cells that are rapidly dividing in many different directions. This can lead to as many as EIGHT tops from a single pruning. When you FIM you take away 90%, leaving 10% intact. Force vigorous plants (preferably Sativas) to do lateral branching earlier by reducing amount of leaves on the plant, before you FIM.

FIM Step-By-Step

Step 1) Locate the very top of the new growth

Figure 2. Step One.

Step 2) With a clean sterilized scissors, Fold the fan leaves over and cut approximately 80% of the new growth off the plant.

Figure 3. Step Two.

Step 3) View from the top showing the Cut.

Figure 4. Step Three - After the Cut Has Been Made.

Step 4) View of the Cut section after 2 days growth, showing the 4 new growth shoots (branches).

Figure 5. Step Four - Cut After 2 Days of Growth.

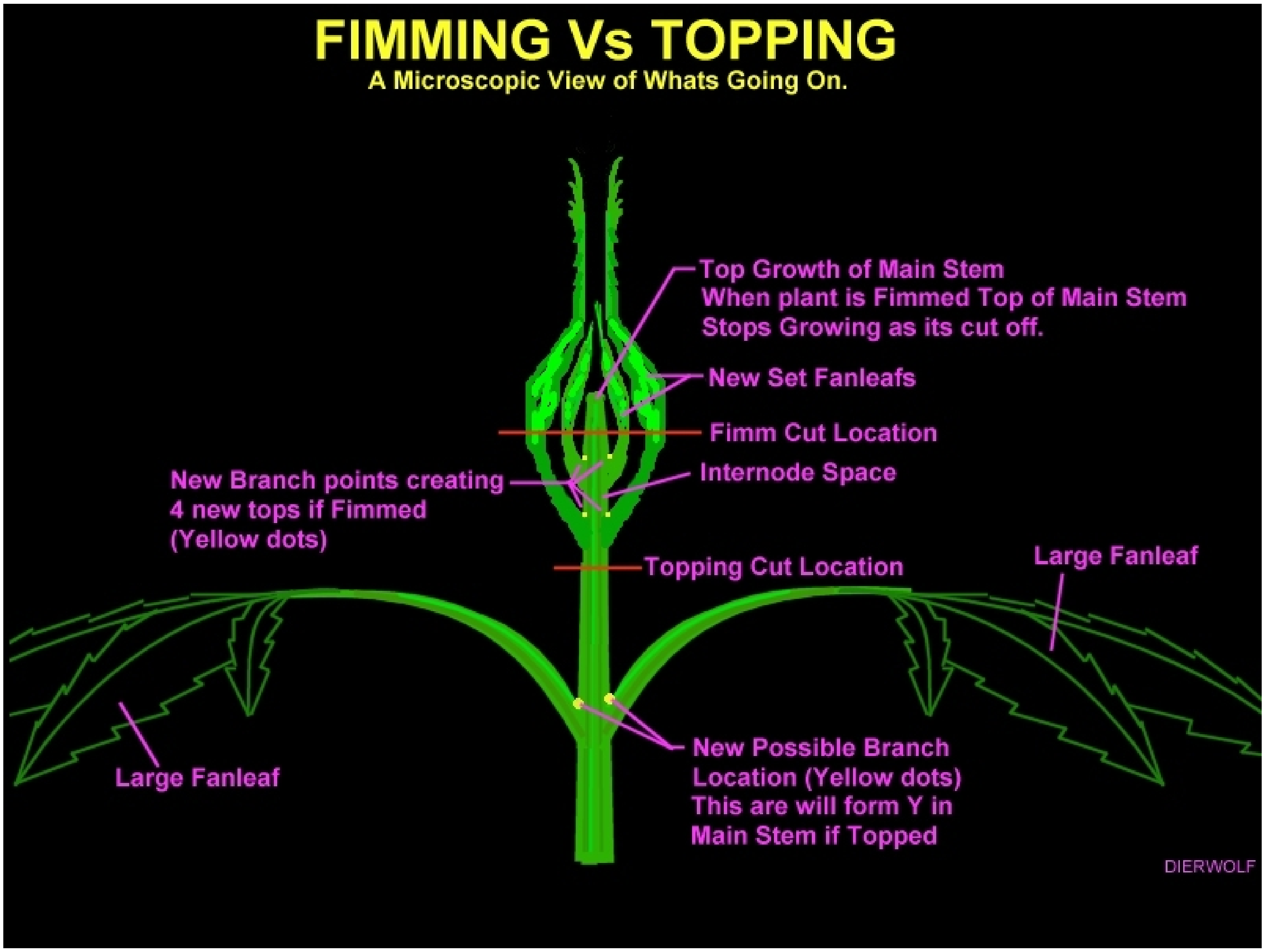
Thats it! You should be well on your way to Topping and Fimming of your plants.

The following picture is an example of a plant that is properly FIMMEd and LSTed. As you can see this plant already has lots of branching, which will become the new tops. As you can see the tiny growing tip was removed, while leaving the precious fan leaves intact, and that's what constitutes a proper FIMMing.

Figure 6. A Successful FIM.

I've chosen to include this next diagram as a decent graphical image, but it is wrong. Where it says "FIMM cut location" is NOT where you want to cut! First you want to gently spread the tiny "new set of fan leaves" out of the way, find the actual growing tip, and then make then nip it out.

Only then can you be sure you are pruning out the growing tip, while at the same time preserving the surrounding growth.



Keys to A Successful FIM:

1. Cleanliness

2. Separate the new growth (fan leaves) using your fingers, knife tip, tweezers, or whatever works best for you.

3. Locate the growing tip - that would be the main stalk ONLY where it says to cut, in the above pic.

4. Using a very small knife, scissors, or clean finger nails, carefully remove the growing tip, while being careful not to clip the surrounding growth. Be especially careful if attempting this with a razor blade, because they have a way of cutting

through more than you intended. Remember, Just cutting through the uppermost growing tip is a terrible idea at best, and you're liable to cut the new fan leaves, which isn't good for your bud growth.

FIM isn't much different than topping, but it's less drastic (stress), and leaves more auxin's, and more nodes. FIM gives you more natural growth, and stronger branching, and it doesn't limit you to 2 tops as topping does. I also understand some people are getting 4 tops using the old topping technique, but to achieve that result, you need to top at a specific time, or node. There are no restrictions using FIM - to get multiple tops - other than the normal ones; never prune a seedling, or a plant in flower.

Bushing

Many growers like to keep their plants small and wide. It's fairly easy to achieve this. During the 3rd week of vegetative growth prune half the plants branches and leave the other half. 50% is the amount you want to prune, any more or any less than that and you might end up stunting your plants growth. Prune all over, not just one side to get it to 50%. Next step is to wait until the 5th week of vegetative growth and then rune the remaining 50%. Only proceed to do this if your previous prune cuts have grown new leaves and branches. At around the 7th week of vegetative growth you will begin to see your plant take a liking for growing outwards instead of upwards.

Bending

Another way of modifying your cannabis plant's hormones in order to manipulate its harvest quality is by utilizing a technique known as “bending”. The effect bending has is that it neutralizes the effects of growth-inhibiting hormones. You can also limit the height of your plant (training) using bending. Bending, although very similar to pruning, and is much less stressful on plants.

Limiting the height of your plants by using bending is an art form in and of itself. Here we have the art of tying down your plants main stem so it grows in an 'S' shape, preventing the plants from reaching their natural height without having to worry about pruning (you can still prune if you need to, don't worry).

Simply put, bending is when you lean a branch in the desired direction and tie it into place. The process is fairly simple. Take a small string or thread and attach it to the stem, then bend the plant over. You then need to lock the string down to another part of your plant or to the grow room frame. You can really make this an art form. Some growers make corkscrews, circles, various 'S' shapes etc.

WARNING: DO NOT tie your string too tightly!!! If tied too tightly around your stem the liquids cannot flow and death or retarded growth may result.

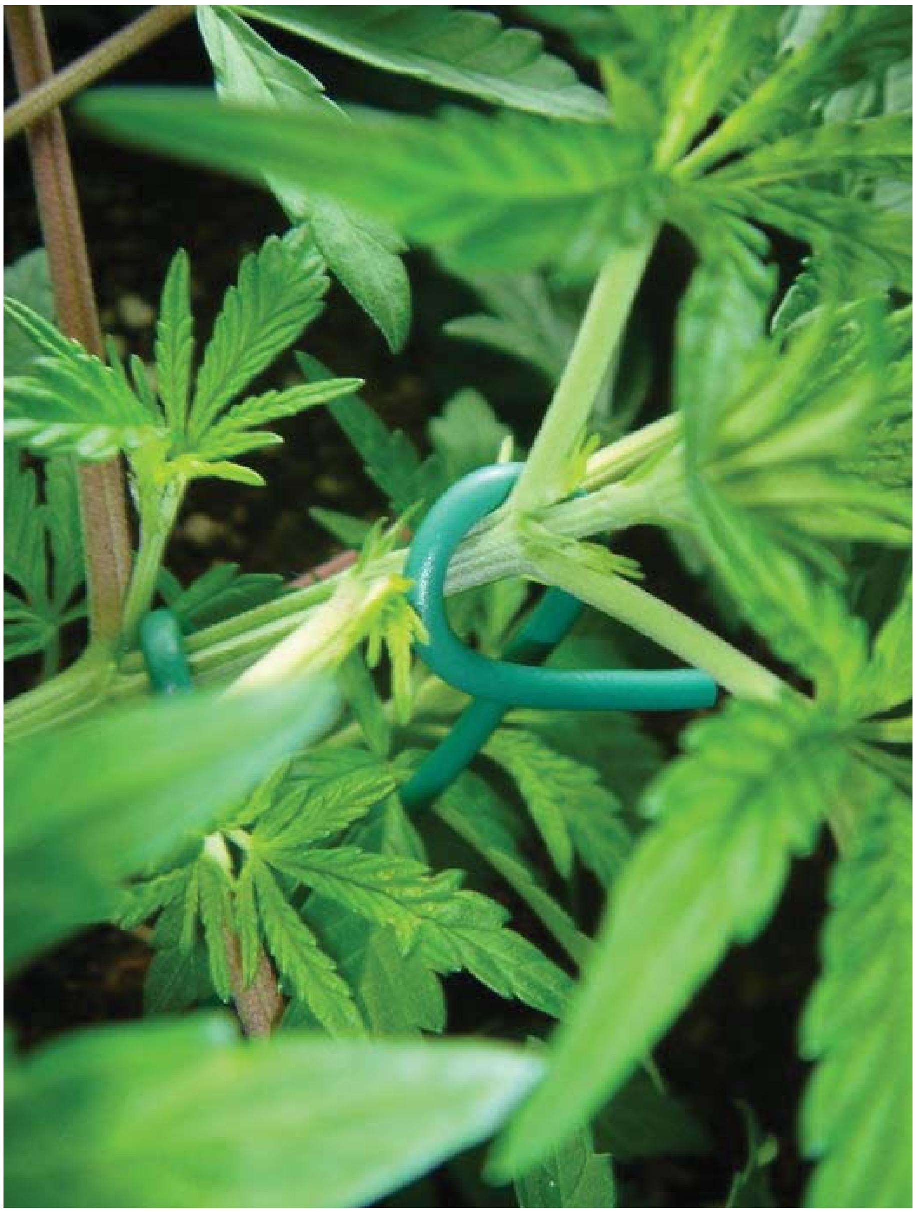
Be creative! Branches are tough and can take a lot of bending stress before they break or fold over. Keep in mind younger branches are prime candidates for bending than older stiffer ones.

Note: Even though cannabis can take a lot of abuse (it really is a tough plant), you want to be very gentle when bending.

Here's a cool tip: Many growers like to bend their branches to ensure maximum light exposure. A key example of this is bending the branches horizontally so that the buds grow vertically towards the light source. Because the buds all receive much more light, they will turn into a very generous top.

Low Stress Training (LST)

Low Stress Training is a technique where a plant is trained through the use of ties or ropes. The idea is that you use a support rope at the base of the plant pulled one direction and another tied to the top pulling it down in a different direction. Every couple of days the top will be pointing upward again while auxins (branching hormones) reach the other nodes. Each time the top pulls up above the other branches the top rope should be moved up and the top pulled down. Continue doing this until the top does not pull above the other branches.



Bushes are ideal plants to grow for anyone who has a small HID flower light (under 400 watts) or uses fluorescents. Smaller lights and fluorescents emit the most intense light for only a short distance, so keeping as much vegetative growth in the lights sweet spot is a must to make your lights most efficient. ScrOG growers take maximum advantage of this by weaving tops through a screen so only tops are exposed to the light. Well, training attempts to achieve the same goals only with a less work intensive method that will make more use of your small lights limited effectiveness.

Note: Topping and Super Cropping are examples of High Stress Training.

Topping and LST training work quite well together but it's not necessary to top the plant in order to start the LST training. Some people prefer to leave the plant untopped and tie down the main shoot at ground level instead. This will have the same effect as topping it because once again, the centre for growth control located in the main shoot will dictate how the plant grows. When the main shoot is tied down, all shoots above it will grow more rapidly as the plant now assumes that these are the main shoots.

When it comes to marijuana growing, LST refers to a particular type of low stress training. It appears on the outside(and to the untrained eye) that the training of a plant is simply teaching a plant to be short and grow lots of buds. It is much more important and involved than that.

Topping the plants is actually done for similar reasons that LST is done. Even though it is a completely different method. It, too, is a form of training (a high stress one).

Why LST Works

One of the crucial things you need to understand about LST is auxins. If you don't understand how auxins affect your marijuana plant, then you are just putting strings on your plant so they look like other plants in pictures. Auxins are plant hormones that interact with other plant hormones to form the "plant nervous system", so to speak. Auxins are used to help stimulate nearly all facets of plant growth.

Auxins are used to help promote new root growth and is often part of what is used in rooting compounds or rooting hormones that are so popular in marijuana horticulture. There has also been various scientific studies that indicate that levels of auxins also influence the sex of a marijuana plant. Some research has also indicated that levels of auxins also play a role in the ways flowers mature on a plant.

Most of all, auxins in marijuana plants are known for producing adventitious buds along the stem and in the roots. Adventitious is sort of like it sounds: it's the "adventurous" part of the plant that sprouts when the plant is wounded or trained.

More auxins is good when it comes to marijuana right?! Well, no, not in this case. Auxins are most concentrated and synthesized at the apical bud (the tip) of the plant closest to the light. The rest of the plant has the ability to produce auxins, but the cells must be triggered to do so. Now, although auxins are hormones essential for many facets of growth, it is also an inhibiting hormone for the other buds further down the stem. This is to prevent the plant from producing buds which may compete with the apical bud.

In other words; The plant is very happy having one bud that it tries to stretch as close as possible to its source of energy. It will do what it can to inhibit other sprouts below it from becoming that bud as it would require the plant to push those sprouts up to that level again.

If you are still a bit confused, think of images of trees and picture the growth that they have in a cone-shaped fashion. They are working to push the apical bud up to the sky.

Now that you understand what auxins are and how they are important for growth in marijuana, you can begin to understand how LST works and how to utilize this cannabis cultivation technique effectively.

How LST Works

When you top a plant, you are removing the apical bud (the bud closest to the light) where most of the auxin is concentrated and synthesized. The plant stresses itself out (high stress training) and eventually produces new sprouts along the stem that will form new growth so that it can get a new apical bud and send it soaring towards the heavens.

LST is helping to stimulate that growth near the bottom but by tricking the plant instead of chopping it. In nature, if something happens to a plant and the bud that is closest to the light gets blocked, it will try to move around that something. If it can't, then eventually new growth will form lower along the stem to try and send a new shoot out to head towards the light.

When you Low Stress Train your plant, the reason that you are tying the tip of the plant down is so that the plant gets confused. It is used to producing the auxins in the tip of the plant close to the light. However, because the tip of the plant is pulled down to such a degree, it is not receiving light at the very tip like it used to so it sends the auxins down the stem to produce new sprouts to become new apical buds (or so the plant hopes).

This is why some people continue training as the plant gets older, but like to start when the plant is new as auxin development starts with roots and continues through all stages of the plant. Continued training of the plant is helpful because, as you can imagine, each apical tip can be brought down to promote new growth further down the stem. Every time you bring the tip down, the plant will be fooled. As new tips of the plant are reaching towards the light, pulling them back down below 90 degrees (or close to it) will make those auxins start to flow again. This can continue on and on.

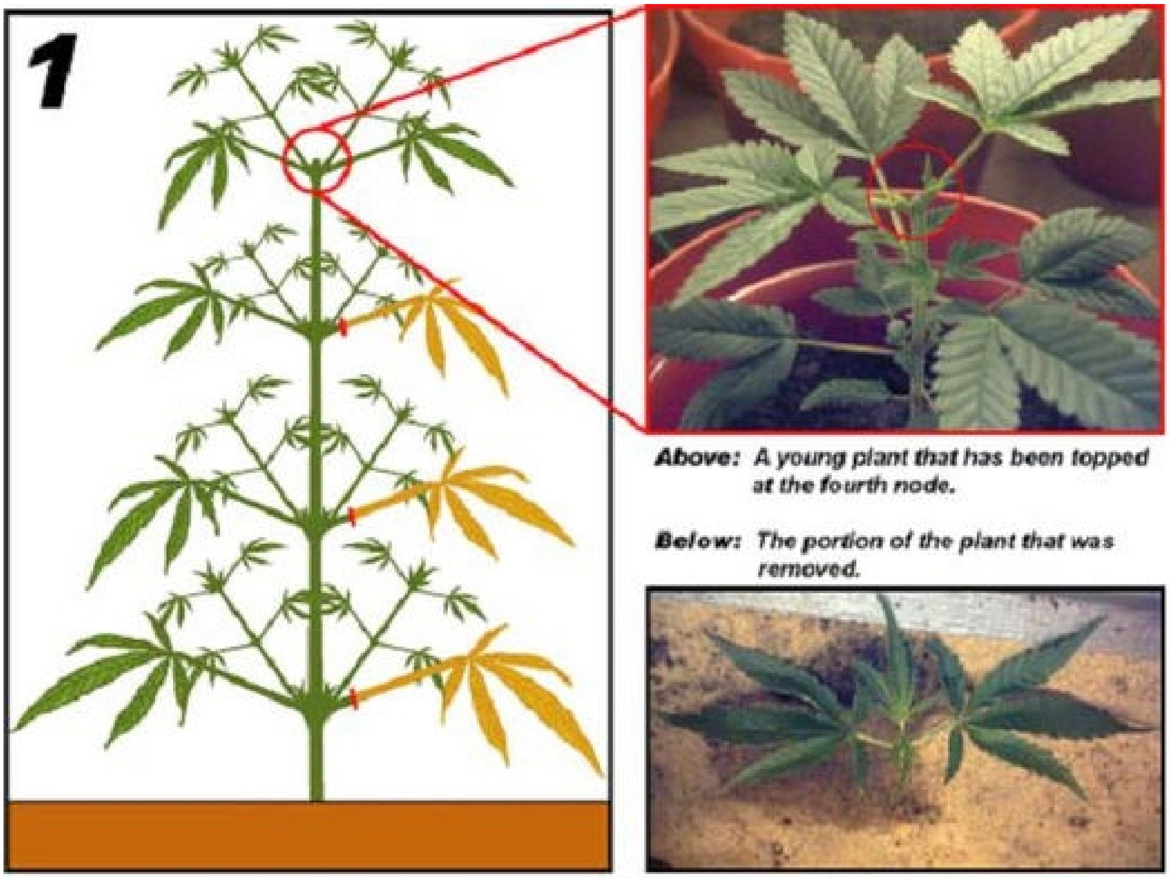
Now that you know how LST works, you just know that you need to trick the plant into thinking it's highest tip is no longer its highest tip. It's as simple as that, but it is also as complex as you want it to be.

Low Stress Training Conclusion:

- LST can be done for all strains of marijuana, with great success.
- LST is another way of altering/stimulating the auxin hormone to produce additional growth just like other training methods.
- LST is not just for training height.
- Understanding auxins will help you understand LST better.

Note: Using copper wiring instead of string when LST'ng is not only easier (there are no knots to tie), but it is very reusable because there are no knots to un-tie.

Low Stress Training Step-By-Step



Above: *A young plant that has been topped at the fourth node.*

Below: *The portion of the plant that was removed.*

big_buddha

Here's the first diagram.

I generally start training my plants after they have grown to four or five nodes. Before training, I top the plant, you could also FIM technique. The whole point is to promote branching.

I also remove the fan leaves from one side of the plant, this is so they don't get in the way when we train the plant.

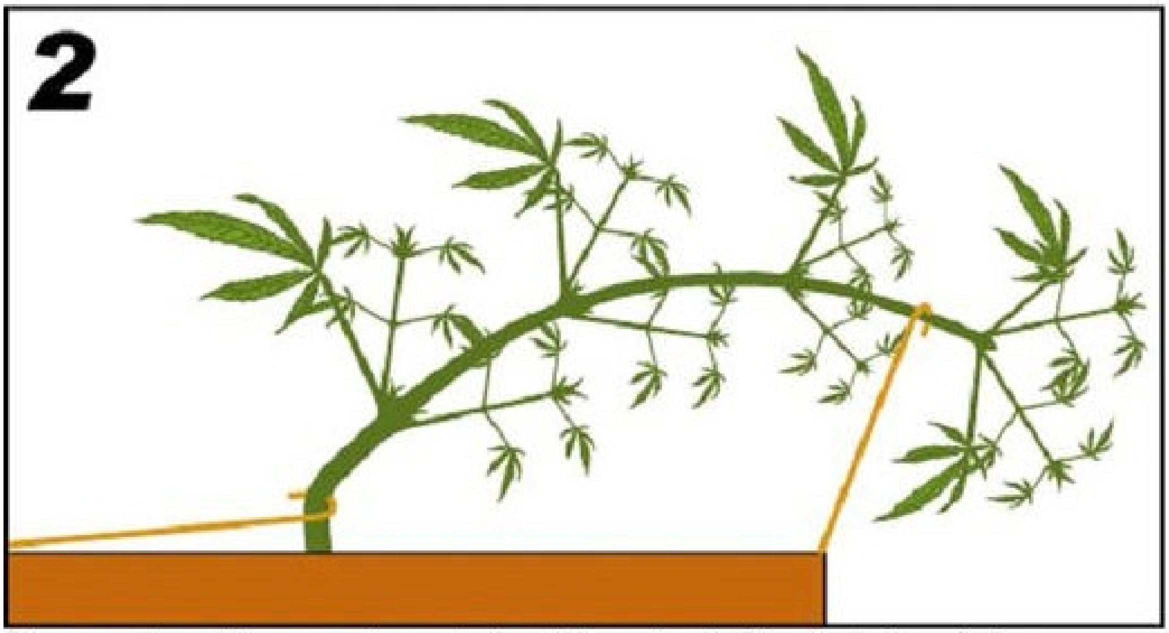


Diagram two. Here we have trained the plant. The first step is to secure one tie to the base of the stem, this stops the plant being pulled over and out of the soil. The second tie is used to pull the stem down. It is always better to train your plants when they are in need of water, this means they will be softer and more pliable. If you train the plant when it is freshly watered, the stems are much more rigid and can snap easily.

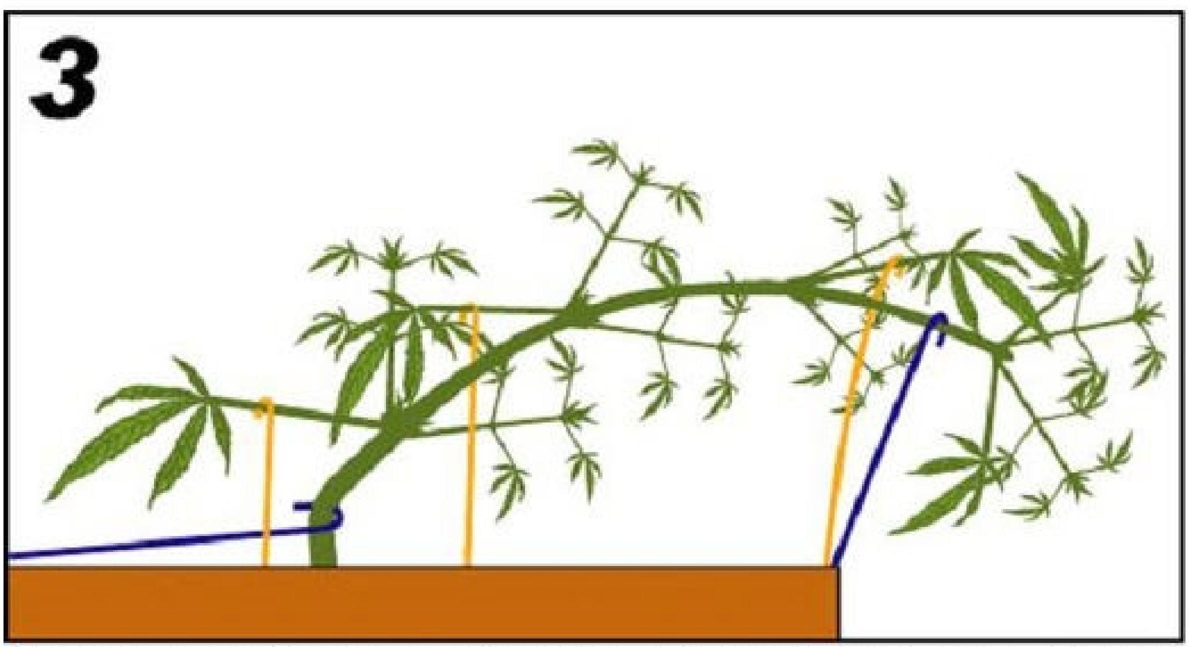


Diagram three. This illustrates how I tie down the fan leaves to allow more light to get to the side branches.

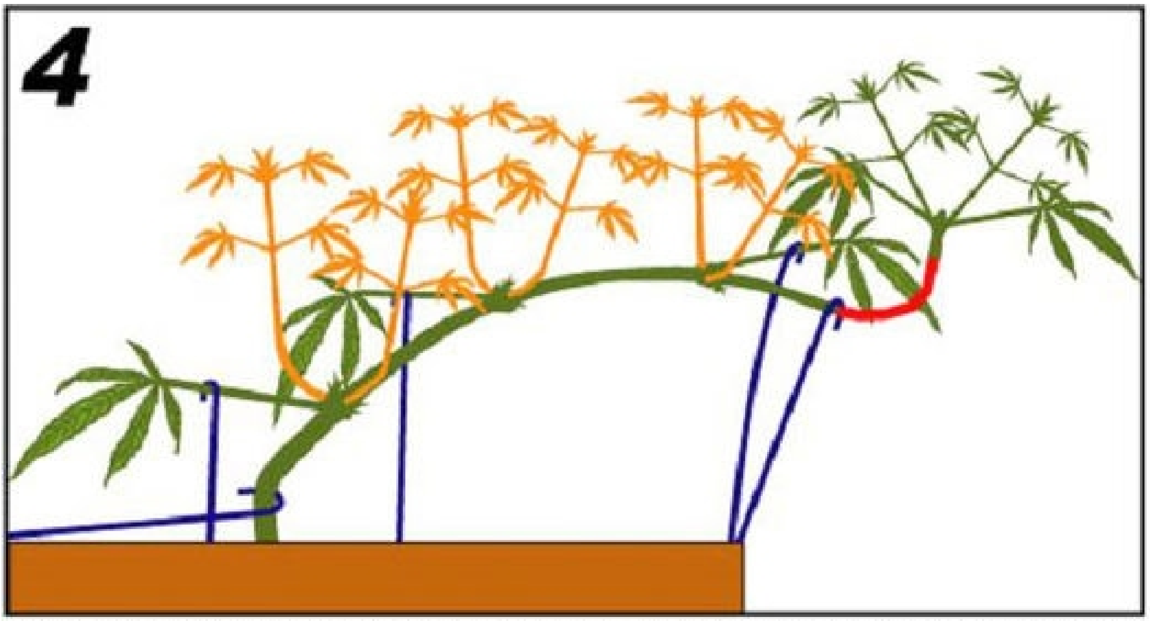


Diagram four illustrates how the side branches will begin to grow taller and the plant will adjust its growth.

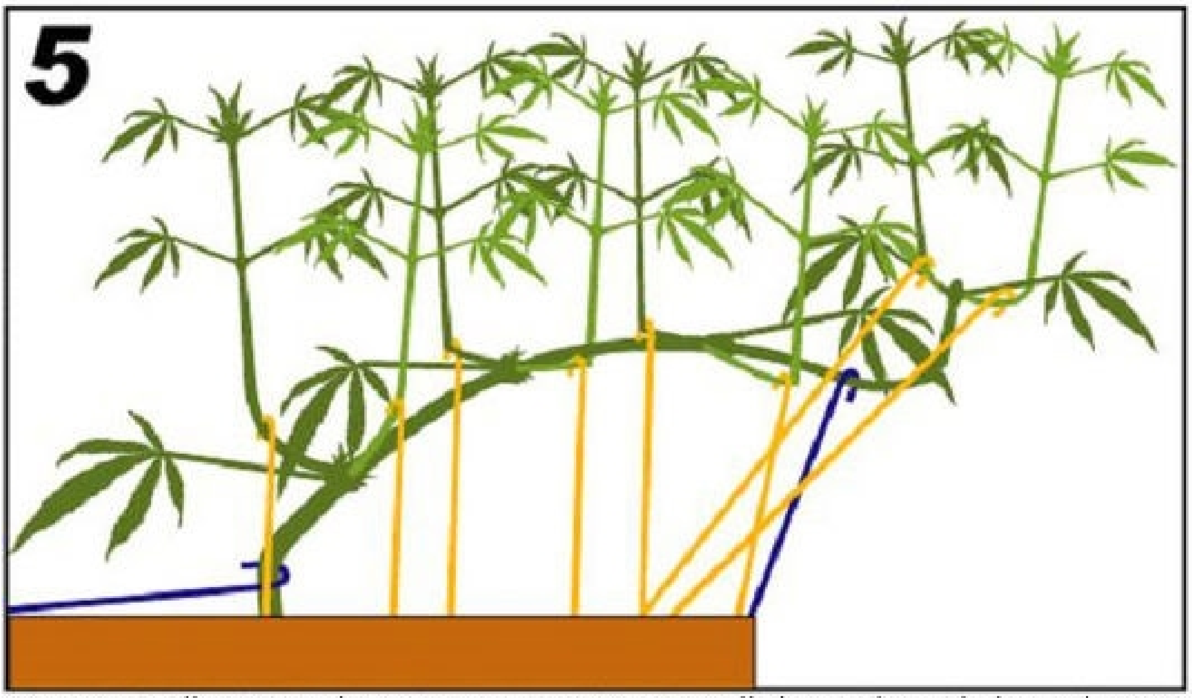


Diagram 5 illustrates how I use more ties to pull down the side branches to form an even canopy. I grow under fluoro tubes so my aim is to create a flat, level canopy.

Air Layering

Air layering is a way to make clones from strains of plants that are difficult to clone. Air layering is taking a clone from a plant - it is removing part of a plant, not adding too a plant, and not grafting onto a plant.

Air Layering Step-By-Step

Step 1) The first step is to select a branch you want to propagate from, come down 12 inches from the tip of the branch and make two parallel cuts 1½ inches apart with a sharp sterilized knife. Don't cut through the branch, just cut deeply enough so the outside bark peels off (what you're going for is an exposed wound).

Step 2) Next coat the exposed area with rooting hormone to speed up the rooting process. Next you wrap the wound with moist sphagnum moss (or potting soil), then cover it with plastic wrap to form an airtight pouch. (This is the hardest step – and it can be amusing just trying to keep the moss from falling off the limb while getting the plastic wrap securely around it. To make the task a bit easier place the moss or potting soil in the plastic wrap first, then wrap both around the wound at the same time.)

Step 3) Then put rubber bands around the ends of the plastic wrap. (So now you should have a ball of moss wrapped in plastic wrap around the wound.) You cannot allow sunlight to strike the newly forming roots so you will need to cover it with something. Black plastic cut from a trash bag will work but aluminum foil is a better option in that it will not only block light it will also reflect some light rays keeping the newly forming root-ball cooler.

Step 4) Then you wait (and wait). To determine if a cutting is fully rooted, periodically check it by removing the aluminum foil to see if roots have grown to the edge of the plastic. Once you know that the cutting is fully rooted, it's time to clip and then plant your baby plant as you would with any rooted clone.

Here are some graphical examples that will hopefully help:

Above: The first step to air layering. Pick a branch that is at least 1/8" thick if possible. Scrape away the outer layer of tissue, the phloem, below (or above and below) a node, which is where a leaf, branch and/or bud will grow. This exposes the inner xylem and a layer called the cambium, which is from where the roots will grow. Leaving the inner xylem allows the clone to continue to draw water and nutrients from the mother plant and root system. The clone will continue to grow foliage, while simultaneously growing roots.

(Here is a shot of the roots developed on the clone, while still attached to the mother. The stem of the clone is thicker above the root site because of the phloem having been removed. The carbohydrates created by photosynthesis in the leaves normally travels down the plant to the roots via the phloem. Because this outer layer was removed, the carbs build up in the stem above the wound.)

(Here's an attempt at air layering. As you can see the top twist is tied too tightly, which is why the stem is so skinny.)

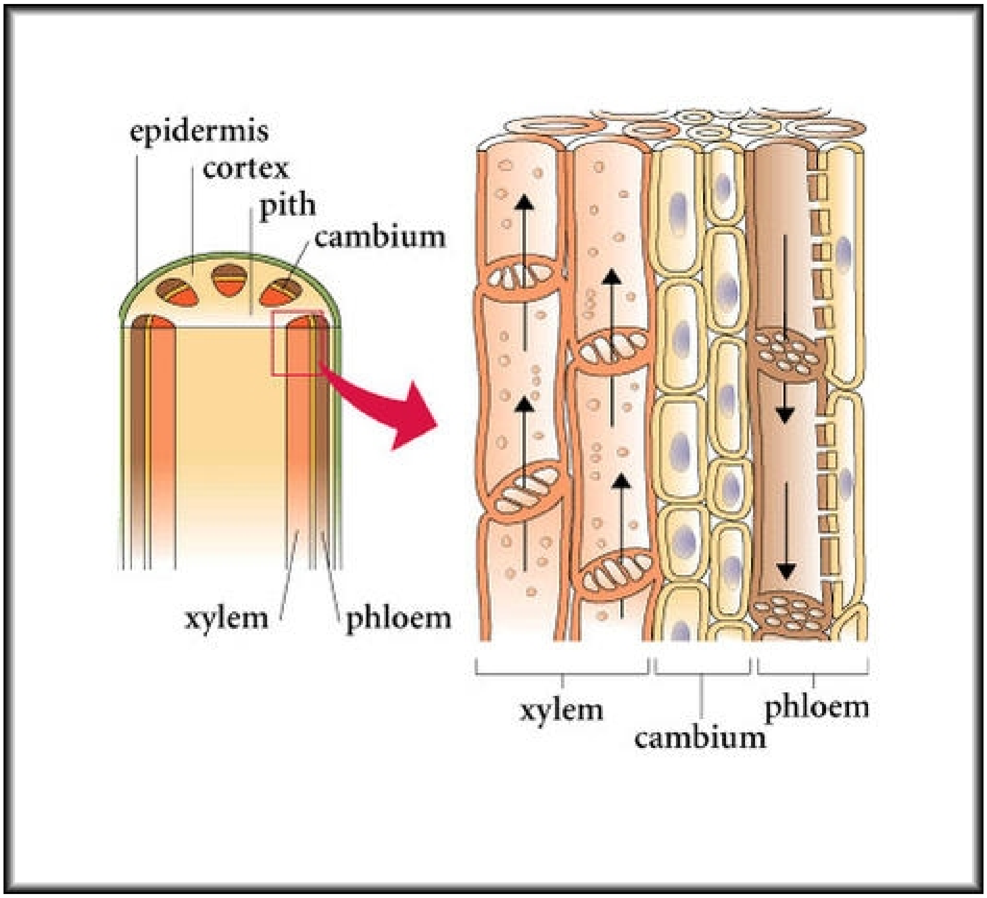
The wound site is wrapped in your choice of medium. Rockwool is used in this case. Soil can also be used; a small square of plastic wrap is taped around the wound and soil is packed inside, forming a ball of soil just like the rockwool pictured. If using rockwool, just cut the cube in half, put the two halves around the wound, and wrap twist ties or string around the cube to hold it in place. Make sure to soak the rockwool in 5.5 pH water before using. The plastic wrapper is left around the rockwool to help to retain moisture.

A better method of exposing the cambium, making only 3 cuts with a sterilized scalpel or razor blade. Make two concentric cuts around the stem, just deep enough to go through the outer layer of tissue. Connect the two cuts with one vertical cut, and if done correctly the outer phloem should simply peel away.

(The exposed xylem. You can see two alternating nodes are exposed.)

Super Cropping

Super cropping involves crushing of the soft inner tissue of the stem in order to gain some control over the plant;s growth patterns, but the primary reason grower's super crop their cannabis is to drastically increase health, potency, and harvest yield. This soft inner tissue is made up of cellulose and forms a network of vascular tissue that can be divided into two groups, namely the xylem and phloem. These two are responsible for the transport of water and nutrients along the stem.



Breaking the plant's inner walls will induce a need for the plant to rebuild. The plant will adapt to the stress by rebuilding the tissue stronger than before and this is exactly why this technique can increase harvest size. While rebuilding the tissue the plant expands on the network of cellulose, which is why the stem grows thicker than before at the point where it was crushed. Think of it this way; instead of having a two way street for water and nutrient transport, you now have a multi-laned super highway.

If you pinch the main stem it will grow very thick, which will benefit the entire plant. Pinching the side branches will allow you to have more control over how she takes shape. Thanks to the bend on the newly crushed branch you can now redirect it in any way that you see fit. This will also allow more light to reach the lower buds. Since the branch will grow stronger at the breaking point, it will also be able to support more weight. The branches that are closest to the breaking point will also grow stronger in order to compensate for the injury.

In this photo you can clearly see how the stem has grown stronger where the vascular tissue was damaged and then repaired.

The idea here is to gain some control over the shape of the plant while simultaneously drastically improving health and increasing harvest yield. Pinched plants usually grow into very healthy bushes with thick stems. Super cropping is also a good way of getting several main colas - the pinched branches will eventually grow so thick that the plant will treat them as if they were main colas instead of secondary branches. The added stress that comes with super cropping also tends to increase potency.

Super cropping should be carried out during the second or third week of vegetative growth. Take a branch between your forefinger and thumb and proceed to pinch and twist at the same time until you feel the insides start to collapse under the pressure of your fingers. Slowly squeeze and bend the stem without snapping it. Just squeeze lightly until you feel the branch give, then let go. The branch might droop for a while but that's OK as it will heal over time.

Supercropping is based on a pretty simple principle: strong plants will become & grow stronger and better if forced to endure certain types of stress. In this case, that type of stress is breaking or crushing the inner husk of the meristem (In ScrOG you would be breaking a number of branches, not just the meristem).

Once broken, the husk is given a week to recover in which time the stem becomes thicker, growth becomes more vigorous, nutrient uptake increases, and bud size as well. Technique and timing is crucial, but it's really quite easy if you know how. Here is an example on how you would do it with a Screen Of Green grow:

After the clones have established themselves in the 4" Rockwool cubes is the time to very carefully begin. The first treatment will occur on the meristem beneath the top grow shoot. To break the husk, you simply pinch the stem in between your thumb and forefinger and gently crush it while simultaneously moving/rubbing your fingers in opposite directions (it's a good idea to gently bend the cutting over so that the injury becomes more pronounced and the clone wilts). Bamboo poles come in handy for supporting healing and growth.

Now the awesome part. You will surely begin to notice much more vigorous growth over the next few days, and the cuttings will really begin to take off. After the initial wound is healed, and several new leaf nodes have grown (best rule is when growth has doubled), you may resume the process. Now this time working larger areas between the nodes, and leaving about a 2" space between each break. You can vary it a lot, making fairly large 3" wounds, and then several smaller breaks.

WARNING: For best results it is CRITICAL that you allow adequate recovery time to allow your plants to heal properly.

Many growers ask if hey need to change the technique at all as the plant gets larger, and the answer to that is both yes and no. You will continue to pinch and twist the stem, but you also have to carefully listen for the sound of the husk breaking to make sure you're doing adequate damage to your plant. Don't worry, it's really not that hard. After a few tries you will master this awesome little grower skill.

Keep in mind that sometimes you will have to keep the plant in a vegetative state a bit longer than usual as it takes the plant some time to repair the broken tissue and redirect energy. It is probably best to choose either topping/LST training or super cropping, as both techniques have the same purpose and applying all of them at the same time might put the plant under too much stress. Pruning super cropped plants might however become necessary at some point or the other in order to ensure that the plant is functioning at its full potential.

If this technique is applied correctly and with patience, the outcome will most likely be a stronger, bushier plant and a greater harvest.

You'll also find that even severe damage can be done to the stems without affecting growth (as long as you are supporting it properly using the bamboo so that the plant is not strangling itself), and will in fact DRASTICALLY increase bud weight in the end. Some of the largest colas I've seen have had horrible-looking wounds all the way up the meristem. The key here is providing a proper environment for recovery by allowing and giving them adequate time, using proper support, and keeping food and environmental conditions at optimum levels. Also remember to re-break already broken areas once they have fully healed.

Once flowering is initiated and the clones begin to stretch, you should work about every several inches up the meristem focusing on making large and small wounds. Not all the breaks should be equally traumatic. Try to keep it to one or two severe breaks each treatment. You can probably up your food levels to 1800EC right after you go to 12/12 since they will be eating A LOT to recover.

The treatment is to be repeated and continued until 3 weeks into bloom. You will be pleased with the results. Also note that additional support may be necessary since the top colas of these supercropped plants become so large and heavy that the rockwool cubes cannot support their weight and they end up tipping and falling over creating a big mess. Packing Hydroton or rockwool between your cubes might help keep them supported. The black plastic also helps to keep the cubes in their place. If you are truly dedicated some reinforced chicken wire would be optimal. This would also help to keep your profile in check during the stretch.

Keep in mind supercropping will cause a slight delay in harvest. The delay can be anywhere from a few days to just over a week. Fortunately the delay is highly rewarding because the buds grow much larger than usual and have a longer time to produce more resin. This is just like some sativas which are so richly potent and can be such massive yielders under natural light primarily because they have such a long timeframe to flower and produce THC & bud. The extra time is definitely worth it!!!

But what if I hurt my plant?

Believe me, you cannot and will not ruin your plants with supercropping. It is not recommended for immature seedlings, but clones and mature plants can be done without worrying about a thing. It's completely safe just as long as you have something to properly support the plants in case you go overboard and break the stem severely enough that the plant can no longer stand. This actually turns out to be a good thing. You see once you tie the plant up to stabilize it, it will immediately begin to heal, and a tough woody knob will replace what was once flimsy, green stem. The best place to supercrop for SOG is the very bottom of the plant, and just below your top cola. But of course you can pretty much do it anywhere.

