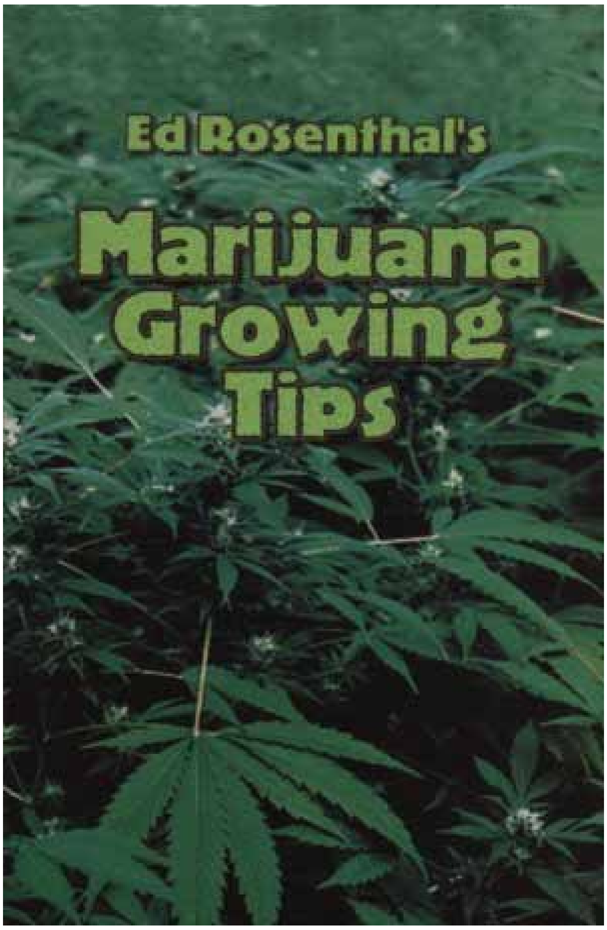

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Preface

When I asked Ed how to describe himself he thought for a moment. I could palpably feel his brain working. Then he said, "I'm not sure whether I was placed on Earth as an agent of Cannabis or if I am just another advocate for justice. Marijuana, though important, is just one of many issues."

Whatever the reason, Ed has worked tirelessly to change the marijuana laws. He has participated on political campaigns, testified before Congress, helped defendants as an expert witness, and advanced many organizations from behind the scenes. Most Important, he has inspired many to organize and advocate a change in the marijuana laws.

All of this has only tangential connection to the material that Is in this book. Readers acquainted with Ed's writing will welcome the breadth of topics. New readers will find here a good introduction to his writing. His down-home, humorous style appeals to a wide audience.

For the record, Ed Rosenthal has documented the transformation of pot cultivation more successfully than arty other writer His books articles and columns have had a profound effect on consciousness In America and throughout the world

Marijuana Growing Tips is dedicated to the memory of Tom flowers.

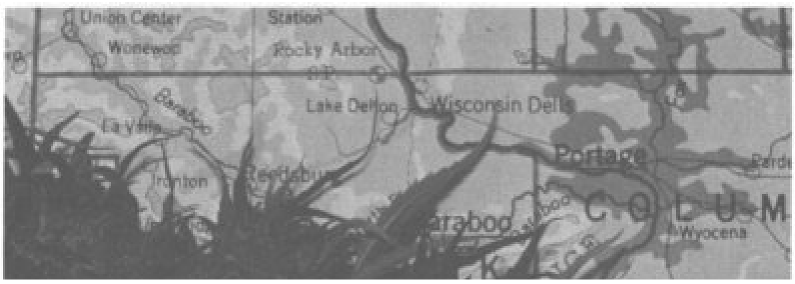
Chapter One

Choosing a Cannabis Variety

Seed catalogs are fascinating. For instance, the tomato section of a typical catalog devotes pages and pages to the different tomato varieties. Some are early bloomers, others mold-or-wilt-resistant; they produce fruits from the size of a cherry to that of a grapefruit; some are good for canning, others for juice. There are even square tomatoes. Each variety was developed by researchers to meet a specific need.

When cannabis becomes legal, commercial seed houses will develop varieties to suit each gardener's requirements: "Let's see, I'd like something thai grows about six feet in six weeks, develops a giant cola, matures in sixty days, smells like cheap perfume, tastes like heady champagne, and takes me to the moon."

There are already illicit seed co-ops functioning on a small scale. Last season, in certain western states, breeders commanded five dollars per seed for acclimated varieties. Even at that price, growers consider these seeds worth buying: they view the seed money as a minor investment in view of the total value of the harvest. Rooted cuttings from proven outstanding plants can sell for $15 per plant or more.



Wiscany marijuana, displayed on a map ot the region near Madison, Wisconsin, where it was grown. This variety is the result of several generations of careful breeding. It is ready to harvest before October 1st.