Tie And Train Super Cropping Step-By-Step

There are a few different ways one can go about super cropping other than the basic method. An alternative name for this technique I'm going to describe would be Tie and Train, and I find it to be a lot like a ScrOG, but without the screen, and they are similar in the way they create a mostly flat even canopy of buds. This allows us to move the grow light closer to the top, obviously reducing the loss of lumens through distance. Also, this technique cuts in half the amount of plants needed to cover a given area.

Super cropping relies on far fewer lateral buds growing vertically and more on multiple colas in a small space. Yield on a supercropped plant will be gathered from the length of the stem, light size dependent.

There are several ways to achieve a room of multi-cola plants forming an even canopy. One way is to tie the plant's tip to base for a week to induce lateral growth, and a second way is to simply tie the plant over 45°F(7.2°C) early in the vegetative stage of growth.

Once lateral growth is achieved, and the tieing method is the only way to nearly cease horizontal growth from the mainstem, the branches are observed over the course of a week or so to see which ones grow faster. These branches are gradually tied to the outside of the planter. Smaller growing shoots either get tied to the inside or made into clones or discarded. Obviously, we're tieing the faster growers to the outside so the smaller shoots can keep up with them height wise.

12 plants from seed at 3 weeks:

I do employ the snapping of the hurd technique, but only to lessen the possibility of the stem folding or snapping when the tip is tied to base. So, pick your spot in the middle of the plant. Using the thumb and forefinger from each hand, slightly above and below the spot, counter-rotate your hands till you feel a light breaking inside the stem. It may or may not happen. If it doesn't, don't worry. Twist back and forth a few times to create a general loosening in rigidity of the plant. It should lean a bit.

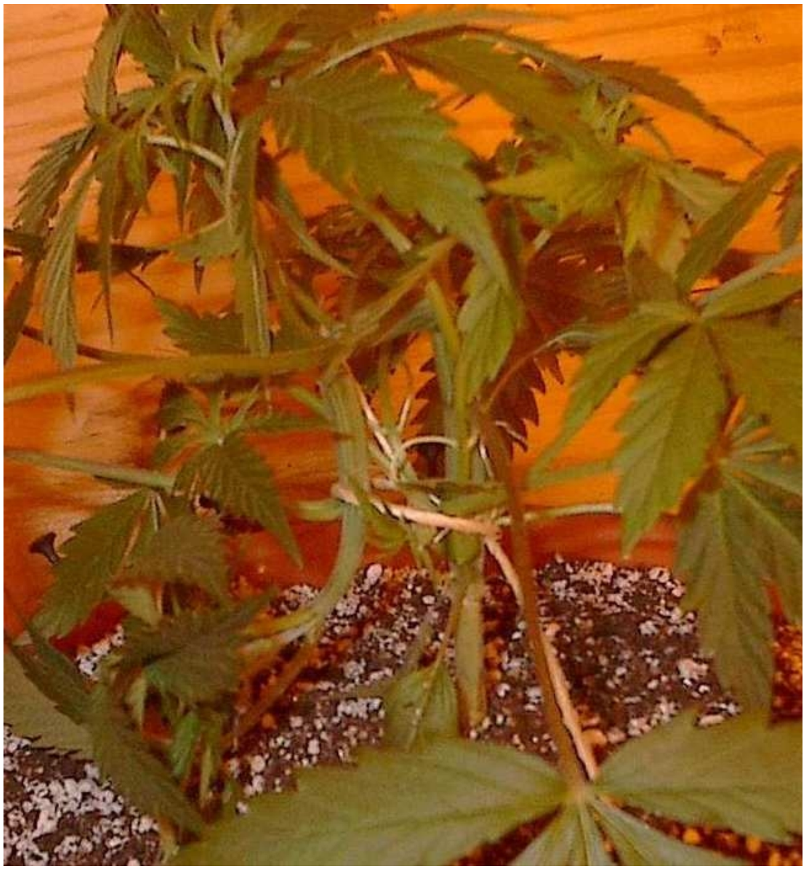
Take your tying material, (a 10,000 foot roll of twine works good), and circle it loosely around the base and top of the plant. You want to pick a top node with some decent sized leaves (1"+) on it to prevent the plant from slipping its bond.

They do try hard to do this:

Slowly compress it down to the shape you see here and cinch the tie. A bit of pressure at the top of the circled stem will help prevent folding. If the stem does fold, don’t worry. It really doesn’t appear to make a difference in the plant, except for the ease of tying it later. The plant WILL recover as long as its not severed, sometimes even to spite you, it seems.

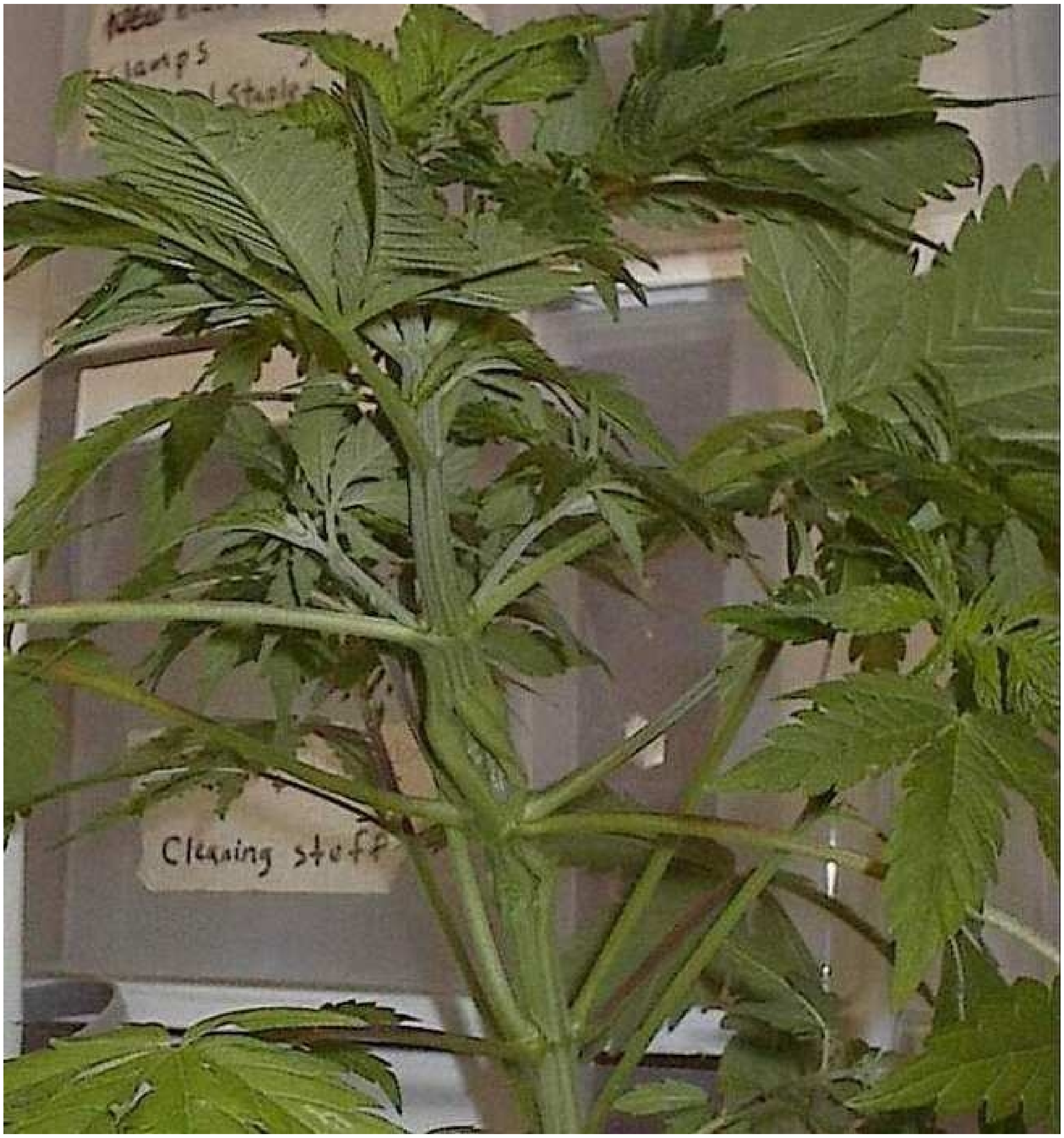
You can see she badly wants to turn that grow tip towards the light. The week in tie, through hormonal responses, forces the plant to stop primary growth from this tip and focus on growing out all the branches at the nodes just above and below the tie. Until it is released of course, when the meristem once again begins to receive a share, though not the main share anymore.

This is just before release:



It has already almost resumed its vertical stance. It'll grow like this for a week and then we'll begin the tying for training. See where the damage is and look at the growth from the nodes under it compared to the growth above it.

You can clearly see the goal with this one:



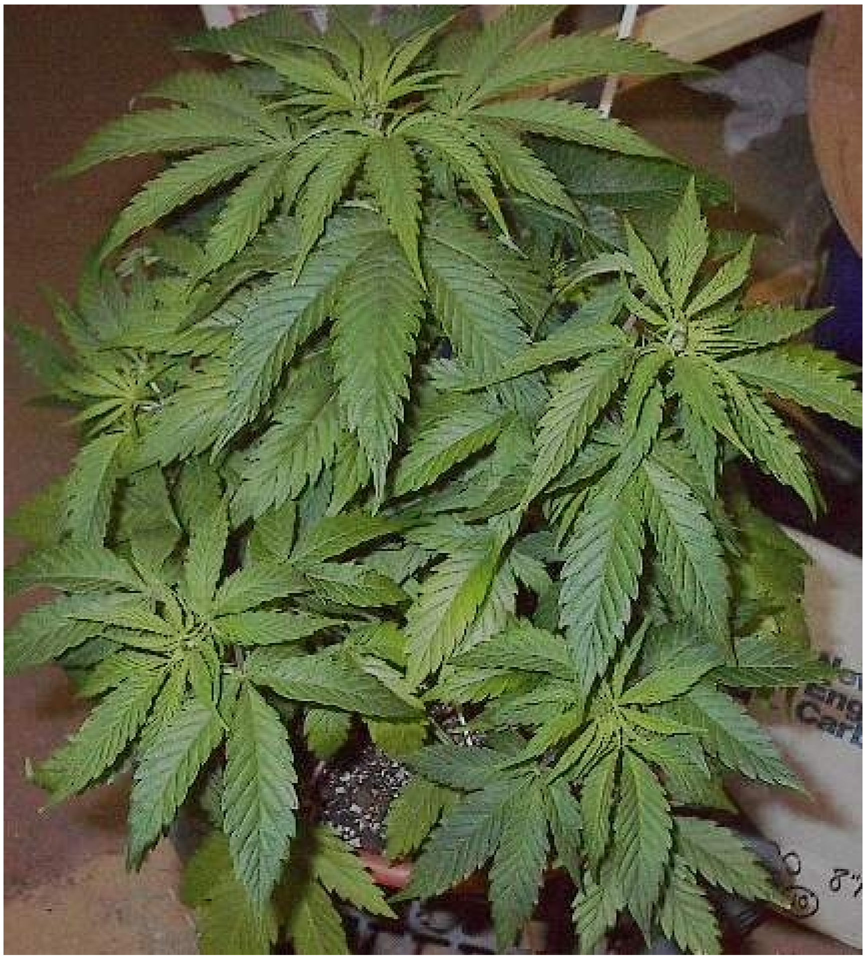
Start with the countertie down low. It should be opposite of the way the stem is leaning from the tie for training. Far enough over that it is leaning in the other direction. Put the next tie on the stem, above where the hurd was snapped. Pull the plant over like shown. These ties will remain in place for the duration of the grow, and may have to be adjusted if the plant grows too far off of one side of the planter. Several inches of movement in any direction from center is possible. These two ties will also have to be watched carefully to make sure they don't constrict the plant as it thickens. I use the twine because it has a lot of friction against itself and a single 1/2 knot is all that's needed for most branches.

The first two ties are pictured here:

Already adjusting to the new shape:

Its has some ties in place already, but when your done there will be a ton more. All the flower tops you see are at different heights before training.

This plant is several weeks older:



After:

All tops that have been pulled over will reorient themselves toward the light in a matter of hours. They'll also be at the same height.

Here is a side by side of a different picture. See the difference in the internode spacing? Some on the topped plants are 4" apart! The tied ones clearly have nodes all the way down the stem only an inch apart. You can also clearly see where the topped plant was cut. If this grower allowed the branches to grow unfettered, they would easily be a foot or more taller than the tied ones. Keep in mind these all had their training technique performed at the same time.

They do grow up to be pretty
similar even from seed:

The reason for doing all this:

An even canopy of buds just a week from harvest. That’s it, another viable alternative for small space and/or small light growers that want to maximize yield and focus all of their ladies' productive energy into unbelievable big buds.

Monster Cropping

Monster Cropping or Flowering Clones is another method of growing cannabis. This method involves taking clones of flowering plants and then forcing them to root and re-vegetate, which eventually leads to very bushy plants with a great number of branches and nodes. This technique has been coined Monster Cropping within the community because that is exactly what you will get, real monster plants, but also because this method was introduced to the scene by a grower named greenmonster714. He in turn credits a grower named Feral for discovering this technique. There is a long legacy of these legendary growing techniques to produce awesome frosty big buds...

Taking clones from flowering plants goes against all that has been said about cloning cannabis and might therefore seem a bit confusing at first but the science behind the technique is sound, and the results really do speak for themselves.

You start by taking clones of a plant that is about 21 days into flowering. This seems to be the best time to do it but you can also takes clones at a later stage with the same results. The lower branches make better clones as they have not yet become rigid and will also root faster and more easily than say the top cola. Move the new cutting into a glass of water and let it sit for a while in order to make sure that no air gets into the vascular system during handling, as this can be fatal to your new plant. You should make the cut so that it runs along the stem as this will increase the surface area for water and possibly nutrient uptake, depending on what method of cloning you use. Many growers have found that using a small hydroponic setup is by far the best way to clone cannabis plants.

In the picture below, you can see how the clone from a flowering plant been has placed in a propagation bubbler for rooting and re-vegging. This also means that you will have to put the clone back under a veg light schedule of 18/6, 20/4 or even 24/0. Clones do not need strong light so a small CFL will do. You can remove some of the buds at this stage in order to encourage the plant to revert back into its vegetative cycle but leave the topmost flower alone.

It will take several weeks for the clone to root (some never do) so it is best that you take a large number of clones at the same time. This will ensure that at least one survives to make it on to the next stage. It is also a good idea to place the clones inside a humidity dome, which can be bought at gardening stores or custom built for your specific needs. The high humidity (moisture) inside the dome will make sure that the plants do not dry out and die. Ventilate the dome every day just to make sure that the plants don't get attacked by mold.

Keep in mind that the most important thing when it comes to cloning is to provide the fresh cuttings with plenty of oxygen and that is why the propagation bubbler is so effective in this regard when compared to other methods.

The clones might be a depressing sight at first, but as soon as they root they will immediately revert back into the vegetative stage and start growing again. Once the clones have rooted properly and started flourishing again, they will put out single unserrated leaves at first (no worries - the normal leaves are soon to follow). It might be a good idea to apply some training at this stage, tying down some of the tops will encourage even more branching. You can also provide some heat underneath the clones as this will speed up the rooting process considerably.

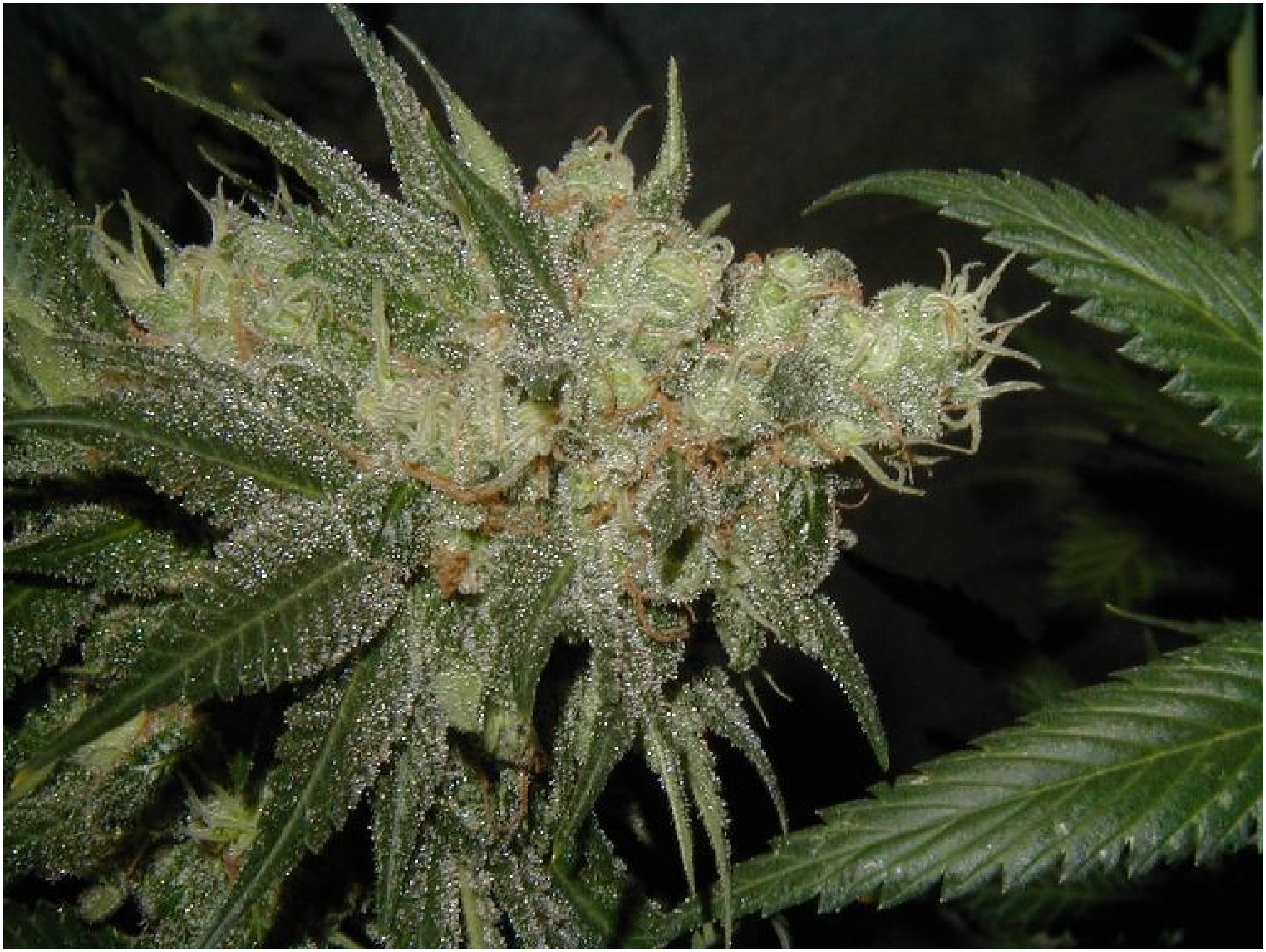
When the plant starts growing again, the incredible branching power of the flowering clone becomes apparent.

As you can see, this plant has grown into a real monster (and all this without ever topping the plant!). That's the beauty of this technique; you can forget all about topping and FIM'ing since the flowering clone will sprout all these new branches all by itself.

This plant is now perfectly suited for a ScrOG or perhaps even a SOG grow. This one plant can easily fill up an entire ScrOG net in no time. Several of these plants grown in SOG will definitely give you a grand harvest.

There are other benefits from using this technique; it also removes the need for keeping mother plants. When the newly re-vegged plant is flowered, it can also provide more clones for a perpetual harvest. Recycling at its best. This might be of interest to those who need to keep down their number of plants.

Needless to say, this method is highly effective thanks to the heavy branching that occurs after a flowering clone is re-vegged. With further training and some patience, you will get some real monster plants and thereby also an amazing monster of a harvest.



Common Growing Mistakes

Oftentimes people get extremely excited when they grow, and that's perfectly natural. Watching your tiny little seeds grow into huge flourishing crops is a really fun process that stimulates a lot of positive emotions inside. But these emotions can also cause many growers to overlook critical aspects of growing and cause them to do some very stupid things that end up severely hurting their grow. Below I have listed the most common growing mistakes that people will make during their first grow (and other more "advanced" growers oftentimes make these mistakes too!).

This section will save you loads of wasted time money, and effort. These mistakes are made by first time growers and the more experienced marijuana aficionados as well. By reading through this section you will have a through understanding of what to do and what not to do in order to ensure a completely successful, quality, satisfying grow.

The Top 11 Most Common Growing Mistakes

#1) Talking About Their Grow: Weed growing can be extremely exciting, but new growers must force themselves not to tell anyone that they are growing. Word can easily spread like wildfire and their newfound hobby may accidentally fall upon the wrong ears.

#2) Spending Too Much Money: Newer growers frequently commit themselves to unrealistic and expensive first grow setups even before they have mastered the basics of cannabis cultivation. It is much more effective to learn to grow properly on a basic setup and then invest in higher end equipment and advanced growing techniques when you have no idea what the hell you are doing. An experienced kid with a <$100 setup in his closet could grow better pot than a newbie with an $850 Aeroponic setup.

Key: Master the basics.

#3) Over Analyzing: The first time grower will be like a mother with their first born child. New growers commonly will watch every single little move their newborn “child” makes, and then freak out when something unexpected happens. It is important to pay attention to your plants, but do not excessively over-analyze them. Growers tend to worry and stress out at the first sign something might be going wrong. It is important to pay close attention to what happens during your grows, but do not try and find a remedy for every yellow leaf or crooked stem. The remedy of flushing your medium causes more problems than it solves. Be responsive and intelligent when things go wrong, but be conservative with your remedies. You don't want to end up doing more harm than good. Remember it is technically a weed and is one of the easiest plants to keep alive.

#4) Touching/killing Germinating Seeds: Newer growers tend to grow extremely impatient during germination. As you read in the Germination section, it can take up to 10 days for a seed to sprout. It is important to be delicate with your seeds and follow the proper germinating instructions outlined in this guide.

#5) Growing Seeds From Sketchy Sources: Newer growers tend to purchase flashy extravagant seed strains from underground questionable internet sites or from various other risky sources. Unless you are prepared for possible disappointments don’t use "unknown" seeds. This is why so many people recommend growers need to buy seeds from reputable seedbanks.

#6) Over-fertilizing: Oh man. If there were two spots for number one then this one might just take the cake. So many gardens are ruined from this mistake. A general safety rule is to fertilize after first 2 spiked leaves appear. It is also advisable to begin with ~25% of the recommended label strengths and work your way up. If the leaves suddenly twist or fold under, Leach and Spray with purified, distilled, or R.O. treated water for several days! Don’t fertilize your plants every time you water(soil)! A common watering schedule is to fertilize at full strength, then water at half or quarter strength. This prevents excess salt buildup, leaf and root burn. In addition, don’t water at full strength if the medium is too dry – root burn can occur. As a precaution, leach the plants with lots of pure water approximately every 2-4 weeks.

An all-too-common mistake for newbie growers when they reach the flowering stage is to start hitting the plants with a high Phosphorus fertilizers like 10-60-10, continuing to use this blend exclusively, and when their plants start experiencing a deficit of Nitrogen or micros as reflected by the dropping of lower leaves and chlorosis, they wonder why. Plants flower as a response to long nights, not because of fertilizer blends high in Phosphorus. A ratio of 10-60-10 is WAY too high in Phosphorus. The plant will only take what it needs and compete for other elements that may be more important to it at the time.

You may have heard that too much Nitrogen can inhibit flowering. No question about it, exclusive use of a plant food that is rich in Nitrogen such as blood meal, a 5-1-1 blend, or ammonium nitrate may inhibit flowering (especially if the phosphorous level is low), but most balanced blends have sufficient amount of Phosphorus to do the job. Manufacturers/horticulturists will give you element analysis and what effect the elements have on plant growth, but it is important to remember that this does not necessarily mean you will get better yields. Using a high Phosphorus fertilizer exclusively during flowering can actually work against you. It's an abundant amount of healthy leaves going into 12/12 that produce a lot of bud, not high Phosphorus fertilizers.

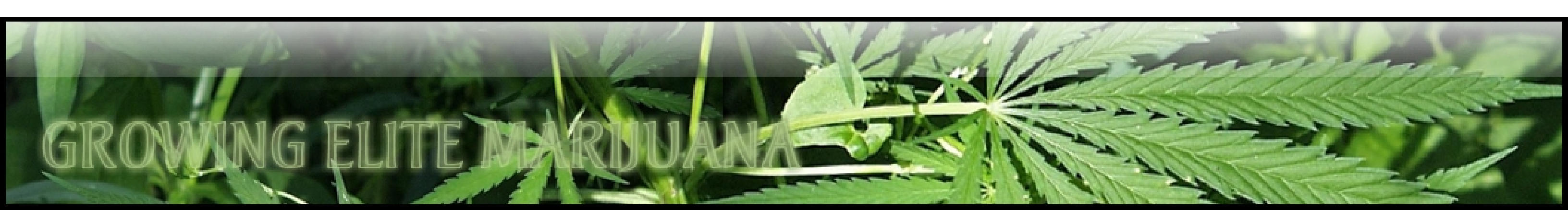
Rotate fertilizer blends as the plant "requires" them, not because it is "the thing to do." For example, when your plants are going thru the stretch phase during early flowering, they may need more Nitrogen, especially if you're getting some yellowing in the lower/mid leaves. Give up the cannabis paradigms, and give them what they need. Go back to mild high Phosphorus fertilizer when the stretch ends, maintaining the foliage in a healthy state of growth until harvest for maximum yields. A 1-3-2 blend such as 10-30-20, is one of the best flowering blends on the market because of several factors - it is higher in nitrate Nitrogen and Magnesium.

#7) Under-fertilizing: This occurs much less than over-fertilizing, but still a VERY common issue. This is common when growers become afraid to over-fertilize their plants. If you are one of the overly concerned and prefer to give the plant "just enough nutrients", then you can use an organic soil mixture with blood meal and bone meal or some slow release fertilizer with micro nutrients.

#8) Providing A Bad Growth Environment: Too many growers neglect the basics of keeping a healthy grow environment to ensure flourishing cannabis growth. Always provide air circulation and fresh air even during the night cycle. As a general rule of thumb all the air indoors should be replaced every 5-10 minutes to ensure optimal growth quality. Remember that even seedlings need a gentle fan to strengthen the stems. Do check for pests and fungus or any other plant diseases/abnormalities daily and handle accordingly. When doing this many newbie growers never check underneath their leaves surface, and this is CRITICAL.

#9) Harvesting Too Early: This is such a common mistake it's not even funny. Did you know that 25% of the weight will form in the last 2 weeks? When flushing begin with 100% pH balanced water when the pistils are 25% brown. Harvest when the plants have COMPLETELY STOPPED GROWING and the white pistils are at least 50-75% brown.

#10) Over-watering: Rarely do first time growers under-do ANYTHING, it's not their fault, they are just being too eager. Over-watering commonly kills many poor unsuspecting marijuana plants. When you first put soil in your plant lift it up to see how heavy it is, now remember how light it was and this will gauge you for the rest of the grow. Once the seed is in place water the plant and lift it again. As a general rule water only once the top few inches of the soil dries out. As soon as you pot your plant, judge its weight dry by lifting. Then, water the plant thoroughly until the water runs through the drain holes. Lift it again. When your pot feels as nearly as light as it did dry, it is time to water again. Hydroponics systems are harder to over-water than soil, mainly due to the abundance of water roots. When Rockwool is in combination with a hydroponic system; it has such excellent drainage properties. As long as the rockwool cubes are not sitting in liquid it is virtually impossible to over water a hydroponic setup. A hydroponic setup could either be watered constantly as the drip method, or once to three times a day as in the flood and drain method.



#11) Starting Too Early: This is bad for several reasons! If you are starting outdoors June 1st is perfect. But if I start earlier you will get bigger buds right? Wrong! It's strange but usually true. Plants started in early spring will get big but they will take significantly longer to start flowering. This is because at the peak vegetative period they sense the light cycles getting longer and longer, until June 21. But they don't realize that its time to flower yet. Finally in the middle of August the plant realizes it is time to flower so it produces buds in August and September or later. They will be tall as trees but thinner buds due to the fact that the sun is not as strong in September. Start at the appropriate times.

11

HARVEST

Harvesting Marijuana

Finally we have arrived!

A bountiful harvest is the payoff for all the hard work, research, risk, and investment you put into your garden (not to mention the long, patient wait). A properly executed harvest is essential to ensure the highest quality cannabis.

When To Harvest

Harvesting your plants at the precise time will allow for maximum bud growth and THC production (potency). After a certain point, THC will begin to break down losing quality and potency.

There are several important points to consider when choosing the optimum time to harvest your marijuana crop. There are different factors to consider between indoor and outdoor marijuana plants. There is the difference between Sativas and Indicas in bloom duration and final effect. There is the difference between early and late harvest to encourage head to body high. There is also the issue of chemistry because what we are really considering in terms of the ripeness relates directly to the chemical nature and state of the plant at harvest.

Some growers feel that harvest timing is a matter of personal preference. When the glandular trichomes are clear with very little, if any coloration, THC levels are at their peak with CBD and CBN both at levels that will not overly influence the THC with their sedative effects. Some prefer more overwhelming narcotic type effects, allowing the resin glands to cloud and begin to amber or darken to increase overall cannabinoid content. The resin glands appear and therefore will mature at different times. A compromise is made when determining the desired overall maturity level to harvest. It depends on the growers preference in effect and palate.

The "Window" For Marijuana Harvest

This term indicates the period during which the plant is at its optimum state of ripeness. The window opens when the plant is first ripe. Somewhere along the line the plant becomes over-ripe which signifies the closing of the window of harvest. For most Indicas grown indoors, the window of harvest is about two weeks long give or take a couple of days for various strains. Indoors, if going directly from an 18/6 hour vegetative light cycle to a 12/12 hour bud cycle, most Indicas take about eight weeks to fully mature. As to outdoors at the 45th parallel and the bloom times there. At the 45th parallel most Indicas to be at peak harvest starting at the beginning of October, sometimes very late September, and running until the end of October, sometimes running into

November during mild years or in a greenhouse. Many outdoor growers like to harvest Indica outdoors in the second to third week of October. For Sativa grown either indoors or outdoors, the window may be open much longer. Some Sativas take up to thirteen weeks to mature indoors. Outdoors many will go well into November and even December, if conditions are right (again, this is near or at the 45th parallel).

Type of High

An important consideration has to do with one's preference for a head high or more of a body high. A good head high can positively influence one's mental state much like a psychedelic; whereas a good body high is more similar to a narcotic "couch potato" effect. Generally, head highs tend to be more up and body highs tend to be more down. A good healthy mix of the two is a fine goal to achieve. Sativas and early window harvests tend to be more of a head high, whereas Indicas and late window harvests tend to be more of a body high. Given this rule of thumb you can pretty much come up with what you want. If you prefer a very psychedelic head high then an early harvested Sativa will probably be best. If a very narcotic body high is desired, then a late harvest Indicas would probably do best. For that best-of-both worlds high, experimentation with late harvested Sativas and early-to-mid harvested Indicas would be ideal.

Trichomes

When we speak of various highs experienced by different products, we are noting variations in plant chemistry. The chemicals we enjoy are produced within the glandular stalked trichomes, along the surfaces of the bud flowers (calyxes), bracts, leaves and stems, starting in or around the fourth week of the bud cycle. More and more of these trichomes develop as

the plant matures. As far as trichomes are concerned, the tall ones with swollen, clear, bulbous heads are what to shoot for. The denser the concentration, the greater the potency.

The best way to determine when to harvest is to examine the maturity of the trichomes - their level of maturity gives you an idea of both how mature the plant is and the effects you can expect from the plant if harvested at a given stage.

Trichomes are stalks with a head at the tip, it is the tips that you will look at. You will want to look at the trichomes in a couple areas over the plant to get a good idea of the plant's overall maturity. The tips start out clear, then later they will begin to cloud, finally the tips will turn amber. Clear trichomess aren't very potent; the ratio of cloudy to amber is really what you want to look for. The more amber the trichomes the more of body physical stone the pot will deliver.

A heavier ratio of cloudy will deliver more of a soaring mental high. All of this is of course relative to the general effects provided by the strain. Most harvest at 30-50% amber, professional growers recommended to never go beyond 75% amber.

Trichomes start out clear, turn a milky color, then turn amber (light brown). This is the "red hair" you see on fully matured bud. As the THC builds up in the gland, which holds the head, swells and strains the membrane. The gland begins to look like a mushroom.

On your first harvest, if you are having a hard time judging when to cut the plants down, a good rough guide as to when to harvest a plant is to wait until 50%-80% of the white pistils (hairs) have turned dark (usually brown or red) and about 50% of the trichomes start to turn amber.

WARNING: Almost all marijuana strains will have trichomes that will turn color, but some people who grow marijuana have come across strains that don't.

After Flowering For...

- A few weeks – trichomes start to turn a milky color.
- A couple more weeks – trichomes will be totally milky in color.
- The later stages of flowering – trichomes will turn a light brown color.

Note: The amount of time required to get to this point depends on the marijuana strain and the growing conditions.

Other Factors:

- Your plant stops producing crystals.
- Your plant stops producing resin.
- The fan leaves and lower leaves have turned yellow and are starting to drop off.
- The smell has reached its peak.
- Bud mass has not increased at all in the past few days.

When grown indoors most marijuana strains will be ready to harvest within 7-12 weeks after starting a flowering light cycle (12 hours on and 12 hours off). Most mainly Indica strains will be ready to harvest in 7-9 weeks. Mainly Sativa strains can take up to 12 weeks to reach maturity

If you are at the third stage of floral maturity with fully-formed trichomes, you can assume most strains have packed on all their final weight.

Use the guidelines spelled out below to help gauge the best harvest window for your plants based on the trichomes:

1) Fully-formed but still clear will provide a cleaner 'up' high with less sedative effect; this is the best window for heavy Indicas.

2) Fully-formed and turning slightly cloudy or milky; this is probably the best time to pick most hybrids available today.

3) Fully formed completely cloudy or milky with at least 30% of the heads turning amber; this is usually best window for the late maturing Sativa's such as Haze. This is also a good window when using the plant primarily for Hash production.

Viewing Trichomes

In order to properly examine trichomes you will need a pocket microscope or similar tool. 60x is perfect. I highly recommend that the serious cannabis student acquire a 60X power, handheld illuminated magnifier. Cheap ones can be found at most local electronics stores. With the aid of the magnifier one can learn more about the detail of trichome development and ripeness. The view of your buds is awesome!!

A 60-100X lighted magnifier is a tool any grower serious about harvest timing should have. They make it extremely easy to monitor the resin development process. A 100X magnifier will offer you an incredible view of your plant's trichomes - providing an enhanced perspective of resin gland condition and development.

One *very* popular, high-quality, handheld magnification device used amongst elite growers today is 420 Science's *420 Scope*. The 420 Scope is a powerful hand-held microscope specifically designed for the entire 420 community. Medicinal patients, growers and midnight tokers alike can use the 420 Scope to look for bugs, molds, mildews, ripeness, potency or simply just to admire the beauty of Cannabis. Bright, ultra-white LED light, 60-100X magnification, & long-lasting battery life. And it's only 24.95!

A 60-100x pocket microscope allows for a much closer inspection of the clarity, color and condition of the resin glands, which should be swollen and unbroken while remaining transparent and slightly amber, if at all, at the peak of ripeness. Some prefer harvesting earlier, as THC degrades to more sedative cannabinoids as the glands ripen. This is key.

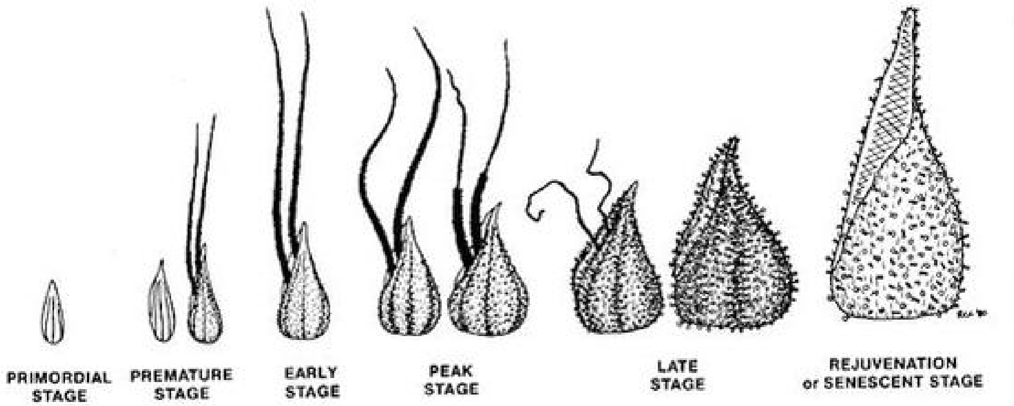
Many agree the ideal time to harvest the plant is when 3/4 of the white pistils hairs have turned brown. They should appear amber right before you cut the plants. If they are clear the resin has not reached full potency. If they are brown then the resin has already peaked and potency is declining rapidly. Be sure to look for the white hairs to turn red, orange or brown, and the false seed pods to swell with resins. When most of the pistils have turned color (~80%), the flowers are ripe and that is a good indication to harvest.

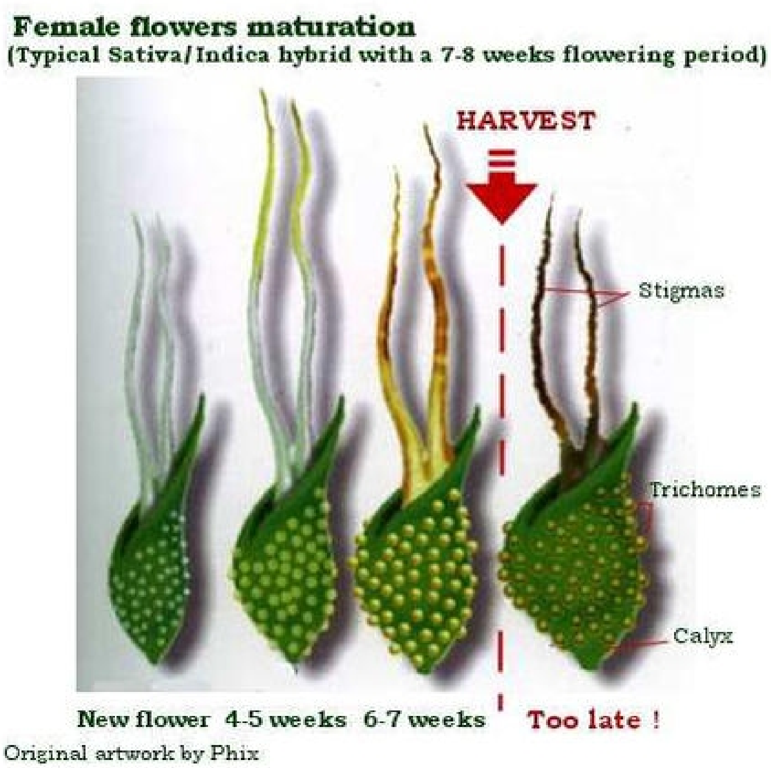
Warning: Don’t touch those buds! Touch only the large fan leaves if you want to inspect the buds, as the THC will come off on your fingers and reduce the overall yield if mishandled.

Plant Maturity for Frosty Buds

Starting in the third or fourth week of the flowering light cycle, glandular stalked trichomes will begin to form along the surfaces of leaves, flowers, bracts and stems. At the same time, more and more flowers (also called calyxes) develop into densely-packed floral clusters. The pistils of the young flowers are bright white and turn reddish brown with age. Typically, the pistils and flowers develop from the bottom of the bud to the top. The older, lower pistils are the first to turn reddish brown. For most basic Indicas this usually happens by the sixth week in the flowering cycle. It is about this time that the calyxes begin to swell.

Calyx swelling is a major indicator of peak maturity. The lowest, oldest calyxes swell first and the swelling works its way up to the highest, youngest flowers on each bud. At peak maturity about 90% of the calyxes will almost look seeded they are so fat. Three quarters to 90% of the pistils will have turned reddish brown as well. For a basic Indica, this happens well into the seventh week of the flowering cycle.





By the end of the eighth week most of the calyxes will have swollen and a surge of trichome development has coated most of the buds. Patience is key during these delicate stages. The ripening signs for most Sativas are highly similar, except extended over a longer period of time. Occasionally, some Sativas have windows of peak harvest that actually open and close. That is, for a week or so the plant may exhibit signs of peak ripeness. However, a week later the plant may have a growth spurt, which lowers the trichome-to-fibre ratio and overall potency for a little while. Usually a fibrous growth spurt is accompanied by a trichome increase. Again, time and experience are the key elements in determining the perfect harvest time.

Changes In Chemistry

As the plant matures through its "window" of harvest its chemistry changes. As the window closes, the more desirable compounds begin breaking down into less desirable ones. Primarily it is THC breaking down in CBNs and CBDs. Which particular combination of chemicals is the most desirable is purely a matter of taste and choice, developed over time and with experience. Set and setting also play an important role in determining which type of product is best appreciated. Pleasant head highs are often desirable for social occasions, whereas a narcotic late-window Indica may work better as an evening medicinal herb. The main point is that these differences are chemical in nature and more research is needed to more fully understand this phenomenon. Another important point is that much can be done to further enhance the chemical process, especially in regard to bouquet, aroma and flavour (that is, as long as the proper curing process is followed).

The Best Time to Harvest

The question of when to harvest cannabis plants is a question that puzzles many new growers. Most farmers' goal is to pluck the fruit at the exact moment when the potency of the bud is at is peak. Realistically, the skills needed to detect the specific day (or even hour) when a plant is at its peak can only be acquired through years of experience. However, even the novice grower should be able detect the window of time during which the harvest results in premier crop of outstanding dank bud.

Maturity and THC: Most growers consider the plant to be mature when the percentage of THC found in the plant reaches its maximum. It is not practical for the average grower to actually measure THC in a plant, as the chemistry is somewhat complex (not to mention measuring THC requires practically a full blown laboratory and is quite a daunting task indeed!). In a growing plant, each successive pair of leaves contains more THC than the previous pair. The budding tips of the plant contain the most THC of all. Both male and female plants contain THC. Some research has shown that in the early stages of growth the males actually contain more THC than the females. Many growers feel it is worth cutting and sampling shoots before the THC has reached its maximum.

Plant Size: The size of the plant has little to do with its maturity. Outdoors, a plant might reach a height of over eight feet (2.5m) and still not be ready for harvest. Indoors, mature, budding plants can be under 18" (.5m) high.

Photoperiod: The age of a plant has little to do with its maturity level. How quickly a plant matures is mostly dependent on the amount of light the plant receives each day (photoperiod). Typically, a plant will transition from the growing (vegetative) stage to the budding stage when the light per day drops below 12 hours. This is not to say that a 3-week-old seedling will begin to bloom when the light is cut. As a general rule, a plant must be a minimum of 60 days old before it is mature enough to respond appropriately to decreased light. For indoor growers, the decision on when to cut the photoperiod depends on available growing space, as well as the need to harvest weed. Some growers report that clones (cuttings) can be forced to bloom prior to 60 days old, perhaps since the cutting itself is somewhat mature at the time it is rooted.

Male Versus Female: Almost always, male flowers will show prior to female buds. Thus, once the males in the garden are detected, you can be sure that that the female budding process will start soon - usually within 1-2 weeks.

Different Varieties: Many gardeners report that certain cannabis varieties take longer to mature than others. In particular, the narrow-leafed Sativas are said to take significantly longer to initiate and complete budding, as compared to the wide-leafed Indicas. Under some conditions Sativas will require an additional month or more to mature after the Indicas have been harvested.

Time of Year: Obviously, indoor growers cannot use the seasons as a guide to harvesting (though a cold winter-time grow room can significantly retard the growth of the plants). Outdoor growers on the other hand can use the seasons as a predictor of the ideal harvest time. In the Fall, once the length of day drops below 12 hours, the count-down to harvest will be begin. Weather conditions will affect the exact harvest day from year to year, but generally you can expect to harvest within the same two-week window each year. If you can avoid it, don't harvest during or immediately after a rainy spell.

Monitoring Buds: The best way to tell if the plant is ready is to examine the bud. In the paragraphs below, the terms "pistil" and "stigma" refer to the white hairs in the center of the female bud. The term "calyx" refers to the pod that would surround the seed. Many growers like to pick each bud individually, as it reaches it prime. "Buds are at their peak potency about one week after flower formation slows...Harvest the plants when about half the stigmas in the buds have withered... When the plants are left in the ground, the resinous qualities of the plant may become more apparent. The bracts and tiny leaves may swell in size...The resin content of these buds may be higher, [but] the grass will smoke more harshly than if the buds were younger when picked." *Frank and Rosenthal "Marijuana Growers Guide" pg 289, pg 295.* "In the primordial calyxes the pistils have turned brown; however, all but the oldest of the flowers are fertile and the floral clusters are white...Many cultivators prefer to pick some of their strains during this stage in order to produce marijuana with a clear cerebral, psychoactive effect." *Robert Connell Clarke "Marijuana Botany", pg 140.* "Eventually the pistils start to turn color from pale white to red or brown...When the glands have swelled and the pistil has receded into the false pod, the bud is ready to pick." *Ed Rosenthal, "The Closet Cultivator", pg 100.* "At the peak of florescence, all but the oldest of flowers have white pistil development...Another indicator is bouquet. When a plant is at the peak of florescence, it has a sweet and musky fragrance. Later, it loses the sweetness." *Kayo, "The Sinsemilla Technique", pg 125.* "The best way to harvest is to examine the resin glands on each bud. As they turn from clear to amber, that is the optimum time to pick. Buds usually mature from the top down, if grown under artificial light, and you will end up with more high-quality pot if you pick each bud when ready. However, the plant will not just continue to produces buds at the same rate. Like any other plant, the flowering cycle lasts a specific period of time. If you wanted a further harvest of buds, the plant would need a second cycle of vegetative growth. This can be achieved indoors by simply turning the lights back up to a 24 hour cycle for a few weeks. Outdoors though, you are dependent on the seasons. Frost and long nights will usually kill the plant. Of course, such a strategy is only variable if growing a few plants. If your operation runs on an industrial scale, just drive the combine harvester through the field."

Conclusion: If you're new at this don't worry; as you gain more experience in growing particular strains you will have a good idea of when it will be ready to harvest. You can also check with who you get your seeds from who can tell you what the average harvest time is of your particular strain.

Harvesting Your Buds

Welcome to the funnest part of growing marijuana, Harvesting! Harvesting is the exciting part of the process when you get to reap your hard-earned rewards. First and foremost, if being discreet is a problem and you have any smell concerns I would like to warn you that Harvesting really really smells. Harvesting will spread that potent marijuana odor into the air very quickly, so be warned if smell is a major concern for you.

There is way more to harvesting marijuana plants than simply cutting them down. Plants are cut down at the stems below the base(below the lower leaves) with a sharp clean knife or hack saw.

With a small indoor or outdoor garden (less than 15 plants) it can take a few hours to harvest, manicure, and hang the buds to dry. There's really no way around it as the plants must be manicured and hung to dry immediately after they are cut down. This can be time consuming for sure.

Note: Make sure you set aside a steady 6 hours of time to work undisturbed the first time you harvest a small garden. If it's a large garden (more than 50 plants), make sure you leave yourself a full day to work.

Flushing

Right before harvesting, the plants should be fed plain water only with absolutely no nutrients (or fertilizer if you're using soil). This is to remove any fertilizer that has built up in the actual plants themselves, and the hydroponic media or soil they were grown in. After the plants are harvested they must be manicured and dried.

It's important to know when the plants will be ready to harvest because prior to harvesting you will need to remove the fertilizer (nutrients) contained in the plants. The plants themselves and the hydroponic media or soil the plants were grown in will store some of the nutrients that have been fed to them.

Marijuana plants need fertilizer so they can grow and mature to produce THC. In order to remove the fertilizer from plants, you feed them plain water (with no nutrients) for one or more feedings just before they are harvested. This is called flushing.

Note: Tap water tends to have lots of chemicals (recent studies found traces of antibiotics, anti-convulsants, mood stabilizers and sex hormones in drinking water in the Southern California region), it is best to use distilled/purified water or water treated with reverse osmosis for this purpose.

Don't be concerned where the plants are getting their food as they will use up the fertilizer they have stored in them (growth does not slow down). That is if you do it correctly. If you do not flush the nutrients from the plants, the resulting marijuana will taste bad and may be very hard to ignite.

If you have been growing the plant on organic nutrients then there is seldom a need to clear the plant since it has not taken up any foul tasting chemical nutrients. The extra N stored in the foliage will have been used up(translocated for budding fuel) as part of the natural process of final budding.

When growing hydroponic marijuana, start clearing about 7 days before harvest. This can by done easily by changing the solution and using only distilled water or water treated with reverse osmosis (NO NUTRIENTS!). Some growers even change the water two or more times before harvest because there's a chance the media may still hold nutrients after the first flush.

With soil, same pure water rules apply above but instead of 7 days you need to change the water 14 days before harvest. Avoid slow-release fertilizers because they are hard to remove. If you have your heart set on using slow-release fertilizer, not to worry just replace it with regular nutrients for the last month.

Oh and if you're growing in soil here's a trick to speed the drying process: you can stop watering the plants 2 days prior to harvest.

WARNING: DO NOT stop the flow of water to hydroponic plants. If you do they will WILT ad begin to DIE within a few minutes to a few hours!!!!! Not cool dude.

It is best keeping as many leaves green on the plant until week 5 or 6. Then, metabolize the remaining minerals present in the plant during the final 2 or 3 weeks. Total dissolved solids in the final flushing solution is between 400-500ppm. In hydroponics, it is important not to reduce the solution ppm much lower, as this will shock the plants by causing reverse osmotic pressure on the roots. The plant stores excess nutrients in the plant tissue, that are available for photosynthesis. If there is a lack of available nutrients to the roots, the plant will access these reserves and the final product will burn,
smell and taste far better.

For quality flushing & for making sure your harvested buds taste sensational, many growers(including myself) swear by Botanicare's Clearex as one of the best cannabis clearing solutions currently available.

What To Cut

So its harvest time!!! But, you do not know where or what you should cut and how to go about it. Well the truth is that this is mostly personal preference.

Regardless of how you cut and trim your plants touch the flowers as little as possible and avoid breaking up the buds. Damaging the delicate trichomes will reduce the potency of the marijuana a lot. One way to safely handle your plants is to leave the plants in their pots (more or less intact) and spread out a couple news papers. Toss large sun leaves on newspaper and do small bud trimming over the other.

Start with the sun leaves and then trim progressively smaller. This way you will have less in your way. For now, leave the buds on your stems. For trimming the buds, first take all the tiny popcorn lower buds and put them where you are going to put your trim.

Next trim the actual bud leaves, this trim will have lots of trichomes so should be saved to make hash oil, butter, or something else so they don't go to waste.

To trim the bud leaves, simply clip off the stem to remove it. Then begin to trim in a circular motion around the bud until you have cut back to the sugar coating. Trimming past this point is just wasteful. Don't worry if they look fluffy or leafy, they will dry and cure into sticky potent buds if you've done everything right.

This should leave you with all the buds on a nice thick stem network that is suitable for any drying/curing process you want to use. Some drying processes will involve just clipping at the main stem and hanging upside down to dry; others will require you to further break down the plant into smaller bud pieces.

When you cut be sure to leave enough stem for you to handle and work with the flowers - you can (and likely will) trim down the stem later and a dried stem doesn't weigh a significant amount compared with dried bud. Also, you will find that you can trim the large top buds into smaller buds one node at a time. It is better to leave as large of a single bud mass as possible.

WARNING: When plants finally mature, they are in their most vulnerable susceptible state to mold. Mold can be disastrous. Mold formation begins inside the bud and grows outward, making it invisible until it is too late. Molds can wipe out an entire crop overnight. Maintaining a low humidity during the final weeks of maturity will greatly reduce the chance of a mold attack!

Harvesting via Cutting

You'll need some pruning shears, some real sharp sturdy scissors, some type of clothes line type of set-up that you can hang the plants on, a smell proof room that's dry and cool and if possible a T-55 silkscreen to work over when your doing the manicuring.

You can harvest the plants by cutting them down at the base of the stem with a pair of scissors, sharp clean knife, hacksaw or some other cutting tool, just above where the plant meets the hydroponic media or soil. This allows you to harvest the entire plant at the same time. You can also wait for each individual branch to mature and cut it off separately. Try to leave a few inches of stem at the base of each bud. If you do, it will be easier to hang the buds to dry. If you're a very spiritual person be sure to thank Mother Earth for the plant before cutting it!

If growing outdoors due to the constantly changing growing conditions, you can not assume a particular strain will be ready in the exact amount of time each time you grow it. Harvesting outdoor plants (that can grow up to 12 feet!) produce massive yields. These plants tend to be a challenge to harvest, as it is in no way easy. In order to harvest your outdoor marijuana plants you will need a canvas spread or some other material you can use to wrap up and properly carry the bud in. Begin by chopping the plant at it's base and spread it out on the canvas. Next roll up your canvas or other material and tie it down tight to ensure a safe transport.

Harvesting via cutting procedures for sativa and indica are slightly different, we'll go over the key differences and steps for harvesting these now.

Harvesting Indica Step-By-Step

Step 1) Your 1-4 foot plant should be cut at the base, turned upside-down, and hung in a cool room with no light and plenty of fresh air.

Step 2) Using a pair of clippers remove as many of the fan leaves as you possibly can (you can also remove the big leaves by hand).

Step 3) Next remove the secondary small leaves (around the tops) and place these in a separate pile.

Step 4) Next step is to gather the trim from the actual bud ("trim" is the tiny leaves surrounding the bud that are covered in resin).

That's all there is to it!

Note: For precision cutting you can buy a machine. Even the smallest tops can be cut away without any problem using one!

Harvesting Sativa Step-by-Step

A Sativa harvest is slightly harder than an Indica harvest, and takes a little bit more work but is so so worth it. It is done in the same way as an indica harvest basically.

Step 1) Cut your plant at its base and hang it upside down in a cool room with no light and plenty of fresh air.

Step 2) Take your pair of clippers and remove leaves (you can also remove the bigger ones by hand) and trim as mentioned in the harvesting Indica section.

Note: Sativa plants tend to be very bushy. You may have to cut the branches and hang these up separately. Also be sure to keep your room dark as light will degrade your precious THC quantities. Try not to expose your harvest to any direct light as much as you can.

After the marijuana plants have been harvested it is now time for the next part in the cultivation process, we need to manicure them and then dry them. Leave the plant as it is until you can easily break a branch between your fingers, once you can do this, you are ready to cure the bud.

Manicuring

After all the plants have been harvested, it is now time to manicure them - it's time to remove the buds from the branch and remove the rest of the leaf material as best as possible. This is what is referred to as "manicuring" of marijuana buds. Manicuring, simply put, is cutting off the leaves that were growing from the buds. Cut off all the leaves surrounding the bud, so that just the bud remains. Manicure immediately after harvest when plant leaves are still soft and supple.

Trimming immediately also increases drying times. Simply put this is the process when we remove the non resin-covered fan leaves around the buds before hanging. These do not contain high concentrations of THC. This is a very time consuming process, but you will find if done properly and with care it produces more potent, less leafy, better looking buds. This can be done before or after drying, but you will find it is much easier to do it before.

WARNING: Remove the entire leaf stem! If not it can attract moisture and attract mold.

Tear fan leaves away from the stock while handling buds as little as possible. (In fact, do not touch them at all for a great selling point " buds never touched by human hands!") Continue to trim protruding leaf tips from the buds. The degree to which you trim your buds is a matter that is entirely personal choice.

A good time to begin manicuring is when your plants are *nearly* dry. When they are too dry, many of the glands will fall off with handling. When there is moisture most of the glands will remain intact.

Work over a smooth surface such as a glass table. This will make it easy to be able to see and collect all the material that has been cut away from the buds. It is lower in THC than the buds, but rather than throw it away you can make hash oil.

(Fore more information please see the Hashish section.)

When manicuring your buds, be sure to use a pair of scissors with small blades (to reach the hard to get leaves) that is comfortable. If you have a small crop, you can handle the plants with your bare hands. For the larger crops, be sure to wear powder free latex gloves.

If you want to consume the resin, be sure to place the latex gloves in a bag and then place it in the freezer for 2-3 hours. The trichome resin can easily then be peeled from the latex gloves and consumed the way you would use hashish.

If it is absolutely necessary, you can postpone manicuring the buds. However, the job will take even more time if you choose to wait. Manicuring right after the plants are harvested will also speed up the drying process tremendously.

Note: At this point the buds should be a little moist, including the inside of them. Some can be smoke-able at this point, you can get even better smelling and tasting buds instead of smoking marijuana directly after it is harvested and manicured - it's best to dry and cure it. Most newbie growers are in such a rush to try the marijuana that they don't want to dry the crop, or they might even be tempted to put it in the microwave – BAD IDEA. Why? Read on.

Drying

After trimming it is now time to dry out buds. Drying and curing marijuana is a critical step in the growth process. During this stage you can lose, preserve, or cultivate odor, flavor, and potency. Odor and flavor must be carefully cultivated. The drying and curing process allow the plant to purge sugar and if desired to purge chlorophyll (although some have developed a taste for the chlorophyll in the plant). Improperly dried and cured marijuana can lose almost all of its original potency and lower potency marijuana can be concentrated to slightly higher potency if handled properly. Four things reduce the potency of marijuana those things are exposure to light, heat, damage to the plant tissue, and air. Additionally, marijuana that is not dried and stored properly can contain too much moisture and grow mold. It is important to remember that many rapid drying techniques will dry only the outside of a compact flower and that slow techniques like curing may be needed to draw that moisture to the surface. The virtue in drying and curing as with all stages of growing is patience. Initially drying can be preformed free hanging or enclosed in cardboard boxes or paper bags, both of which will act as a desiccant.

Drying can be performed by taking the branches and hanging them up side down so the fan leaves droop and cover the buds. During this step you need to put the branches in a cool dark place (not humid) with enough good ventilation. You probably don't want to smoke marijuana that is harsh and tastes bad. If you don't take the time to dry the bud, you will not get the best possible smell and taste your crop is capable of producing. If you dry your buds too fast it will make your buds smell like pine needles, hay, and taste very bad. Proper drying and curing also ensures the maximum potency of the marijuana you have grown. Hanging your marijuana upside down in a cool dry place of total darkness is essential for potent buds. This way all the leftover THC is forced down into the buds. Marijuana is typically not potent just after harvest – some of the THC is in a non-psychoactive acidic form. Drying marijuana the right way will also convert the non-psychoactive acidic compounds into psychoactive potent THC.

The area where drying is done should be completely dark. Light and high temperatures(anything higher than 80°F (26.6°C)) will cause the THC to break down and lower the potency of your finished product.

We're going for making the dankest buds we can here, so this step is CRUCIAL.

Air Drying

Air Drying is probably the most popular method of drying marijuana today (and for good reason!). It can be very well controlled - by controlling the amount of airflow, you control the speed of drying. The most common technique of air drying is to suspend the plants upside down in a room with a circulating fan blowing (but not actually blowing on the plants themselves) to keep air moving.
Another technique to put the buds on a half open drawer or tray in a place with moving air. The further along in the drying process the more you close the drawer to reduce airflow.

A simpler way to dry the marijuana is to put the buds in a layer in a brown paper bag. This is simpler but faster and therefore the output is less desirable. The speed in this process is a trade off. If you dry too fast then it will take longer to cure the marijuana properly. If you dry too slowly you will be exposing the marijuana to more air therefore reducing potency. Many growers shoot for about seven days drying time. If you are not going to cure the marijuana the plants should be dried until the stems snap easily rather than bend. If you are going to cure then you can begin with slightly more damp (but still mostly dry) marijuana.

How To Dry Buds

In order to dry the crop is to hang the buds upside-down from their stem, from a string or wire that has been secured to a wall or any other stationary object. You can use nails, screws, thumbtacks etc to attach the string or wire to whatever it will be held to. Make sure your setup is secure enough to be able to hold the weight of the marijuana that is going to be hung drying on it. Nails or screws in wood is typically very sturdy and recommended. Make sure you leave enough room between the plants for air to properly circulate.

It is good idea to check up on the buds every day to watch for signs of mold and mildew and correct the problem if it happens. After the fan leaves droop down over the flowers and turn crisp or break off easily, you would want to start trimming off the fan leaves only.

The drying marijuana must have some circulation blowing over it at all times. Proper ventilation is CRUCIAL. A gentle breeze that circulates all over the plants is necessary. A fan or two will circulate the air within the drying room perfectly. Fans aid in drying the plants evenly and reducing the chances of mold forming on your buds. If mold is prone to grow due to your drying environmental conditions, it can ruin all of your crop. Mold looks like white fuzz or white spots and has a distinct unpleasant odor.

WARNING: NEVER ever smoke moldy buds, as this can make you very very sick and might even kill you!

Optimal Drying Environment

A dark cool drying environment is critical. ANY light that touches your buds will at once begin to degrade it's THC content.

In order to ensure optimum drying results, you are going to have to keep the temperature and humidity within a certain range for optimal results. Conditions should remain somewhere between the following ideal ranges;

Temperature: between 65-76°F (18.3 to 24.4°C).

Humidity: between 45%-55%.

If the temperatures lower more than 65°F (18.3°C) the drying time will be lengthened. At temperatures higher than 75°F (23.8°C), the heat will cause the other portion of the bud to dry quicker than the inner part and as a result the taste will suffer.

At a humidity lower than 45% the marijuana will dry way too fast and the taste will suffer. If the humidity rises higher than 55%, the marijuana will take a long time to dry and will be prone to mold.

To measure these levels, be sure to keep a hygrometer and a thermometer in the the drying area very close to the plants. A hygrometer allows you to keep tabs on the relative humidity level in the room and a thermometer will display the temperature. Some hygrometers have built in thermometers so you can measure both temperature and humidity at the same time. Depending on the time of year and your current location, a heater or an air conditioner might be necessary to adjust the temperature.

To control the humidity levels a dehumidifier can lower the humidity and a humidifier can be used to raise it. There are two types of humidifiers – warm mist and cool mist.

A warm mist humidifier raised the temperature while a cool mist humidifier doesn't affect the temperature at all. There are also humidifiers that allow you to switch between a warm or cool mist. If you're going to purchase a humidifier, be sure to take your climate into consideration and then go ahead and buy an appropriate humidifier to suit your individual needs.

Warm mist actually heats up the water and releases warm humidity. Cool mist water isn't cooled, it just means that water is not heated. In most cases a cool mist works best. If you're not sure and want to be safe then go ahead and grab a humidifier that lets you switch between warm and cool mist.

Typically the ideal time it takes is two weeks to dry the crop between temperatures of 65-75°F (18.3-23.8°C) and relative humidity between 45%-55%. Never rush the drying of your buds (that is, if you want to make sensational bud!) A bud is completely dry, cured, and ready for consumption when the stem in the middle of the bud snaps (rather than fold) easily with the fingers. The snap is easy to detect with practice. You can test a little bit(about a half a gram or less) in a joint if you want to be absolutely sure it is dry enough. The surface of buds should be dry to the touch.

Note: Good ventilation in the room will allow buds to grow faster, but any air that is directed at buds will cause them too dry out too quickly. Make sure you don't dry it too much (hard crisp stems will snap way too easily) this can lead to a harsh smoke. In time you will get a feel for the perfect drying methodology, no worries.

WARNING: Light will rapidly decompose THC! So ALWAYS keep harvested marijuana in darkness as much as possible.

And remember, you can use all sorts of little tricks and methods to increase drying time, but ultimately – the longer and slower your buds dry, the smoother the smoke will be in the end.

The bud will smoke smoother if it takes around a week or more for the moisture to evaporate; quicker drying will harshen the taste and degrade the burning properties. So please, for the sake of your smoke (and your buds!) take your sweet time. It will pay off in the end, I promise.

Peeling Stems For a Faster Dry

If you MUST dry your buds faster then peeling stems is a *much* quicker way to dry the product. The first day of drying you would normally cut all fan leaves off and score the main stem with a sharp knife. Peeling the stem exposes the inside of the stem to air, cutting drying time by up to ~33%. You can do this scoring ritual everyday for 5 days until all is dry.

Re-moisturizing Dry Buds Step-By-Step

Should a sample of bud become over-dried before proper curing is complete, many different techniques may be used to slightly re-hydrate the bud and continue curing as normal. Fresh buds, orange or lemon peels, lettuce, apple or many other fresh fruits and vegetables can be added to a sealed jar of pot to allow more moisture to diffuse into it. Plain water either sprayed directly on or applied via towel to the buds is also a good way to re-moisten them.

Be very careful when re-moisturizing buds though, because sometimes the re-moisturizing material can carry pathogenic fungi and bacteria, which if not monitored carefully, can destroy your crop. Venting, checking, turning, and even re-moistening of buds is necessary so that the proper moisture content to promote curing is present, slow even drying is the optimum process for curing cannabis.

Adding moisture to a smoking bag of over-dried, crispy buds is easy! All you need is a sealed container (A Ziploc bag or a glass jar works just fine), fresh fan leaves and about a days time.

Step 1) Put your over dried buds into a Ziploc bag or a 1 quart mason jar (a jar being the better choice).

Step 2) Add a few freshly cut fan leaves (fresh shoots work great too) to your jar or baggie. Use about 3-5 leaves to half a mason jar. Start with a few leaves; add more leaves as necessary. Fan leaves will become dry and shriveled when they give up their moisture.

If fresh leaf is unavailable, a small piece of lettuce, or apple/orange/potato peel can be used as well. A paper towel with a few drops of water on it also does the trick.

Step 3) The final step is to wait about a day. How long it takes depends on how much is in the container and how dry the buds were. It can work as fast as 5 hrs.

Check the container at least once a day. The buds will have a nice, soft texture will not feel crispy or brittle when they are ready. They will smell better too!

Note: To re-moisten larger amounts of dry bud, simply scale everything up. You may want to separate large and smaller buds into separate containers. Once a day, turn the pile of buds over to expose the bottom buds. Check for any signs of rot. The process may take 1-3 days.

Recycling Cannabis

It is possible to harvest plants and then rejuvenate them vegetatively for a 2nd and even 3rd harvest. A second harvest can be realized in as little as 6-8 weeks. Since the plant's stalk and roots are already formed, the plant can produce a second, even third harvest of buds in a little more than half the time of the original harvest. When harvesting, take off the top 1/3rd of the plant. Leave most healthy fan leaves in the middle of the plant, cutting buds off branches carefully. On the lower 1/3rd of the plant, take off end flowers, but leave several small flowers on each branch. These will be the part of the plant that is regenerated. The more buds you leave on the plant, the faster it will regenerate. Feed the plant some high nitrogen plant food immediately after harvest. When you intend to regenerate a plant, make sure it never gets too starved for nitrogen as it is maturing, or all the sun leaves will fall off, and your plant will not have enough leaves to live after being harvested.

Harvested plants can come inside for rejuvenation under continuous light or are left outside in Summer to rejuvenate in the natural long days. It will take 7-14 days to see signs of new growth when regenerating a plant. As stated before, and in contrast to normal growth patterns, lower branches will be the first to sprout new vegetative growth. Allow the plant to grow a little vegetatively, then take outside again to re-flower. Or keep inside for vegetative cuttings. You now have two or three generations of marijuana growing and will need more space outside. But you will now be harvesting twice as often. As often as every 30 days, since you have new clones or seedlings growing, vegetative plants ready to flower, and regenerated plants flowering too.

Regenerating indoors can create problems if your plants are infected with pests. It may be best to have a separate area indoors that will not allow your plants to infect the main indoor area. An alternative to regenerating indoors is to regenerate outdoors in the Summer. Just take a harvest in June, then allow the plant to regenerate by leaving some lower buds on the plant, and leaving the middle 1/3rd of the plant's leaves at harvest. Feed it nitrogen, and make sure it gets lots of sun. It will regenerate all Summer and be quite large by Fall, when it will start to flower again naturally.

Curing

Curing is essential in order to smoke marijuana without damaging your lungs and for getting the best taste possible out of your buds. A fan leaf will be an okay smoke, the middle leaves a little bit better, the trim is very good, and the bud is obviously the PRIME that will give you the best quality euphoric high.

The last critical step is to create a way to bring out the full flavor and best smoke possible from your marijuana buds. This is the final step in which moisture is redistributed throughout the bud. If left dry bud will dry from the outside-in. The problem with this is that by the time the buds center becomes dry, the outside will become overly dry – it is crisp and crumbly. In order to dry the center without over-drying the outsides, your buds will need to be cured. To cure the marijuana crop, you're going to need to get your hands on an airtight glass jar container or plastic bags. These will distribute them moisture evenly throughout the bud. Glass is recommended because most plastics will impart a gross taste to the marijuana. Containers that have a rubber seal work best, but any tight fitting lid will do. One quart canning jars work great if you're curing a few pounds or less. They have a rubber seal and hold about 2 or more ounces of marijuana per jar. Cool beans. When the buds feel firm and crisp, it is time to seal them in an airtight light proof container and stored in a cool dark place.

The sweet spot is when marijuana is dry enough to be stored in room-temperature airtight containers without growing mold, and being moist enough (wont break down and crumble when handled) to ensure a sensational smoke.

Curing and Potency

Curing can seemingly affect potency because often the first time the buds feel "dry", they really aren't. Once they start to cure and sweat, you will see how much moisture is left. Curing is mostly for aroma and taste, but the first week after "drying" will still have some effect on the potency as the bud fully dries.

Drying bud converts crude acidic THC from its nonactive form into a neutral pH psychoactive substance. Each THC molecule has to lose it's moisture content in order to become fully psychoactive. When the water exits the bud, the THC becomes slightly different in molecular structure. Heating can make THC readily active by immediately vaporizing the bud's moisture content away. However, aging is equally as important too. First the bud is "dried", but can still contain some moisture within. By using the "cure", the THC slowly becomes psychoactive. Curing builds a more uniformly dried bud with a better burn and taste.

Almost all the THC converts to the usable psychoactive cannabinoid over the allotted time without the degradation gotten from heat drying the bud quickly. The bud that has equalized "cured" moisture content throughout will give the bud a nice firey glow when burned. Cured buds pack in bowls easier and break down into blunts and joints without difficulty. Hash that has been cured forms a beautiful rhine around the outside with a rich creamy inside. Cured bud and hash is great and worth the trouble. The taste is awesome as all the excess chlorophyll has been broken down. A smoother smoke is created. Curing bud makes it more tasty and much more enjoyable to use than it already is.

How To Tell When Buds Are Dry Enough To be Cured

There are many variables to consider when it comes to drying-time: humidity, temperature, air-circulation, bud-density, bud-size, manicure/trim, and the method of drying are all major factors.

Establishing an environment that promotes slow and uniform drying is key. Whatever drying method you prefer, maintaining cool temperatures and low humidity is essential for preserving flavour/aroma.

- Using a fan assists in keeping temp/humidity levels constant.
- Evaluating the "crunch" of the stem is a good technique when assessing whether or not buds are ready to be cured. When the stems snap, instead of bending, they are ready to be jarred and stored in a cool, dry, dark place. Another method of judging dryness is to bite the stems and evaluate the crunch this way; your jaw is more sensitive than even your fingers.
- You can also grind/cut/break up a bract from the center of a larger bud, and roll a joint with it; if it is smooth-smoking, with even-burning properties, then the rest of the buds should be ready for curing.
- Once the correct dryness is attained, place the buds into an air-tight container/jar, filling it as much as possible to expel as much air as possible, and cure to your favorite vintage!

The Best Way to Dry & Preserve The Cure For Smooth, Sweet Buds

Commercial growers take the colas from the plant and manicure them before drying. They usually dry them on a line, upside-down, which is fine. However, usually airflow is forced, temperatures too high, and humidity too low. As soon as the buds are considered dry (usually within a few days), it is sold. The reason for this behavior is the fact they are “commercial” growers and in a constant hurry to exchange their buds for cash. Every minute counts and they don't want to 'waste' the space or the time needed for drying and curing. This results in harsh, grassy tasting weed that lacks the full-bodied flavor and smooth stone of properly dried and cured bud.

To Do It Right: At harvest-time all you have to do is cut the plant as low as possible and hang the whole thing upside down to dry on a line. The room you use to dry should be the about the same size you grew in (if not the same room). Reminding you from earlier - the humidity should remain a constant 50-60%. Too high and buds will mold, too low and they dry too fast and taste bad. Temperature should be around 65-68°F (18.3-20°C), wherever possible. Make sure the room is dark, as you learned that light degrades THC pretty quickly.

All kinds of processes, like the transport of sugars inside the plant still take place, even when you cut it down. These processes will slowly come to an end while the drying progresses, but are the main factor for the end-taste of your smoke. That is the first reason why you don't want to quick-dry your weed. The second reason is the way that a plant dries. Plants are made up of cells and, as we all know, cells contain mainly water. Exposed to air, the (dying) plant's outer cells will dry out first but the above-mentioned processes will still transfer water from the inner cells to the dryer outer cells, thus causing the plant to dry equally all over. By removing the stalk and cutting off the individual colas, you prevent this natural process by taking away the extra moisture that would be drawn from the stem to the leaves and bud.

Make sure you hang the plants so that they do not touch each other (invites mold). With constant temp and humidity, the plants should be ready for manicuring in 3-4 weeks. At this time trim colas from the main stalk, and trim large and medium fan leaves (save them for making hash), leaving most of the smaller leaves sticking out of the bud in tact. Hang them up again and for a day or two, until 'popcorn' dry. The stems should snap when you bend them, and the bud should be dry, but not brittle.

Curing Properly: Trim all remaining leaf (save for hashmaking) tight to the buds, and trim smaller buds from larger stems. Store them airtight; air at this point degrades THC.

Note: Ziplock bags are not airtight! You could use buckets with an airtight lid like used for food and sauces and such, but the best containers are those glass jars with the rubber seal and latch.

Just put as much bud in it as possible using light pressure. The point is to fill it as much as possible, so not too much air remains in the container. The less air, the better. To be safe, check them the next day to make sure it's still dry (did not “sweat”). Any excess moisture at this point will invite mold. If it did sweat and is moist (soft) again, lay the bud out on something other than newspaper and put in a dry place to get the last water out. Repack and place the container in a cool, dark place, like a refrigerator. Fridges have high humidity so they must be absolutely airtight. The longer it sits (up to around a month, maybe longer in the fridge) the better it gets, both in taste and potency.

At around the month mark, you can move it to the freezer to almost stop the aging and curing process. Once you've got some buds stored in the freezer, you have a private stash that will last a long time. If you've got the patience to wait, the smoke will be sweet and smooth. The high will be mellow, and longer lasting. If you grew enough to last you a while, then after a few harvests you will be able to have properly cured buds at your disposal, with no downtime waiting for the next batch to cure! If you're not in a hurry to sell your crop you owe it to your head to wait the extra time and have great tasting, very potent bud! Curing is the only way to make harvested bud more potent, so try it, you won't be disappointed

Once you have learned how to grow a crop the next step is to cure it. You don't want to always smoke weed that's harsh and bad tasting. Here are some basic tips and a few advanced ones you can experiment with. Preparing the harvest curing the crop adding flavors.

Preparing The Harvest

Curing your harvest is an important step in the cultivation process. Many new growers are so eager to try the product they don't even wait for it to mature. They cut off buds that aren't ripe and dry them out fast. I've heard of people putting buds in the microwave because they couldn't wait for them to dry. If taste, aroma and maximum potency is important to you then you want to cure your buds and not just dry them.

The First Steps: Preparations must be made well before curing begins. The experienced grower harvests his crop when 50% - 80% of the pistils have turned color. If you have grown out the strain before you have a good idea when they will be ready. Don't forget to flush! Remember - the growing medium and the plants themselves store some of the nutrients you have given them. This will give a nasty taste if you harvest without clearing it out. Excessive nutrients will also make the buds hard to burn. This can be done by changing the solution and using only plain water. Some growers will change the solution twice because the rockwool or grow rocks may hold a little. With soil you need to change to plain water at least a week and preferably two weeks before harvest depending on how much soil in each pot. Don't use slow release fertilizers because they are very hard to clear out.

Note: Outdoor farmers who need to use slow release can time it and use just liquid fertilizers toward the end.

So by now you have harvested right at the peak. You cleared out the nutrients beforehand and you have fragrant, spicy highly potent buds you want to preserve.

Curing The Crop

Immediately after the harvest comes the cure. The reasons for curing and not just quick drying your crop are to make the herb sweet smelling and increase the quality of smoke. You want it mild not harsh and you want a good smell and flavor. After all that work don't ruin it with a too quick cure. A good “proper” cure lasts for from 3 to 8 weeks but satisfying results can be had in two weeks or so. Some growers cure their bud for years! The idea is to remove the water slowly enough to let biological processes take place that convert the sugars and starches into harmless and flavorful compounds. Sugar or starch will give a harsh smoke that hurts the lungs. Plants need sugars to live on and they produce them from fertilizer and sunlight.

This curing process also breaks down some of the chlorophyll which gives herb it's green color. Too much chlorophyll gives an unwanted leafy vegetable taste.

Your main enemy when you are curing is mold. After pot is dried it's not very susceptible to mold but you have to maintain a certain level of humidity to let the curing process do it's work. The way you control humidity is by controlling how much ventilation you allow. You want some ventilation but not too much. Too much and it dries out without curing properly, too little ventilation and you may get mold. If you see or smell the slightest sign of mold you must immediately stop the cure and let it dry out. If mold is unchecked it can destroy your crop in short order. Mold can be detected by sight and smell. It looks white usually and will be fuzzy. If you see it in one part you can be sure the spores are all over so you may as well let it dry. Mold also has an odor which is always nasty. Never never smoke herb that has mold on it.

You want to avoid light and heat at all times with your crop after it has been harvested. Light will destroy it and temperatures over about 80°F (26.6°C) are bad. The best place to store it is in the freezer or fridge. If that's not practical a cool dry dark place will do. You need an enclosure to put your crop in for the cure. Depending on the size of you crop you can use a cardboard box, a closet or an unused room. With the cardboard box you want to hang the plants from a string. Don't just dump everything into the box because the plants on the bottom won't get enough air and may turn moldy. Many growers put string across the open top of a box and tape the ends to the outside. They then would crisscross several strings and attach the plants with twist ties. Make sure the box is tall enough for your plants. If it's not tall enough you can cut the plant in half or even cut off each branch and hang it in the box. The plants or branches should be loose and have some space between it and the next. It doesn't take a lot of space just as long as air can circulate.

With a closet you do the same thing. You might want to put nails or thumbtacks in the walls for the strings or the clothes hanger bar may be enough. If you are using a whole room you need to set up something to keep the plants hanging upside down off the floor. The first few days you allow more ventilation and as the plants get dryer you allow less. In the box leave the top off, with the closet leave the door open and if you use the whole room leave the door open and use a fan to blow air in. After one or two days you will have lost a good bit of moisture and you can begin to restrict air flow.

Put a section of newspaper over the top not quite covering the whole top of the cardboard box. As the cure progressed cover the top more and more. As soon as the leaves began to get stiff cover the top completely. They still got a little air because the newspaper was not airtight. With a closet after a day or two close the door all except for a couple inches. As the cure progresses and the plants get drier, close the door completely. Almost all closets have cracks around the door that air can come through. If you have a very large closet treat it like a room. When using a whole room to cure, after a day or two of letting the fan blow air in, close the door part way. With the room cure it's a good idea to have a fan inside moving the air around and another fan in the doorway blowing fresh air in.

Watch the plants very closely to see how fast they are drying. As soon as you notice a little bit of stiffness to the stems they have lost probably 50% of their moisture. When the leaves start to get a little bit crisp you have lost most of the excess moisture and you must restrict ventilation some more. Using a whole room at this point you turn off the fan blowing air in but you leave the door open a little. You never cut off ventilation completely because mold is a threat right up until the end. The leaves should start to get a little crisp after a week or two. If it happens sooner you may be using too much ventilation and should cut back.

Along about this time you should notice a very nice smell. This is the curing smell and it smells a little like baking bread along with a piney or fruity or skunky smell from the pot. This is the nice smell you want your herb to have. If you notice the least bit of a nasty or rotten smell it is probably mold and you need to check very closely. After the leaves start to get a little stiff and you have restricted the air flow it takes anywhere from a week to 6 week more to finish it. When to stop is up to you. You might want to decide by the color of the herb. It gets less green as it goes along. Buds will retain the green color longer than will the leaves. Buds may still be green at the end of the cure but not quite as bright a shade of green.

You will be the proud possessor of a stash of sweet smoking, good tasting buds without the harshness of fresh cured smoke.

Adding Flavors

People pay a lot of money to get seeds they think will grow pot that smells like blueberries or chocolate or something else. Often these strains are hard to grow or may not be as potent or high yielding as other less expensive varieties. People want to know if orange bud smells and tastes like an orange. With the proper techniques you can make your favorite variety smell and often times taste like anything you want. You want to do this without ruining the cure. It's no point having blueberry pot that burns your throat or doesn't get you high. Do not pour any syrup or similar flavorings on your pot. The sugar will make it very harsh and you are inviting mold. There are better ways. The best flavor enhancing starts while the plant is still growing. You can do a certain amount while it's curing and you can even affect the smell/flavor somewhat after it's been cured. There are two main approaches, inside out and outside in. You can apply flavors inside the plant while it's still growing and you can try to add flavors after it's been harvested but this is from the outside. Anything you put in your plants water will affect the taste of the finished product particularly if you harvest it right afterwards. Many growers learn this lesson the hard way. One grower even reported fertilized using fish emulsion right before he topped the plant. Bad move! His resulting top smelled like fish and had a foul taste. Yuck.

What you want to do is select a flavoring that is very concentrated. Lets take orange for an example. You could use orange juice but if you could find concentrated orange extract you would have less pulp etc to deal with. You will find some concentrated flavor extracts in the grocery store. Want your pot to smell like vanilla? Vanilla extract is cheap and readily available, so is lemon extract (cooking variety). Other extracts can be found in stores that specialize in baking supplies. Lets say you can't find any of that and you want to use what you have on hand. I took the example of orange flavoring. If all you have is orange juice you could use that. I would suggest filtering it first to get out as much of the pulp as possible. A coffee filter works well but it'll take a while to filter it all. You may have to change filters a few times. Those with hydroponic units will shudder at the thought of a lot of goop going through their system. That's why I suggested the concentrated extracts if you can find them. It's important to do this shortly before harvest. For one thing, most extracts including the ones you make up yourself have a lot of sugar in them.

This sugar will ferment and decay rapidly, even more so in a hydro unit. With hydro I recommend putting the flavoring in the water between 1 and 3 hours before harvest. This rule isn't set in stone but I heard from one grower who used a sugar based clearing solution on his crop and less than 24 hours later the water was foaming from bacteria growth. Plants draw up solution fairly quickly so one hour should be enough for some of the flavoring to reach the top. Three hours should not be enough time for bacteria to grow but you will want to dump out the solution right afterwards and clean out your unit. Use plain water for a few days before harvesting your hydro crop so all that will be in the water will be the flavoring.

If you are a soil grower it's even easier. You might think it would take longer for the flavor to work it's way through the plant but this is not the case. All you have to do is let the plant dry out a little before your apply the solution. In other words schedule a watering just before harvest. Naturally you were giving your plants plain water for several days to a week or two before harvest weren't you? Give the plant the water with the flavor when it's a little bit thirsty and it will draw it right up. One hour is more than enough time for this to happen. After harvest it's important to give it a good cure. Resist the temptation to fast dry some of the weed to try it out. You will find it's even more harsh than it would be normally because you have added some sugar to the plant by way of the flavoring. The curing process will take care of the extra sugar and give you nice mild smoke. It will also have the flavor and aroma you are looking for.

What some people think is a nice hint of strawberry may be way too strong to the next person. What one grower thinks is very blueberry may not smell or taste like blueberry to his friend. I suggest that you don't treat your whole crop this way while you are experimenting. Soil growers will find this easy because they could use something different in each pot. Hydroponic people may want to isolate a plant or two with the solution. This wouldn't be very hard because you wouldn't need circulation for the short period of time it would be soaking in it. Other things you could try are guava, pineapple, grapefruit, passion fruit, cherry, mint or even pina colada. Stronger and more concentrated flavorings will have a more pronounced effect than more dilute products. You may need gallons of orange juice to get what you want but a half ounce of concentrated strawberry essence might do the job nicely.

In short, experiment and see what works for you. The other approach is to use something in the curing process. People have had good results with orange peel, lemon peel or other citrus peels. This will only give a bit of odor, it's not as strong a technique as the previous one I mentioned. For those who just want a hint of something this may work fine. It's important to watch very closely for mold when curing. The moisture from the peels may promote mold if you're not careful. Let the herb dry for a day or two before you add the peels This might work a little bit with pot that's already cured and dried but it's less effective at that point.

Water Curing

Water curing is an innovative idea. The resin in marijuana is not water soluble, so everything in the plant that is water soluble is an impurity. Water curing involves taking dry marijuana and submerging it in distilled (or at least not chlorinated) room temperature water (room temp is important, heat degrades potency and cold will make trichomes brittle). Change the water daily. This can be done for anywhere from 3-14 days and results in a dark chocolate brown marijuana. We marijuana is wet marijuana and the same slow drying techniques should be used to remove the moisture from the marijuana the second time around to insure complete drying.