When it comes to choosing a variety, commercial growers are concerned with several factors, among them: branching habits, drought resistance, ease of manicuring, color, and uniform ripening. Of primary importance is the ripening time. Most outdoor growers want plants that mature early, before the arrival of frost, thieves, and law enforcement Indoors, commercial growers want compact plants that ripen quickly and uniformly, so that light and space are used most efficiently.

Commercial growers are also interested in the plant's yield. Some plants bud heavily and grow thick colas; others do not. A heavy-yielding plant may be worth twice as much as a lighter-yielding one. The type of high does not seem to be an important marketing factor, though the yield, the aroma, the taste, and the bud appearance are important in determining the price.

Home growers, however, have different priorities. The yield or growth time may not be as important as the type of high. Home gardens often contain several varieties of marijuana, some taking as long as six months to mature.

Seeds-people have concentrated their efforts on developing indica hybrids, which are desirable because of their early maturing

(September to early October), and because of the heavy yields available from these compact plants. Some indica varieties are cold or drought resistant. Although the indicas exhibit a range of highs, I find most to be heavy and stupefying.

Commercial growers have tended to overlook potency and quality of high in their search for plants that mature early. Their reasoning is that they would rather have a poorer-quality sinsemilla harvest than no harvest at all. Very much like the square tomatoes I mentioned earlier, commercial varieties of cannabis ship well but are tasteless.

Turning to the sativa varieties, most mature too late (three to four months later than the indicas) for outdoor cultivation, and hence are avoided by most commercial growers. Sativas also tend to grow tall with loose branching, so that their yield per square foot is less than that of indicas. However, the quality of high from sativa grown in the equatorial regions (Colombia, Congo, Nigeria, Kenya and Laos) is unsurpassed. It is unfortunate that only the home grower (and his/her friends) can experience these highs; they're just not available commercially.

Sativa varieties grow all over the world. At the 15th parallel, in Jamaica and Mexico, there are some excellent sativa varieties that mature earlier than their equatorial cousins. Thailand is also at the 15th parallel, but its plants have a long growing season. Most of the commercial varieties available at the 30th parallel are indicas such as Kush, Afghani, and Lebanese. But in the Southern Hemisphere at the 30th parallel, Southern African varieties will mature early and are often quite potent.

Typical afghani flowering top.

Durban poison, Capetown gold, Lesotho brown, and Zuluweed are vigorous, short-to medium-height plants with internodes of up to eight inches. They are also the earliest-flowering and fastest-maturing plants ever introduced in the United States.

Like most cannabis varieties found at the 30th parallel, South African plants tend to vary within a specific population. This is an evolutionary technique of survival for species situated in an environment with a varying climate.

African varieties are not usually imported into the United States, but find their market in Europe; there is usually a large number of Africans available in Amsterdam, for example.

Sativa varieties grown above the 30th parallel have been used for hemp, and are commonly regarded as having no psychoactive qualities. But reports from the Midwest, where this “hemp” has escaped from cultivation and grows in wild stands, indicate that potency varies from terrible headache-weed to pot that delivers a fair buzz. Cultivators in areas where such varieties of sativa are growing may wish to use these in their breeding programs because such plants are well acclimated to the area, having survived with no human help. With a little patience, high potency and aroma can be bred into this hardy stock, which matures every year.

Flowering Sativa. It is light and fluffy with long, elegant hairs.

By controlling all pollination and keeping detailed records, it's easy to develop a simple breeding program, and within five or six generations you can develop and stabilize several characteristics.