Curing & Potency Level

Curing does affect marijuana potency in a very positive manner. Curing cannabis after harvesting for few days to several months will improve the potency, as well as the taste and texture of the buds. As you know; curing takes place after cannabis has been harvested, manicured and partially dried.

Most cannabis will retain a significant quantity of moisture within its stems and inner buds even when the outside feels dry. This is especially true for very dense buds, more care must be taken in drying loose airy buds because sometimes they can dry too fast.

Cured Buds Undergo a:

- Reduction in Chlorophyll content.
- Reduction in plant starch content.
- Reduction in nitrate levels.
- Loss of moisture.
- Loss of volatile terpenoids, and the polycyclic aromatization of other terpenoids.

There are several process and effects which take place during curing that can rationally and scientifically explain the increase in potency and improvement of the smoke in cured material:

Moisture Content: Moisture is essential for the curing process, it is both your friend and enemy. If too much moisture is left in the buds, with out the regular mixing, venting and turning of buds involved with curing, molds and bacteria can quickly form and ruin the taste and potency of your stash. On the other hand, without the necessary moisture metabolic processes essential to curing do not take place.

Fresh cannabis plants are around 80% water(all %s by weight); curing generally begins after the cannabis has lost half of its initial mass, and contains approximately 33% of its initial water.

Once curing is complete and the pot is dry, it should still contain 10-15% moisture, approximately 2-4% of its initial water. This is an ideal because most bacteria and molds can not grow below 15% water content, and below 10% cannabis buds tend to powder.

Cannabinoid Conversion: Naturally, as the metabolic processes continue during curing, the conversion of cannabergerol to tetrahydrocannabinol will continue and the potency of the pot will increase. This is because cannabergerol(CBG) is the non-psychoactive precursor for tetrahydrocannabinol(THC). Of course, the exact change in THC content will necessarily be dependant upon the concentration of CBG in the fresh material at harvest. Of course any remaining precursors necessary to form additional cannabidiol(CBD) and other cannabinoids will also be consumed and converted.

Be aware though if curing is excessively prolonged (most connoisseurs would agree after 6 months no more benefit could be had from curing), the conversion of THC to non-psychoactive cannabinol (CBN) will occur. The exact rate of decomposition can vary widely depending on handling and storage conditions, but can be less than 10% to greater than 40% decomposition per year.

Continued Metabolism: Also as these metabolic process take place, the plant needs energy which leads it to consume the sugars, starches, nitrates, and minerals. Many of these compounds are metabolized and released as water and carbon dioxide, therefore removing what is essentially inert material from the pot increasing the concentration of cannabinoids therefore making it more potent.

Much of these positive metabolic processes can be most effectively begun with thorough flushing and stripping of the plant before harvest. This will help reduce the amount of time necessary for a good cure.

Curing will not only improve potency, but the color and look of most cannabis buds because as the chlorophyll is broken down purple, gold, and white coloration can emerge and the trichomes will appear more pronounced.

Decarboxylation: Some decarboxylization will take place during curing as well. This happens when the carboxyl group (COOH) located at C-2, C-4, or the end of the hydrocarbon chain at C-3 is destroyed leaving a hydrogen attached and liberating CO2.

Decarboxylization is necessary to convert cannabinoids to usable psychoactive forms; the plants (and your body) carboxylize cannabinoids to make them more soluble in water (for metabolic reactions and excretion).

Research indicates that this effect is fairly minimal during the curing process though. Decarboxylization will take place naturally very rapidly at temperatures of over 100C. So smoking and most any cooking will decarboxylize the cannabinoids. As decarboxylization occurs, the loss of CO2 will liberate a small amount of inert material making the pot more potent via concentration of the cannabinoids.

Taste & Odor: Terpenoids are the highly volatile compounds that give marijuana much of its characteristic odors, and therefore tastes.

The most current research also suggests terpenoids lend to the high, sometimes very significantly. Cannabinoids are phenolated terepenes so its not surprising that many hundreds of different terpenoids are synthesized as well.

As pot ages, some of the terpenoids go through polycyclic aromatization in the process of decomposition. This agglomeration of terpenoids will change the flavor; hence the ability of cured pot to show flavors that didn't seem present in the original fresh material. Much of the very volatile terpenoids will also evaporate and or decompose, especially with prolonged curing or storage. This action will remove some matter from the pot increasing the cannabinoid concentration and therefore potency. It must be noted that excessively long curing or storage, higher temperatures, or extremely low moisture content will cause such through evaporation of the terpenoids that the cannabis will generally loose almost all of its natural flavors.

Fermentation: When vegetation dries, the individual cells which maintained life processes die. But marijuana can still be conditioned by means of fermentation. Fermentation is the process in which microbes and plant enzymes break down complex chemicals into simpler ones, mainly starch and sugars into alcohol and simple acids. In the process chlorophyll is destroyed, giving the material a more ripened appearance. If the fermentation is stopped early, the marijuana has a sweeter taste because of the sugars which the ferment produced.

Fermentation occurs when the moisture content of the marijuana is raised above 15 percent and the temperature is above 60°F (15°C). The more tightly packed the material, that faster the ferment proceeds. The rate of ferment is controlled primarily by varying the moisture content, but each batch proceeds at its own rate because of differences between plants in nitrogen content. (Nitrogen is necessary to maintain fermenting bacteria.) The process is delicate; should the ferment proceed too rapidly, the marijuana may be converted to compost. Watch the fermentation closely. After the desired colour or flavour (from a dried sample) is reached, dry the grass quickly to stop the process.

During fermentation, flavorings can be added to give the marijuana a spicy aroma. Such spices as cinnamon, cloves, ginger, mace, sage, or vanilla are placed between the fermenting material. Orange, lemon, or lime peels are also used. About half an ounce of spice or four ounces of peel are used for each cubic foot of material to be fermented. The spices are wrapped in cloth sachets. The citrus peels are strung. They can be placed between the layers of marijuana.

There are two types of fermentations: self-generating and forced. They are best used with leaves or immature plants.

Self-Generating Fermentation: Self-generating fermentation proceeds rapidly only when there is enough material to make a heap at least one cubic yard large. When smaller quantities are used, too much of the heat generated by the bacteria is dissipated, so that the process is slow and is more properly considered aging.

Place the material in a large container or in a pile with a tarpaulin placed over it, and lightly spray it with a mister if it is dry. Let the pile heat up for a few days, and then break it down. If it is repacked, the marijuana will develop a dull matte appearance and lose its sugars. IF the process is allowed to proceed even further, the marijuana will disintegrate.

Forced Fermentation: Forced fermentation can be used with small quantities of material. It requires an enclose chamber in which heat and humidity can be regulated. Pack the marijuana loosely in a kiln or other chamber, and raise the temperature to 135°F (57.2°C). Maintain humidity at 75 percent. Check the progress of the ferment periodically. Within a week the ferment should be completed. During this ferment there is a release of ammonia compounds, resulting in some foul odors, but upon completion of the ferment and drying, the marijuana should smoke sweet and mellow.

Curing With Glass Canning Jars Step-By-Step

This method for glass canning jars gives the strongest aroma and best texture for smoking. Here's the procedure, it couldn't get easier:

Step 1) Cut, manicure, hang your plants in a cool, dark place until totally crispy and smokeable in a joint – usually will be for 5 to 8 days. Optimum conditions are 68-74°F (20-23.3°C) and between 50% and 60% RH.

Step 2) Place bud gently into wide-mouth glass canning jars. Close the lid until buds sweat (usually 2 or 3 hours the first time). Open jars and let buds dry to crispy again. If you are curing larger buds you have to get some air in there and turn the buds over. Larger colas usually have enough flow around them so you don't have to mess with them too much unless they are really touching each other inside the jar. Be gentle.

Step 3) Repeat the sweating process - open the jar until crisp, close until sweated. After about a week of this (depending on location), you get to that perfect point of curing where there is enough moisture to keep it smelling strong but as soon as you take it out of the jar to smoke, it crisps up and can be rolled.

Storing Marijuana

When curing and storing your precious buds that you have waited so long to finally enjoy, the single most important investment you can make is a quality container. The absolute best container for curing and storage of cannabis buds is an all glass jar, with a large opening for easy access. Wide-mouth jars with glass bodies and tops with a rubber seal are an ideal choice. Never store cannabis in plastic! Always glass. Generally try to avoid all plastics in direct or close contact with your cannabis - these materials are slightly porous and the phenolic acids and terpenoids can react with plastics, leaving your buds a bitter aftertaste. This never happens with glass. With a proper rubberized top, glass containers also offers tighter seals(which means creamy-centred, incredibly potent, tasty preserved buds).

Using a wrong container means a cruddy cure and bitter-tasting weak buds. As featured in High Times Magazine, 420 Science has created specialized medicinal marijuana storing jars to guarantee elite bud preservation. These high-quality containers contain hermetically-sealed lids and are made of 100% Italian borosilicate glass. These superior containers ensure your buds *stay* super fresh.

420 Science's 420 Jars come in all sorts of sizes (up to a monster size 1.5 gallon!), colors, and designs. You can even totally customize any cool artwork you want on the outside!

So in order to store your marijuana properly, gently handle and place your fresh marijuana into the containers (you may have to cut the buds to size if they don't fit) and then seal the lid. Store the containers in a dark area where the temperature is between 50-65°F (10-24.4°C) and the humidity is between 40%-60%.

It's recommended to open up the containers 3-6 times daily for a few minutes to allow moisture to escape by fanning with your hand. Also shake the bud around a bit every couple of days. If any moisture builds up on the inside of the cap, wipe it off. Also, give the buds about a quarter turn once a day. This will ensure that different parts of the buds are exposed to the air in the container, maximizing drying effectiveness. Continue to do this for 7-10 days. When properly dried, marijuana will burn evenly when smoked in a joint (if all the stems are removed that is).

If using glass, the taste will be of supreme quality and the THC will have finally reached a point where it is ready to be ingested or stored. You don't have to keep opening the containers to release moisture after the initial ~8 day curing period.

If you're planning on storing your buds for a year then they should definitely be sealed in an airtight container and stored in a location that is dark and cool. A freezer works best but it is totally fine to store them in a fridge, basement, or closet. Just remember in order to preserve the marijuana potency at the maximum level then storing marijuana near light, air and heat are the things you want to avoid.

It is not recommended to store your dried buds in the freezer. Some of the THC can become easily damaged when frozen. Refrigerators also contain too much humidity. If you can somehow control the humidity levels in your refrigerator then this is an acceptable storage location.

If you plan on storing your marijuana for a few months or so then you will need to purchase a vacuum sealer (for sealing food) to seal the marijuana in a completely airtight sterile environment. If stored in a dark area that is between 40-55°F (4.44-12.7°C), the the marijuana in vacuum sealed plastic will keep your buds potent, healthy, and "vintage" for up to 5 years!

Note: If marijuana is stored in an area of high humidity (such as the beach or tropical climate), even vacuum sealed marijuana can eventually become as humid as the surrounding air. No worries, as long as you kept a close eye on it and no mold was allowed to form on your buds this just means you'll have to dry it again before smoking. As long as there is absolutely ZERO mold then the humidity itself will not degrade the THC quality.

WARNING: Make sure your storage environment is DARK. Any light will degrade your precious THC.

Final Storage tips:

Potency during curing and storage can be maintained by observing some basic precautions:

- The buds need to be kept in the dark, protected from light, which will quickly decomposes the THC.
- Moderated temperatures should be observed during curing, 50-75°F (10-23.8°C) being ideal.
- Excessively hot temperatures will promote oxidation and the growth of mold and bacteria, and very cold temperatures can prolong curing and drying for up to several months.
- During storage, buds should be stored as cold as possible, if temperatures of 32°F (0°C) or less are to be used, make sure the bud is dried to a very low moisture content before storage (to ensure that cell

walls are not burst by the freezing water).

- If prolonged storage is planned evacuating the oxygen and replacing it with carbon dioxide, nitrogen, argon, nitrous oxide, or any other inert gas will help slow oxidation, as well as the addition of antioxidants such as ascorbic acid packets or vitamin C tablets.
- The most stable way to store cannabis is as whole unbroken buds or unpressed trichomes. Excessive rough handling or pressing can easily damage the protective cell walls and plant waxes that help protect cannabinoids from oxidation.

Regeneration/Rejuvenation

After a seedling has been grown to maturity and the buds are harvested, you may realize you want to perpetuate a plant you neglected to take cuttings from. This is possible through a technique known as *regenerating*. The regeneration process begins at harvest. High grade favorable plants that have already been harvested can be forced back into the vegetative cycle and then into flowering. There is no seed preparation, cutting, planting, or re-potting involved. To regenerate, rather than cutting the plant down at the stem as you would normally during harvest time, you leave it intact with a few branches. Be sure to leave some vegetation and growing tips on the plant to increase its survival rate.

Cut the main stalk down to the point where below which several growth tips or buds are remaining. Return the plant to a vegetative fertilizer and constant photoperiod. Over the next several weeks, the plant will elongate and develop new upward growth. It is very important not to overwater the plant after it has been cut back. The reduced above ground plant structure is still being fed by the entire existing root system, which can cause an excessive amount of water uptake and the resultant stress associated. The use of fertilizers containing some ammonium form nitrogen, such as chicken manure, will encourage rapid growth and stem elongation. Trace element supplements, co2 and strong light are helpful.

Once the plants are pruned, leave the lights on continuously. The plants will switch into vegetative growth and start to grow in about 1-2 weeks. They can be forced to flower once more when they reach their desired size. A common method is to first grow the plant indoors and then after harvest regenerate it outdoors in the spring.

Pruning Regenerated Plants

Plants that are regenerated, cloned and even grown from seed will need to be pruned at some point to encourage the plant to produce as much as possible and remain healthy. Pruning the lower limbs creates more air-flow under the plants in an indoor situation and creates cuttings for cloning. It also forces the plant's effort to the top limbs that get the most light, maximizing yields.

Plants that are regenerated need to have minor growth clipped so that the main regenerated growth will get all the plant's energy. This means that once the plant has started to regenerate lots of growth, the lower limbs that will be shaded or are not robust should go. The growth must be thinned on top branches such that only the most robust growth is allowed to remain.

One nice aspect of regenerating plants is that some small buds left on the plant in anticipation of regeneration will not sprout new growth and may be collected for smoke. The plant may provide much smokeable material if it is caught before all the old flowers dry up and die with the new vegetative growth occurring.

Try to trim a regenerated plant twice. Once as it is starting to regenerate, collect any bud that is not sprouting with new growth and smoke it. Then later, prune again to take lower clippings to clone and thin the upper growth so that larger buds will be produced. If a regenerated plant is not pruned at all, the resulting plant is very stemmy, does not create large buds, and the total yield will be significantly reduced.

Hashish

Since so much time, labour, and cost has gone into the production of each plant, growers do not overlook utilization of the "shake" or leaves. Extraction involves the process of removing the essential oil, THC resin, from the leaves remaining on the plant and those removed during pruning.

Hashish is a psychoactive drug derived from the Cannabis plant. It is solid, of varying hardness and pliability, softening under heat. Its colour can vary from reddish brown to black, and can also be greenish or golden. It is usually smoked in pipes, and sometimes in joints mixed with tobacco or Cannabis buds. It can also be added to cookies or other food and ingested. Hash is used for its relaxing and mind-altering effects. Many people have claimed that using it gives them enlightened insights.

Hashish is comprised of the compressed trichomes collected from the leaves and flowers of a mature, flowering Cannabis plant. Certain strains of Cannabis are cultivated specifically for their ability to produce large quantities of trichomes, and are thus called hash plants. Trichomes are small glandular hairs containing plant resins which appear on the leaves and stems of the Cannabis plant.

Hash oil is a solution of tetrahydrocannabinol, but is a misnomer in suggesting any resemblance to hashish. It is made out of cannabis and is very potent due to its high THC concentration, which generally varies between 15 and 20%, but can reach 60 to 70% in some cases.

Hash oil is most often dropped on a cigarette or a joint, or it is mixed in food (such as brownies or Scooby Snacks).

Production

Hash oil is produced by allowing a solvent to dissolve the psychoactive cannabinoids that are present in marijuana. These cannabinoids remain behind when the solvent is subsequently evaporated, leaving a relatively pure, high-potency form of marijuana. The color and odor of the resulting extract will vary, depending on the type of solvent used. Current samples of hash oil, a viscous liquid ranging from amber to dark brown in color, average about 15 percent tetrahydrocannabinol.

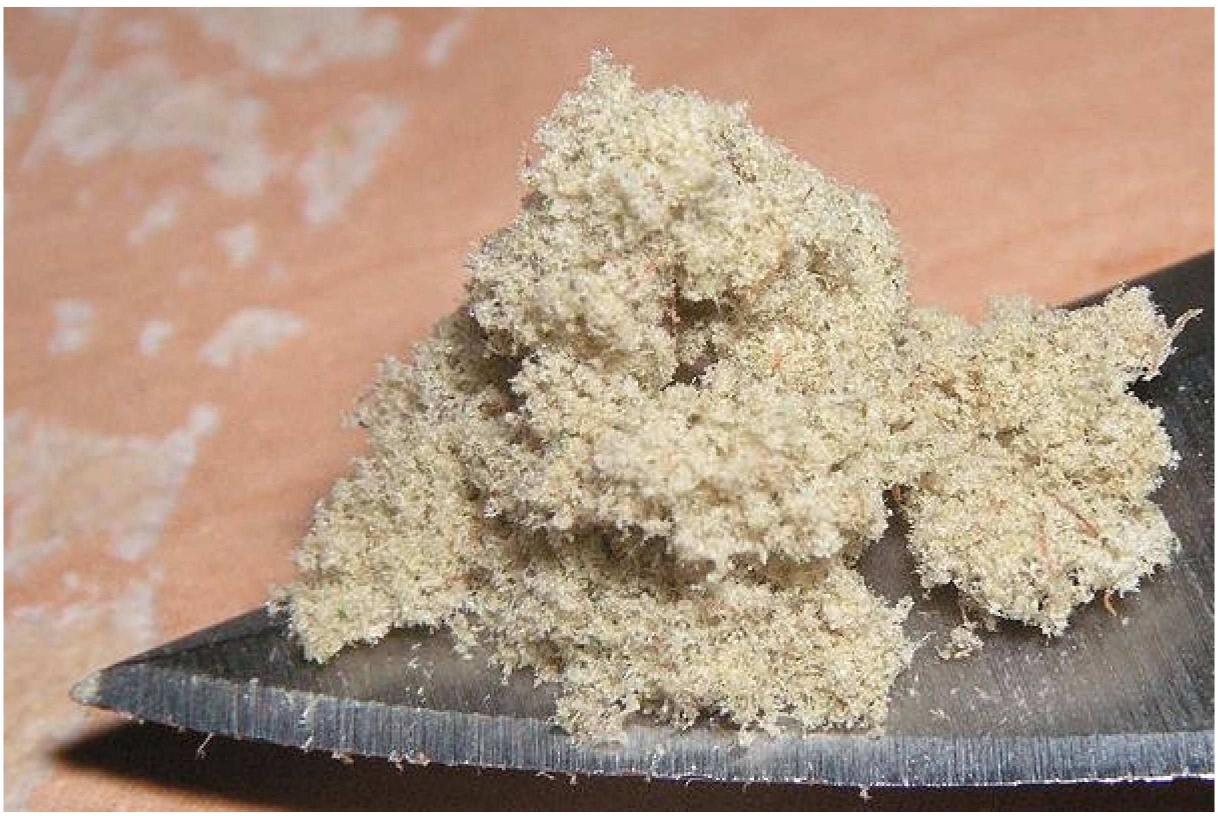
Various solvents are suitable for the production of hash oil. Isopropyl alcohol, petroleum ether, and acetone are three commonly used solvents. Supercritical fluid extraction methods using various volatile compressed gases are also rumored to be used.

Butane is advantageous to use as it has a boiling point of 31°F (−0.6°C), meaning that it will fully evaporate when left for long enough at room temperature. Butane is cheap and widely available in the form of “lighter refill” cans. Butane also has the advantage of not dissolving the chlorophyll component of whole cannabis - it dissolves mainly the psychoactive resins. Drawbacks include the risk of explosion associated with large volumes of butane gas, and the possibility of contaminants in the butane or the extraction vessel. BHO, or butane hash oil is a common term for the output produced by butane extraction of cannabis. "Purging" of the product or further processing is highly suggested in order to remove any trapped butane/solvent(s).

Instead of throwing away all those resin-covered leaves you cut off during your harvest, you can instead turn them into dank hashish! Resin filled THC glands are produced EVERYWHERE on the plant. It is produced on the stems, leaves, and vegetation surrounding the flowers. The leaves near the flowers are most potent, followed by the younger and then older fan leaves. Our goal is then to separate the THC from the plant and make it into concentrated Hash.

Not all glands are created equal. The quality of marijuana affects the quality of the hash. Every cannabis varieties' number of glands varies per square centimeter.

What is "Hash" ?



You see the gland heads (the rounded tips of your trichomes) secrete major cannabiniods(THC) in an oil-like substance that you can remove by rubbing your fingers over the bud. This is what is known as resin. The stalks that support the gland head contain less cannabiniods than the actual glandular ball heads.

Making Hash

Hash is made by knocking the trichomes off the surface of the plant, by either mechanical action, and then by pressing the glands together into a glob-like ball or cake. Depending on the method used, the hash may consist of gland heads and stalks and various contaminants, such as the elements mentioned above, and small bits and pieces of plant tissue. Hash made purely from gland heads is very strong and compresses to a hard plastic-like lump with hand pressure. Hash with a lot of contaminants may require heat and pressure to compact. Hashish contains lots of THC (25-30% is totally common!) Along with the potency of the oil itself, the ratio of oil to powdered marijuana determines strength.

Smoking Hash

The effect of smoking hash can differ from the parent plant, as the heads of the stalked glands may contain more THC in comparison to the side chemicals than the stalks and the tissues of the plant. Hash made only from the heads of the stalked glands is very potent, and can create an uplifting high similar to a vaporizer hit, though deeper and more persistent. As more stalks are added to the hash, the character of the high changes in various ways, though typically good hash has a strong initial rush and a mild, soft letdown. The cystolith and hair trichomes add nothing to the high, but may add to the flavor.

Believe it or not there's actually a little trick to smoking hash. You can't just break a big ol' chunk off and go at it, all that'll produce for you is a burned coal. An easy technique for properly smoking hash is to place a small chunk of it on the end of a paper clip and light it on fire. It will take a second to flame up. After a second or two of burning blow it out and instantly break it up by spreading it between your thumb and forefinger. If you break it all up quickly enough it will fluff up into a little pile of dark crystals. You can these stick these in your pipe and puff away. Be careful when smoking, you will probably cough up a storm. Take small “sips” and watch out, the cherries might burn your tongue if inhaled too sharply.

Hash Rating

The Moroccan rating system for hash, starting with double zero, then zero, and so on referred to the stage of sifting from which the glands were collected. Zero zero comes from the first pass, zero from the second and lesser grades from subsequent passes over the mesh screen. With each screening a higher proportion of impurities mixes with the glands.

Preparing "skuff"

Before we get into making hash, it is essential to prepare skuff. Skuff ("shake" or bud trim), simply put is leaves and undersized flower parts that are trimmed off of cannabis buds. Unless glands can be seen on the surface of the leaves, they should not be collected as skuff, as all they can provide to the hash is contaminants. Sometimes a leaf will have a frosted appearance, but on closer examination the structures on the leaf turn out to consist principally of hairs, common on the stalks of fan leaves. The first tool needed in making hash is a handheld magnification device to observe the plant surfaces.

In order to be ready for smoking, the THC oil must be dried. Also in order to allow mechanical skuffing the plant material must be dried as well. It is not necessary that the skuff be "cured" as buds are, because the vegetable material will not be used in any way. But I have found that the skuff needs to be thoroughly dried over a long period of time, at least a month, though I prefer two. Skuff processed before that time is not as potent as it should be, and the resulting hash seems never to dry properly to gain the potency back.

Skuffing done in cold, dry conditions will prematurely kick out a lot of cystolith mineral trichomes. The ideal skuffing environment is at low room temperature approximately 60°F (15°C) or so and at normal humidity. Although it has been reported that excellent hash has been made in colder and hotter conditions.

The skuff shouldn't be physically altered. A drum machine will remove nearly all the drug potential from the plant, regardless of the shape and size of the leaf parts. With large leaf pieces, like those produced by the buds of certain strains, a mechanical aid can be introduced into the machine, like a rubber ball. The ball will gently press the leaf pieces to the screen over time. Crunching up the skuff will only serve to introduce vegetable contaminants into the hash, and will release cystolith and unicellular hairs into the first product from the skuffing, a product which should be the most pure. Be very gentle with the skuff!

Hash Extraction Methods

Hash is the collected and pressed resin glands from buds. The best hash is "blond" (in reference to its light tan color); only the pure resin crystals are used. Green hash is the next grade, it contains much more of the plant matter than the blond hash giving it its characteristic green appearance. Black hash is generally either hand rubbed hash, which has turned black because of THC oxidation or a mixture of keef (the crystalline resin glands) and other psychoactive alkaloids.

The methods of collecting this resin vary depending on who makes it and what materials are being used. Typically, most hash is made from the manicured leaf left over from trimming fresh pot, but some is made from buds, and can be chemically extracted from all manner of herb leftovers. Real hash handles easily and tends to stick to itself, instead of you. Under very brief heat, it becomes very soft and easy to crumble or smear into little hash curls that can be rolled into cigarettes, or thrown on bowls or hot knives. Remember the best hash is made from the best bud!

Traditional Preparations

1. Crystal Collection:

A) Hand rubbing - Hand rubbing is the practice of accumulating lots of resin on your hands then rubbing them together to produce small black balls of hash. Scissors hash is very similar, it is taken off of manicure scissors when pruning bud. This is probably the least effective method of making hash because the hand rubbing breaks open the resin glands oxidizing THC and giving it a black color, but sometimes it's convenient if handling lots of bud.

B) Sieving - On it's most crude level, a sieve is a piece of cloth stretched over a pot, which you break up, handle, bounce, or scrape your buds over to knock the resin glands off into the bowl. The best screens are sized at 150 microns and only allow the resin glands and some fine debris to fall through. They can be obtained from hobby and art supply stores. Green keef can be re-sieved to make it more blonde, the plant matter will tend to float on the screen while the crystals fall through. Alternatively, hash can then be turned over a 50-micron screen, which will allow most of the debris to fall through, but leaves the keef. To maximize the resin collection, the bud or budleaf trimmings should be extremely dry and cold. Put it in the freezer for a few hours before processing. Cruder sieved type hash is made bye drying or rolling dried pot in burlap bags, the resins tend to stick to the sides leaving hash.

C) Water extraction - A crude water extraction can be done with some really dry pot and a jar full of ice water. Don't fill the jar more than 1/5 full of material, throw in some ice cubes and cold water, shake, and voila! The resin tends to sink to the bottom while the leaf matter floats. The vegetation is removed the crystals caught in a coffee filter. A more advanced extraction can be done with 150-micron pore bag to separate the crystals from the leaf. The remaining leaf can be saved to make butter or honey oil.

2. Pressing:

Once the keef has been collected it can then be pressed into hash. Keef needs pressure and warmth to become that dense lovely THC laden wonder called hash. Very small amounts can be pressed between your fingers and rolled into a ball (if done in a piece of cellophane it will help inhibit THC degradation). Alternatively, a precision press can be used, it's important to have a good die fitted to 0.001 inches, unless you want to squeeze a bunch of your hard won keef to smash into the gap in the die. Once pressed, most hash tends to darken on the outside but remains blond in the middle. Make sure to pre-press water-extracted hash in a piece of cellophane to help get rid of the water.

Chemical Preparations

1. Volatile Solvent Extraction:

A volatile solvent extraction is the simplest method of chemical extraction since it involves simple equipment and solvents that are liquids at room temperature, but low boiling points. Good choices for solvents are alcohols and fine petroleum distillates (EG 99% isopropyl alcohol, 95% ethyl alcohol, and white gas), ketones tend to redux with the cannibinoids, and naphia and heavier solvents are too hard to drive off. Pick a solvent that boils at less than 90 degrees Fahrenheit, and exhibits non-polar tendencies.

Soak your dry weed in the solvent for a few hours to a couple of days, the longer you soak it the more trash comes with the solvent. Then separate the solvent and evaporate. The left over gum is chemically extracted hash. Typically it tends to have a green/black color because most solvent also dissolve plant waxes and chlorophyll, as well as cannibinoids. This green oil can be cleaned from dark green -> light green -> red -> amber using an activated carbon filter on the solution before evaporation. Just fill a tube or funnel with activated carbon (fish tanks, air filters) and run the juice through it. If allowed to soak in ethyl alcohol (usually vodka) and left diluted the green solution is usually refereed to as green dragon, and is drank for some intense effects.

2. Lipid Based Extraction:

Cannabutter.

(See below for how to make it.)

3. Direct Isomerization:

Sometimes if the pot is crappy, or you're dealing with a bunch of roaches, trimmings, or some other inferior source of THC it is desirable to go well beyond what a simple volatile solvent or super critical fluid extraction can do. You want to convert all those free available cannibidiols into more potent THC analogs and cannabinols.

This technique also will render a fully decarboxylized end product, as well as destroying many terpenes and aromatics which can improve or destroy a product depending on the original quality. It is important to understand this is not a full conversion to 9-THC, but to THC analogs and more active cannibidiols, and is included in this discussion more as an educational exercise. Basic isomerization takes place with a quick reflux of your cannabinoids in the presence of any H+ source (acid).

1. Treat your stuff as if it were a volatile solvent or critical fluid extraction.
2. With the remaining resin, dissolve it in a non-polar solvent. Be sure to use one that separates easily from water such as naphia or white gas.
3. Treat this mixture with sulphuric or hydrochloric acid until a pH around 1-2 is reached (approximately one drop of concentrated acid per gram of extract).
4. Place this in a reflux apparatus and cook it for about an hour. In case you're not familiar this is basically just Pyrex breaker with a large looped tube plugged into the top. This will cause the solution inside to be exposed to elevated pressures as well as temperatures, as well as preserving all of the original contents. Simply simply boiling the mixture in a small strong covered vessel can mimic it.
5. Wash whats left with water, keep the oil layer.
6. Neutralize your mix (bring it to pH 7.0) with a little Sodium Hydroxide solution (pH 9.0) or baking soda then rewash it with water. Save the oil layer again.

7. Allow your oil to evaporate and you should be left with a sticky amber liquid that contains almost pure THC.

I would recommend an extraction for a starting point, since if you start clean your product can only get much better. Once you've obtained nearly pure THC, converting it to an acetate is supposed to produce more psychedelic like effects.

More THC analog modifications can be made (to yield pure 9 or 6 THC), but generally the consumption of the original products in these reactions makes them hardly worth while (usually 5-20% yield, so it may be half as psychoactive but you have 5 times as much of it in the beginning).

Hash Oil

Hash oil is basically hash in which the walls of the resin glands have been broken down leaving a gooey oil. Often chemically-extracted hash will be almost an oil, or keef can be dissolved in alcohol, then the alcohol is allowed to evaporate. Hash oil can be smoked like hash in cigarettes, bowls, hot knives, reconstituted into a more hash like substance with the addition of ash or powdered plant matter, or applied to bud to make it more potent (way more potent!).

Hash Additives & Preparations:

A variety of different plant extracts can be, and sometimes have been, added to hash for more a more intense psychedelic experience. Generally only a very small portion of additive is added for the amount of keef available, maxing out around 20% additive and around 5% additive on the low end.

Making Hash – The Primary Methods

The first is flat screening. This is accomplished by using a silk screen frame with fine plastic fabric. Fine steel screens are also used in flat screening. The method involves rubbing cannabis trim across the surface of the screen, the glands and other contaminants dropping through the screen to be collected on a surface like a piece of glass. A flat screen can also be used with an electric motor rigged to produce a back and forth or vibrating motion.

The second method also uses screen, but in a rotating drum, typically motorized using a rotisserie-type motor. A rotating machine takes less skill to use. A drum machine can remove nearly all the glands without depositing any plant tissue. This would be very difficult when solely using a flat screen.

The third method: the glands can also be knocked off the plant by agitating the material in ice water. The glands sink to the bottom of the mixture and can be sieved, dried and pressed together. While this method requires only a blender and a coffee filter, it seems to produce more contaminants than screening, and the output can't be controlled as well, if at all.

Flat Screening

Flat screens can be made from commercial steel fabric, usually available by special order in printing supply shops, or from plastic silk screen fabric. Because the grade of the hash from a flat screen depends on the vigor of the handling, screens with smaller holes are better, in the range of 110 lines per inch to 137 at the high end. A 125 "mesh" frame is a good compromise. The silk screen material is attached by glue to the bottom of the wood frame, leaving a well on top with the wood pieces forming the sides.

Making good hash from flat screens depends on a lot of personal involvement. The method is simple. The frame is placed over a collection surface, like a sheet of glass or a mirror. I like to attach small wooden blocks to the bottom of the screen frame so that it can be used right side up, with the flat side of the frame on the bottom. That way the skuff is held within the walls of the frame as it is skuffed. The skuff is placed in the frame and is gently pushed back and forth over the screen with a pusher, like a credit card.

Making the best grade of hash can be done by applying almost no pressure to the skuff as it is moved around on the screen. There's no way that a flat screen can produce as much of the top product as a drum machine, since a lot of the capitate glands will not be in contact with the screen unless pushed into it.

The pressure of the tumbling skuff accomplishes that in a gentle fashion in a drum machine, but extra pressure applied by hand will cause contaminants to be expressed in flat screening.

Additional pressure on the skuff is best done by tilting the plastic pusher card into the skuff as it is moved across the screen. But there is a limit to how much pressure can be applied before vegetable material starts to break off and be passed through the screen. Some vegetable material is acceptable in the lowest grades of hash, but too much pressure will produce a light green product that does not provide the expansive rush expected from hash.

It is difficult, if possible, to extract all the glands from the skuff by flat screening. I've found that the exhausted flat-screen skuff is still quite potent, and is welcome by smokers who remember the good old days when you could sit and smoke Mexican grass for hours on end, a social event lost in modern times due to the uniform high potency of home-grown pot.

Although flat skuffing is not as productive or as easy to control as a drum machine, it brings gland hash within the range of anyone with a few dollars and some bud trim.

Drum Machines

A drum machine tumbles the skuff inside of a wheel with fabric attached to the rim, like a squirrel cage. The key to the drum machine is the slow speed it operates at. Time replaces the pressure of flat screening, the longer the run, the more contaminants. But proper drum screening never introduces vegetable material into the hash, as it never handles the skuff vigorously enough to crumble the leaves. A drum machine can gently strip nearly all the drug containing glands from plant material.

Drum machines can be purchased from at least one supplier in Holland who calls their product the "Pollinator". The Pollinator may be a nice machine, but the price is very high considering how simple the machine is. A home-built machine can easily be made for a few dollars by anyone with a reasonable degree of home handyman skills, which is just about a given for cannabis growers.

The BubbleBag Method Step-By-Step

The easiest plant essence extraction method is accomplished through the use of a hash bag, aka swag bag. What your leftover leaves (known as "shake") and such are composed of is a water base, and on it is resin. Resin is an oil base. Water and oil do not mix, this is how screening works.

You're first going to need to purchase a hash bag kit (these dudes make really good ones), two 5 gallon buckets, and an electronic egg beater. Swag bags/hash bags are bags with a mesh at the bottom, usually cylindrical in shape. They will get progressively smaller as you continue the process.

First take your work bag, and place it inside a 5-gallon bucket. Next take some ice (about 2 scoops) and pour it in the work bag in order to keep everything cold. Then add a little bit of water. The idea is to make sure everything gets very wet.

WARNING: Water must be PURE water that comes from reverse osmosis only! This water will have very few dissolved solids such as salts that will contaminate your hash and degrade its quality.

Now pour the leaf in slowly and mix it with the ice and water thoroughly.

Your next step is to separate the leaf from the resin. You can do this by using an electronic eggbeater. Hold the bag up and have at it! Mix for about 10 minutes. DO NOT skip this step, you must make sure your leaves properly separate from the resin and the resin settles properly.

Note: You may need to add a lot more water in order to get everything to mix properly.

Next you will place in your second five gallon bucket the rest of your bags, in linear order, starting with the smallest swag bag (should be 23 micron).

Shake your big bag filled with your hash mixture gently. Jiggle it. Next you're going to lift it up and strain it. Let all the water drain down into the bucket and squeeze the bag. Make sure you squeeze out all the liquid into the bucket.

Now you pour the liquid from bucket #1 that you just strained into bucket #2 (the one filled with the bags in order from smallest to biggest all packed in there at the same time)

Jiggle the first bag up and down to let the water fall through. What you should start to find is resin appearing at the bottom of your bag! Grab it and squeeze the water out of it (you can wear gloves if you like) and place the dried resin on your working surface. We recommend you use a spoon to scoop out the resin.

Continue this process for all the bags. You may want to put each bag's hash in a separate pile, as each will have a different consistency per micron sized bag.

Your ideal consistency is one that presses together very well, is a bit grainy and oily. The resin glands shouldn't be entirely broken either, which further adds to the hashishs' potency.

When all your hashish has been salvaged, let it dry overnight for at least 12 hours. Now some people will just smoke it as it is, but it works best to put it in the oven at 125°F (51.6°C).

The Blender Method

Put water in a blender. Add a large handful of leaves, stems, seeds and mild weed. Put in 3 or 4 ice cubes and blend it for about 3-4 minutes. Just make sure everything is very finely chopped. Secondly, you will need a gold reusable coffee filter (or 90-line silk screen). Get a large mouth quart mason jar, and strain your Slurpee mixture through it. Once you have strained all the liquid through, run some more water through the leaf material to wash out any extra trichome.

After a few minutes you will notice a white collection at the bottom of the jar, this is the trichome. Let the trichome settle at the bottom for about 20-30 minutes. Next, pour off the top 2/3's of the filtered green water, leaving the settled trichome at the bottom. Add more ice water to get the green stuff out, and let the trichome settle at the bottom for about 20 minutes again. Repeat this step once more. Pour off as much water as you can without pouring off the trichome, filter the resulting trichome/water mix through a paper coffee filter. The trichome will not go through the paper, but the water will. When all the water has filtered through, a slightly wet, cold, mass of trichome will be left. This will be easy to handle and compress.

The Alcohol Method

Take your stash (stems, seeds, mild weed) and place it in a covered pot, with enough alcohol to cover everything. Isopropyl alcohol is commonly available at pharmacies. Look for alcohol that is 99% pure. Denatured alcohol also works well. Sometimes isopropyl alcohol is called rubbing alcohol. Now carefully boil the mixture on an electric stove.

WARNING: Be careful; the alcohol is very flammable!

After 45 minutes of heating you can strain the solids out, saving the alcohol. Now, repeat the process with the same residuals, but with fresh alcohol. When the second boil has finished, remove the solids again, combine the two quantities of alcohol and boil again until you have a syrupy mixture. This syrupy mixture will contain much of the THC formerly hidden in the stash.

Making Cannabutter

Bring a pot of water to a rolling boil, then put a small amount of butter in the water. The butter melts, and mixes with the water. Then put the grass or stash in and boil it. Now all the grass will be riling around with the water and the butter. The THC dissolves into the butter. Stir the stuff regularly. After half an hour of cooking the grass, strain out the grass and stash and squeeze all the juice out of it. Then put the liquid in the fridge.

A few hours later, the mixture is cold enough and the cannabutter has solidified on the surface. It will look kind of scummy, but it's just enchanted butter. Scoop it out and retain it in a bowl or a jar. The cannabutter can be used just like butter, in brownies, cake, etc. Enjoy! (Check out the Cannabis Cookbook for more.)

12

ADVANCED GROWING

Advanced Growing

Now comes the exciting part. It is one thing to grow marijuana, it is another thing to grow A LOT of *quality* marijuana. Mastering the basics of marijuana growing will then allow you to begin considering some advanced marijuana growing techniques to increase yield, potency, genetics, and many other qualities of your cannabis bud cultivation. Following the tips in this guide and the ones in this section you will most certainly be able to.

Many growers, after mastering the basics of cannabis cultivation, wish to delve into whole new realms of even more enhanced marijuana growing...

Genetics

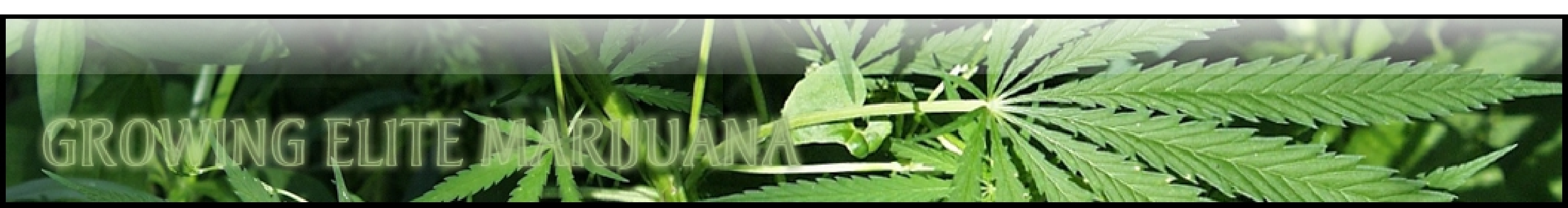
In depth genetics is beyond the scope of this work. You could literally fill an entire 1000 page volume on the technical scientific topic of cannabis breeding alone. I wanted to include as much information as I could to get you guys started without making this into an overly scientific “encyclopedia” if you will. I've included everything you'll need to know to get started breeding your own cannabis right away! Feel free (and I recommend that you do) to go research this topic on your own to develop your own comprehensive understanding; the results are very rewarding!!!!

Breeder's Glossary

Before you get started breeding you need to become familiar with a few technical terms. You don't have to read them all, but if you become confused below refer back to your very own Breeder Glossary. Breeding is an advanced cannabis cultivation process, know that going in.

Adaptation: The process by which individuals (or parts of individuals), populations, or species change form or function in such a way to better survive under given environmental conditions. Also the result of this process.
Allele or Allelomorph: One of a pair or series of forms of a gene which are alternative in inheritance because they are situated at the same locus in homologous chromosomes.
Asynapsis: Failure of pairing of homologous chromosomes during meiosis.
Autogamy: Self-fertilization.
Avirulent: Inability of a pathogen to produce a disease on its host.
Backcross: a cross of a hybrid to either of its parents. In genetics, a cross of a heterozygote to a homozygous recessive. (See test cross)
Backcross Breeding: A system of breeding whereby recurrent backcrosses are made to one of the parents of a hybrid, accompanied by selection for a specific character or characters.
Balance: The condition in which genetic components are adjusted in proportions that give satisfactory development. Balance applies to individuals and populations.