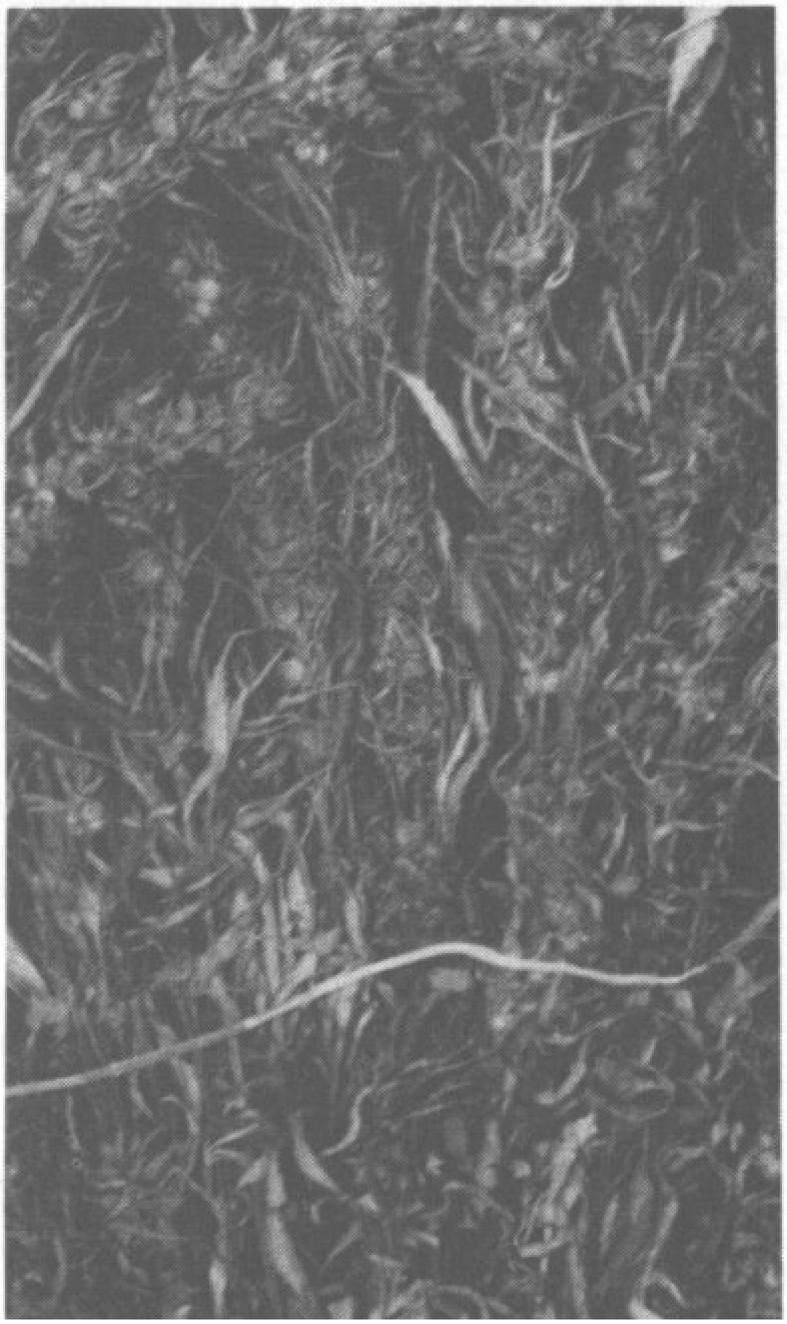
Commercial breeders grow large numbers of plants from which a few outstanding specimens are chosen. Their descendants are again selected, and are often crossed with varieties that have other desirable traits. For instance, a hemp plant that matures very early might be crossed with a potent, later-maturing plant. The first generation will be fairly uniform. The second generation will sort out into early and late plants of varying potency. If only early/potent plants are selected for further breeding, this pair of characteristics will stabilize after several generations. Usually, commercial seeds-people try to stabilize many characteristics at once so that the plants will be uniform.

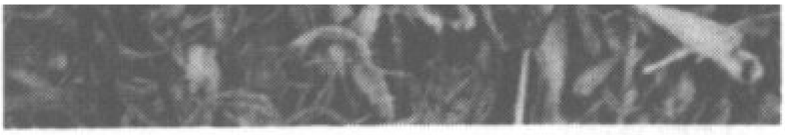
A sophisticated breeding program can be developed indoors under controlled conditions. Many environmental factors can be easily controlled and the plants bred throughout the year. By setting the light cycle at 15 hours per day (the number of hours of daylight available in late July), the researcher can select early-maturing plants. Later-maturing plants may need longer periods of uninterrupted darkness, approximating late autumn or winter, before they flower profusely.

Indoors, full-sized plants can be grown in one to two gallon containers. About two square feet of space per plant are required. Plants can be selected after a few weeks of growth, so that less space is required and the breeding program can be speeded up to between three and five generations per year. Taking cuttings is the only way of preserving the exact genetic makeup of any plant. You may wish to keep an outstanding plant for garden clones or for breeding.

Over the years, American cultivators have developed tens of thousands of varieties. American sinsemilla is now the most potent in the world. Traditionally, marijuana cultivation extended only to the 30th parallel. However, American growers have expanded the growing area to Maine and Alaska.

Novice cultivators would do well to borrow seed from a successful local grower whose pot they especially like. That way, they know that the plants will mature in time and will be pleasant to smoke.





Moroccan plants are grown close together so that they have one main flowering stem. It ripens early, but is not very intoxicating.

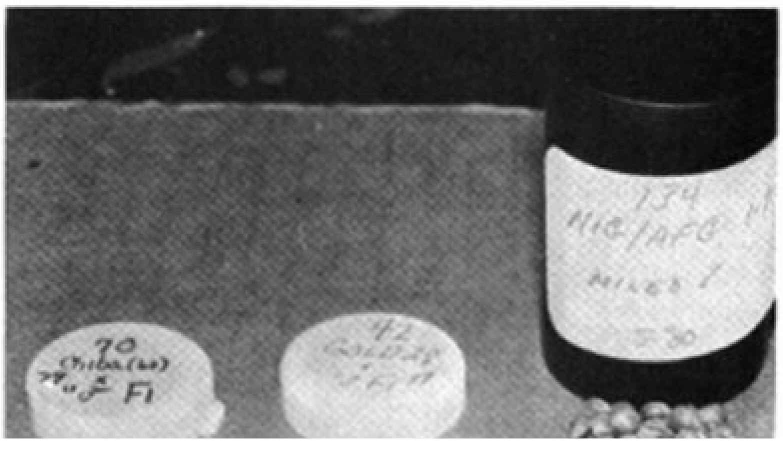
Chapter Two

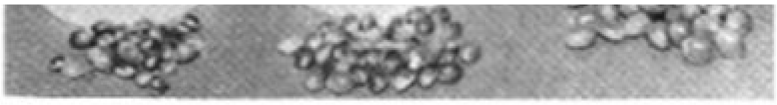
Selecting Seeds

Choosing the right seed is probably the most important decision a grower makes.

The seed (actually the fruit of the cannabis plant), properly known as an achene, contains the germ plasm or genetic material. This genetic material determines the plant's potential size, shape, time to maturity, and cannabinoid content. Given adequate amounts of warmth, light, water, nutrients, oxygen and carbon dioxide, the plant can achieve the full potential that is present within the seed.

By choosing seeds from plants suited to the growing conditions in your garden, you can assure yourself of a large, potent yield.





Seeds vary in size and coloring according to variety. A large seed does not necessarily mean a more potent plant.

There are several factors to consider when deciding what varieties to plant: the desired high, the maturation time, and the shape of the plant.

The high is the most important factor. Choose seeds from grass that you like. Potency should not be the sole determinant — the quality of the high is just as important. The ratios and absolute amounts of the known cannabinoids that are found in any particular sample is partly genetic, much the same as with grapes. (Each variety of grape has a distinctive taste, but there are variations from year to year because of differing climatic conditions.)

Maturation time is another important characteristic, especially for outdoor growers. Most imported marijuana now comes from Colombia or other equatorial countries with a growing season of eight to ten months. Plants from these areas have a long time in which to flower and produce seeds. When equatorial plants are grown in an area with a shorter growing season, they do not have enough time to produce mature colas, or seeds, before the end of the growing season (or before the start of the hunting season).

Ditchweed, or Midwestern cannabis, is descended from plants escaped from hemp fields. It was cultivated for fiber and seed from colonial times until the 1940s. Hemp matures in three to five months, depending on the variety. Unfortunately, most varieties contain large amounts of CBD, which doesn't get you high, and small amounts of THC, which does.

There are several methods you can use to get plants that will mature within the American growing season. The easiest way is to choose seeds from plants acclimated to regions situated at some distance from the equator. Marijuana from northern Mexican states, such as Sonora, Sinaloa, and Jalisco, may mature up to six weeks earlier than Colombian. Other countries that grow marijuana and have shorter growing seasons are Nepal, Afghanistan, Iran, Pakistan, and northern India.

The problem with plants from these countries is that, as the distance from the equator increases, the ratio of CBD to THC increases. Marijuana from Afghanistan, Lebanon, and Nepal — countries that lie on the 30th parallel -may have equal amounts of CBD and THC. But this is not always the case. Remember that a particular population of plants (a patch or field) evolves in response to the conditions it experiences — the microclimate — rather than to the average conditions found in the region.

Another method for producing faster-maturing strains is to develop your own strain by selecting for particular qualities. For instance, you could plant a garden using an equatorial marijuana variety. By selecting for early-flowering potent plants, you can develop your strain into a fast-maturing one after several generations.

Marijuana and hemp can be crossed to produce hybrids. These plants will mature earlier than the equatorial parent and will be quite hardy, but the marijuana will not be as potent or have the same quality high as the exotic parent. Another drawback is that the progeny of the F_1, or first generation — the F_2 generation — will not breed true because of differences in genetic makeup.

This means that for a uniformly flowering garden, only F_1 hybrids can be used. But growers can produce more than enough seed from just a pair of plants

To assure seed maturation, growing should be done in a greenhouse or indoors. Indoor growers can choose seeds and develop breeding programs based on the following considerations:

1. Fast development under limited-light/long-day conditions. This is similar to the light cycle experienced by northern latitude hemp plants.
2. Insect and disease resistance: some plants may not get infected when the others do. The resistance could be genetic.
3. Full bud development.
4. Ability to regenerate for multiple flowering. Indoor plants can often be regenerated after flowering by changing the light cycle.

Sativa leaf is slender with long fingers.

Sativa plant is tall and hardy with fluffy buds.

Indica leaf is wide, with short fingers.

Indica plants are squat and dense with heavy, compact buds.

A final consideration is the size and shape of the plant. For each garden, there is a plant of ideal size and shape. In forest areas, growers may require a tall-growing plant such as a South Korean, a northern Mexican, or a marijuana-hemp F_1 hybrid. In areas where a bushy plant might be obvious, the more diminutive Indica varieties will fit right in. Colombian plants grow into a conical shape, but can be pruned to a low bush, or trained by bending the main branch.