Basic Number: The number of chromosomes in ancestral diploid ancestors of polyploids, represented by x.
Biotype: A group of individuals with the same genotype. Biotypes may be homozygous or heterozygous.
Bivalent: A pair of homologous chromosomes united in the first meiotic division.
Breeder Seed: Seed produced by the agency sponsoring a variety and used to produce foundation seed.
Breeding: The art and science of changing plants or animals genetically.
Bulk Breeding: The growing of genetically diverse populations of self-pollinated crops in a bulk plot with or without mass selection, followed by single-plant selection.
Certified Seed: Seed used for commercial crop production produced from foundation, registered, or certified seed under regulation of a legally constituted agency.
Centromere: (See kinetochore)
Character: An attribute of an organism resulting from the interaction of a gene or genes with the environment.
Chiasma: An exchange of partners between paired chromatids in the first division of meiosis.
Chromatid: One of two threadlike structures formed by the longitudinal division of a chromosome during meiotic prophase and known as a daughter chromosome during anaphase.
Chromosomes: Structural units of the nucleus which carry the genes in linear order. Chromosomes undergo a typical cycle in which their morphology changes drastically in various phases of the life cycle of the organisms.
Clone: A group of organisms descended by mitosis from a common ancestor.
Combining Ability: General, average performance of a strain in a series of crosses. Specific deviation from performance predicted on the basis of the general combining ability.
Coupling: Linked recessive alleles occur in one homologous chromosome and their dominant alternatives occur in the other chromosome. Opposed to repulsion in which one dominant and one recessive occur in each member of the pair of homologous chromosomes.
Crossing Over: The exchange of corresponding segments between chromatids of homologous chromosomes during meiotic prophase. Its genetic consequence



is the recombination of linked genes.
Diallel Cross, Complete: The crossing in all possible combinations of a series of genotypes.
Dihybrid: Heterozygous with respect to two genes.
Dioecious: Plants in which staminate and pistillate flowers occur on different individuals.
Diploid: An organism with two chromosomes of each kind.
Diplotene: The stage of meiosis which follows pachytene and during which the four chromatids of each bivalent move apart in two pairs but remain attached in the region of the chiasmata.
Disease: A departure from normal metabolism and a reduction of its normal potential for growth and reproduction.
Disjunction: The separation of chromosomes at anaphase.
Dominance: Intra-allelic interaction such that one allele manifests itself more or less, when heterozygous, than its alternative allele.
Donor Parent: The parent from which one or a few genes are transferred to the recurrent parent in backcross breeding.
Double Cross: A cross between two F1 hybrids.
Emasculation: Removal of the anthers from a flower.
Epistasis: Dominance of one gene over a non-allelic gene. The gene suppressed is said to be hypostatic. More generally, the term epistasis is used to describe all types of interallelic interaction whereby manifestation at any locus is affected by genetic phase at any or all loci.
Epiphytotic: An unarrested spread of a plant disease.
Expressivity: The degree of manifestation of a genetic character.
F1: The first generation of a cross.
F2: The second filial generation obtained by self-fertilization or crossing F1 individuals.
F3: Progeny obtained by self-fertilization of F2 individuals.
Factor: Same as gene.
Facultative: Parasites which can grow and live in environments other than living host tissue.
Family: A group of individuals directly related by descent from a common ancestor.
Fertility: Ability to produce viable offspring.
Fertilization: Fusion of the nuclei of male and female gametes.

Foundation Seed: Seed stock produced from breeder seed under the direct control of an agricultural experiment station. Foundation seed is the source of certified seed, either directly or through registered seed.

Gamete: Cell of meiotic origin specialized for fertilization.

Gene: The unit of inheritance. Genes are located at fixed loci in chromosomes and can exist in a series of alternative forms called alleles.

Gene Frequency: The proportion in which alternative alleles of a gene occur in a population.

Gene Interaction: Modification of gene action by a non-allelic gene or genes.

Germplasm: The sum total of the hereditary materials in a species.

Genome: A set of chromosomes corresponding to the haploid set of a species.

Genotype: The entire genetic constitution of an organism.

Haploid: A cell or organism with the gametic chromosome number (n).

Heritability: The proportion of observed variability which is due to heredity, the remainder being due to environmental causes. More strictly, the proportion of observed variability due to the additive effects of genes.

Heterosis: Hybrid vigor such that an F1 hybrid falls outside the range of the parents with respect to some character or characters. Usually applied to size, rate of growth, or general thriftiness.

Heterozygous: Having unlike alleles at one or more corresponding loci (opposite of homozygous).

Homology of Chromosomes: Applied to whole chromosomes or parts of chromosomes which synapse or pair in meiotic prophase.

Host Resistance: The result of genetic manipulation of the host which renders it less susceptible to pathogens that would or do attack the host.

Hybrid: The product of a cross between genetically unlike parents.

I1, I2, I3... Symbols that are used to designate first, second, third, etc. inbred generations.

Inbred Line: A line produced by continued inbreeding. In plant breeding, a nearly homozygous line usually originating by continued self-fertilization, accompanied by selection.

Inbreeding: The mating of individuals more closely related than individuals mating at random.

Independence: The relationship between variables when the variation of each is uninfluenced by that of others, that is, correlation of zero.

Isogenic Lines: Two or more lines differing from each other genetically at one locus only. Distinguished from clones, homozygous lines, identical twins, etc. which are identical at all loci.
Isolation: The separation of one group from another so that the mating between or among groups is prevented.
Kinetochore: Spindle attachment. A localized region in each chromosome to which the "spindle fiber" appears to be attached and which seems to determine movement of the chromosomes during mitosis and meiosis.
Line Breeding: A system of breeding in which a number of genotypes, which have been progeny tested in retrospect to some character or group of characters, are composited to form a variety.
Linkage: Association of characters in inheritance due to location of genes in proximity on the same chromosome.
Linkage Map: Map of position of genes in chromosomes determined by recombination relationships.
Linkage Value: Recombination fraction expressing the proportion of crossovers versus parental types in a progeny. The recombination fraction can vary from zero to one half.
Locus: The position occupied by a gene in a chromosome.
M1, M2, M3... Symbols used to designate first, second, third, etc. generations after treatment with a mutagenic agent.
Male Sterility: Absence or non-function of pollen in plants.
Mass-Pedigree Method: A system of breeding in which a population is propagated in mass until conditions favorable for selection to occur, after which pedigree selection is practiced.
Mass Selection: A form of a selection in which individual plants are selected and the next generation is propagated from the aggregate of their seeds.
Mating System: Any number of schemes by which individuals are assorted in pairs leading to sexual reproduction. Random; assortment of pairs is by chance. Genetic assortative mating; mating together of individuals more closely related than individuals mating at random. Genetic disassortative mating; mating together of individuals less closely related than individuals mating at random. Phenotypic assortative mating; mating individuals more alike in appearance than the average. Phenotypic disassortative mating; mating of individuals less alike in appearance than individuals mating at random.
Meiosis: A double mitosis occurring in sexual reproduction which results in

production of gametes with haploid (n) chromosome number.
Metaphase: The stage of meiosis or mitosis at which the chromosomes lie on the spindle.
Mitosis: The process by which the nucleus is divided into two daughter nuclei with equivalent chromosome complements, usually accompanied by division of the cell containing the nucleus.
Modifying Genes: Genes that affect the expression of a non-allelic gene or genes.
Monoecious: Staminate and pistillate flowers born separately on the same plant.
Mutation: A sudden heritable variation in a gene or in a chromosome structure.
Obligate: Parasite that cannot multiply in nature without a host.
Oliogenic Resistance: Resistance determined by one or few genes whose effects are readily detectable.
Outcross: A cross, usually natural, to a plant of different genotype.
Pachytene: The double-thread or four strand stage of meiosis.
Parasite: Lives in or on another organism and obtains nutrients from it.
Parthenogenesis: Development of an organism from a sex cell in respect to some characteristic.
Parameter: A numerical quantity which specifies a population in respect to some characteristic.
Pathogen: A parasite which produces disease in its host.
Pedigree: A record of the ancestry of an individual, family, or strain.
Pedigree Breeding: A system of breeding in which individual plants are selected in the segregating generations from a cross on the basis of their desirability judged individually and on the basis of a pedigree record.
Penetrance: The frequency with which a gene produces a recognizable effect in the individuals which carry it.
Phenotype: Appearance of an individual as contrasted with its genetic make-up or genotype. Also, used to designate a group of individuals with similar appearance but not necessarily identical genotypes.
Phytolexins: Substances produced or formed by host plants in response to injury, physiological stimuli, infectious agents, or their products that accumulate to levels which inhibit the growth of microorganisms. Some include toxic substances produced to repel insects and nematodes.
Polycross: Open pollination of a group of genotypes (generally selected), in

isolation from other compatible genotypes, in such a way as to promote random mating.
Polygenic: Determined by several genes whose effects are readily detectable.
Populations: In genetics, a community of individuals which share a common gene pool. In statistics, a hypothetical and infinitely large series of potential observations among which observations may actually constitute a sample.
Progeny Test: A test of the value of a genotype based on the performance of its offspring
produced in some definite system of mating.
Protandry: Maturation of anthers before pistils.
Protogyny: Maturation of pistils before anthers.
Pure Line: A strain homozygous at all loci, ordinarily obtained by successive self-fertilizations in plant breeding.
Qualitative Character: A character in which variation is discontinuous.
Quantitative Character: A character in which variation is continuous so that classification into discrete categories is not possible.
Random: Arrived at by chance without discrimination.
Randomization: Process of making assignments at random.
Recessive: The member of an allelic pair which is not expressed when the other (dominant) member occupies the homologous chromosome.
Reciprocal Crosses: Crosses in which the sources of the male and female gametes are reversed.
Recombination: Formation of new combinations of genes as a result of segregation in crosses between genetically different parents. Also, the rearrangement of linked genes due to crossing over.
Recurrent Parent: The parent to which successive backcrosses are made in backcross breeding.
Recurrent Selection: A method of breeding designed to concentrate favorable genes scattered among a number of individuals by selecting, each generation, among the progeny produced by matings of the selected individuals (or their selfed progeny) of the previous generation.
Registered Seed: The progeny of foundation seed normally grown to produce certified seed.
Rogue: A variation from the standard type of a variety or strain. Roguing; removal of undesirable individuals to purify a stock.
Resistance: The restriction of development of a pathenogenic agent or

parasite. Can vary in degree from immunity (no development) to only slight retardation relative to a so called susceptible reaction.
S1, S2, S3... Symbols for designating first, second, third, etc. selfed generations from an ancestral plant (S0).
Segregation: Separation of paternal from maternal chromosomes at meiosis and consequent separation of genes leading to the possibility of recombination in the offspring.
Selection: In genetics, discrimination among individuals in the number of offspring contributed to the next generation. In statistics, discrimination in sampling leading to bias. Opposed to randomness.
Self-Fertilization: Fusion of male and female gametes from the same individual.
Self-Incompatibility: Genetically controlled physiological hindrance to self-fruitfulness.
Single Cross: A cross between two genotypes, usually two inbred lines, in plant breeding.
Species: The unit of taxonomic classification into which genera are subdivided. A group of similar individuals different from other similar arrays of individuals. In sexually reproducing organisms, the maximum interbred group isolated from other species by barriers of sterility or reproductive incapacity.
Strain: A group of similar individuals within a variety.
Synapsis: Conjugation at pachytene and zygotene of homologous chromosomes.
Synthetic Variety: A variety produced by crossing a number of genotypes selected for good combining ability in all possible hybrid combinations, with subsequent maintenance of the variety by open pollination.
Telophase: The last stage in cell division before the nucleus returns to a resting condition.
Tetraploid: An organism with four basic (x) sets of chromosomes.
Top Cross: A cross between a selection, line, clone, etc., and a common pollen parent which may be a variety, inbred line, single cross, etc. The common pollen parent is called the top cross or tester parent. In corn, a top cross is commonly an inbred-variety cross.
Transgressive Segregation: Appearance in segregating generations of individuals falling outside the parental range in respect to some character.
Translocation: Change in position of a segment of a chromosome to another

location in the same or different chromosomes.
Variation: The occurrence of differences among individuals due to differences in their genetic composition and/or the environment in which they were raised.
Variety: A subdivision of a species. A group of individuals within a species which are distinct in form or function from other similar arrays of individuals.
Virulence: Capacity of a pathogen to incite a disease.
x: Basic number of chromosomes in a polyploid series.
X1, X2, X3... Symbols denoting first, second, third, etc. generations from and irradiated ancestral plants (X0).
Zygote: Cell formed by the union of two gametes and the individual developing from this cell.
Zygotene: A stage in meiotic prophase when the threadlike chromosomes pair.

Breeding

Breeding is a method whereby you can make seeds from your crop. If you are like most growers out there, you have purchased or obtained a great strain that has become your new favorite & you would like to produce more seeds from your crop in order to continue the strain. In the following method we will show you how to continue a strain. Please note that you will not be able to replicate the plants again unless they are IBL. What breeding can and will do for you is generate seeds that will contain most of the parent plant's genetic blueprint (features), but maybe not all. Some of your offspring will turn out to be like the parents but others will show different traits. These different traits can include color, potency, and taste.

The cool thing about cannabis is that it can be reproduced asexually or sexually.

Asexual propagation is what is known as “taking cuttings” or “cloning”. The process is when growth shoots or branches are removed from chosen donor plants and induced to form roots in a separate grow medium. These rooted cuttings are then used to plant a uniform crop of genetically identical individuals. This method of propagating growth asexually to ensure uniformity in growth, yield, and consistency is quite popular today (as you recall reading from the Cloning section).

Sexual propagation on the other hand is when the male and female sex cells (biologically labeled “gametes”) unite in the female plant to form a new offspring. This process occurs when the male pollen unites with an ovule within the ovary of a female flower to create an embryo which eventually matures and develops into a seed.

Once Flowering ends, the bud will contain seeds. Check them. Ideally they need to be dark in color. If they are white shiny then they aren't good because you have harvested them too early. Make sure you wait until the very end of Flowering to harvest your seeds!

Each seed has its own unique genetic blueprint that contains genes from both of its parents. Since offspring produce slightly varied traits, the goal of advanced breeding methods is to weed out the plants that do not contain favorable traits, and continue breeding the one's that demonstrate superior genetic traits in order to develop new and improved strain varieties.

Here's what the general process looks like: Commercial breeders will often grow a very large number of plants which only a few outstanding specimens are chosen. Their offspring are then selected and oftentimes crossed with other varieties of cannabis that have desirable traits. An example of this is a plant that matures super early that is not very potent may be crossed with a plant that takes a very long time to mature but produces extremely potent flowers. The first generation will be fairly uniform. The second generation will tends to sort out into early and late plants of varying potency.

The desirable characteristic-bearing plants (in this case early potent plants only) are then selected for even further breeding, this will stabilize the variety of cannabis after several generations. The goal of commercial seed growers is to stabilize many characteristics at once so that the plants will be uniform.

Since indoor growing allows for manipulation of many indoor environmental factors, you can breed some pretty awesome bud.

One awesome method for producing lighting fast maturing strains is to plant a garden using equatorial cannabis variety (extremely early-flowering plants). By breeding this type of plant with high potent plants, in a few generations you can develop your strain into an incredibly fast-maturing, potent marijuana plant.

Note: Remember, taking cuttings is the only way of preserving the exact genetic makeup of any plant.

Breeding Technique

It is possible to breed and select cuttings from plants that grow, flower, and mature faster. Some plants will naturally be better than others in this regard, and it is easy to select not only the most potent plants to clone or breed, but the fastest growing/flowering plants as well.

Find your fastest growth plant, and breed it with your "best high" male for fast flowering, potent strains. Clone your fastest, best high plant for the quickest monocrop garden possible. Over time, it will save you a lot of waiting around for your plants to mature.

When a male is starting to flower (2-4 weeks before the females) it should be removed from the females so it does not pollinate them. It is taken to a separate area. Any place that gets just a few hours of light per day will be adequate, including close to a window in a separate room in the house. Put newspaper or glass under it to catch the pollen as the flowers drop it.

Keep a male alive indefinitely by bending it's top severely and putting it in mild shock that delays it's maturity. Or take the tops as they mature and put the branches in water, over a piece of plate glass. Shake the branches every morning to release pollen onto the glass and then scrap it with a razor blade to collect it. A male pruned in this fashion stays alive indefinitely and will continue to produce flowers if it gets suitable dark periods. This is much better than putting pollen in the freezer! Fresh pollen is always best.

Save pollen in an air tight bag in the freezer. It will be good for about a month.

It may be several more weeks before the females are ready to pollinate. Put a paper towel in the bag with it to act as a desiccant.

A plant is ready to pollinate 2 weeks after the clusters of female flowers first appear. If you pollinate too early, it may not work. Wait until the female flowers are well established, but still all while hairs are showing.

Turn off all fans. Use a paper bag to pollinate a branch of a female plant. Use different pollen from two males on separate branches. Wrap the bag around the branch and seal it at the opening to the branch. Shake the branch vigorously. Wet the paper bag after a few minutes with a sprayer and then carefully remove it. Large plastic zip-lock bags also. Slip the bag over the male branch and shake the pollen loose. Carefully remove the bad and zip it up.

It should be very dusty with pollen. To pollinate, place it over a single branch of the female, zipping it up sideways around the stem so no pollen leaks out. Shake the bag and the stem at the same time.

Allow to settle for an hour or two and shake it again. Remove it a few hours later. Your branch is now well pollinated and should show signs of visible seed production in 2 weeks, with ripe seeds splitting the calyxes by 3-6 weeks. One pollinated branch can create hundreds of seeds, so it should not be necessary to pollinate more than one or two branches in many cases.

When crossing two different varieties, a third variety of plant will be created. If you know what characteristics your looking for in a new strain, you will need several plants to choose from in order to have the best chance of finding all the qualities desired. Sometimes, if the two plants bred had dominant genes for certain characteristics, it will be impossible to get the plant you want from one single cross. In this case, it is necessary to interbreed two plants from the same batch of resultant seeds from the initial cross. In this fashion, recessive genes will become available, and the plant character you desire may only be possible in this manner.

Usually, it is desirable only to cross two strains that are very different. In this manner, one usually arrives at what is referred to as "hybrid vigour". In other words, often the best strains are created by taking two very different strains and mating them. Less robust plants may be the result of interbreeding, since it opens up recessive gene traits that may lead to reduced potency.

Hybrid offspring will all be very different from each other. Each plant grown from the same batch of seeds collected from the same plant, will be different. It is then necessary to try each plant separately and decide it's individual merits for yourself. If you find one that seems to be head and shoulders above the rest in terms of early flowering, high yield and get buzz, that's the plant to clone and continue breeding.

Breeding to Make Seeds

Sinsemilla: When the female plant is not allowed to pollinate, it grows full of resin that was intended to make seeds. False seed pods swell with THC laden resin and the pistils turn red and orange and withdraw into the pods. Then the plant is harvested. Seeds are not part of the bud when the flowers mature. This is called Sinsemillia, and simply means "no seeds".

Sinsemilla Seeds: It is possible to cross your favourite two female plants to create a new strain of seeds that will produce all female plants. Preferably, these two plants will be different types of plants, not from the same mother's seeds.

This will create the best offspring, since it will not lead to inbreeding. It is easier to gauge the quality of female plants than male plants, since the smoke is more potent and easier to judge it's finer qualities. Plants from seeds created in this fashion will be all female plants since there will be no chance of male chromosomes from female parents.

Use Gibberellic Acid on one branch of a female plant to induce male flowers.

Gibberellic Acid is sold by nursery supply houses for plant breeding and hybridizing. Spray the plant once every day for 10 days with 100 ppm gibberellic acid. When the male flowers form, pollinate the flowers of your other target female plant you have selected. Just pollinate one branch unless you want lots of seeds!

Once the branch has male flowers, cut the branch and root it in water, with glass under it to catch the male pollen when it drops. Use a rooting solution similar to the above cloning solution. Collect the pollen with a plastic bag over the branch and shake it (more on pollen in a moment). Use a razor blade to scrap up fallen pollen and add it to the bag too.

It is also possible to pollinate the flowers of the plant you create the male flowers on, crossing it with itself. This is used to preserve a special plants characteristics. Cloning will also preserve the plants characteristics, but will not allow you to store seeds for use later. Crossing a plant with itself can lead to inbreeding problems, so it may not be the optimum solution in many cases.

Some growers have tried using Gibberellic Acid, sprayed on a healthy female, every day for over a week reporting no male flowers appearing on the plant. Your mileage may vary.

Making Seeds Step-By-Step

So say you purchased an expensive strain and you would like to make more seeds without any interference from another strain. Well you're in luck because this is actually quite simple!!

The first factor that must be followed to ensure success is to make sure the male and female plants are together from only the same strain batch. DO NOT introduce another strain into the mix. Say for example you have God's Gift (or any other) strain, make sure all the male and female plants in your grow room are the God's Gift strain. By allowing the males to pollinate the females you will get God's Gift seeds. Unless your strain is an IBL, the offspring will lose some of the genetic features that the parent plants had.

Step One - Selecting Breeding Parents: In selecting female plants, you will want to select one based on yield, smell, potency, flavor, resistance to pests, color, etc. In other words, choose the best female plant with the most favorable genetics. (It is even optional, but recommended to smoke a sample harvest from your chosen plant strain, so make sure it is optimal. Drying and curing can change the aromas and flavours, so it is good to include a post-harvest evaluation.)

Choosing male parent plants with desirable characteristics is a little tougher. Since males do not produce flowers it is hard to judge by resin content, smells, floral size etc. Many breeders have a crude, but time-tested method of determining superior male plants, and that is by rubbing the stem with your finger. If it exudes a pungent odor, it is most likely a good plant. A superior method, that is more time consuming, is by taking the pollen from your chosen male plant and using it to make seeds with the chosen females. Then you grow out your resulting seeds and examine them to determine the male's effect. This is by far the most reliable method for determining the genetic value of the chosen male candidate.

Note: The male plant MUST Remain on a 12/12 schedule. Many growers report that if the male does not have ample lighting it will in most cases cease to finish the flowering cycle followed by complete shutdown of pollen production within several days.

Step Two - Collecting Pollen: Once the flowers are ready to open you can then extract the pollen from the male flower. You will witness the male flower open out from its pod. The best place and time to gather pollen is after it bursts and falls onto the leaves. Start off by cutting off a branch. Place a plastic bag over the branch and secure the bottom with a piece of string or a tight rubberband. This prevents pollen from leaking. You have to be careful as airborne pollen can travel miles. Keep the branch inside the bag for several days to collect pollen. Once enough pollen seems to have been collected inside your bad, shake the remaining pollen off inside the bag.

Step Three – Storing Pollen: A great way to store pollen is to purchase small jar or an oldschool film canister. (You can also put some water in a film canister and drop an alkaseltzer tablet in, then pop the lid closed... watch what happens! Just kidding ;).) You can save your pollen in these canisters for the next harvest.

It is very rare to have excess pollen to store, but if you happen to have extra pollen available you can store it in a freezer in an airtight container for about 18 months (below freezing temperatures). I highly recommend you use it within 6 months to ensure maximum quality. Pollen does not have a long natural shelf life; it is easily destroyed by high temperatures and moisture.

Step Four – Pollination, Method 1: In order to pollinate the eager females simply cover the female branch with the bag of pollen (sealing the bag with a rubber band, string, or wire tie around the base of the bag and stem) and shake the pollen onto the female flowers. And wha-la! Make sure you do a through shaking that will allow the pollen to come into contact with as many pistils as possible. Congratulations, you now have some very happy pollinated female plants. Some veteran growers leave the bag on for up to as much as 3 days to ensure maximum pollination.

Note: Be very careful when shaking and removing the bag, as any airborne pollen can easily pollinate any nearby plants. Many experienced growers pollinate their plants in a completely separate isolated area because of this very reason. They then will spray the plants with water to destroy all the unused pollen and then move the plant back into the grow room.

Method 2: An additional method of pollination is to use a small paint brush to carefully paint the pollen onto the pistils. Start by dipping your brush into the pollen container. Next gently brush the pollen onto the pistils. This technique is very beneficial to the breeder who only needs to make a few seeds. After fertilization, most seeds will become completely ripe and ready in approximately 6 weeks, some even earlier. How can you tell when your seeds are ripe? It's simple. Seeds become ripe when they turn mostly a dark brown or grey, tiger striped, and they sit loosely in the calyx. White, yellow, and green seeds are 9 times out of 10 immature and not viable.

Now that you have a general overview of each step, let's dive into more details of each process:

Collecting Pollen Step-By-Step

Step 1) First, take a mature flowering male plant, like the one pictured. It is advisable to wait until the majority of the flowers are open and practically bursting with pollen. This is obvious from yellow powdery residue on the leaves.

Figure 1. Mature Flowering Male. (Notice the matured sacks.)

Step 2) Next, get a pair of scissors, piece of wax paper folded in half, with one end folded over to form a corner. Wax paper works extremely well here since it resists moisture which will quickly spoil your pollen.

Figure 2. Folded Wax Paper.

Step 3) Then take the scissors and cut a nice big branch off - just snip one so it is easy to handle.

Figure 3. Cut Branch.

Step 4) Carefully lay the branch in the opened wax paper, close the sides with the holding hand so a breeze doesn't blow too much away. Then; twist, jiggle, shake, and rub the branch against the wax paper.

Figure 4. Branch Placed in Wax Paper.

Step 5) After a few branches to see how much you have collected, remove some of the flowers that have fallen off and check out what you have so far.

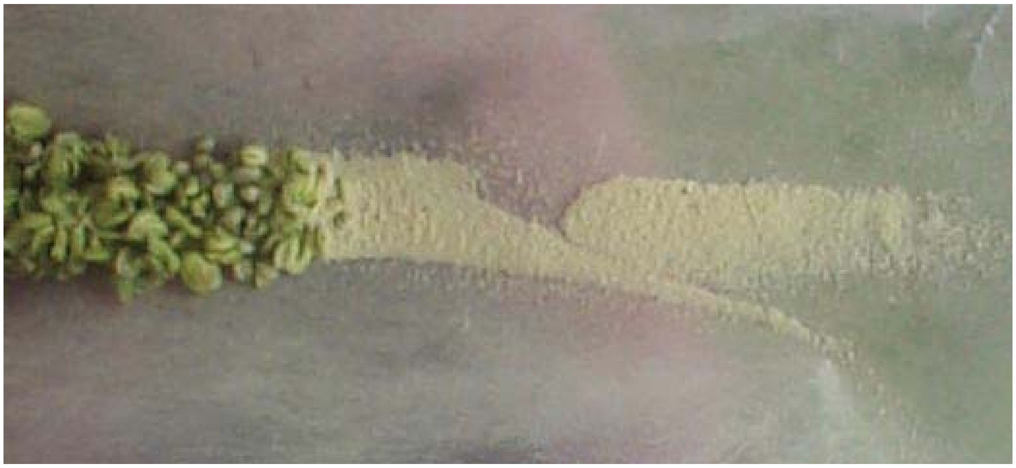


Figure 5. Pollen.

Step 6) Once you have run out of branches (or you feel you have enough pollen) shake the pollen down into the cover you made and remove any additional flowers that still remain. Once all the male flowers are removed you can unfold the wax paper to be sure to get them all. You can then transfer the pollen to a new piece of wax paper if you desire.

Figure 6. Collected Pollen.

Step 7) The final step is to wrap it up, tape it, and congratulations – you now have enough pollen for a few million seeds. You can now carefully unfold it and use a small paint brush to dip into it and pollinate buds. Or if you are really lazy you just pinch some out and sprinkle it.

Making A Basic Hybrid

In order to make a basic hybrid you must take a male plant from one strain and a female plant from the other. Depending on genetics, certain features of one strain will be more apparent and favored in offspring than the other, and vice-versa. Also some variations that were not present in the parents may also appear (if the parents were both not IBL).

Before you begin it is important to keep in mind cannabis is an extremely variable and polymorphic species. Many traits have many many possible expressions. So keep on growing lots of variations which will ensure you a wide array of phenotypes and combinations of traits for future selection.

The first step is to determine what your goal is, or in other words, what desirable characteristics does your ideal plant have?

For indoor plants, these traits include it's shortness, bushy growth, height, densely formed buds, taste (including specific flavors), aromas, THC content, and quality of high (long-lasting, soaring, sedative). Also the plant's resistance to disease, insects, and any other health related issues is important. It is critical to select plants that have vigor and good strong health.

Figure out your end breeding goals first. Begin with the end in mind.

Sometimes plants will have ideal traits and negative ones. For example one may produce high THC content buds, but grow lanky and tall and be very susceptible to growing mold.

Your strategy is then to slowly weed out the negative traits in each generation of bred plants, until you have an ideal breed you are happy with, for yourself or for your customers.

Crossing

If you cross an Indica with a Sativa you get seeds which produce a hybrid. All seeds carry a genetic mix of their mother's and father's traits. The traits that are the same for the mother and the father will be passed on to the seeds. One way of crossing I this. Let's label the parents as P.

Crossing these parents give the F1 generation of seeds.

1. P(mother) x P(father) = F1
2. F1(female) x F1(male) = F2(if two f1 seeds are crossed they give rise to the f2 generation sons and daughters)
3. F2(female) x F2(male) = F3
4. F3(female) x F3(male) = F4

Most likely the fathers and mothers don't have the same traits, and after some generations the traits you prefer will therefor have gotten lost in the gene mixing. When you reach F4 the traits that you like will most likely (there is always the possibility but it is a really really small possibility) be gone. An inbred line (IBL) is a strain that is stabilized, i.e. the good traits are preserved and the bad traits are excluded. An IBL (inbred line) is a genetically homogenous strain that grows uniformly from seed. A hybrid is a strain made up of two genetically unlike parents, IBL or hybrid. If you don't own a laboratory, you can not know that the mother and father share the same traits, you can only make a good guess. To create an IBL you need to cross a lot of plants and grow many many generations of plants, I.e you need both time and space. Backcrossing involves breeding a descendant back against one of the original parents (eww!). :)

I'll call the first backcross seeds B1:

Two examples of Backcrossing:
P(mother) x F1(male) = B1
F1(female) x P(father) = B1

Cubing produces a larger population with a very close genetic heritage. Cubing involves backcrossing three times using the subsequent generations back against the original parent that you want cubed. i.e. first cross:

1. P(mother) x P(father) = F1
2. (begin cubing with the first backcross) P(mother) x F1(male) = B1
3. (second backcross) P(mother) x B1(male) = B2
4. (third backcross) P(mother) x B2(male) = B3

How can I change my marijuana's taste / smell?

The different tastes of certain strains of cannabis are a product of controlled-breeding programs. The flavour and smell of Cannabis comes from five substances: mono- and sesqui-terpenes, alpha- and beta-pinene, limonene, myrcene, and beta-phalandrene. The amount of each substance present in a given strain will determine the flavor and smell.

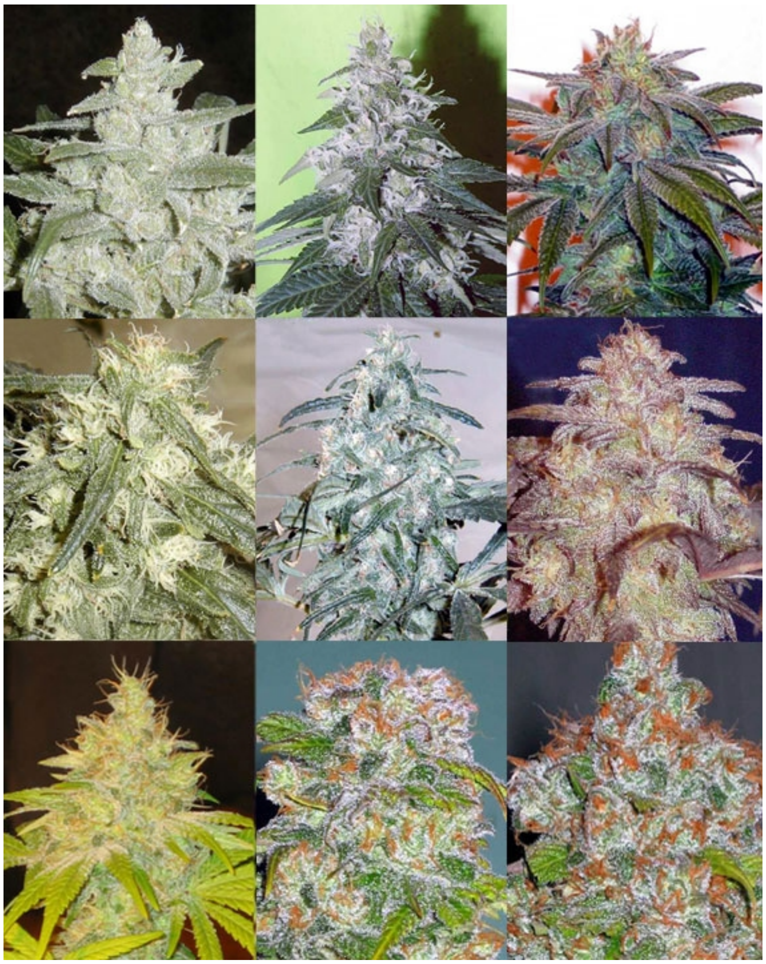
Breeding Goals

Before you begin any breeding strategy, the most important first step is to define your goals. Are you growing for yourself or for commercial production? Indoors or out? Mostly Sativa or mostly Indica? Keep only the plants that have the qualities you want, and mercilessly kill the rest.

Select plants that don't fall over; if you have to prop them up with toothpicks you might as well cull them. Keep the ones that are free from abnormalities and hermaphroditism. Hopefully you've got enough many seeds to be ruthless. Keep the ones that show better resistance to disease and pests. Even though the progeny performance is more important than the individual, there is a positive relationship between the overall vigour of an IBL and the yield of its hybrids. If they produce vigourous plants they are more likely to pass these traits on. Then employ a breeding strategy.

Choosing Your Breeding Stock

Breeding fine cannabis involves carefully choosing the breeding stock. To choose wisely you must first understand the key differences between male and female cannabis.



Female Cannabis: The female cannabis plant, unlike the male, is grown to produce potent marijuana. Premium marijuana is produced in seedless form by eliminating all pollen sources from the growing environment. Seed production reduces the value of marijuana dramatically by lowering the yield and potency of the flowers. Hermaphrodites are plants expressing both male and female flowers. They may fool a grower who mistakes the "hermie" for a female - only to find his crop is ruined by the unexpected release of pollen. Knowledgeable marijuana breeders are very careful to avoid hermaphrodism in their seed lines.

The attributes of a valuable female are the following (in descending order of importance):

1. Potency.
2. Scent.
3. Resistance to hermaphrodism.
4. Flavor.
5. Rate of flowering response.
6. Resin production.
7. Stature.
8. Floral color.
9. Floral structure.
10. Vigour/Yield

Male Cannabis: The male cannabis plant is essentially only useful for breeding. The male plant makes very poor marijuana, being mostly leaves without the dense resinous floral clusters of the female the yield is miserable. More importantly, the male of the species has virtually no potency in comparison to that of female cannabis. The males do carry genes that influence the expression of all the traits listed above, but not many of them are directly observable in the male itself due to the male phenotype being markedly different from the female phenotype. A male cannabis plant's value is determined by the quality of his daughters.

When starting out with a large number of potential breeding individuals, one desires to weed out the undesirable individuals.

The female is easy to evaluate because all the traits favoring marijuana production are directly observable in the female.

It's a simple matter of growing and then flowering the females to grade their performance and smoking the resulting marijuana. The breeder then chooses only those females most closely matching the breeder's personal ideal to be used as seed parents.

The directly observable & important traits of male cannabis are as follows:

1. Maturation rate.
2. Stature.
3. Vigour.
4. Resistance to hermaphrodism.

All males expressing poor quality in any of these traits should be culled so as not to pass the weak trait on to the progeny. Males are also observed to have a certain scent and floral structure but the importance of these traits pale in comparison to those listed above.

The potency of male plants, and especially the potency difference between individual males in a group, is generally too subtle to be measured by anything short of professional scientific laboratory equipment. There is no conclusive proof that the most potent male in a group actually creates the most potent female progeny; although it seems intuitive that that should be the case. The difficulty of determining a male plant's potency is a major hurdle to proving this link.

The potency of a male plant itself isn't very important, as we aren't interested in growing males for marijuana production. The value of a male lies entirely in the traits he consistently passes on to his daughters. Therefore its unnecessary to identify the one male amongst a group of potential pollen donors with the greatest potency. It is far more logical to evaluate the female progeny of each male to define the potency of each male in the group.

Male cannabis individuals may be graded for quality by a controlled pollination of identical female clones (one for each pollen donor). This isolates the influence of the male by holding constant the influence of the female on each cross. The seeds resulting from each clone are then grown and the progeny is graded to determine which of the crosses was the most successful. When the group with the most desirable female progeny is identified, the responsible male has been identified as the most valuable.

As you know, males can be kept in the vegetative state exactly like female mother plants; at this point they would be”dads”. Clones from the favored male can be flowered as needed along with the breeding female(s) when seeds are desired.

In most cases there will only be about 10 males to be evaluated after culling all those with directly observable defects. Breeding with larger populations is always preferable, as genetics tends to be a statistical "game".

By following the above method, growers can accurately pinpoint the ONE male in their small group which is the most potent...in the only meaningful sense of male potency.

Cubing a Clone

This is the technique of mixing pollen from all the selected males. This method guarantees that from the very first group of seedlings, a predefined fraction will be the offspring of the best male plant(defined as the male responsible for creating the best daughters). They will be easy to identify, being the superior plants.

The disadvantage of this method is that the identity of the responsible male is lost, rendering that specific cross difficult to repeat. That's a major disadvantage if the intention were commercial production of the hybrid strain. However because its more time-saving & practical, mixing the pollen is the best method for home breeders wishing only to obtain a great clone mother. One need only germinate a large enough group of seeds to ensure several female offspring of each select male & the future clone mother will be among them.

Cubing a clone is a way to create a unique seed line (a strain) modeled after a currently existing female individual. The goal is to create seeds from which the females replicate the phenotype of the original female. Obviously the chosen female should be an outstanding specimen.

The Cubing Procedure Step-By-Step

Remember; You must CONTINUOUSLY keep a Bonsai Mother in the vegetative state to provide clones.

Step 1) Pollinate a flowering clone of the original female with the pollen of a related male. The resulting seeds contain ½ the original female's genes and ½ those of the male. An unrelated male wont have the Y-chromosome of the chosen females family and therefore any Y-linked traits of the family will always be missing in the seed line.

Step 2) Grow the above seeds and flower them. Collect an equal quantity of pollen from each selected male and mix it together.

Step 3) Pollinate a flowering clone of the original female with the above pollen. These seeds contain ½ the original females genes plus ¼ more because the male used was ½ her genetics too. You can call this generation .75 to capture the idea that its ¾ of the original females genetics.

Step 4) Grow the above seeds & flower them. Collect an equal quantity of pollen from each selected male and mix it together.

Step 5) Pollinate a flowering clone of the original female with the above pollen. These seeds contain 7/8 the original genes (1/2+3/8), the ".88" generation.

Step 6) Grow the above seeds & flower them. Collect an equal quantity of pollen from each selected male and mix it together.

Step 7) Pollinate a flowering clone of the original female with the above pollen. These seeds contain 15/16 the original genes (1/2+7/16), the ".94" generation. Theoretically this will be a stable, true-breeding seed line from which all females are replicas of the original.

Note: In cubing we have no further use for the males of previous generations after taking their pollen. Therefore mixing the pollen & losing the identity of best male is no problem here. The goal of the cubed strain is to reproduce the female phenotype, independent upon P1 generations for reproduction after a certain number of steps in the cubing process.

Carefully evaluate the females produced in each generation of the cubing process to monitor their progress. If the results don't progressively shift toward your goals, then you may have to change your male selection parameters.

Convergent Improvement: If you have a good single cross (A X B), and you know the vigour is the result of the dominance of growth factors, back-cross it several generations to A, selecting for qualities of B that are lacking in A. After two or more generations of back-crossing and selecting, IBLs are produced. Do the same for B. After improved A and B are obtained, they are tested in crosses and compared to the original (A X B).

Multiple convergence is improving an inbred by convergence of gametes from different sources. If A is a very desirable inbred in crosses, it can be modified in two separate back-cross programs {eg. (A X C) X A, and (A X D) X A}, with the idea that the improved inbreds will be vigourous enough to use as the male parent of a double-cross.

Creating a True Breeding Strain(IBL)

There are a few situations where a plant breeder would want to create a true breeding strain(IBL) and a few ways of accomplishing the task. But understanding the subtle differences of the various techniques is not so easy. This section will attempt to give a basic understanding of what is actually happening with each technique and then apply what is learned to actual projects. Breeding is not a black and white subject and as a whole, it would be too complex to put on paper in an easily understood form. Therefore, I will create small fictional examples to reinforce various concepts and then we will take those examples and concepts and apply some reality to them. Try not to get hung up on the erroneous assumptions used here such as flavour being monogenic, the assumption is simply used to make it easier to learn a certain concept.

Just What Is It That We Are Doing?

Before we dive in to the more heavy material of this segment, maybe we should take the time to understand what we are trying to accomplish when we set out to create a true breeding strain. There are hundreds of possible phenotypic traits that we could observe within a cannabis population. Are we trying to make all of them the same and remove ALL variation? Not likely, the genetic code is just too complex to try. Plus, since phenotype (what we see) is ½ genotype + ½ environment; everytime the population was grown under new conditions, new heterozygous traits would be observed. Basically, all we are trying to create is an overall uniformity while not worrying about the minor individual variations. No different than a dog breed. You can look at a German Shepard and recognize it as belonging to a discrete breed. But if you look closer at several German Shepards all at the same time, you will find variations with each and every one of them. Some will be a little taller, some a little wider, some more aggressive, some a little fatter, some darker, etc. But they would all fall within an acceptable range for the various traits. Generally speaking, this is what a plant breeder is trying to accomplish when creating a true breeding strain, or IBL.

However this isn't always the case. Sometimes a breeder will just concentrate on a specific trait, like say outdoor harvest date, or mite resistance. You could still have a population where some are 2' bushes and some 10' trees. In this case, you would say that the strain was true breeding for the particular trait, but you wouldn't consider it true breeding strain per se. In genetics, wording plays a big part in meaning and understanding.