Home gardeners usually like to grow several varieties, so that they can see what does best in the garden. Each variety has its own look, fragrance, taste, and bouquet of cannabinoids.

Indica (forefront) and sativa (background) were started at the same time. Notice how much taller and wider the sativa is.

Chapter Three

Cuttings

The traditional way to start a new marijuana crop is to plant seeds. About half the resulting plants will be male. The remaining females, even if their background is certain, will be of varying quality.

Most flower and vegetable seed sold in the United States is standardized. Seed of a particular variety will have uniform growth habits, harvest time, and yield. But marijuana has been bred for uniformity by only a few dedicated growers. Of course, their seed is not commercially available. Without an intensive breeding program, clones (cuttings or slips) are the only way to get a uniform crop. For an all-female crop, of known quality, growers can use either clones or plant regeneration.

Regeneration, or recropping, is a method of obtaining a second harvest from the same plant. A plant can be returned to its vegetative growth stage by letting a number of healthy shoots and leaves remain on it at the time when most of the buds are harvested. (Bring the lights back up to 18 or more hours per day and fertilize with a high-nitrogen fertilizer.) Plants growing outdoors in containers can be brought inside for another harvest using this method. In a greenhouse, the fall and winter natural light should be supplemented and extended. Within a few months the garden should be ready to be turned back into the flowering phase, which is achieved by increasing the number of hours of uninterrupted darkness (turning the light cycle down to 12 or 13 hours of light per day).

Such regeneration has several advantages. Your garden can be designed and used most efficiently because you know the plant’s growth habits. Each plant’s qualities are already known, so you can devise a rational breeding program.

A clone is a genetic duplicate of its parent. Clones should be made whenever you have a unique plant whose particular genetic code is worth preserving. Examples might be extremely potent, fast-growing, or early-flowering plants. A garden of these plants, given the same environmental conditions as their parents, will behave identically. They will be the same height, will have the same growth habits, will flower and ripen at the same time, and will have the same potency.

Equipment used for cutting includes: a) boiled water to float cutting b) bleach to sterilize the blade and the cutting, and used in a 5% solution (2 oz per quart) with the water to prevent infection c) rooting compound and fungicide (Rootone®) d) high phosphorous fertilizer used diluted at one-quarter recommended concentration, and e) cutting immersed in sterile water, awaiting preparation.

Growers often make clones from all their plants while the plants are still in the vegetative growth stage. Later, after harvest and testing, they decide which clones to keep. These plants are grown under lights for their cuttings so that the grower can have a uniform crop the next spring or fall. It is essential for anyone who is performing controlled environmental experiments to use plants of a uniform genotype. Otherwise the experimenter has no way to know what’s being measured.

Homogeneous or “clone” gardens have several disadvantages. Plants with identical genetic structures have similar resistance and susceptibilities to insect attack and microbial infections, and any type of degeneration is likely to spread more quickly than if the plants were of different varieties, or had simply been grown from different seeds.

As I mentioned earlier, clones from the same parent will all taste about the same and create the same high. This is fine for a Commercial operation, where standardization may increase profits, but most smokers enjoy using several varieties of pot. For this reason, you may wish to culture clones of several varieties that will flower in succession.

There are several cloning techniques, including air and soil layering, and tissue culture, that are used commercially to mass-produce some nursery stock. But the easiest and most familiar method of cloning is taking slips or cuttings. Cuttings can be taken at any time in a plant’s life cycle, but those taken before the plant is flowering will root more easily. Larger branches sometimes exhibit white protuberances near the base of the stem. These are called adventitious roots. They appear under humid conditions, and grow readily into roots when placed in water or in various mediums. Cuttings from the lower branches, which contain less nitrogen and have a higher ratio of sugars, root somewhat faster than slips from the top of the plant, so it’s wisest to take your cuttings from the bottom branches.

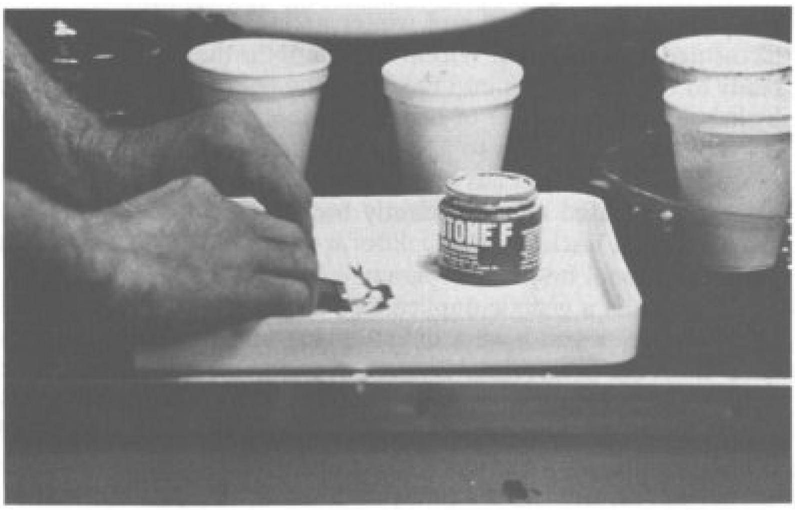
To take a cutting, make a clean cut with a razor, knife, or clippers. Place the cut end in water. Remove the large fan leaves so that the cuttings’ water uptake capabilities won’t be overtaxed. The cutting can be propagated in water, pasteurized prepackaged soil, or vermiculite—perlite mixtures. Before being placed in the medium, cuttings should be treated with a fungicidal-B^1 mix that promotes root growth, such as Rootone F.