Ok, so we want to make a cannabis population fairly uniform over a few phenotypically important traits, like say flavour for instance. For simplicity sake, we'll just deal with the single trait flavour, it's complex enough. And although flavour is controlled by several gene pairs (polygenic), we'll make the simplistic assumption that it's controlled by a single gene pair (monogenic) for many of the models and examples in this paper. There are many flavours such as chocolate, vanilla, musky, skunky, blueberry, etc, but in this section we'll just deal

with two flavours, pine and pineapple. Either gene in the gene pair can code for either of the flavours. If both genes code for pineapple or both genes code for pine flavour, we say that the gene pair (and individual plant) is homozygous for flavour. If the one gene codes for pine and the other codes for pineapple, we say that the gene pair(and individual plant) is heterozyous with respect to flavour. The heterozygous individual can create gametes (pollen or ovules) that can code for either pine flavour or pineapple flavour; the homozygous individuals can only create gametes that code for one OR the other. A homozygous individual is considered true breeding and a heterozygous individual is not.

However, as the words imply, when we are creating a true breeding strain, we are looking at a population, not individuals. We are trying to make all the individuals in the population homozygous for a particular trait or group of traits. Lets say we have a population of 50 individual plants, and each plant has has a gene pair coding for flavour. That means that 100 flavour genes make up the flavour genepool (reality is much more complex). When trying to create a true breeding strain, we are in fact trying to make all 100 of those genes code for the same trait (pineapple flavour in our case). The closer our population comes getting all 100 genes the same, the more homozygous or true breeding it becomes. We use the terminology gene frequency to measure and describe this concept, where gene frequency is simply the ratio or percentage of the population that actually contains a specific gene. The higher the gene frequency, the more true breeding the population is. A fixed trait is where the gene frequency of the trait reaches 100%.

This is the basic backbone of what breeding is all about, manipulating gene frequencies. It doesn't matter if your making IBL, F1s, F2s, selecting for this or selecting for that, all you are really doing is manipulating gene frequencies. Therefore, to ever really understand what is happening in any breeding project, the breeder must pay attention to gene frequencies and assess how his selective pressures and models are influencing them. They are his measure of success.

What are we trying to create a true breeding strain from?

This a good question. Sometimes a gardener will notice a sport or unique individual in an F2 population, like say it has pineapple flavour when the rest have pine flavour. For one reason or another he decides he wants to preserve this new trait or combination of traits from that single individual. For the sake of ease of comprehension, we tend to call this special unique individual the P1 mom. He could start by selfing the individual OR breeding that individual with another and create what can be described as F1 offspring. If the F1 route was chosen, then breeders can diverge down two new paths. Some breeders will take the progeny of the F1 crossing and breed it back to the P1 mom, and then repeat for a couple more generations. This is referred to as backcrossing or cubing by cannabis breeders. Another common strategy is to make F2 progeny from the F1 population and then look for individuals that match the P1 mom. They would repeat the process for a few generations. We can call this filial or generational inbreeding since the parents from each cross belong to the same generation.

In another situation, sometimes a farmer will notice a few individuals in his fields that stand out from the crowd in a positive manner. Like say they are resistant to a problem pest such as powdery mildew. In this case, he will collect the best of the individuals and his starting population will contain several similar individuals and not a unique single individual as in the previous example. He would skip the hybridizing step (making the F1s) and go straight to the generational inbreeding step.

Applying the Pressure: Another excellent method to influence gene frequencies is to apply selective pressure. The idea here is to select only individuals that carry the desirable genes, and discard the rest.

IBL, f1, F2

An IBL (inbred line) is a genetically homogeneous strain that grows uniformly from seed.

A hybrid is a strain made up of two genetically unlike parents, IBL or hybrid.

When you cross two different IBL strains for the FIRST time, it is called the F1 generation. When you cross two of the same F1 hybrid (inbreed), it is called the F2 generation.

The process of selective inbreeding must continue at least until the F4 to stabilize the recurrently selected traits. When you cross two specimens of an IBL variety, you get more of the same, because an IBL is homozygous, or true breeding for particular traits.

How do I backcross my special female?

In this first situation, we'll deal with the situation where a plant breeder finds a special individual or clone.

It's a natural thing to be curious and cross a couple of plants that catch your fancy. Grow them out and find a new variation that you like even better. We can preserve the new variation through cloning indefinitely, but accidents happen and clones die. They can get viruses or can suffer clonal deprivation from somatic mutations over time. It's also harder to share clones with friends through the mail than seeds. So it's only natural that we would want to create seed backups of this special clone.

But before we start breeding this clone, we should try and figure what exactly it is we want from the seeds we are going to create. Do we want them to simply be able to reproduce individuals like the special clone? Simple backcrossing (cubing) will accomplish this. Or do we want to to create seeds that will be able to create more seeds like the special clone, a true breeding strain? These are very different in nature. You see, chances are that your special clone will be heterozygous for many of traits she phenotypically expresses. This just means that she will contain genetic information (genes) for two opposing traits, but you can only see one, the dominant one. However, her seeds will only get one or the other of the genes, so her offspring will express all the genetic information she has, including what you can't see within herself. If you want to create a true breeding strain, you need to preserve all the genes you can see, and remove all the genes that you cannot, but may show up in the offspring. Creating homozygousity. The only way to accomplish this is through selection and generational inbreeding(selecting the homozygous offspring to be parents for the next generation).

Backcrossing and Cubing

Backcrossing is where you breed an individual(your special clone) with it's progeny. Sick in our world, but plants seem to like it.

1. Your first backcross is just a backcross.

2. Your second backcross where you take the progeny from the first backcross and cross back to the SAME parent (grandparent now) is often called SQUARING by plant breeders.

3. Your third backcross where you take the progency (squared) from the second backcross and cross back to the SAME parent (great grandparent now) is often called CUBING by plant breeders. You can continue the backcrossing but we just call this backcrossing. Cubing is in reference to the number three, as in 3 backcrosses

Cubing works on the basis of mathematical probabilities with respect to gene frequencies. The more males you use with each cross, the better the chance that your reality matches the theory. In theory, with the first backcross, 75% of your genepool will match the genepool of the P1 parent being cubed. Squaring increases this to 87.5% and cubing increases it to 93.75%. You can arrive at these numbers by taking the average between the two parents making up the cross. For instance, you start by crossing the P1 mom(100%) with and unrelated male (0%) getting 100% + 0% divided by 2 = 50%. Therefore, the offspring of this first cross are loosely thought of as being 50% like the mom.

Take these and do your first backcross and you get 100%(mom) + 50% divided by 2 = 75%. And this is where we get the 75% for the first backcross. Same thing applies as you do more backcrosses. As you will see later, you can apply this same probability math to specific genes or traits, and this can have a dramatic effect on your methodology and selection methods.

Your selection of the right males for each backcross are the crucial points for success with this technique. In each case, you could select males that contain the genes you want, or you could inadvertently pick those individuals that carry the unwanted recessive genes. Or more likely, you could just pick individuals that are heterozygous for both genes like the P1 mom being backcrossed. One of the easiest ways to deal with this is to start by only looking at one gene and one trait, like lets assume that flavour is determined by a single gene (in reality it's probably not). And do some punnet squares to show gene frequencies through 3 generations of backcrossing. Now lets assume that we found a special pineapple flavoured individual in our pine flavoured population that we wanted to keep. The gene causing the pineapple flavour could be dominant or recessive and the selection abilities and cubing outcome will be different in both cases.

a) pineapple flavour is dominant.

P = pineapple flavour and p = pine flavour

Therefore since each individual will have two flavour genes paired up, the possible genotypes are PP, Pp, and pp. Since P is dominant, PP and Pp will express pineapple flavour while pp will exhibit pine flavour, these are their phenotypes. Now since the pineapple is a new flavour, chances are that the special individual will be heterozygous, or more specifically, Pp. Therefore, the only possible parent combination is Pp X pp with the Pp being the parent to be cubed.

Now most will find it tough to pick males with the gene for pineapple flavour since males don't produce female flowers. Therefore, they will select males randomly and blindly with respect to this trait. The ratio of P to p genes of the male F1 generation to be used in the first backcross will be 2:6. Another way to look at it is to say that the P gene fequency is 25%. This means that one out of four pollen grains will contain the gene for pineapple flavour.

Now it's this first backcross that first creates an individual that is homozygous (PP) for the pineapple flavour. However, again because of our limited selection abilities, we choose males randomly. From the random males we should expect three out of eight pollen grains to to contain the gene for pineapple flavour. The P1 female will still contribute one P gene for every p gene.

The second backcross (Squaring) will produce the following:

3 PP 8 Pp 5 pp

Therefore, 68.75% will have pineapple flavour and 31.25% will have pine flavour. The frequency of the P gene has risen to 7/16 or 43.75%.

And finally, the third backcross (Cubing) will net the following genotypic ratios:

7PP 16Pp 9pp

Therefore, 71.875% will have pineapple flavour after cubing has been completed. Roughly 22% (7/32*100) of the cubed progeny will be true breeding for the pineapple flavour. The frequency of the P gene has risen to roughly 47% (30/64).

If the backcrossing continued indefinitely with random selection of males and with large enough of a population size, the frequency of the P gene would max out at 50%. This means that the best that can be expected from cubing is 25% true breeding for pineapple flavour and 75% that will display the pineapple flavour. You would never be rid of the 25% that would maintain the pine flavour. This model would hold true when trying to cube any heterozygous trait.

b) Pineapple flavour is recessive

In this case, P is for the pine flavour and p is for pineapple flavour. Convention is that the capital letter signifies dominance. For the breeder to have noticed the interesting trait, the mom to be cubed would have to be homozygous for the pineapple flavour (pp). Depending where the male came from and whether it was related, it could be Pp or PP, with PP being more likely. It won't make much difference which in the outcome.

F1 cross is pretty basic, we'll skip the diagram. We simply cross the female (pp) with the male (PP) and get offspring that are all Pp. Since the pine flavour is recessive, none of the F1 offspring will have pineapple flavour (hint). However, the frequency of the gene p will be 50%.

pp X PP = Pp + Pp + Pp + Pp

Since the F1 generation are all the same (Pp), the pollen it donates to the first backcross will contain a p gene for every P gene. The first backcross will be:

B1 = pp X Pp = Pp + Pp + pp + pp

As you can see, 50% of the offspring will be pineapple flavoured and the frequency of the p gene is 6/8 or 75%. This B1 generation will generate pollen containing 6 p genes for every 2 P genes.

As you can see, the second backcross or squaring produces pineapple flavour in 75% of the offspring. And the p gene frequency within those offspring is roughly 88%. (Remember C88). Of the pollen grains from this squaring, 14 out of 16 will carry the p gene for pineapple flavouring. When they are backcrossed to the P1 mom for the third time, they net the following cubed progeny:

After cubing of a homozygous gene pair, we end up with roughly 88% of them displaying the desired trait (pineapple flavour in this case) and also being true breeding for that same trait. The frequency of this desired gene will be roughly 94%. If the backcrossing was to continue indefinitely, the gene frequency would continue to approach 100% but never entirely get there.

It should be noted that the above examples assume no selective pressure and large enough population sizes to ensure random matings. As the number of males used in each generation decreases, the greater the selective pressure whether intended or not. The significance of a breeding population size and selective pressure is much greater when the traits to be cubed are heterozygous. And most importantly, the above examples only take into account for a single gene pair.

In reality, most of the traits we select for like potency are influenced by several traits. Then the math gets more complicated if you want to figure out the success rate of a cubing project. Generally speaking, you multiply the probabilities of achieving each trait against each other. For example, if your pineapple trait was influenced by 2 separate recessive genes, then you would multiply 87.5% * 87.5% (.875 * .875 *100) and get 76.6%. This means that 76.6% of the offspring would be pineapple flavoured. Now lets say the pineapple trait is influenced by 2 recessive traits and and a heterozygous dominant one. We would multiply 87.5% by 87.5% by 71.9% (.875*.875*.719*100) and get 55%. Just by increasing to three genes, we have decreased the number of cubed offspring having pineapple flavouring down to 55%. Therefore, cubing is a good technique where you want to increase the frequency of a few genes (this is an important point to remember), but as the project increases, the chance of success decreases .... at least without some level of selective pressure.

Applying Pressure

The best way to significantly increase your chances of success is to apply intended selective pressure and eliminate unintentional selective pressure. Try to find clearcut and efficient ways to isolate and select for and against certain traits. Find ways to be sure your males are passing along the intended traits and remove all males that do not. This includes ALL traits that may be selected for. Some traits you will be able to observe directly in the males. Other traits like flowering duration you may not. If you are selecting for a trait you can't directly observe, you want to do some progeny tests and determine which males pass on the most desireable genes. I'll explain more on progeny tests later.

It's important that when choosing your best males to ignore the superficial traits having nothing to do with the real traits your looking for. You see, cannabis has several thousand genes residing on just 10 chromosome pairs or 20 individual chromosomes. Therefore each chomosome contains hundred of genes. Each gene residing on the same chromosome is said to be linked to each other. Generally speaking, they travel as a group. If you select for one of them, you are actually selecting for all of the traits on the chromosome. There is an exception to this rule referred to as breaking linked genes via crossing over, but for simplicity sake, we will ignore that for now. Getting back to selection, you could decide to select for a trait such as you like the spikey look of the leaves while really being interested in fixing the grapefruit flavour. But as it may happen, both traits may be on the same chromosome pair but opposite chromosomes. If so, as long as you select the plants with spikey leaves, you will never get the grapefruit flavour you really want. It's good to keep in mind that each time you select for a trait, you are selecting against several hundred genes This is why most serious breeders learn to take small methodical steps and work on one or two traits at a time. Especially with inbreeding projects such as selfing and backcrossing.

Now let's see what kind of improvements we can make in the first example of trying to cube a heterozygous dominant trait using some selective pressure. Let's say that with each generation, we are able to remove the individuals recessive for the pine flavour (pp), but can't remove the heterozygous ones (Pp). If you recall, our P1 mom had the genotype (Pp) in that model and the F1 cross yielded (Pp + Pp + pp + pp) as possible offspring combinations. We remove the two (pp) individuals leaving us with only Pp. Therefore our first backcross will be:

Pp * Pp = PP + Pp + Pp + pp

Again we remove the pp individual leaving us with PP + 2Pp. Going into the second backcross we have increased our P gene frequency from 37.5% up to 66.7%. This means that going into the second backcross 4 of every six pollen grains will carry the P gene.

As you can see, after selecting against the homozygous recessives for 2 backcrosses, we have increased our P gene frequency to 58% from 44% in our squared population. If we again remove the homozygous recessives, our gene frequency increases to 70% (14/20) going into the third backcross, meaning that 7 out of 10 pollen grains will carry the P gene.

B3 cross = 7 PP + 10 Pp + 3 pp

This translates to mean that 95% of the progeny will taste like pineapple after cubing a heterozygous dominant strain if the homozygous pine tasting ones are removed prior to to each backcross. This is an improvement from 72% when no selection occurred. The frequency of individuals true breeding for the pineapple flavour rose to 35%. But more importantly, the P gene frequency improves to 60%. This will be an important consideration when we discuss progeny testing . But for now lets recap the percentage of individuals true breeding for the pineapple taste in each of the models. In the case where the pineapple flavour trait is heterozygous dominant and no selective pressure is used, cubing produced 22% true breeding individuals. By selecting against the homozygous pine recessive, we were able to increase this too 35%. And finally, when cubing a homozygous recessive gene, we are able to achieve a cubed population that is 87.5% true breeding for the pineapple flavour. And as I pointed out earlier, these numbers only apply to single gene traits.

Let's say the pineapple flavour is coded by two separate genes, one dominant and one recessive, and you are able to select against the homozygous recessive pine flavour while selecting for the dominant pineapple flavour gene. Your cubed population would then contain 87.5% * 35% (.875 * .35 * 100) = 30% true breeding individuals. As you can see, as long as the cubed source is heterozygous, it doesn't matter how many backcrosses you do, you will never achieve a true breeding strain.

Increasing Bud Potency and Harvest Yield

There are several things growers can do to improve their marijuana yield and potency (THC content). Increasing marijuana yield and THC content is accomplished first by mastering and keeping all the basics consistent, such as marijuana grow room temperature, watering schedule, nutrient feeding, and using the proper high intensity discharge light. This in and of itself will grow impressive marijuana plants. The two most determinate factors of your yield amount is the strains you choose (good genetics) and the Light. Optimal high quality lighting along with spectacular strains will produce awesome yields and an abundance of potent buds from your plants. Also be sure to read the information throughout this eBook for tips on producing massive yields and quality potent buds. Increasing marijuana yield is the desire of all marijuana growers who have mastered the basics.

Mastering the basics of marijuana growing will then allow you to begin considering some advance marijuana growing techniques to increase yield and bud potency. The marijuana plant yield and quality can be increased in many ways.

You see, yield is equally contingent on a number of factors; light, temperature, humidity, water, nutrients, CO2/ventilation, genetics, etc. Think of it as an engine, with each factor of cultivation representing a single piston, sure the engine will run if some of the cylinders are misfiring or not firing at all, but to get the most power from that engine, all cylinders must be firing in sync and at maximum capacity.

Big frosty buds are your reward for doing everything correctly. There is no magic bullet that makes your yields go from zero to hero. With that being said, I personally think the most important things in regards to yield are proper pH, canopy management, and a reputable line of nutrients.

Here are the factors that will greatly affect your marijuana plant's harvest yield and potency/quality the most:

Regulate Humidity

THC is found in the resin glands that form on the plant during the maturation process. These glands act as a shield to protect the seed from the searing heat of the sun. This is needed more in a hot, dry atmosphere, than a hot humid one. To maximize resin production drop the humidity in the room for the flowering stage, the lower the better. But no matter how much resin you induce on an Indica it's still not going to give you the stone of a Sativa; so it does have a lot to do with your personal tastes and expectations.

Cannabis does best around 45%-55% rH (relative humidity). During vegetative and late flowering, however letting it drop lower during the final two weeks of flower is advised, as it will help prevent mold problems.

Proper Lighting

Plants need rest too! Some growers recommend 20/4 for vegetative growth. The theory is that plants do better (produce more carbohydrates) with less light over a longer period of time in contrast to a lot of light for a shorter period of time. There is a point of light saturation where more light will work against you by bleaching out the lifeblood of the plant - chlorophyll. Learn to "read your plants" and keep those leaves healthy and green until harvest. Some growers feel that in general you want to give your plants more light during vegetative growth and less during flowering. Their theory is to think about what occurs in nature. The flowering response is not the time to bleach out the leaves with high light intensities (and high Phosphorus foods). Their claim is that ultra low levels of Nitrogen found in bloom foods will generally not support leaf health.

Many will find that after turning to 12/12 for 3-4 weeks to put it up to 13/11 increases yields dramatically and makes the plant flower slightly longer which adds more growth time and overall increases yield.

But still, many grower stress the importance of maximizing light efficiency. They feel the more light marijuana plants receive the faster and healthier they will grow; increasing their yield. Properly hanging high intensity discharge bulbs so light hits the marijuana plant more than anywhere else can easily increase yield. Adding white reflective plastic to bounce light off the walls back to the cannabis plants is important to produce great marijuana. Focus light where it is needed most. Find the right amount of light for your plants, in due time you will get a feel for the EXACT amount and light exposure times needed to ensure an explosive harvest.

Maximize light efficiency: The more light marijuana plants receive the faster and healthier they will grow. Typically the more light you give the plant , the better the yield will be. Double the lux, double the yield.

Approximate Coverage:

- 400W is 1m2: 5-10 plants
- 600W is 1.5m2: 7-14 plants
- 1000W is 2m2: 15-20 plants

Properly hanging high intensity discharge bulbs so that the light hits the marijuana plant only (in other words, the light does not disperse) can easily increase yield. Adding white reflective plastic, Mylar, or painting the walls a Flat White to bounce light off the walls back to the cannabis plants is an important foundation to produce great marijuana and massive yields. Typically, the more light the merrier, but be warned that more light will create stronger water, nutrient, and CO2 demands on the plants. You must also have the proper spectrum of lighting as well as a means of efficiently reflecting as much of the light as possible into the garden's canopy. The norm is to use more bluish light (Metal Halide, cool-white fluorescents) for Vegetative Growth and more reddish (High Pressure sodium, warm fluoros) light for Flowering.

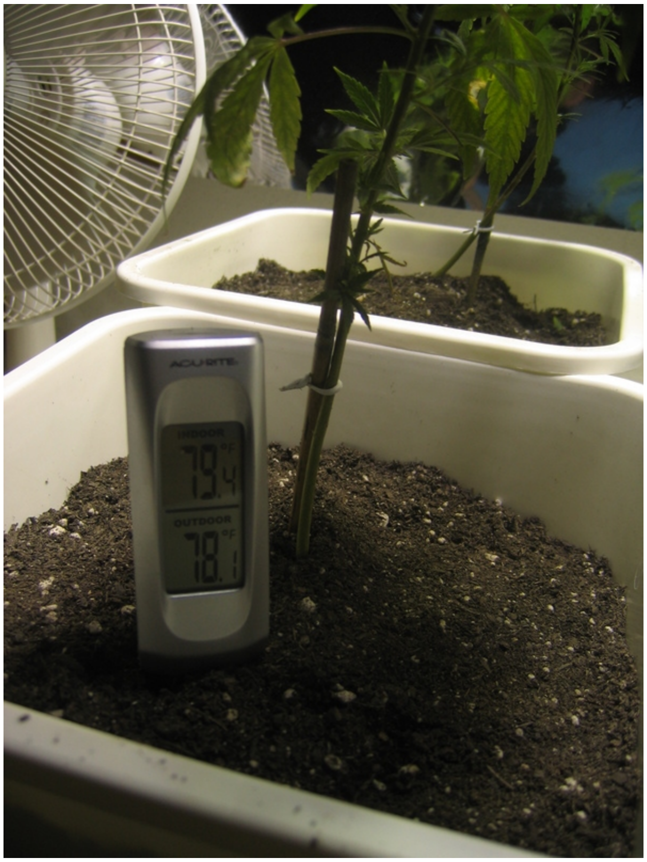
Though it is possible to grow great buds under fluorescent lighting and a few will even argue their superiority to HID's, most indoor growers use High Intensity Discharge lights such as MH and HPS, and many use fluoros for vegetative growth and HPS for flowering. As you can recall from the lighting section it's very important to have the light as physically close to the canopy as possible without burning the foliage and still allowing for even coverage. Many new growers believe that dropping the light closer to the plant will be beneficial. Besides heat stress, the bulb puts out radiant energy that causes leaf burn.

(Note it is possible to complete a grow using just HPS or MH).

Lamps can greatly lose lumen output over the course of 9 months to a year. They usually depreciate in lumen output by 30% over this time frame. This means that you will get 30% less yield from your plants but it is costing you the same amount of electric to run them. It is therefore a false economy to run old lamps.

Maintain Optimal Temperature

Temperature and the importance of day/night differential play a key role in both bud potency and harvest yield. In general, a 85°F (29.4°C) / 70°F (21.1°C) day/night temperature is best for most hybrids for maximum carbohydrate production. What's really important is a good drop in temperature at night, of at least 15°F(-9.4°C). If night temperatures are too high, the plant will use up the carbohydrates manufactured during the day to the process of respiration as opposed to plant cell division/elongation (tissue production).



Most cannabis plants will slow or cease growth when temperature gets above 85°F (29.4°C) or below 65°F (18.3°C). Optimal lights-on temp for most strains is about 72-78°F (22.2-25.5°C), with 5 to 10°F (-15 to -12.2°C) cooler during the dark period being a good rule of thumb.

Control Water

Contrary to popular belief, wet/dry cycles are NOT good, especially for organic growers. Keep the soil medium moist but not saturated to the point where air is excluded. When you water, don't be shy. Water until there is a good runoff. The issue is not over-watering, it's watering to the point of the exclusion of air.

Digital Meters

Calibrate your digital pH and cf meters regularly. Using buffer 4 and buffer 7 for your pH meters and conductivity standard for your cf meter. Without regular calibrating, these meters could be out of skew, and a wrong reading can make a lot of difference.

Fertilizers

It is critical to use the proper marijuana fertilizers according to the cannabis plant needs. Understanding how and when to use marijuana fertilizers will greatly increase your marijuana yield.

Developing their own marijuana fertilizer formula is often one of the major talents of a veteran marijuana grower. A pH and PPM meter is required to develop the best marijuana fertilizer formula. This is discussed in detail in the Nutrient section.

Understanding how much cannabis fertilizer your marijuana plants can handle during both the vegetative and marijuana flowering phase is critical to increasing marijuana yield. Some marijuana plants are referred to as heavy eaters, that is, they can consume plenty of marijuana fertilizers. Whereas some marijuana plants are more delicate and require less marijuana fertilizer.

WARNING: Some Grow Bloomers and advanced feeding products on the market today may actually produce higher yields but greatly lower the potency of your bud and produce an awkward taste. Experiment with them in order to achieve the optimal effect for your specific strains.

During the vegetative phase marijuana plants will dramatically increase their growth by using the correct amount of marijuana fertilizers. Not all marijuana fertilizers are made the same. Nirvana potassium based suspension or Wet Betty (an organic marijuana fertilizer) are excellent at increasing marijuana yield by building a strong healthy plant during vegetative phase. Both these marijuana fertilizers can be used to spray on cannabis plants just before the lights go out. They will increase marijuana growth.

There are all sorts of way to implement fertilizers for increasing harvest and potency. For example, Dr. Hornby's Organic Iguano Juice is a liquid organic marijuana fertilizer that is applied during watering. This marijuana fertilizer increases root production, creating the foundation to increase frosty marijuana yield.

Inexperienced marijuana growers often use too much Dr. Hornby Big Bud when they begin to see the results during the cannabis flowering phase though. Just a little Big Bud marijuana fertilizer is needed to increase marijuana yields. This powder is added during regular watering at the start of the marijuana flowering phase. Add Big Bud to increase marijuana yield, but never during the last two weeks of flowering. Do not use Big Bud (or any other fert) during the last two weeks of marijuana flowering as it will greatly effect marijuana taste. Flushing is critical if you want incredible tasting buds.

When achieving increased marijuana yields many marijuana growers make the mistake of using too much marijuana fertilizer. This can have a negative impact on the marijuana plant.

During the final weeks of marijuana flower it's critical to use clean water to flush the marijuana plant of all remaining fertilizers. The best marijuana growers won't harvest their marijuana plant until all the fertilizers have been cleansed from the plant.

Grower's skill/Advanced Feeding: Growers can add yield by: using additives (like *B1, kelp, enzymes*), foliar feeding, and topping/FIM.

Foliage Production

Grow for the most amount of foliage you can going into the flowering response. Maintain those leaves in a green and healthy condition up until harvest, even if it means switching fertilizer to a high N value, like a 9-3-6.

Use Molasses

Molasses is equivalent to the carbohydrate loading products sold in the hydro stores. They help add bud mass during flowering, feed the good bacteria, add beneficial micro-nutrients.

Molasses is a syrupy, thick juice created by the processing of either sugar beets or the sugar cane plant. Molasses (average NPK 1-0-5) contains potash, sulfur, and many trace minerals, it can serve as a nutritious soil amendment. It is a good, quick source of energy for the various forms of microbes and soil life in a compost pile or good living soil.

Molasses is also an excellent chelating agent. A Chelating agent means that molasses is one of the substances that can convert some chemical nutrients into a form that's easily available for critters and plants. Chelated minerals can be absorbed directly and remain available and stable in the soil.
Any kind of molasses will work to provide benefit for soil and growing plants, but blackstrap molasses is the best choice because it contains the greatest concentration of sulfur, iron and micronutrients from the original cane material.

It's a great source of carbohydrates to stimulate the growth of beneficial microorganisms. It simply is the best carbohydrate sugar for horticultural use and should be used by any grower serious about growing some serious weed.

Blackstrap Molasses is the best kind for supporting explosive growth and sparkling crystal buds.

Roots

Anyone who has experience with plants knows that healthy and prolific root growth is crucial to a bountiful harvest. Plants with unhealthy root systems are going to yield less than plants with lots of space for root growth and healthy thriving roots.

Plant/Root/Container Size: The longer a plant is vegetated, the bigger it will get and the more it will yield. Almost always overlooked because unseen are the roots - root mass is directly related to bud production. Simply put, the more roots you have the more bud you will (potentially) have. Be sure to always allow plenty of space for the roots to grow and spread out, even more-so in soil. A general rule of thumb is 1 gallon of soil for every foot of plant height.

Upcanning(repotting): This is a cool little technique to explode root growth. Score the rootball – that is; pop the ball out and using a razor blade or sharp knife insert it about ½" into the rootball at the top and slice thru the exposed roots from top to bottom concentrating on any root spinout at the bottom. Rotate the rootball and do this about 4 times. Bury the "trunk" as deep as you can even if it means pulling off some of the lower leafsets. This will induce root output all along the buried trunk.

Strain Selection

For massive yields, purchasing marijuana seeds that are designated high yielding is the building block to increasing marijuana yield. Avoid Sativa marijuana strains as Sativa marijuana plants produce light fluffy(potent) marijuana buds. Sativa is an uplifting motivational marijuana high. For heavy yields purchase a pure Indica marijuana strain. These marijuana types produce dense heavy marijuana buds and couch lock marijuana high. Commercial marijuana growers always grow Indica marijuana because of increase marijuana yield versus Sativa.

Note: These tips outlined in this section will assist in producing maximum yields(pushing them to the max) for your Sativa plants as well though.

By choosing marijuana seeds suitable to your indoor marijuana grow conditions you will ensure a very good yield.

Some strains simply have the potential to yield more than others. Also keep in mind having a heavy-yielding strain doesn't automatically equal big yields either. It only means that the potential for heavy yields is there. The grower must provide the optimum environment for that particular strain in order for it to be able to reach it's yield potential, and each strain has slightly unique requirements. Also, within a strain there are usually several phenotypes, each of which will exhibit unique characteristics which is to say that some phenotypes of a particular strain will weigh more than others. Remember that selecting marijuana seeds for increasing marijuana yield doesn't mean you have to sacrifice any other desirable phenotypes. With so many marijuana seeds to choose from a marijuana grower can find a marijuana type that is both heavy yielding, potent, and great tasting.

Depending on the marijuana growers preference some grow for marijuana high while others are looking for a great marijuana yield. Selecting marijuana seeds for increase marijuana yield doesn't mean the marijuana grower has to sacrifice yield. With so many marijuana seeds to choose from a marijuana grower can find a marijuana type that is both heavy yielding and great tasting.

Pruning

One of the most effective ways to improve your harvest yield is by pruning your plants so that they produce fewer, but much bigger buds. The pruning section in this guidebook covers pretty much everything you need to know but we can go into more details here with specific techniques for increasing harvest yield.

Depending upon the genetics of your plants and your goals for harvest you should determine the type and style of the trim. A lot of hard work goes into pruning and stalking plants, but it results in bigger, higher grade buds that require less manicuring.

Before a serious pruning a marijuana plant might have 16 - 20 branches. When the prune is completed the cannabis plant will only four or six remaining branches that receive plenty of light. Clip any small buds and branches under the canopy, along with any less developed branches. Many of the undergrowth branches will only produce popcorn size marijuana buds. Instead cut these branches to create marijuana clones. These smaller cannabis buds will only zap energy from the cannabis plant. Buds under the canopy that are small do not mature well and leech energy from the upper buds. By removing them a marijuana grower will increase yields and quality of their harvest because the marijuana plant is focusing all its energy on a select few heavy producing branches.

This branch's top is less than half the way to the top, so it's useless. First start at the bottom of the plant. Make sure that there's nothing to stop airflow under the plant. Air flow is extremely important in getting healthy plants with good yields. As the leaves use up the CO_2 and produce O_2, small pockets of useless O_2 are collecting under the leaves. If your garden has good circulation, this won't be a problem, the air is constantly moving throughout the entire surface of every leaf, however gently. So start by cleaning up useless leaves and branches that are at the bottom four to five inches of the plant. NO GREEN will exist here except for the branches themselves. Snip right off any stray branches like the one in the picture above.

You can also start by pruning a leaf from each node in a staircase pattern, as soon as the first 5 bladed leaf appears. This will stimulate lateral growth and open the plant to more light.

Top around the 4-5 node, using the FIM technique, leaving about 20% of the growth tip intact. Topping will create at least 2 new budding sites, and with proper use of the FIM technique I have had as many as 5, and have heard of as many as 8. Topping will allow bottom branches time to grow and catch up, making them closer to the lights.

With proper training and manipulation, you can get these giant plants to grow horizontal, effectively reducing the overall height of your garden as much as 50%. This way you can lower the lights as close as possible to all budding sites. With many budding sites very close to the light, you will get a better yield of grade-A bud. As opposed to having smaller shaded buds trapped under an untrained canopy, which will never fully develop.

Scrog/Sog/Vertical Gardens: These systems have a higher g/w/time yield than comparable large plant system over the same time period. Many modern growers report yields increasing drastically once they started doing the ScrOG method and FIMming their girls.

Super Cropping: Cutting branches to create a plant that grows bigger buds is done according to the plant. Some marijuana plants can be topped, that is their top branch cut off, to produce two marijuana colas. But it is important to note; many marijuana types can't be topped.

Pinching Leaf Tips

Another still-experimental process to increase the resin it to pinch off the leaf tips as soon as they appear from the time the plant is in the seedling stage on through its entire life-span. This produces a distorted, wrecked-looking plant which would be very difficulty to recognize as marijuana. Of course, there is less substance to this plant, but such wrecked creatures have been known to produce so much resin that is crystallizes a strong hash all over the surface of the plant - might be wise to try it on a plant or two and see what happens.

Bending & Training

Many growers like to bend their branches to ensure maximum light exposure which directly influences harvest yield.

A key example of this is bending the branches horizontally so that the buds grow vertically towards the light source. Because the buds all receive much more light, they will turn into a very generous top. This is one way to assist in generating massive yields.

The fan leaves are necessary for the photosynthesis and stores a supply of sugar, which the plant needs to develop rich thriving flowers. In order to get more light to lower bud sites during flowering, bend and tie the fan leaves so that they don't block the light from the other plants. You can also do this (only do the following if it's REALLY necessary) cut away portions of the fan leaves located on the top of the plant, blocking the light. Cut away the fan leaves. If you remove too many fan leaves the plant will have no supply of sugar, so be very careful with this.

Crushing Buds

Mel Frank (an expert on growing quality cannabis) uses a secret tip: you should roll the new buds between finger and thumb hard enough to crush the tip.

This will cause many more buds to start exploding at that site.

Seedlings

Do not plant young plants into systems unless they are showing good root development. If no roots are showing wait till there is before transplanting to your system. If you plant too soon, the rootball becomes saturated and this prohibits the plant's growth.

Control Water

Cannabis generally doesn't like "wet feet", or a soggy environment so it's very important to have a fast draining soil/soil-less mix (or well aerated solution in a hydro garden). Excessively wet or damp conditions can also lead to mold problems during flowering.

Miscellaneous Tricks

Tricks like keeping nutrients and the air temperatures warm during night cycle can help final yield. Although it's a topic of hot debate, it is generally thought that any system that supplies the roots with maximum oxygen (aeroponics) would outperform a system that restricts 02 input (such as soil). So, as you can see there's much more to yield than throwing some plants under tons of light with tons of nutrients. Before one becomes too concerned with yield, one must first learn how to grow plants well, learn how to "listen" to the plants and give them just what they need. It's best to start with simpler methods, in fact, I think the simpler method is always the better one. Learn how to grow strong, healthy, fast-growing plants (master the basics) and the yields will come.

Cutting Off Watering: You can stop any watering as the plants begin to make the resin rise to the flowers. This increases the resin a little bit.

Sunlamps: You can use a sunlamp on the plants as they begin to develop flower stalks.

Bud Snipping: You can snip off the flower, right at the spot where it joins the plant,and a new flower will form in a couple of weeks. This can be repeated two or three times to get several times more flowers than usual.

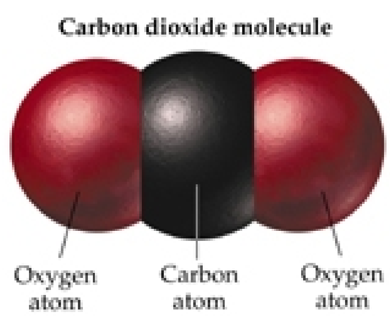
Ethel: If the plants are sprayed with Ethel early in their growing stage, they will produce almost all female plants. This usually speeds up the flowering also, it may happen in as little as two weeks.

Experimental Colchicine: One recent method floating around out there to increase THC content greatly is by the use of colchicine. Colchicine is a highly poisonous alkaloid, originally extracted from plants of the genus Colchicum. Originally used to treat rheumatic complaints and especially gout, it was also prescribed for its cathartic and emetic effects. Its present medicinal use is mainly in the treatment of gout. It is being investigated for its potential use as an anti-cancer drug as well. It can also be used as initial treatment for pericarditis and preventing recurrences of the condition. When added to marijuana apparently the results are nothing short of awesome...

Note: I haven't tried this myself so I can only report it to you here. Use at your own risk.

CO2 Generation

Through the process known as photosynthesis, plants thrive off of CO2 (carbon dioxide) intake. Plants require CO2. There is sufficient CO2 in our atmosphere to support massive bud growth, but when growing inside you must either have adequate ventilation (the volume of the room exhausted at least once/5 minutes) to ensure that there is a constant supply of fresh, CO2 enriched air. Plants can consume and benefit from up to as much as 5x the amount of CO2 that would normally occur in the air in nature.



One must have supplemental CO2, which requires higher temperatures and more nutrients to be utilized effectively. CO2 is a trade secret on how to generate big buds, to increase the CO2 levels in your grow areas environment the purchase of a CO2 generator is recommended. Under bright lights marijuana plants can greatly decrease the amount of CO2 in the marijuana grow room. Normally the CO2 levels in the air of most grow rooms are quite low, so adding a CO_2 tank on a timer will help your buds growth tremendously. Marijuana plants grow much faster, and produce heavier yields, when they receive CO_2-enriched air right up until the last two weeks of marijuana flowering. Be careful with this one, as you may not know what to do with all the quality marijuana you will be producing!

Elevating environmental carbon dioxide levels in your grow area can increase growth speeds tremendously, likely even doubling them!!! CO2 is a gas that make up approximately .03 ppm (parts per million) of our atmosphere. It is one of the basic raw materials used by plants in the process of photosynthesis. When your plants are exposed to a CO2 rich environment, they grow like crazy!

Note: Check the below section on Calculating CO2 Requirements if you want to know how much to introduce into your grow room to ensure maximum growth.

Many growers boast about increased yield from providing a CO2 rich environment for their plants. Back before air pollution was a problem, the natural level of CO2 was much much higher in the natural environment. The plant uses CO2 for photo-synthesis to create sugars it uses to build up its plant tissues. Elevating the CO2 level will increase the plants ability to manufacture these glucose sugars and plant growth rate is enhanced considerably.

When plants are growing indoors in an enclosed area, there tends to be a limited amount of CO2 available in the air. Once the plants use up all the available CO2, photosynthesis stops. When .2 percent (2000ppm), or six times the amount usually found in the atmosphere is used it can increase your plant's growth rate by up to a factor of five!

The downside is that CO2 can be a pain to manufacture cheaply, safely, and/or conveniently. It's very expensive to set up if you use a CO2 tank system. CO2 is most usable for flowering, as this is when the plant is most dense and has the hardest time circulating air around its leaves. If you're strictly growing vegetatively indoors (transferring your plants outdoors to flower), then CO2 will not be a major concern unless you have a sealed greenhouse, closet or bedroom, and wish to increase yield and decrease flowering time, as this is an awesome method of doing so.

The simplest way to create CO2 in your environment is to combine vinegar and baking soda. You can get creative here and design a mechanism where vinegar will drip into the baking soda at appropriate timed intervals, this will ensure CO2 to be created continuously. Another method is through sugar fermentation, but serious growers rely on more advanced methods.

For a medium sized indoor operation, one way is to use CO2 canisters from wielding supply houses. This method's initial cost can be quite pricy, but fairly inexpensive in the long run. These canisters are good only if your area is not too big or too small

Does light from a co2 generator interrupt the dark cycle?

Yes. Any light during the dark cycle should be completely eliminated.

This is not difficult because co2 is not necessary during the dark cycle and will not increase the rate of photosynthesis - it should be turned off to conserve resources.

Basic CO2 Setup

The basic CO2 tank system setup looks like this:

20 lb tank	$100
Regulator	$159
Timer or controller	$10-125
Fill up	$15-20

Total = $395 for a CO2 tank setup synced to a exhaust fan with a thermostat.

CO2 is cheaply produced by burning Natural Gas. However, heat and Carbon Monoxide must be vented to the outside air. CO2 can be obtained by buying or leasing cylinders from local welding supply houses. If asked, you can say you have an old mig welder at home and need to patch up the lawnmower (trailer, car, etc.)

For a small closet, one tank could easily last 2 months. (All you would have to do is have it on a hose and surround your plants with the hose poking holes in it for maximum CO2 dispersion). This all depends on how much is released, how often the room is vented, hours of light cycle, room leaks, enrichment levels and dispersion methods. Keep in mind that this method might be overkill for your small closet. It is recommended to have a small constant flow of CO2 over the plants at all times the lights are on, dispersed directly over the plants during the time exhaust fans are off.

Many opportunities exist to conserve CO2, but this can cost money. When the light is off you don't need CO2. So during Flowering, you will use half as much if you have the CO2 solenoid setup to your light timer. When the fan is on for venting, CO2 is shut off as well. This may be up to half the time the light is on, so this will affect the plants exposure times and amount of gas actually dispensed.

Environmentally, using bottled gas is better, since manufacturing it adds to greenhouse effect, and bottled CO2 is captured as part of the manufacturing process of many materials, and then recycled. Fermenting, CO2 generators, and baking soda and vinegar methods all generate new CO2 and add to greenhouse effect.

CO2 generation is all possible from fermentation. A simple CO2 generator would be a propane heater. This will work well, as long as the gases can be vented to the grow area, and a fan is used to keep the hot CO2 (that will rise) circulating and available below at the plants level. Fire and exhaust venting of the heat are issues as well. A room that must be vented 50% of the time to rid the environment of heat from a lamp and heater will not receive as much CO2 as a room that can be kept unvented for hours at a time. However, CO2 generators are the only way to go for large operations.

Fermentation or vinegar over baking soda will work if you don't have many vent cycles, but if you have enough heat to make constant or regular venting necessary, these methods become impractical. Just pour the vinegar on baking soda and close the door, (you lose your CO2 as soon as the vent comes on).

This method leaves a great deal to be desired, since it is not easy to regulate automatically, and requires daily attention. It is possible however, to create CO2 by fermentation, let the wine turn to vinegar, and pour this on baking soda. It's the most cost-effective setup for most closet growers, for whom $400 in CO2 equipment is a bit too pricy.

In fermentation, yeast is constantly killing itself, it takes a lot of space. You need a big bin to constantly keep adding water to, so that the alcohol levels will not rise high enough to kill the yeast. Sugar is used quickly this way, and a 10 pound sack will run $3.50 or so and last about 2-3 weeks. This is also difficult to gauge what is happening as far as amounts actually released. A tube out the top going into a jar of water will bubble and demonstrate the amount of CO_2 being produced.

You can try sodium bicarbonate mixed with vinegar, 1 tsp: ~30cc- this will gush up all frothy as it releases CO_2. Do it just before you close the door on your plants. A MUCH cheaper way to provide CO_2 is 2 Oz sugar in 2 liters of water in a bottle(sterilized 1st with bleach and water, then rinsed), plus a few cc of urine or if you insist, yeast nutrient from a home brewing supplier. Add a brewing yeast, shake up and keep at ~70°F (21.1°C).

Over next 2 weeks or so it will brew up about 1/2 Oz CO_2 for every Oz sugar used. Keep a few going at once, starting a new one every 3 days or so. With added CO_2 growth is phenomenal!!! One grower reports measuring 38cm growth in 8 days under a 250watt HPS bulb[tubular clear, Horizontal mount.]

A good container is a 1 gallon plastic milk jug, with a pin-hole in the cap. Also, the air-lock from a piece of clear tube running into a jar filled with water will keep microbes out and demonstrate the fermentation is working.

A variation of this method is to spray seltzer water on the plants twice a day. This is not recommended by some authorities, and receives great raves by people who seem to feel it has enhanced their crop. It stands to reason this would work for only a small unvented closet, but may be right for some situations.

It could get expensive with a lot of plants to spray. Use seltzer, not club soda, since it contains less sodium that could clog the plants stomata. Wash your plants with straight water after 2 or 3 seltzer sprays. It's a lot of work, and you can't automate it, but maybe that's good! Remember, being with the plants is a beautiful experience, and brings you closer to your spiritual self and the earth. Seltzer is available at most grocery stores.

Club soda will work if seltzer water is not available; but it has twice as much sodium in it. A very diluted solution of Miracle Grow can be sprayed on the plant at the same time. One factor of using seltzer water is it raises humidity levels. Make sure your venting humidity during the dark cycle, or you could risk fungus and increased internode length. (Remember: an internode is the place on the stem where the leaf (plus its stem) intersects the main stem.)

WARNING: Don't spray too close to a hot bulb! Spray downward only, or turn off the lamp first.

Even though CO2 enrichment can mean 30-100% yield increases, the hassle, expense, space, danger, and time involved can make constant or near constant venting a desirable alternative to enrichment. As long as the plant has the opportunity to take in new CO2 at all times, from air that is over 200 ppm CO2, the plants will have the required nutrients for photo-synthesis. Most closets will need new CO2 coming in every two or three hours minimum. Most city's' will have high concentrations of CO2 in the air, and some growers find CO2 injection unnecessary in these circumstances.

Some growers have reported that high CO2 levels in the grow room near harvest time lower potency. In order to avoid this it is a good idea to turn off CO2 two weeks before harvesting.

Calculating CO2 Requirements

So you need to know how much CO2 to add?

1. Measure and multiply: Length x Width x Height of your grow room to calculate the volume of cubic feet.

2. Generally, the CO2 level in a grow room is 300 ppm. To bring your room to an optimum level of 1500 ppm, you will need to raise the c02 by 1200 ppm.

3. Multiply your room volume by 0.0012 (1200 ppm = 0.0012) to determine how much c02 to add to your grow room.

EXAMPLE: a 10' x 8' x 10' room:

1. Volume= L x W x H
volume= 10 x 8 x 10 = 800 cubic feet

2. 800 cubic feet x 0.0012 =.96 cubic feet-- you can round this to 1 cubic foot. You will therefore need to add 1 cubic foot of c02 to a 10 x 8 x 10 grow room to bring the c02 level to 1 500 ppm.

Fermentation

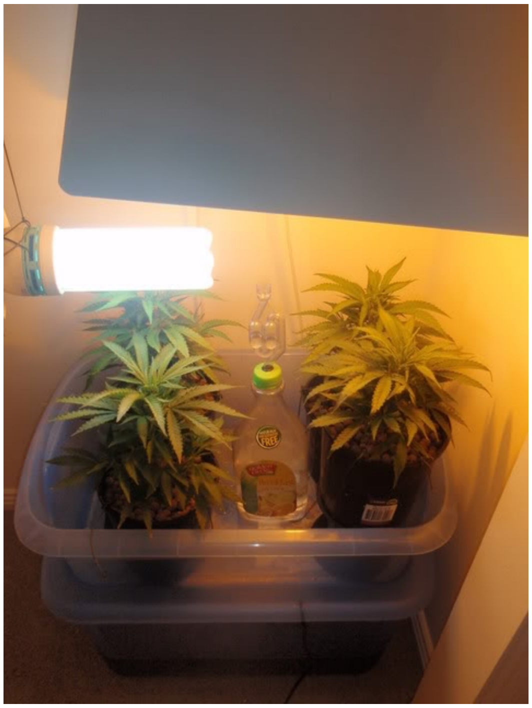
This is done by fermenting sugars with yeast. Sometimes even basic sugar and water is used for this purpose. Others use a more sophisticated blend with nutrients for the yeast. You will need to use an airlock (tubing coming out of a sealed fermentation vessel or jug and placed in a cup of water so the CO_2 has to bubble out through the water will work). This method is very cheap and easy to setup but while every bit helps this will not raise your CO_2 levels to the ideal 1500-2000ppm.

Dry Ice

Another method to generate CO_2 by simply melting dry ice (which is frozen CO_2) but it is difficult to control the speed of release to precisely control the CO_2 levels. Additionally you will need to add ice each day and the ice can not be kept in your freezer.

Vinegar and Baking Soda

When vinegar and baking soda react they release CO_2. You can produce CO_2 at a controlled rate by utilizing a drip system. You can make your own bottle.



Propane Burners

Propane burners generate lots of CO_2 and can be controlled but they also generate lots of heat that must be exhausted.

Stored CO_2 Canisters

As mentioned above; these can be purchased with cash at any gas supply shop. This is the least expensive and most controlled way to supply CO_2. The only downside is that there is a high up front cost and a few calculations are required to determine how to setup the system and output CO_2 at the proper rate. The details of the setup will vary based on your equipment but there are a few basic components you will need to use this method. The first is a tank. Tanks must be refitted with new seals periodically. Generally a gas supply will exchange your canister with another that has a similar amount of time left on it rather than fill the canister on the spot.

In addition to the canister itself you will need a solenoid switch to allow you to use a timer to control when the tank releases gas and when it does not. A regulator is needed to regulate the pressure to a lower and fixed pressure that won't damage your other equipment. To the output of the regulator you will need a flow meter with needle valve. Usually this will consist of a tube with increment markings and a little ball that raises to show you how much CO_2 is flowing through the flowmeter. This allows you to fine tune the output of your CO_2 system. Finally you will need plastic tubing with holes in it in order to actually distribute the CO_2 around the grow area. Remember CO_2 is heavier than air and will fall downward when released out of the tube. This means you should position the tubing above your plants.

You can purchase all of these components aside from the canister as kits sold for hydroponics. Follow the directions that come with the kit to set your timer, flowmeter, and regulator.

Creating Your Homemade CO2 Generator

Introducing your very own home-made CO2 generator; *The Sugar Bucket.*

Materials Required:

- 10lb. white sugar
- 5 gallon clean bucket W/lid
- 4 1/2 gallons of water
- A piece of toast browned and hard

A table spoon of dry active yeast (for baking bread)

First boil the water, (this will ensure clean water) remove from the heat and add the sugar. Stir until sugar dissolves. Let cool until water is room temperature(if you don't let it cool down it won't work).

After the sugar water has cooled, float the piece of toast on top of the water. Now, empty the tablespoon of yeast over the toast. After a few days, the yeast will take over the toast and start making bubbles (CO2) in the bucket. After a week, the amount of bubbling (CO2) will increase.

Keep the lid airtight on the bucket. CO2 travels up the dispersion tubing, and due to it being heavier than air, falls directly onto your plants. Timing your exhaust, is essential in maintaining an effective level of CO2.

Note: Use a CO2 analysis kit to help manage (exhaust timing etc), and maintain, an optimum level of around 1500PPM.

Bushier, More Productive Plants

A cool method to get bushier, more productive plants is to trim the uppermost growing tip of the plant after it has produced three sets of "true leaves." True leaves are those that have the serated edges and overall growth patten characteristic of marijuana plants. Using a small pair of sterilized scissors, cut the uppermost growth tip. In a few days, a dual set of leaves will develop from the cut tip. To create even bushier growth, you can cut the tips of these two new sets.

The result of these accumulated first and second rounds of cuts will be to produce four sub-main branches where only one vertical growing tip would have naturally otherwise been. This changes the shape of the plant from the natural Christmas tree shape with one main vertical stem and several side stems beneath it to a more horizontal shape that has several sub-main stems. Plants that are properly “topped” will be shorter, wider, and more productive than those that are untopped and left to grow in a natural way.

Healing Vibes & Music to Enhance Growth

In 2004 there was an American botonology researcher named Kathy Creath. Kathy published an article on a VERY interesting study she did. The study included her research on the effects of music on the germination of seeds. According to the article, Dr. Creath experimented by playing different genres of music in her research gardens where zucchini seeds and okra were being grown.

The research found that seeds had higher germination rates and germinated faster when “gentle flute music” was provided to the germinating seeds for a few hours a day, as compared to other tye of music or noise. We recommend you play some Bach, the plants love the soothing gentle vibes!

Recent research in a study done at the University of Arizona published by Dr. Creath also indicated that plants grow better and produce more when they are given “energy healing” techniques and other New Age type interventions along these lines. There was also a study done by a scientist over the course of a year. What he basically did was plant two trees in his yard. Every day the scientist would wake up, go outside into his garden, and put his palms up to the plants. For the plant on the left (Plant #1) he would send it hate energy. He would think terrible dark, angry, negative, hateful toxic thoughts. For the plant on his right (Plant #2) he would love it with all his heart, sending it healing loving energy, thinking thoughts of adoration, praise, healing, love, light etc. After a few months of doing this the plant on the left (Plant #1) that had received the hateful negative energy withered and died, whereas the plant on the right (Plant #2) that received the loving healing energy FLOURSIHED.

In fact it grew at an ALARMING rate.

There was also a similar study done on human babies(thank goodness cruel inhuman scientific studies cannot be done like this anymore). What basically occurred was they deprived babies of human affection, love, and touch, but supplied them with all the biological needs(air, warmth, water, nutrient rich food etc) in order to grow. What happened is the babies that were deprived of human “love energy” literally shriveled up and died of grief! How terrible. On the other hand, the babies that received the loving energy from the female nurses / doctors and their own parents were cheerful, happy, and healthy and grew just fine.

So keep your plants away from that blaring punk rock, play some calming flute symphonies or Bach during germination, feed your seeds and seedlings the right formulas, and send some healing vibes to your plants to enjoy better germination rates, faster growth rates, and greater yields!

Silicon

Silicon is a cool little trick many growers implement. Although silicon has not been recognized as an essential element for higher plants, its beneficial effects have been shown in many plants. Silicon is abundant in all field grown plants, but it is not present in most hydroponic solutions. Silicon has long been recognized as particularly important to rice growth, but a recent study indicated that it may only be important during pollination in rice. The beneficial effects of silicon (Si) are twofold: 1) it protects against insect and disease attack, and 2) it protects against toxicity of metals. For these reasons, you can add silicon (about 0.1 mM) to nutrient solutions for all plants unless the added cost outweighs its advantages.

Organic Fertilizer Super Grow Tea

One great secret to explode growth and increase potency that is used by many elite growers today is to make an organic purified water fertilizer "tea". To make a teabag fill a pillowcase with llama manure and sheep manure. This is an INCREDIBLE vegetative growth mix that will supercharge your plants with a whole range of essential enhancing nutrients.

Soak your tea bag inside a big container of water for several days, and the end result will be an organic super tea fertilizer water packed with nutrients for your plants.

For flowering you will use the same above method but this time use bat guano and llama manure. This will grow unbelievable buds like you have never seen before due to their high phosphorus and potassium content.

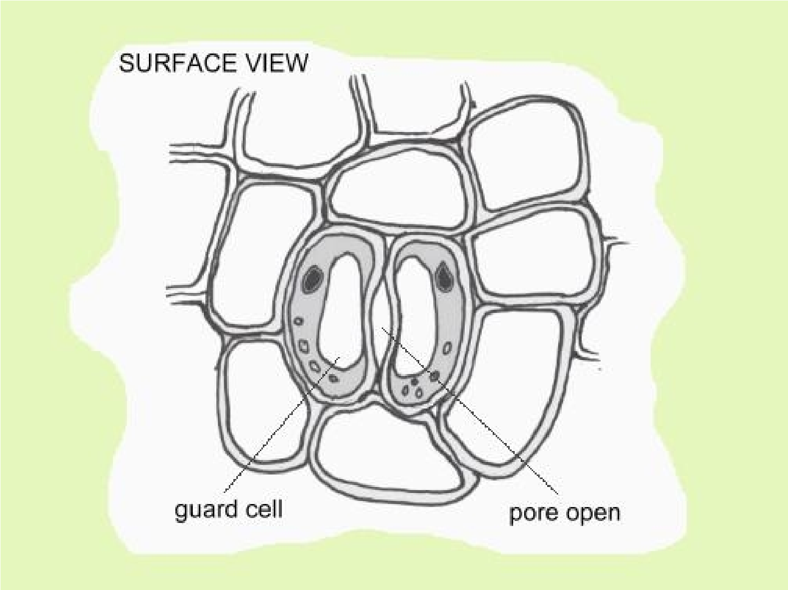
You will want to purchase a pump that will keep your organic fertilizer tea well-mixed and emulsified during the entire process. This will plug into your garden hose and on the other end of it attach a water wand. Add also a breaker head to the end of your water wand, this will add air to your water mix, oxygenating the water just before it is supplied to your plants.

Positive Pests

A really awesome classic grower trick is to introduce what is known as "positive pests" into your grow room. These buggers will only feast on known enemies of cannabis plants. The most useful commonly used positive pest is to release ladybugs into your environment. They will feast and be on the prowl for aphids. When ready to remove them, just vacuum them up and store them in the fridge in a plastic baggie! Don't worry - it wont hurt them.

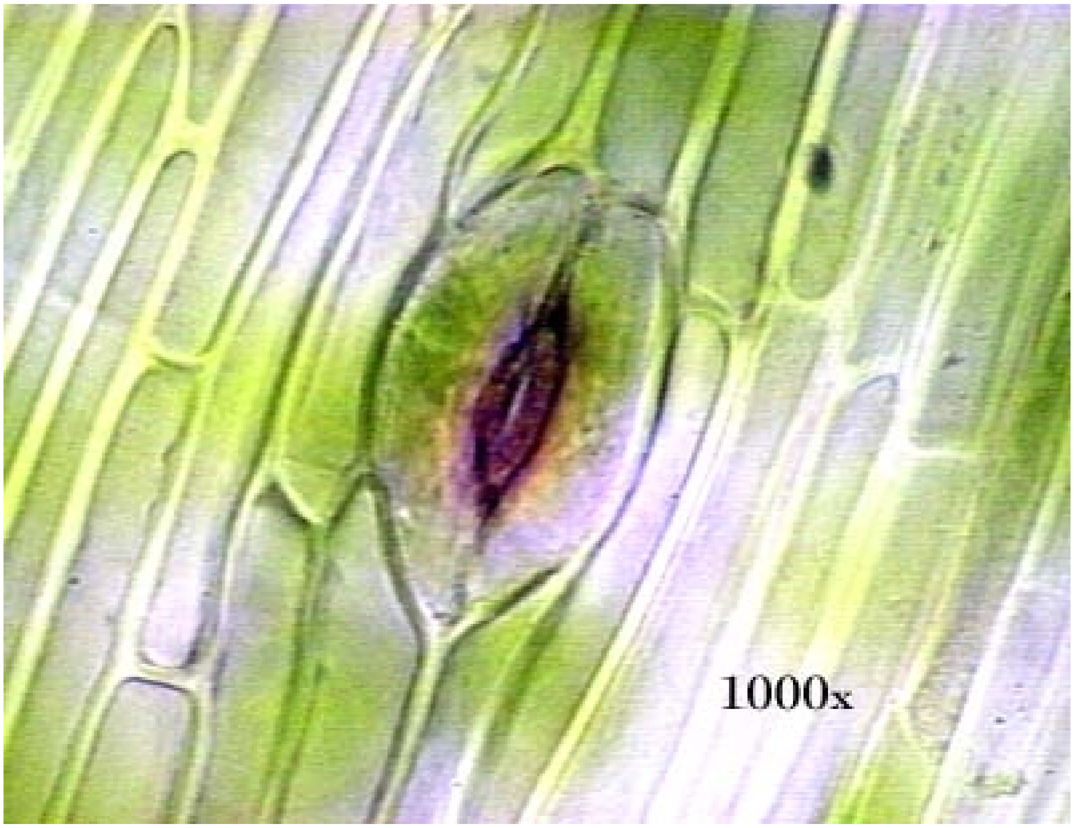
Folair Feeding

Folair feeding has to be one of the easiest ways of increasing yield, growth speed, and quality in a well vented grow space. As the plant ages it's roots become less and less effective at bringing nutrients to the plant. You may decide to start foliar feeding at this time, that is, spraying a nutrient solution directly onto the leaves. The leaves can absorb nutrients just as well as the roots can. If you do desire to foliar feed than back off the fertilizer to half strength.

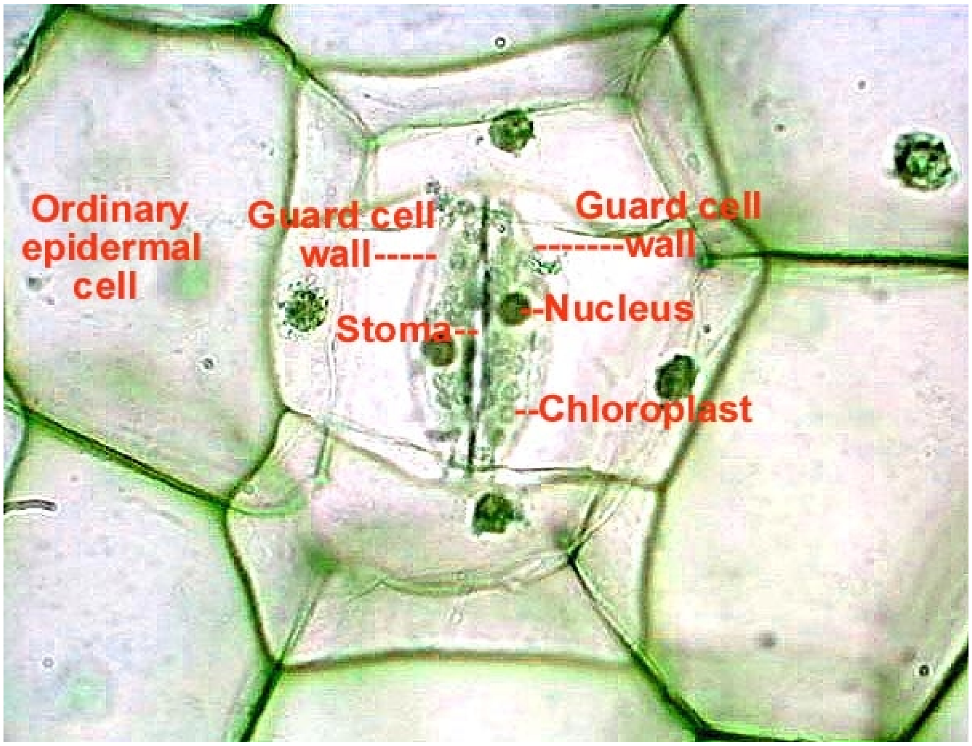


Plants need to be regularly sprayed and/or misted. Plants do and will feed off of nutrients supplied to their leaves with a nutrient solution mixture. Foliar feeding can give your plants a quick boost for a bigger, better, and overall higher yielding harvest. Foliar spraying will not replace your regular program of root feeding, but this technique will supply valuable supplementary nutrients to plants quickly and efficiently. Foliar feeding is a process of spraying the fertilizer directly onto the plants leaves. Foliar Feeding provides nutrients through the foliage, or leaves of a plant. Growers, with the help of scientists, and researchers, have been studying foliar feeding and have incorporated it into their growing programs for many years.

Regular spraying helps to feed the plant through its "stomata", as well as feeding the plant with direct exposure to nutrients, regular spraying also help to keep these stomata clean and open. Stomatas are the microscopic openings between two adjacent guard plant cells. Changes in the water content of the guard and subsidiary cells cause the stomatas to open and close in response to changes in water status of the plant. Marijuana plants carry on the process of



photosynthesis by combining together several ingredients in their leaves. Some of these materials are gaseous(carbon dioxide), some are liquid(water), and one is energy(light). If one were to look at the anatomy of a leaf, it would be easy to see how these materials are brought to the leaf so that they can form the food. The "stomata" play a very important role in allowing the gaseous materials to enter and leave the leaf. Think of a stomata as microscopic pores in your plant's skin. When a plant needs more carbon dioxide for photosynthesis, it opens its stomata. When the leaves get too hot and want to release water during transpiration, the plant once again uses its stomata, this time to let something out. There are many advantages to foliar feeding. Foliar applied fertilizers are three to five times more effective than root nutrition and can successfully reduce the nutritional stress situations of plants. Foliar applied nutrients can also make elements, such as iron, available to plants immediately when they are not available, or in low amounts in your soil, water, or hydroponic nutrient solution.



So then spraying is also useful in correcting plant deficiency problems, because of the very rapid absorption of plant nutrients through the leaves. Foliar spraying applications of fertilizer will provide almost instantaneous results. The best time to foliar spray is early in the morning for outdoor growers, and when the lights come on for indoor growers. This is the period when the stomatas are open. However, if the temperature is 80°F (26.6°C) or above, the spray will have less of a effect, as a lot of the stomatas are closed. Foliar feeding is extremely beneficial to clones, seedlings, young plants, and all plants while in the vegetative stage. Clones are not rooted so they need foliar feeding to develop roots, and prevent yellowing, a common problem among propagators (cloners). Once a Marijuana plant is put into flowering it is recommended that you eliminate foliar feeding for the remaining of its flowering stage.

When marijuana gets hot and dry it secretes resin as natural insulation from the harsh elements. They secrete this resinous insulation to naturally keep the plant cool. If foliar feeding is used in the flowering stage, we bring down the temperature of the plants, thusly resin secretion is less. Foliar feeding should only be done in the vegetative stage and ceased two weeks after flowering has began.

Foliar feeding should also stop in the flowering stage as nutrients can and will stay on your floral clusters. Not a good thing to be smoking once dried a heavy nutrient infested marijuana. All fertilizers made for soil or either hydroponics make great foliar sprays, especially the fertilizers that contain trace elements (micro-nutrients). Usually their mixed at half or reduced strength, to reduce the chances of fertilizer burn to leaves. A strongly mixed spray and close under high intensity or strong sunlight, can burn your leaves from light reflexion cause by the water droplets and/or common fertilizer burn. Foliar feeding is most efficiently achieved with mist-type sprayers. The smaller the particle size, the better the response and the less fertilizer is required to achieve the same end result.

An Overview:

- Use a fine misting spray bottle.
- Mist or spray once a day, early in the day, or when the lights come on.
- Mix root (nutrient) fertilizers half strength.
- Spray the whole plant.
- Foliar feed clones, seedlings, and vegetative plants.
- Cease foliar feeding two weeks into flowering.
- Use a specifically designed foliar spray with trace elements made for foliar feeding.
- The best temperature is about 72°F (22.2°C)(when stomata on the underside of the leaves are open); at over 80°F (26.6°C), they may not be open at all. So, find the cooler part of the day if it is hot and the warmer part of the day if it is cold out.
- Use a good quality sprayer -- should atomise the solution to a very fine mist.
- Always be sure your light is off and cool before foliar feeding! For extra safety, wipe your bulb with a dry cloth after spraying and make sure H.I.D lights are raised to a safe distance (double the distance is a good rule of thumb) to prevent burning.
- Make sure the PH of your solution is between 7 and 6. 2.
- To prevent the water from beading up (acting as small prisms) and thereby burning the leaves, for each gallon made, add half of a teaspoon of liquid

detergent (wetting agent).

- Spray leaf surface - the tops and the undersides - until the liquid begins to drip off the leaves. Stop spraying 2 weeks into flowering. Use sparingly on bud sites.
- Dispose of excess spray according to manufactures instructions - home made fertilizer sprays will be fine for at least 2 weeks.
- Spray one time a week every week, if any white residue is found, rinse the foliage with plain ph'd water to reduce salt build-up.
- Watch your growth explode!

The process in detail: Get a good spray bottle and set it to the finest spray. Foliar feeding should be done between 5 AM and 9 AM when the leaves stomata are open. If it is done later than this than the stomata may not be open at all. The leaves should be misted with the nutrient solution. Do not drench the leaves. It is better to feed twice a week than drench the plants once every two weeks. The day after foliar feeding the leaves should be sprayed with water to wash off any unabsorbed nutrients from the leaves.

Just prepare a tea of worm castings, fish emulsion, bat guano, or most any other plant food right for the job and feed in vegetative and early flowering stages. It is not recommended for late flowering, or you will be eating the sprayed-on material later. Stop foliar feeding 2-3 weeks before harvesting. Wash off the leaves with straight water every week to prevent clogging the stomata of the leaves. Feed daily or every other day. The best times of day to Foliar feed are 5 to 10 A.M. and after 5 P.M.

This is because due to the cycle of nature the stomata on the underside of the leaves open at these times. Also, the best temperature is about 72°F (22.2°C). If the temperature rises to over 80°F (26.6°C), they may not be open at all. So find the cooler part of the day if it's hot, and the warmer part of the day if it's cold out. You may need to spray at 2 A.M. if that's the coolest time available. The sprayer used should atomize the solution to a very fine mist; find your best sprayer and use it for this. Make sure the pH is between 7 and 6.2. Use baking soda to make the solution higher pH, and vinegar to make the solution lower pH. It's better to spray more often and use less, than to drench the plants infrequently. Use a wetting agent to prevent the water from beading up, and thereby burning the leaves as they act as small prisms. Make sure you don't spray a hot bulb and better yet, spray only when the bulb has cooled.

Perhaps the best foliar feeding includes using seltzer water and plant food at the same time. This way, CO2 and nutrients are feed directly to the leaves in the same spray.

Foliar feeding is recognized in most of the literature as being a good way to get nutrients to the plant later when nutrient lockup problems could start to reduce intake from the roots.

WARNING: It is important to wash leaves that are harvested before they are dried, if you intend to eat them, since they may have nitrate salts on them.

Observe extreme caution while foliar feeding any plants around exposed lamps. Turn off any fans and ventilation while spraying the plants, any water blown onto an exposed, burning lamp can cause it to explode in your face. Be safe.

Foliar Feeding Outdoor Plants

You can foliar feed outdoors, but go easy!

Into 20 gallons of water put:

1 cup ammonia, yep plain old household ammonia
-1 cup alfalfa tea
-1/4 cup Ivory liquid dish soap
-16 Oz. apple juice

You can experiment with other things like fish emulsion, but this recipe is great because it's so cheap and extremely effective.

Allotropic Cell

Research conducted in the UK showed increases in yields. It is a colloidal silver rod that generates a quantum field which makes the nutrients more easily assimilated. How it works is basically this; water contains unpaired electrons available to bond. These electrons bond with the nutrients and the other hydrogen molecules in the water. The allotropic cell excites the H2O molecules causing the hydrogen bonds with oxygen to break, permitting it to attach to nutrient molecules making them more easily absorbed by the roots. This process is always occurring with the quantum field accelerating the process. Colloidal silver also helps inhibit bacterial growth.

Growth Hormones For Enhancing Growth

Hormones are organic molecules which can have influence on the physiology of plants and animals. Plants produce hormones themselves naturally, but when selected hormones are added in low concentrations, they can have a positive influence on the physiology of plants.

1. Transport is not necessarily needed to let hormones work.
2. The effect of hormones depends on concentration and sensitivity of the plants.

The best understood hormones are:

- Auxine
- Gibberellic acid
- Cytokinine
- Ethylene
- Abscisine

Auxine: The most important areas in a plant where they are produced are young leaves, young seeds, pre-flowering buds and the stem.

- Auxine has a positive influence on cell stretching, cambium activity, and bud formation.
- Auxine is transported to the lower parts of the plant by chlorophyll cells

(parenchymcells).
- Auxin transport goes very slowly @ 1cm/hour.
- Transporting Auxine costs a lot of energy.
- Inactivation of Auxine happens when it binds with sugars and/or oxidation.

When you top your plant, the roots of your plant will grow a lot slower. When you add extra auxine, the roots will grow again and form new roots. This is why auxine is a major ingredient in root stimulators. Auxine works better in conjunction with Cytokinine.

Gibberellic Acid: Mostly produced in young leaves, but roots also produce it. It is transported from the roots to the leaves and branches. When Gibberellic acid is added to the roots, it will suppress the formation of lateral roots, but the cell stretching of the other parts of the plant will speed up and be more excessive.

Gibberellic acid can germinate seeds faster, and a higher % of female seeds will be produced (feminized seeds). Be careful though: too much Giberellic acid is not healthy.

Cytokinine: Concentration of Cytokinene is highest in young plant material (leaves and roots).

It activates cell stretching, triggers flowering and germination. Slows the aging of plants, and protects membranes against oxidation. When the concentration of Cytokinine and Auxine is high, it will develop buds, stems and leaves. If the concentration is low, complete plants will form. When there is less Cytokinine than auxine, roots will develop. High Cytokine concentrations will transport products of assimilation.
- Inactivation of this hormone happens when it binds with sugars or because of oxidation.
- The "glucosides" of Cytokinine could be a buffering and transportation form for the plant.

Ethylene: Formed within the plant, but is also produced by fungus and bacteria. Biological activity within the planting medium can regulate amounts of this hormone, and have an influence on your plants. Transport happens because of the intercellular spaces.

- Inactivation caused by oxidation.
- Ethylene can also be given to the atmosphere as a gas
- Normally, Ethylene production will slow down cell stretching and thicken the roots and stem (germination)
- Too much Ethylene can deform and even kill your plants. For instance, when the roots are in too much water, the production of Ethylene will almost stop, but so is the ability to gas it off to the atmosphere. If this happens, leaves will turn chlorotic (eventually leaf death), stems will stretch, and there will be an increased susceptibility to attack by diseases.

Abscisine Acid:

- Slows down cell dividing, cell stretching and bud formation.
- Abscisine acid is an antagonist of Gibberellic acid, Auxine and Cytokinine.
- Slows down the growing and flowering of plants.
- Produced in older leaves and chlorophyll.

Conclusion: Do not start experimenting with plain hormones unless you are very sure of what you are doing! Beneficial hormones / growth regulators are available in most grow shops.

Cutting The Shoot Open

I hope you recall reading about the importance of roots and how they are critical elements to ensure thriving vigorous plant growth. Well put quite simply, more roots = more essential nutrients = bigger danker buds.

In order to make your plant grow more roots and EXPLODE your bud growth, cut the bottom of the shoot (the base stem where the roots split off) open.
This technique works especially well with clones. You can do this by snipping vertically with a sterile pair of scissors, very carefully, a small vertical incision that

splits the shoot in half. By exposing more surface area this will allow your plant to grow many more roots, allowing them to absorb even more nutrients.
You see, there is a thin layer of skin under the outermost layer of the stem known as the cambium. The cambium layer is responsible for ALL root growth formation. When you split the shoot open via cutting it vertically, you are exposing the cambium layer to allow many many new roots to grow, enhancing your plants growth. Another wicked awesome technique is to lightly scrape away the outside layer off the stem to expose only the cambium. When cloning and you apply rooting hormone to concentrate here where the roots begin to form you greatly enhance your root system formation.

Note: Although this technique will vastly increase the number of healthy roots, rooting time will be a bit longer, typically a few days.

Use Seaweed For a Growth Surge

Seaweed extract is being marketed and supposedly has special benefits when supplied with iron. The following comments are extracted from a gardening article on use of seaweed(there are various species of seaweed which may differ in composition that influences biostimulation). Seaweed is a rootless plant in the Fucus family that floats freely or clings to rocks by holdfasts (root-like or disk shaped plant parts that attach seaweed to rocks but don't absorb nutrients). Seaweed photosynthesizes the sunlight that reaches it through shallow water and it absorbs nutrients from sea water through its leaves. Since the ocean receives runoff from the entire earth, it contains all known minerals, trace elements, and vitamins. This primal supermarket supplies a more complete diet for sea plants than any plot of rich soil or fertilizer provides for land plants. Seaweed contains 60 or more minerals and several plant hormones. It is not however a complete fertilizer. It has a fair amount of nitrogen and potash, but very little phosphorus, a major plant nutrient.

Only a few seaweeds are harvested commercially. Norwegian kelp (Ascophyllum nodosum), a brown algae is the seaweed most used in gardening. Norwegian kelp is gathered off the coasts of England, Ireland, Norway, and both the Atlantic and Pacific coasts of North America where it is called rockweed. Gulfweed (Sargassum), a floating sea plant, is harvested off the coast of North

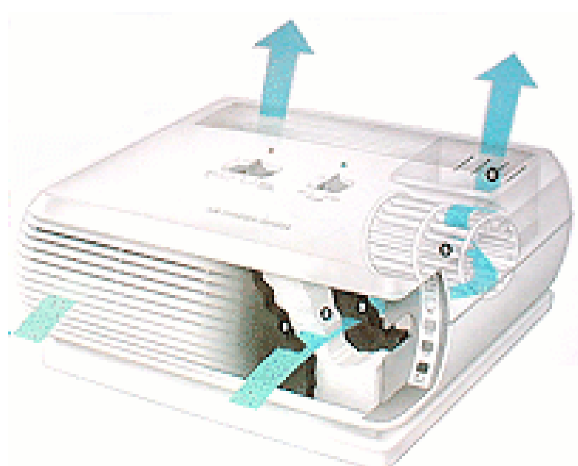
Carolina. Giant kelp (Macrcystis) is collected in the Pacific Northwest.

Seaweed is constantly worn down by tides and eaten by fish, so it must grow rapidly to survive. Studies at the University of California showed that a frond of seaweed can grow a foot or more a day, given optimal conditions. The same growth hormones that prompt such rapid growth in seaweed, when applied to plants as a foliar spray, can increase the rate of cell division and elongation in those plants. The hormones also increase root growth when applied to the soil as meal or when seaweed extract is used as a root dip.

In recent turf tests at Virginia Polytechnic Institute in Blacksburg, plots sprayed with seaweed extract had 67% to 175% more roots than untreated plots. Plots treated in fall showed a 38% increase in spring growth over untreated plots and showed 52% more roots.

In tests at South Carolina's Clemson University, seeds soaked in liquid seaweed extract showed rapid germination, and the resulting seedlings had increased root mass and stronger plant growth than seedlings from untreated seeds. They also had a higher survival rate. Soaking plant roots in seaweed extract reduces transplant shock and speeds root growth. Seaweed foliar sprays promote faster, stronger stem and leaf growth, and earlier blossoming and fruit set when sprayed on leaves and flower buds.

Negative Ion Generator



Negative ion generators have been used for years now to cut down on odors in a grow room, but reports are coming in that a negative ion generator will increase growth speed and yield. No true evidence to support this, however it does make sense, due to the fact that people and animals seem to be altered in a positive way by negative ions in the air, so plants may "feel" better too. Try putting one in the grow room. You may notice the buds don't have as much scent when picked, but that may be desirable in some cases.

A negative ion generator can be purchased for $15 to $100 depending on the type and power involved. Some have reversed cycles that collect the dust to a charged plate.

Another method is also possible by using grounded aluminum foil on the wall and shelf where the ionizer sits, in order to collect these particles. Just wipe the foil clean once a month. It should be grounded to an electrical outlets ground wire. If you don't cover the wall and shelf with paper or foil, the wall will turn dark with dust taken from the air, and you will have to repaint that wall at a later date.

Odor Elimination

Growing and smoking marijuana will produce odors. These odors can be strong enough to attract attention, so it is important to learn how to eliminate them if you don't want your grow area to get discovered. Simple handheld sprays are available, they are cheap and effective, but for larger gardens one may have to take bigger steps for odor prevention. You can also buy a dispenser that will spray a dose in timed intervals.

Another easy method for odor elimination is to purchase some in gel form. These products evaporate into the air and neutralize smell.

You can also use filters, carbon being the best, on your rooms outtake to prevent unwanted odors from escaping. But as said before, for larger gardens more drastic measures may be required. Harvesting is when the marijuana will stink up the place the most.

In some indoor set-ups a fan can be used to extract any unwanted smell away from the corridor outside. It can be pumped through a window or filter to another area where the smell will not be noticed. Not only that but plants love fresh air and wind, so the fan can do two things at once for you. An Ozone generator is a device that can be purchased from most grow shops. It helps to get rid of cannabis odor problems.

Potpourri in electric crock pots works well also. Add scented oils, scented beads, potpourri mixes, spices, you can make it as strong as you like. Fill it up once or twice and it lasts all day.

Place a small fan with a Bounce dryer sheet laying on the back of the fan, place the fan near your grow. The air is filtered by the scent of the sheet. Many of you may know already how well dryer sheets work.

ONA gel/liquid. Open container and let sit. Removes mild smell for up to two weeks before refilling with ONA liquid is required. The gel can also be placed near a fan. ONA Pro Gel is the choice of professionals for maximum odor control! Not a cover-up or perfume, this standalone smell stopper has almost no scent of it's own; all it leaves behind is fresh air. Even when used in extremely odorous conditions, ONA Pro Gel removes almost all traces of unpleasant smells.

Glade plug-ins (or other electronic plug-in scent expulsion devices). They work okay, but won’t be enough to cover the pungent marijuana smell alone. A few around the house can’t hurt, just change them monthly. Hang some car fresheners all over the place.

The best defense is fresh air. ALWAYS crack a window during the day, even in the winter.

Carpet sprinkle and vacuum products. You will smell it at for at least a few hours, good to use when company is coming over. Also, charcoal for use on the bottom of soil, to absorb plant odors. Use an inch or so on the bottom of your soil to neutralize plant odors.

Some other quick smell-busting remedies:

- Cook something.
- Pine Sol.
- Paint something.
- Brew some strong coffee.
- Incense, scented candles.

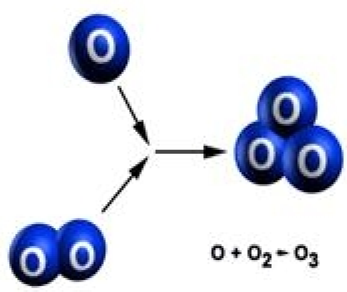
- Spray air fresheners.

Add some of the above to your central AC filter, or furnace air intake. Also, dryer sheets work well in a window AC unit’s filter. Try these things in combinations and use often for the best results.

Ozone

Ozone is a sensible addition to any large garden. Ozone is one of the most powerful sterilents known to Man. It's sole purpose is to kill bacteria, odors, and viruses. Most people learned about the atmospheric layer, the “Ozone Layer” that circles our planet protecting it from harmful UV rays from the sun. Ozone is abundant in nature. It's purpose when it comes to growing marijuana is to eliminate the strong marijuana smell in a grow room or where it is being smoked.

Ozone is extremely powerful, but it has a very short lifespan. As soon as it comes into contact with the odor, bacteria, virus etc, they are both destroyed in a process called oxidation. Both the ozone atoms and the bacteria atoms are destroyed, leaving in their place pure O2, or Oxygen. Aka clean air. Ozone, once airborne lasts at the most 30 minutes. If there is an excess amount of pollutants in the air it will degrade at an even more rapid rate.



Ozone generators are the most effective odor control devices available. Odor is caused by airborne pathogens which float freely and come in contact with our nasal passages. When generated ozone, or 0³ comes in contact with these pathogens one of the oxygen atoms detaches from the ozone molecule, attaching itself to the odor-causing pollutant. This process, in essence, inactivates the odor causing particles in the air, leaving clean, fresh smelling air. Growers report that a good ozone generator will completely eliminate airborne odors from the most pungent crops, but will not affect the dried bouquet of the flowers.

Ozone Production

So you're probably wondering how the heck you can produce ozone in your grow room. This is accomplished by using a device known as an Ozone Generator. An Ozone Generator is the most effective odor control device available today. The gist of it is, how our noses pick up smells is when our nasal passages come into contact with airborne pathogens. The ozone will attach itself to these airborne pathogens and destroy them, leaving in their place fresh, clean smelling air. A good ozone generator will completely eliminate airborne odors from the most pungent crops.

Note: Safety concerns about the effect ozone has on human beings has long been a debated issue. But fear not! The EPA, USDA and OSHA have approved the use of ozone at concentrations of 0.1 Parts Per Million, for an exposure period of eight hours, without any side effects. Most ozone generators will produce .05 PPM, with minimal exposure time. Ozone generation is a safe and effective method of odor control.

You can either buy an ozone generator or make one yourself.

Dangers of Ozone

At low concentrations, ozone is harmless, but at high concentrations it can cause problems in certain situations. Car exhaust is the main producer of ozone at ground level. It's molecular structure is similar to that of oxygen, but the third oxygen atom is unstable, and readily detaches from the ozone molecule and 'attacks' any structure that will accept an oxygen atom. This can be harmful to some organic substances. It's not only organic substances that are affected by ozone. Nearly everything that gets in its way will be destroyed! It is highly corrosive, and can affect everything from metals to rubber. If this gas is so toxic that it corrodes metals and rubbers, just imagine what it does to your lungs!

Ozone Facts:

- Ozone is a colorless gas.
- It is a naturally occurring gas.
- It does not have an obvious odor (although some say it smells like fresh rain, or purified air).
- Ozone is a toxic gas.

Short exposures of relatively high amounts of ozone (found in some grow rooms) can cause problems such as:

- Pains in the chest.
- Throat irritation.
- Coughing.
- Shortness of breath.

Although short exposures to ozone may cause problems, these should clear up over time. Prolonged exposure to high concentrations of ozone can cause severe damage to the lungs and other parts of the respiratory system, and over time may have irreversible effects. The more ozone a person inhales, the more damage is done to their system, and the less chance there is of recovery.

People with asthma are advised to avoid prolonged exposure to ozone, as it may cause an 'asthma attack' or flare up problems with their respiratory system. As an example to the severity of ozone 'poisoning', the New York State Ozone Advisory will issue a warning to people if the level of ozone is above 0.08 ppm for more than 8 hours at a time. 0.15 ppm is intolerable for even short periods.