Place your cuttings in four-to six-inch

individual pots with the stems between two and four inches deep — quart and half-gallon milk containers will work fine — and be sure to keep them in an area that gets only a moderate amount of light or they will wilt. After five days they should be fertilized with the high phosphorous fertilizer, diluted to one-quarter normal strength, once a week. Covering the cuttings with clear plastic will increase the humidity and the success rate.

Plant rooting is inhibited by lack of oxygen. To prevent this from occurring, aerate the water before use by shaking it vigorously. Cuttings that are propagated in water will do best if the water is either changed regularly, or aerated using an aquarium pump and air stone. Make sure the bubbles rise away from the stems and do not create too much turbulence, which may inhibit root growth.

Cuttings root in three to five weeks, after which time you should transplant them to larger pots. If they are growing under artificial light, introduce them to sunlight gradually so that the leaves do not burn when placed in full sunlight.



Cutting is made with a sterile blade. At least two leaf nodes (joints) are required.

As many as six clones may be made from this cutting.

Klone Kit© shown here is no longer available, but can be easily approximated — using 100 ml container, Styrofoam packing disks, and 15 ml of vermiculite. The clone is inserted in a hole punched in the Styrofoam, and floated in mixture of vermiculite and sterile water. The excellent hormone solution used in the Klone Kit© is available from W R Research (Novato, California).

These flourishing clones are ready for transplanting.

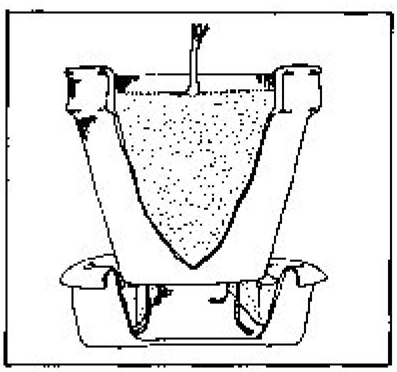
Cuttings are usually taken before flowering. However, this cutting was taken during flowering and has regenerated.

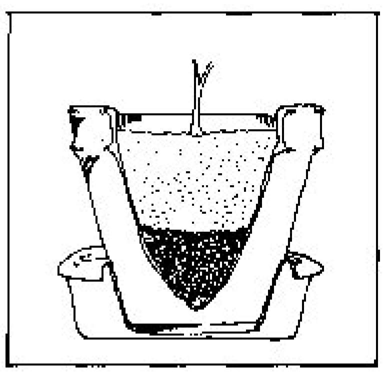
Chapter Four

Do It Hydroponically

If you've ever grown a backyard tomato, or kept a coleus alive through the winter, you have all the expertise you need to grow plants hydroponically. Quite simply, hydroponics is the method of cultivating plants without using soil. The plants are grown in a non-nutritive medium such as gravel or sand, or in lightweight, man-made materials such as perlite, vermiculite (a mineral-mica nutrient base), or Styrofoam. Nutrients are then supplied to the plants in one of two ways: either by soluble fertilizers that are dissolved in water, or by time-release fertilizers that are mixed into the medium.

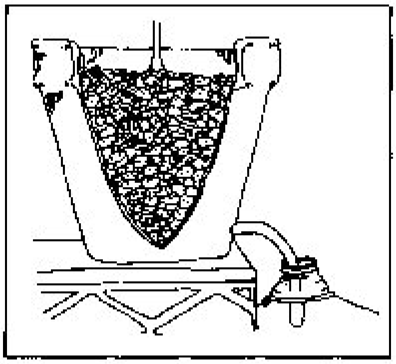
The advantages of a hydroponics system over conventional horticultural methods are numerous and varied. Dry spots and root drowning do not occur. Nutrient and pH problems are largely eliminated, since the grower maintains a tight control over their concentration. There is little chance of “lockup,” which occurs when nutrients are fixed in the soil and unavailable to the plant. Plants can be grown more conveniently in smaller containers. And, because there is no messing about with soil, the whole operation is easier, cleaner, and much less bothersome than it would be with conventional growing techniques.