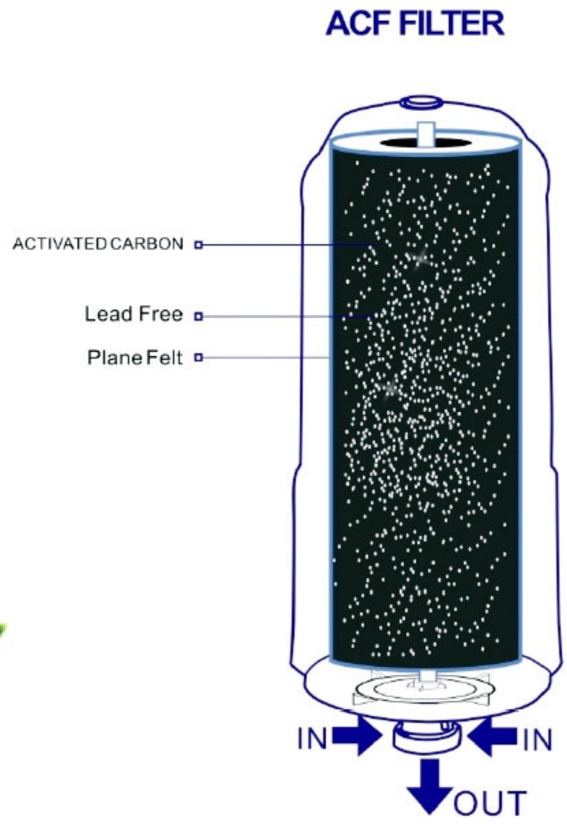
Preventing Over-exposure: Your ozone generator should not be pumping ozone directly into the room. If you are using an ozone generator, us it in conjunction with your ventilation system. This way, no concentrated amounts of ozone are present in the grow room, but instead having all the ozone flow in the exhaust tubing to clean the air as it leaves the grow room. Put your ozone generator inside your exhaust ducting - most generators are round tubes with 4/6/8" diameters, designed to work inline with your grow room air exhaust system. Some generators have a control that regulates the output levels (The generator functions at 100% output, but this rheostat cycles the on/off cycles, much like a microwave).

This method is the safest and most effective way to use your ozone generator, but for added advantages, if you divert some ozone back into the grow room it will help kill airborne substances such as spores, moulds, etc to help keep your grow sterile and clean. If your generator is pumping ozone directly into your grow room you will need to have a strong ventilation system to help keep the levels of ozone from building up to dangerous levels. Having the exhaust air vented outside is the best solution. Avoid spending excess amounts of time in your grow area if you are using an ozone generator.

Concentrations (according to various controlling bodies) should not exceed concentrations of 0.10 ppm for more than a few hours at a time. It is also understood that these concentrations and below are not suitable for controlling odors. This means that if your grow room has an odor problem, and you are using an ozone generator, it is highly likely that you are exposing yourself to harmful levels of ozone. If you run your ozone generator on HIGH in a relatively unventilated area, you can easily reach levels of 1ppm, which is 10 times higher than the maximum recommended level.

Active Carbon Filtration

This technique involves forcing exhaust air through active carbon in order to filter out odors. This method is highly effective and very popular and can also be used in combination with the other methods. These filters can be purchased or you can find plans to construct them online. Ideally, you would use your exhaust fan to pull the air through the filter rather than push air through it.



Conclusion

I hope you've enjoyed your ultimate guide to cultivating elite cannabis. I sincerely hope you've enjoyed reading this as much as I did creating it. I want to thank the countless talented growers and influences who have helped, indirectly and directly, to the publication of this incredible source of knowledge. It is now up to you, the fresh new aspiring talent, to go develop even more advanced powerful growing methods to grow some of the finest bud this planet has ever seen. I'm sure you'll enjoy your own awesome personal ganja supply!

This amazing 420 growing art form is rapidly sweeping the globe, spread the knowledge and help a confused grower in need! Get ready for the Green Rush. I would also like to thank my Dad and the countless other souls who have helped teach me the way of Love, Peace, and GREEN. I have been very fortunate to have some amazing people in my life who have shown me how to give and want nothing in return but the simple joy of unattached giving.

I want to remind you that this guide is in no way meant to be the end-all be-all of growing marijuana. Every day there are hundreds of new tricks, techniques, grow methods, etc, being invented and displayed on forums, books, magazines – you name it, in order to further advance the cultivation of cannabis. It is your job as a grower to continually learn and *never* grow stagnate in your grow techniques in order to bring buds to even more unbelievable heights! I hope you will all keep the riding the uprising wave of GREEN that is sweeping our globe. Good luck tending to your new awesome garden and enjoying its' amazingly dense, sticky sparkling rich bounty. I wish you the best of luck in all your future cannabis endeavors!

I've taken you from start to finish, from seed to smoke - I hope you enjoyed the journey! I know it is a lot of information to digest, don't be discouraged and take your time. You have your whole life to get good at growing awesome strains, and hey, who knows; one day YOUR strain may very well be the next winner of the Cannabis Cup.

What's to stop you?

Remember friend.... keep it GREEN, LOVING,
and full of LIGHT.

Toke on,

Ryan Riley

p.s. To **all those** who support **green** & **One Love** and you haven't heard yet, there is a MASSIVE global shift going on *right now*... tons of incredible people are getting together focusing their resources and have mathematically estimated a World Peace deadline in 5 years, go contribute guys! This is exciting and one of the greatest steps of mankind that you are a part of and really can make a difference!

Check out here and here for more info. Let's do this!

Glossary of Terms

18/6: Time normally associated with the vegetative stage of growth i.e. 18 hours of light to 6 of darkness.
12/12: Timing used to initiate the flowering stage of the plant i.e. 12 hours light to 12 hours darkness.
Abiotic Stress: Non-living environmental factors such as frost, drought, excessive heat, etc. that can have harmful effects on plants.
Abscisic Acid: mediates stress tolerance responses in higher plants, is a key signal compound that regulates stomatal aperture and, in concert with other plant signaling compounds, is implicated in mediating responses to pathogens and wounding. In seeds, ABA promotes seed development, embryo maturation, synthesis of storage products (proteins and lipids), desiccation tolerance, is involved in maintenance of dormancy (inhibition of germination), and apoptosis. As well, ABA affects plant architecture, including root growth and morphology, and root-to-shoot ratios
AC (alternating current): An electric current that reverses its direction at regularly occurring intervals. Homes have AC.
Achene: Seed
Acid: a source substance: An acid or sour soil has a low PH. Active a hydroponics' system that actively moves the nutrient soil.
Aeroponic System: growing plants by misting roots suspended in air.
Aeroponics: the growing of plants in a container in which the roots are suspended in a nutrient mist rather than in a solution. The most popular container for aeroponics is an enclosed A-frame constructed of styrofoam boards. The plants are placed in holes along the sloped sides of the frame. The nutrient mist is delivered to the roots by a vaporizer or by special attachments available with drip irrigation kits. The mist clings to the roots. Any excess runs down the inside of the frame, is collected at the bottom, and is recycled back to the nutrient reservoir.
Aggregate: medium(that is usually gravel) that is all nearly the same size and used for the inert hydroponics' medium.
Alkaline: refers to soil with a high PH. Any PH over 7 is considered alkaline.
Alternating Leaf: as the plant grows, in the beginning, every leaf(that is not damaged) will have another leaf growing from exactly 180°F(82.2°C) on/around the stem. they grow in pairs. when the plants mature, the leaves will grow one

at a time. that is a leaf will pop out on one side, then, up the stem/branch, another will grow. ie alternating.
Amendments: can be considered either a organic or mineral base. Amendments change the texture of a growing medium.
Asexual propagation: is producing plants from clones
Auxins: are plant hormones governing many biological processes in higher plants such as cell enlargement and division, differentiation of vascular tissue, apical dominance, root initiation and signaling.
Ballast: a stabilizing unit that regulates the flow of electricity and start a HID lamp.
Blood Meal: This organic fertilizer is very high in nitrogen and is very soluble in water (unlike most other dry organic fertilizers). It also contains plant growth regulators. All this together means that its effect is strong and quick, but its power will only last a short while, especially in wet weather. When applying blood meal, take care, as it will easily burn a plant's leaves.
Blossom Booster: fertilizer high in phosphorus that increases flower yield.
Bolt: term used to describe a plant that is severely root bound and starved for light. The plant will grow either straight up or bolt.
Boron: chemical element, semimetal of main Group illa (boron group) of the periodic table, essential to plant growth
Breed: to sexually propagate marijuana under controlled circumstances.
Buds: The reason this website exists! -The part of the flowering female plant that contains high concentrations of THC and other psychoactive ingredients.
Bud Leaves: the small leaves that grow in the buds of the plant, usually covered in trichomes when harvested.
Buffer: a substance that reduces the shock and cushions against fluctuations. Many fertilizers contain buffer agents.
Bulbous Trichome: spherical shaped resin producing plant hair with no stalk.
Calcium: chemical element, one of the alkaline-earth metals of main Group IIa of the periodic table
Calyx: the pod harboring female ovule and two protruding pistols, seed pod .
Cannabinoid: A hydrocarbon unique to cannabis.
Cannabis: scientific name for marijuana specifying genus.

Canopy: The top branches of a plant, usually shading the lower branches, except when branch training methods are used. (See LST, SCROG, and SOG)

Capitate Stalked Trichome: A resin producing plant hair , high in THC content.
Carbon Dioxide (CO2): a colorless, odorless, tasteless gas in the air necessary for plant life.
CBD/CBN: byproducts of the main physcoactive ingredient in pot, thc. these byproducts are created when the thc degrades, due to over exposure to heat/oxygen(some thc will naturally do this while the flowers rippen). it is beleived that they are resposible for the stoney part of the high, and known to have a direct effect on the physcoactive effect thc has on the "user". it is only needed in minimal amounts, in comparison to thc.
CBD: Cannabidiol, CBD usually prolongs the high.
CBN: Cannabin
Centigrade: a scale for measuring temperature where 100 is the boiling point of eater and 0 is the freezing point of water.
CFM: Cubic Feet per Minute. This describes the volume of air that is displaced in 1 minute (see ventilation).
Chelate: combining nutrients in a atomic ring so that it is easy for plant to absorb.
Chlorophyll: the green pigment in leaves. Chlorophyll pigment is produced in the chloroplasts of leaf, stem and flower cells. Chlorophyll pigment dominates all other pigments present including the xanthophylls and carotenes. Chlorophyll captures the sun's energy which is used to manufacture sugar from carbon dioxide and water. Chlorophylls are constantly being "used up" and thus are continually manufacture by the plant, provided the environmental conditions are appropriate.
Chlorosis: the condition of a sick plant with yellowing leaves due to inadequate formation of Chlorophyll, Chlorosis is caused by a nutrient deficiency ,usually iron or imbalanced PH .
Cloning: the process of replicating female plants. Cloning Guide, with pics
CO2 Enrichment: adding CO2 to the atmosphere of a grow room to speed growth.
Cola: a marijuana flower top.
CFL: Compact Flourescent Lighting
Compost: a mixture that consists largely of decayed organic matter and is used for fertilizing and conditioning land
Composting: The process by which organic materials mixed together in

specific conditions create a nutrient-rich medium.
Cotyledon: The first leaf or one of the first pair or whorl of leaves developed by the embryo of a seed plant small round leaves that are the first to appear on a small seedling, they are not considered true leaves? and often fall off of the plant early in the growth stage.
Cubic Feet: length x width x height
Cubic Feet Per Minute: how many cubic feet (1FTx1FTx1FT) a fan can replace per minute
Cure: to prepare or alter especially by chemical or physical processing for keeping or use
Curing: Process of placing the dried harvest in tightly sealed, sterile, jar, which should be stored in a dry, dark, cool place. Then according to preference open the jar for a certain amount of time everyday to release co2 and moisture and this slowly dries the crop, thus improving taste and over all quality.
Cutting: a plant section originating from stem, leaf, or root and capable of developing into a new plant. Sometimes the easiest (and fastest) way to grow a new plant is not from seed, but asexually from cuttings. Cuttings are taken from roots, stems, or leaves and encouraged to regenerate by providing ideal growing conditions and (oftentimes) applying rooting hormones. Unlike plants started from seed, a plant grown from a cutting will have exactly the same characteristics of the parent plant (See Also - Cloning)
DC (direct current): an electric current flowing in one direction only and substantially constant in value -- abbreviation DC.
Decarboxylation: This occurs after buds are harvested and during the curing process. The THC loses a CO2 molecule, which then makes the THC psychoactive. This process is why drying and curing buds after harvest is crucial to the high that the bud produces.
Deep Water Culture: easy system of hydroponics with fairly low maintenance & materials with excellent results.
Dioecious: having male reproductive organs in one individual and female in another.
Diploid: contains 2 sets of chromosomes
Dolomite: a mineral CaMg(CO3)2 consisting of a calcium magnesium carbonate found in crystals and in extensive beds as a compact limestone
Drip Line: a line around a plant directly under its outermost branches where roots seldom exceed beyond

Drip System: very efficient watering system where the water is regulated at the emitters for a regulated drip
Dry Ice: solidified carbon dioxide, when dry ice warms it releases CO_2
Dry Soil Pocket: a portion of the soil that does not absorb water , wetting agents are often used as a remedy
Electrical Conductivity: E/C
Emit: give off or out (as light)
Epsom Salts: a bitter colorless or white crystalline salt $MgSO_4 \cdot 7H_2O$ that is a hydrated magnesium sulfate
Equinox: either of the two times each year (as about March 21 and September 23) when the sun crosses the equator and day and night are everywhere of equal length
F1: When you cross two different strains for the FIRST time, it is called the F1.
F2: When you cross two of the same F1 hybrid, it is called the F2 generation.
F3: An f3 comes from breeding an F2 to an F2 (these came from the same parents and they came from breeding F1s together).
F4: An f4 comes from breeding an F3 to an F3 (these came from the same parents and they came from breeding F2s together).
Fan Leaves: usually located exiting main stems directly under side branches, are usually the biggest & very low in potency.
Female: seed producing, pistilate.
Feminized: bred to support only Female seeds. seeds which have a higher likelihood of sprouting female.
Fertilize: a substance(as manure or a chemical mixture) used to make soil more fertile, the process of union of two subjects whereby the somatic chromosome number is restored and the development of a new individual is initiated.
FIM: The FIM technique is where you leave 10% of the top node on rather than traditionally to cut at the stem under the top node . Acronym for F*** I Missed!? A variant of the topping technique, where only a portion of the growth tip is removed, causing an increase in resulting cola sites. (See topping).
Fish Emulsion: This is a liquid organic fertilizer with a NPK ratio of about 4-1-1 to 7-2-2. It is water soluble and thus immediately available to plants. It is valued for its high nitrogen content.
FLIR: Acronym for Forward-Looking Infrared, it is a thermal imaging process whereby differences in heat emission are measured and reflected on a

videotape. Heat concentration is indicated on a videotape on a spectrum of light to dark, with bright white showing intense heat. Increasingly, law enforcement personnel are using FLIR thermal imaging to detect indoor marijuana growing operations. However, the Supreme Court in the U.S. has recently banned the use of FLIR to find these operations.

Florescent: a tubular electric lamp having a coating of fluorescent material on its inner surface and containing mercury vapor whose bombardment by electrons from the cathode provides ultraviolet light which causes the material to emit visible light.

Flo, Flouro, Floro's: Fluorescents come in a wide variety of shapes and sizes. There are compacts, twist bulbs and circle bulbs. They all work the same way. They have a starter and ballast which help provide a steady and regulated amount of electricity to the light.

Flower: one of a seed plant differentiated into a calyx, a state of blooming

Flush: the act of cleansing a plants roots of nutrients and contaminants by giving the plant large amounts of water (usually equal to 3 times the volume of soil the plant is in).

Foliage: a representation of leaves, flowers, and branches

Foliar Feeding: The act of giving water and/or nutrients to the plant through the leaves instead of through the roots.

Force Flowering: Giving a female plant a photoperiod of 12/12 to force the plant into producing buds.

Foot Candle: a unit of luminance on a surface that is everywhere one foot from a uniform point source of light of one candle and equal to one lumen per square foot.

Fungicide: an agent that destroys fungi or inhibits their growth

Gametes/Zygotes: The gamete of the male is the pollen grain, the gamete of the female is the embryo sac. Gametes contain half of the genes of an adult plant and unite to form the zygote. After mitosis the zygote becomes the embryo of the seed.

Garlic: Planted in the same pot/area as your plants will act as a natural systemic insecticide to greenfly and blackfly the plants absorb it from the growing garlic it DOES NOT affect the plants scent or taste, can also be used for same reason with other plants.

Gene: a specific sequence of nucleotides in DNA or RNA that is located in the germ plasma usually on a chromosome and that is the functional unit of

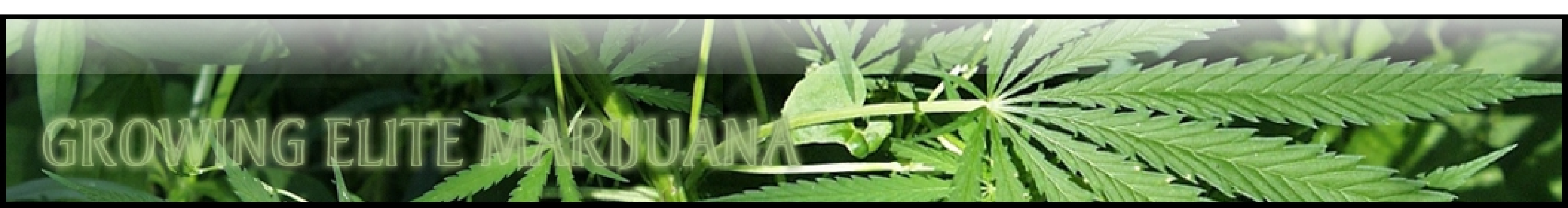
inheritance controlling the transmission and expression of one or more traits by specifying the structure of a particular polypeptide and especially a protein or controlling the function of other genetic material
Genetic Makeup: the genes inherited from the parents of the plant
Genotype: All or part of the genetic constitution of an individual or group
Germinate: To begin to sprout or grow
GH: General Hydroponics which is a nutrient & chemical product line
Gibberellic Acid: A hormone used to promote plant growth, especially that of seedlings, and obtained from the fungus Gibberella fujikoroi (GA) is used to reduce flowering and fruiting which maximizes growth and minimizes pollen transmitted. GA is also used in mature plants to increase the fruiting capacity by stimulating the development of lateral shoots and spurs.
GPH: Gallons Per Hour, how much a quantity of liquid a pump can push per minute
GPM: Gallons Per Minute, how much a quantity of liquid a pump can push per minute
Guano: a substance composed of the excrement (poop) of seafowl, a similar substance (as bat excrement (poop) or cannery waste) used for fertilizer
Harvesting: The act or process of gathering a crop
Hemp: a tall widely cultivated Asian herb of the mulberry family with tough bast fiber used especially for cordage, the fiber of hemp, a fiber from a plant, a plant yielding such fiber
Herbs: Aromatic plants used for seasoning, medicinal purposes, or garnishes. Aromatic herbs are the ones that have fragrant or smelly leaves or flowers.
Hermaphrodite: Hermie, (both sexes)
Hertz(Hz): a unit of frequency equal to one cycle per second
High Intensity Discharge (HID): a lighting group containing , high pressure sodium, Metal halide, mercury vapor & halogen
High Pressure Sodium (HPS): a HID light mostly in the red spectrum
Hood: the reflective cover of an HID light, lamp
Horizontal: parallel with horizon, mounting the HPS bulb side to side
Hormone: chemical substance that controls the growth & development patterns of plants. A biochemical product of a specific cell or tissue that causes a change or activity in a cell or tissue located elsewhere in an organism.
Horticulture: the science and art of growing fruits, vegetables, flowers, or ornamental plants

Humidity, Relative: the ratio of the amount of water vapor actually present in the air to the greatest amount possible at the same temperature
Humus: a complicated material formed during the breakdown of organic matter. One of its components, humic acid, provides many binding sites for plant nutrients, such as calcium, iron, potassium, sulfur and phosphorus. These nutrients are stored in the humic acid molecule in a form readily available to plants, and are released when the plants require them.
Hybrid: A hybrid is a strain made up of two genetically unlike parents, IBL or hybrid. Often refers to a plant or variety that has been developed by interbreeding two or more varieties, species, or genera
Hydrogen Peroxide: an unstable compound H_2O_2 used especially as an oxidizing and bleaching agent, an antiseptic, and a propellant (H_2O_2), a colourless liquid usually produced as aqueous solutions of various strengths
Hydroponics: the growing of plants without soil, instead using a medium like clay pebbles, rockwool-floc or perlite and vermiculite mixture.
Hydroponic System: the growing of plants in nutrient solutions with or without an inert medium to provide mechanical support
Hygrometer: any of several instruments for measuring the humidity of the atmosphere
IBL: An IBL (inbred breeding line) is a genetically stable strain that grows consistent. It is a homogeneous strain that shows uniform growth characteristics from seed
Inbred: (true breed) offspring of plants with the same genetic, breed or ancestors
Indica: Indica is a great plant to grow indoors as well as outdoors due to its low lighting requirements and tight internode spacing, also offering resistance to fungus and pests, early maturation tendencies, and dense flower production. Indica's come from colder climates exhibiting the traits described above by acclimating to the environment from whence they came. Their stout stature and extremely wide leaflets make them easy to identify. An Indica generally produces a hard hitting, tiresome, sedative stone, and will take around 45 to 60 days to finish flowering.
Induce: to move by persuasion or influence, to stimulate flowering by inducing 12 hr photoperiod
Inert: inactive, does not chemically react
Insecticide: an agent or substance that destroys insects

Intensity: the magnitude of a quantity (as force or energy) per unit
Internode: An interval or part between two nodes (as of a stem)
Interveinal: Veins
Iron(Fe): one of the basic elements needed for plant growth --
Kilowatt Hour: a unit of work or energy equal to that expended by one kilowatt in one hour or to 3.6 million joules
Lanceolate: leaf
Leach: to remove (nutritive or harmful elements) from soil by percolation b : to draw out or remove as if by percolation
Leggy: (Spindly) plant, of a disproportionately tall or long and thin appearance that often suggests physical weakness. If seedlings and plants do not get enough sunlight, they grow tall and thin stalks as they seek sunlight. These "leggy" plants have a difficult time supporting the weight of the plant and is easily damaged.
Life Cycles: the series of stages in form and functional activity through which an organism passes between successive recurrences of a specified primary stage, (seedling> vegetative> flower> harvest)
Light-burn: When the heat from a light burns the plant.
Light Mover: a light fixture that is moved on a track or wheel for balanced lighting
Lime: dolomite or hydrated lime most uses to stabilize pH of soil medium
Litmus Paper: pH testing paper triggered by chemical reaction
Loam: medium consisting of sand, clay & silt
LST: Acronym for Low-Stress Training, the technique of manipulating the branches in order to reduce plant height, expose certain branches to light, and/or distribute hormones to lower branches of the plant to encourage larger buds.
Lumen: a unit of luminous flux equal to the light emitted in a unit solid angle by a uniform point source of one candle intensity. one lumen is equal to the amount of light emitted by one candle that falls on one square foot of surface one foot away.
Macronutrient: a chemical element (as (N) nitrogen, (P) phosphorus, or (K) potassium) of which relatively large quantities are essential to the growth and health of a plant. For a plant, there are nine major elements essential for healthy growth; these are called macronutrients. They are: carbon, hydrogen, and oxygen (which are all three derived from air and water); and nitrogen,

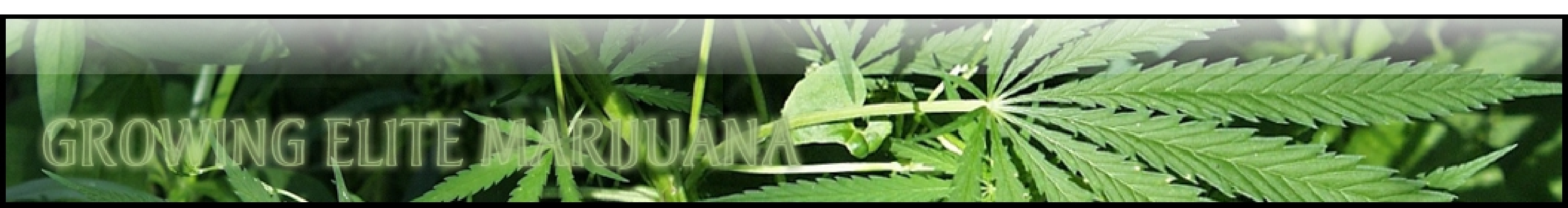
phosphorus, potassium, calcium, sulfur, and magnesium (from the soil).
Micronutrients: There are about eight nutrients essential to plant growth and health that are only present in very small quantities. These are manganese, boron, copper, iron, chlorine, cobalt, molybdenum, and zinc.
Magnesium: a sulfate of magnesium: as a : a white salt $MgSO_4$ used in medicine and in industry Epsom salts
Manganese: Manganese is essential to plant growth and is involved in the reduction of nitrates in green plants and algae.
Manicure: to trim leaves closely and evenly to the buds when harvesting
Medium: A soil or soil-less mix used to start or re-plant houseplants, flowers, vegetables, and other plants
Mercury Vapor: an electric lamp in which the discharge takes place through mercury vapor
Metal Halide(MH): The Metal Halide is a very good source of the white/blue spectrum of light that is ideal for vegetative growth. Many growers use MH during the vegetative phase. MH is bright and cost efficient to operate, but not as efficient as HPS lights. Most commonly used sizes are 400 watt and 1000 watt. Works best when used in combination with HPS lights. an HID light, emits mostly the blue spectrum & high in ultra-violet rays
Micronutrient: or trace elements, a chemical element present in minute quantities; essential to their physiology (S, Fe, Mn, B, Mb & Zn)
Molybdenum: a trace element needed for plant growth
Monochromatic: having or consisting of one color or hue
Mother Plant: female plant kept in vegetative state for using clones , cuttings & maintaining genetics
Mottling of Leaves: Discoloration or spotting of leaves.
Mulch: a organic protective covering spread on the ground to reduce evaporation, maintain even soil temperature, prevent erosion, control weeds, or enrich the soil
MV: Mercury Vapor is the type of lights that were used for streetlights many years ago. Not very good for growing because it doesn't provide enough of the right kind of light spectrum. While they do provide a littleof the blue spectrum, MV also produces too much heat to get very close to a plant, and are very inefficient to operate.
Nanometer: 1 billionth of a meter used to measure electromagnetic wavelengths of light

Necrosis: localized death of living tissue or leaves
Necrotic: Dead tissue
Nitrogen(N): a colorless tasteless odorless element that as a diatomic gas is relatively inert and constitutes 78 percent of the atmosphere by volume
Node: a point at which subsidiary parts originate or center b : a point on a stem at which a leaf or leaves are inserted c : a point at which a curve intersects itself in such a manner that the branches have different tangents
NPK: The elemental symbol for nitrogen is N; for phosphorus it's P; for potassium it's K. All three of these elements are essential for plant growth and are considered macronutrients. N, P, and K are the three principal ingredients in most fertilizers. The NPK ratio is shown by three numbers, such as 2-1-1, that reflect the percentage of each.
Nutrient: a plant food with element N, P, K, or secondary nutrients
Nutrient Film Technique: a hydroponics system (NFT) nutrient flow tables where letting nutrient flow over roots on a schedule (Ebb & flow)
Nute-burn: the result of feeding a plant an excess of fertilizer.
Ohms Power Law: discovered that at constant temperature, the current I in a circuit is directly proportional to the potential difference V, and inversely proportional to the resistance R, or I = V/R. Resistance is generally measured in ohms (volts x amperes = watts)
Optimum: the most favorable condition for the growth and reproduction of an organism, greatest degree attained or attainable under implied or specified conditions.
Organic: of, relating to, or derived from living organisms - of, relating to, yielding, or involving the use of food produced with the use of feed or fertilizer of plant or animal origin without employment of chemically formulated fertilizers, growth stimulants, antibiotics, or pesticides
Organic Nutrients: Natural, non-synthetic nutrients.
Outbreed: the interbreeding of stocks that are relatively unrelated -
Ovule: an outgrowth of the ovary of a seed plant that is a mega sporangium and encloses an embryo sac within a nucellus
Oxygen: a colorless tasteless odorless gaseous element that constitutes 21 percent of the atmosphere and is found in water, in most rocks and minerals, and in numerous organic compounds, that is capable of combining with all elements except the inert gases, that is active in physiological processes
P1: Any two plants you start a breeding project with, no matter the filial



generation are designated P1.
Passive system: a hydroponics system which move nutrient through absorption or capillary action
Peat Moss: The partially decomposed remains of mosses harvested commercially from the wild. Though difficult to wet initially, peat moss can absorb up to 25 times its own weight in water and is therefor valued as a an organic soil amendment. Peat moss is acidic --with a pH of about 3 or 4.0-- and should only be used around acid-loving plants or to help lower the pH of alkaline soils.
Perlite: a lightweight aggregate used as a medium for potting plants, holds water. a unique volcanic mineral which expands from four to twenty times its original volume when it is quickly heated to a temperature of approximately 1600-1700°F. This expansion is due to the presence of two to six percent combined water in the crude perlite rock which causes the perlite to pop in a manner similar to that of popcorn. When expanded, each granular, snow-white particle of perlite is sterile with a neutral pH and contains many tiny, closed cells or bubbles. The surface of each particle is covered with tiny cavities which provide an extremely large surface area. These surfaces hold moisture and nutrients and make them available to plant roots. In addition, because of the physical shape of each particle, air passages are formed which provide optimum aeration and drainage. Because perlite is sterile, it is free of disease, seeds, and insects. Perlite has been used for many years throughout the world for soil conditioning and as a component of growing mixes with materials such as peat moss or bark. Extensive studies have shown that the unique capillary action of perlite makes it a superior growing media for hydroponic cultures.
Among the many uses of perlite today are propagation and seed cultivation, plug production and transplants, interiorscape and planter growing, composting.
Petioles: A slender stem that supports the blade of a foliage leaf
pH: A expression on a negative log scale of 0 to 14 of the extent of acidity or alkalinity of a substance. Materials with pH 7 are neutral. Those below pH 7 are acidic and those above are caustic. Every pH unit of 1, increases or decreases the acidity by a factor of 10
pH Tester: a electronics device or chemical used to determine soil or water pH level
Phenotype: The visible properties of an organism that are produced by the interaction of the genotype and the environment. generally the characteristics

the plant shows, mostly Sativa or mostly Indica traits, although there's quite a lot more that(stuff like tall/short, wide/skinny leaves, high/low THC content percentage.
Phloem: Nutrient conducting tissue.
Phosphorus(P): one of the 3 macro-nutrients that promotes flower & root growth of a plant
Photoperiod: AKA lighting schedule, it is the number of hours of light and darkness the plant is exposed to. Usually expressed as a fraction. Ex: 18/6 = 18 hours of light, and 6 hours of darkness
Photosynthesis: synthesis of chemical compounds with the aid of radiant energy and especially light, formation of carbohydrates from carbon dioxide and a source of hydrogen (as water) in the chlorophyll-containing tissues of plants exposed to light
Pistil: Female reproductive organs on a plant. Seen as white "hairs" at the internodes on female pot plants from the nodes/buds of a female plant, also a precursor to the buds themselves. Pistils turn from white to brown as the buds mature.
Pollen: a mass of microspores in a seed plant appearing as fine yellow dust containing male genes
Pollen sac: one of the pouches of a male seed plant in which pollen is formed
Polyploid: contains 2 or more sets of chromosomes (2 or more nodes)
Potash: Broadly, potash describes any material containing potassium. More specifically, though, potash is potassium carbonate derived from wood ashes. The term potash comes from the process of extracting lye from wood ashes in iron pots.
Potassium(K): one of the 3 macro-nutrients needed for plant life
Power Surge: interruption in electricity flow
PPM: Acronym for Parts Per Million, this term is used most in hydroponics to measure the amount of nutrients given to a plant.
Propagate: the breeding of male & female plant to produce seeds
Pyrethrum: any of several chrysanthemums with finely divided often aromatic leaves including ornamentals provide an important sources of insecticides
Regenerate: AKA re-vegging, refers to the act of putting a plant back into the growth cycle after harvesting the flowering buds off of the plant, in order to bud the plant again or to take clones off of the plant.
Relative Humidity: the ratio of the amount of water vapor actually present in



the air to the greatest amount possible at the same temperature

Reverse Osmosis: a water purifying treatment, by moving of water through a semi permeable membrane reducing sediment & elements

Rock Wool: Mineral or rock wool has been used extensively in Europe and is recently finding applications in the U.S. greenhouse market. Like perlite and vermiculite, it originates from a natural mineral(alumino silicates with some calcium and magnesium) that is heated to 2,700?F to form fibers that are used to make blocks or cubes as a finished product. Blocks or slabs of rock wool are used extensively by hydroponic growers of greenhouse vegetables. Rock wool typically has an alkaline pH, is sterile and chemically inert.

Root: the parts of the plant below medium level either soil or hydroponic

Root bound: or Pot bound , meaning roots have overtaken the majority of the pot supplied usually resulting in slower growth A condition where a plant or seedling's roots have grown compacted and entwined in the pot and has no room to grow. This condition results in stunting the plants growth and potential. The solution is a larger pot or transplanting outdoors.

Root Hormone: a fertilizer directly targeting root growth

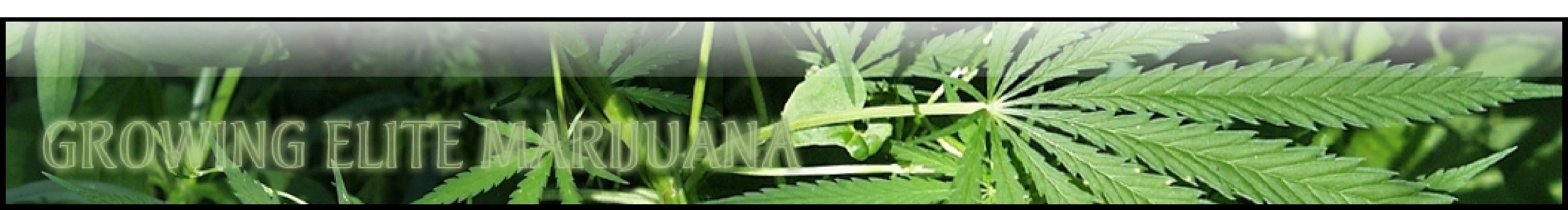
Ruderalis: Ruderalis is not a very good choice for flower production, indoors or out. Despite maintaining a short stature, growing only one to five feet tall, and maturing rather quickly, Ruderalis just doesn't produce the yield or quality one looks for in their flowers. A slight light cycle reduction can trigger a sprout with as little as 2 to 3 leaf sets to flower. Ruderalis spontaneously initiates flowering a few weeks after sprouting, and will not produce decent flowers unless the photoperiod provides around 18 to 19 hours of light. Even then, the yield and quality are less than desirable, incomparable to that of the Sativa or Indica sub-species.

S1: self pollinated – a hermie.

Sativa: Sativa is a hard plant to grow indoors due to high lighting requirements, tall stature, and late flowering traits. Sativas come from equatorial regions, thus the neccesity for high ammounts of lighting and a warmer tropic-subtropic climate. You can identify a Sativa by its long, slender, finger-like leaves. A Sativa will typically produce a euphoric, energetic, cerebral high. Despite the Sativa's climatic limitations, they are truly a reward to obtain, grow, and smoke. A pure Sativa will take 2 to 4 months to finish flowering.

Salt: crystalline compound that is due to different pH levels or build up of fertilizer which can lead to toxic levels & will prevent nutrient uptake

Screen Of Green: a method of growing using a screen at a certain level to stop all flowering ends of plant at the same level for their maximum yield (confined space, or low lighting levels etc.) The purpose of ScrOG is to maximize your usage of the available space and lighting by training the new growth of a plant into a screen or mesh.
Sea Of Green: a method of growing keeping all plants short with the intention of getting more yield by flowering more plants (in volume)
Secondary Nutrients: (Ca) Calcium & (Mg) magnesium
Seed: or Achene; a mature, fertilized, ovule of a pistilate shell harboring an embryo capable normally of germination to produce a new plant;
Sex: The act of determining the gender of a plant by giving it a photoperiod of 12/12.
Seed Casing: The integuments of the ovule, which are the ovule's old coverings, harden and become the seed's protective coat
Sinsemilla: highly potent marijuana from female plants that are specially tended and kept seedless by preventing pollination in order to induce a high resin content
Sepal: Sepals are components of the calyx. Located at the base of the flower, these modified leaves usually function as protection for the petals while in bud stage. Occasionally, sepals will be colored, but they are usually green
Soilless Mix: a growing medium containing mineral like vermiculite, perlite, pumice, sand & peat moss usually intended for a quick draining flushable medium
Soluble: susceptible or capable of being dissolved in or as if in a liquid or water
Spindly: (Leggy) plant, of a disproportionately tall or long and thin appearance that often suggests physical weakness
Square Feet(Sq. Ft.): length X width
Stamen: the pollen-producing male organ of a flower that consists of an anther and a filament
Staminate: having or producing stamens
Stigma: The sticky tip of a pistil.
Stomata: one of the minute openings in the epidermis of a plant organ (as a leaf) through which gaseous interchange (breathing) takes place
Strain: Linage, Ancestry, a group of plants of presumed common ancestry with clear-cut physiological but usually not morphological distinctions refers to the specific genetics of the plant. Example: White Widow, Northern Lights.



Stress: Any unhealthy stimuli the plant receives. Examples: Light-burn, over-watering, nutrient burn. Stress can cause slow growth, mutations, or death.
Sun Leaves: AKA fan leaves, these are the large leaves that grow off of branches, and while not rich in THC, they play an important role in photosynthesis.
Synthetic Nutrients: AKA Chemical nutrients, concentrated and industrial-made nutrients. They have a longer shelf-life than organic nutes, but are known to nutrient burn a plant more quickly.
Tap Root: the root growing vertically from the seed that grows lateral roots from it.
Tetraploid: contains 4 sets of chromosomes (4 nodes)
THC: tetrahydrocannabinol, a physiologically active chemical C21H30O2 from hemp plant resin that is the chief intoxicant in marijuana - obtained from cannabis or made synthetically, that is the primary intoxicant in marijuana and hashish.
b. The main physcoactive ingredient in pot. this is what gets you "high!". it is often(not totally accurately) measured by the trichomes(fairy dust) visible on pot.
Thermostat: an automatic device for regulating temperature
Topping Method: used to increase yield and maximize space, by trimming off the top bud. Traditionally, topping your plant causes two shoots to grow back in place of the one pruned off, thus increasing the number of top/main buds
Total Dissolved Solids, TDS meter: a meter used for measuring PPM of a liquid
Trace elements: or Micronutrient, a chemical element present in minute quantities; essential to their physiology (S, Fe, Mn, B, Mb & Zn)
Transformer: a device employing the principle of mutual induction to convert variations of current in a primary circuit into variations of voltage and current in a secondary circuit
Transpire: to give off or exude watery vapor especially from the surfaces of leaves
Transplant: to lift and reset (a plant) in another soil medium or situation
Transplantation Shock: When transplanting seedlings from one place to another, the roots are often disturbed and occasionally the change in climate can cause the plant to slow down or appear to stop growing. This is transplant shock. It is really redirecting it's energy to re-grow lost roots and to get

accustomed to a change in temperature that it hadn't experienced before.
Trichomes: AKA crystals or sugar, they are tiny, mushroom-shaped capitulate glands full of THC that form on the flowering buds and bud leaves of cannabis.
Triploid: contains 3 sets of chromosomes (3 nodes)
True Breed: Inbred, offspring of plants with the same genetic, breed or ancestors
Ultraviolet: light beyond the visible spectrum at its violet end with very short wavelengths
Vascular: Refers to the xylem and phloem tissues, which conduct water and nutrients through the plant body.
Vegetative: the growth stage at which the plant produces primarily new green chlorophyll growth prior to flowering stage
Ventilation: Circulating air in order to provide the plant with fresh air and/or to reduce the temperature in the grow area. Air movement also encourages strong stems.
Vermiculite: any of various micaceous minerals that are hydrous silicates resulting usually from expansion of the granules of mica at high temperatures to give a lightweight highly water-absorbent material is sterile and light in weight (5 to 8 lbs/ft3). The pH of vermiculite will vary depending on where it is mined. Most U.S. sources are neutral to slightly alkaline, whereas vermiculite from Africa can be quite alkaline (pH = 9). Vermiculite is used extensively in the greenhouse industry as a component of mixes or in propagation. It is usually sold in four size grades: #1 is the coarsest and #4 the smallest. The finer grades are used extensively for seed germination or to topdress seed flats. Expanded vermiculite should not be pressed or compacted, especially when wet, as this will destroy the desirable physical properties.
Vertical: perpendicular to the plane of the horizon or to a primary axis or in the upright position
Vitamin B: thiamine, a vitamin $(C_{12}H_{17}N_4OS)Cl$ of the B complex that is essential to normal metabolism and nerve function and is widespread in plants
Watering Schedule: term referring to how often and how much water a plant is given, usually measured in days and gallons. Ex: 1 gallon every 4 days.
Watts: A measure of the amount of electricity flowing through a wire. Watt hours measure the amount of watts used in one hour. A kilowatt/hour (KWH) is 1000 watt/hours.
Wetting Agent: a substance that by becoming adsorbed prevents a surface

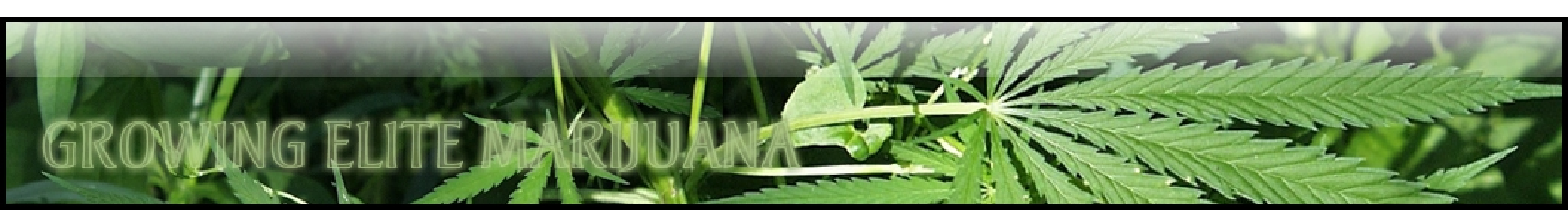
from being repellent to a wetting liquid and is used especially in mixing solids with liquids or spreading liquids on surfaces

Wick: to carry (as moisture) by capillary action

Worm Casting: (Vermiconversion) or using earthworms to convert waste into soil additives, is a biologically active mound containing thousands of bacteria, enzymes, and remnants of plant materials and animal manures that were not digested by the earthworm. The composting process continues after a worm casting has been deposited. In fact, the bacterial population of a cast is much greater than the bacterial population of either ingested soil, or the earthworm's gut. An important component of this dark mass is humus.

Zinc: is an essential micronutrient for both plants

Zygotes/Gametes: The gamete of the male is the pollen grain, the gamete of the female is the embryo sac. Gametes contain half of the genes of an adult plant and unite to form the zygote. After mitosis the zygote becomes the embryo of the seed.



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