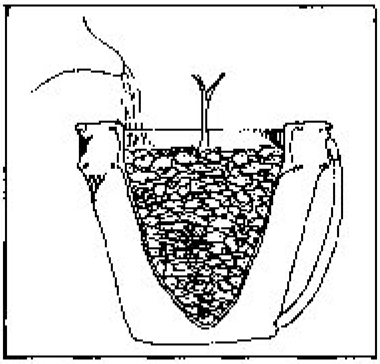




The wick system: A plastic container with 4½" nylon wicks. The container is sitting on two bricks in a plastic oil pan.

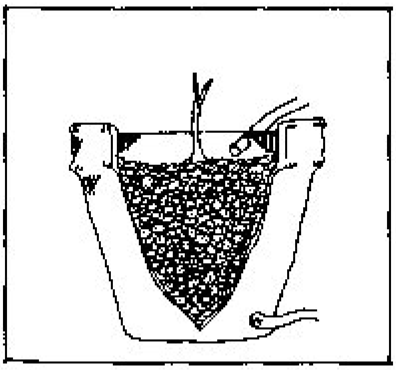
The reservoir system: A plastic container sitting in an oil pan which is kept filled with water. The bottom half of this container is filled with lava and the top half with vermiculite.

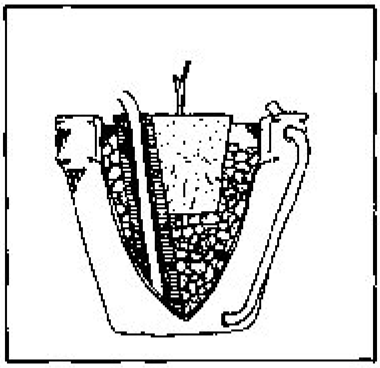




The flood system: A simple flood system in drained position.

The flood system, con't: Container being flooded manually. This unit could easily be used as a component in a larger, automatic system by attaching the tube to a pipe leading to a central reservoir and pump.





The drip emitter system: The drainage tube can lead back to a central reservoir or the water can be recirculated using a small aquarium pump.

The aerated waler system: A plastic column allows air to flow freely upward. The water circulates and picks up oxygen from the air at the surface and from the

bubbles.

Most hydroponic systems fall into one of two broad categories: passive and active. Passive systems, such as reservoir or wick setups, depend on the molecular action inherent in the wick or in the medium to make water available to the plant. Active systems, which include the flood, recirculating drip, and aerated water systems, use a pump to send nourishment to the plant.

Most commercially made "hobby" hydroponic systems designed for general use are built shallow and wide, so that an intensive garden with a variety of plants can be grown. However, most marijuana growers prefer to grow each plant in an individual container. Indoors, a three-gallon container is adequate. Outdoors, a five-gallon (or larger) container should be used if the water cannot be replenished frequently. Automatic systems irrigated on a regular schedule can use smaller containers, but all containers should be deep, rather than shallow, so that the roots can firmly anchor the plant.

PASSIVE HYDROPONIC SYSTEMS

The wick system is inexpensive and easy to set up and maintain. The principle underlying this type of passive system is that a length of 3/8 to 5/8 inch thick braided nylon rope, used as a wick, will draw enough nourishment from a reservoir filled with a water/nutrient solution to keep a growing medium moist. The container, which holds a rooting medium, has wicks running along the bottom and dropping through small, tight-fitting holes to the reservoir. Keeping the holes small makes it difficult for roots to penetrate to the reservoir. By increasing the number or length of the wicks, or their thickness, you can increase the amount of water delivered to the medium. A three-gallon container should have two wicks; a five-gallon container, three wicks. The wick system is self-regulating: the amount of water delivered depends on the amount lost through evaporation or transpiration.

Each medium has a maximum saturation level. Beyond that point, an increase in the number of wicks will not increase the level of moisture. A 1—1—1 combination of vermiculite, perlite, and Styrofoam makes a convenient medium, because the components are lightweight and readily available. Vermiculite alone sometimes develops too air-free an environment and becomes compacted, so that a tall plant might tip over. Perlite, which doesn't compress, keeps the medium loose and airy. Styrofoam beads hold no water, and therefore help keep the medium drier. Pea-sized chopped polyurethane foam, gravel, sand, and lava can also be used to make a medium. In any case, the bottom inch of the container should be filled only with vermiculite, which is very absorbent, so that the wicks have a good medium for moisture transfer.

A wick system can be constructed as follows: Cut four holes, about ½"in diameter, in the bottom of a three-gallon container. Run the wicks through the holes so that each end extends about three inches outside the container. Unbraid the wicks to aid absorption. Put two bricks in the bottom of a deep tray (an oil drip pan will do fine), into which you've poured the water/nutrient solution, then place the container on the bricks so that the wicks are immersed in the solution. Keep replacing the solution as it is absorbed.

A variation on this system can be constructed by using an additional outer container rather than a tray. With this method, less water is lost through evaporation. To make sure that the containers fit together and come apart easily, place the bricks in the bottom of the outer container. Fill the outer container with the water/nutrient solution until it comes to just below the bottom of the inner container.

The reservoir system is even simpler than the wick system. For this setup you need only fill the bottom two or three inches of a 12-inch-deep container with a coarse, porous, inert medium such as lava, ceramic beads, or chopped pottery, and then pour in the nutrient/water solution. Variations on this method include a plastic flower pot or plastic growing bag sitting directly in a tray or pail of the nutrient/water solution.

For watering convenience, a kiddie-pool was used as a reservoir for this indoor garden.

All passive systems should be watered from the top down, so that any surface buildup of nutrients caused by evaporation will be washed back to the bottom.

ACTIVE HYDROPONIC SYSTEMS

The flood system consists of a tub or container holding a medium that is completely flooded on a regular basis, usually once, twice, or three times daily, depending on the growth stage and environmental factors. The medium holds enough moisture between irrigations to meet the needs of the plant. First-generation commercial greenhouses using this method were usually built with long beds of gravel that were systematically flooded. Today, the flood system is most often used with individual containers, with each container attached to the reservoir by tubing or by a leak-proof seal.

With this system, growers have a choice of mediums, including sand, pebbles, chopped-up rubber tires, pea-sized lava, gravel, and vermiculite-perlite-Styrofoam mixtures. A recommended mixture for this setup would be one part each of perlite and Styrofoam and two parts vermiculite, or one part vermiculite and four parts lava. (Note: Because perlite and Styrofoam are lighter than water and will float if this system is fully flooded, neither should be used alone as a medium in this type of system.)

A simple flood system can be constructed using a container with a tube attached to its bottom and a one-gallon jug. Fill the container with the medium. Each day pour the water/nutrient solution from the jug into the container, holding the tube up high enough that no water drains out. Then let tube down so that the water drains back into the jug. Some water will have been absorbed by the medium, so fill the jug to its original level before the next watering. The plants' water needs increase during the lighted part of the daily cycle, so the best time to water is when the light cycle begins. If the medium does not hold enough between waterings, water more frequently.

Flood systems can be automated by using an air pump to push water from the reservoir into the growing unit.

Drip emitters are complete systems that can be bought in nurseries or garden shops. They have been used for years to water individual plants in gardens and homes. They can also be used with a central reservoir and a pump so that the water/nutrient solution will be redistributed periodically. If you choose this system, make sure you buy self-cleaning emitters so that the dissolved nutrients do not clog with salt deposits. Start pumping about a gallon every six hours during the daylight hours. Drip emitters can be used with semiporous mediums such as ceramic beads, lava, gravel, sand, or perlite-vermiculite-Styrofoam mixtures.

The drip method, using a vermiculite, perlite, sand mix with nutrient solution in the water is easily set up with materials available at garden supply stores.

This individual reservoir is easy to set up and maintain. Lava is used as the medium in the 3½ gallon container placed on a 3 inch tray. Nutrient solution is added to the top of the tray. When the tray is empty it is refilled with plain water. Additional nutrients are added about once a month.

The aerated water system is probably the most complex of the hydroponic systems, and because it allows the least margin for error, it should be used only by growers with previous hydroponic experience. To put together an aerated water system, you must first construct a clear air channel in your container. This is done by inserting a plastic tube cut with holes through the medium. Then a fish tank aerator is placed at the bottom of the plastic tube. The air channel allows the air to circulate without disturbing the roots, and the roots use the oxygen dissolved in the water.

Germination

In most systems, with most mediums, seeds can be germinated in the unit, but mediums made of large pieces, such as lava or pea gravel, will not hold seeds in place. Make little beds of vermiculite in a coarser medium and plant the seeds in these beds.

Aerated water units cannot be used to germinate seeds. Instead, start them in peat pellets or in small pots filled with vermiculite or vermiculite-based mix. Transplant them when they are two weeks old. Cuttings and rooted cuttings can also be planted in hydroponic units.

Nutrients

Choose a fertilizer designed for hydroponic growing. Make sure that it supplies adequate amounts of nitrogen during early growth stages. Typical hydroponic fertilizers have nutrient ratios of 9-5-10 or 18-6-16 (nitrogen-phosphorus-potassium, or N-P-K). Fertilizers used for later growth should have lower ratios of N. In addition to N-P-K, the fertilizer should supply secondary and micro-nutrients, which will be listed on the label of the fertilizer package. Some fertilizers seem to be deficient in magnesium (correct this by using Epsom salts) and iron-zinc-manganese (available in combination at large nurseries).

The pH level can also affect solubility of nutrients, so try to keep the pH of the water between 6.3 and 6.8. (The easiest way to gauge your pH level is by using pH paper. You can pick some up at any garden shop.) Before mixing the nutrients into the water, adjust the pH using sulfuric, nitric, or citric acid if it is too high; lime or baking soda if it is too low.

Whatever system you decide to use, once the nutrient/water solution has been added, replacement water should be nutrient-free. If you notice a slowing of growth, or a nutrient deficiency, adjust the nutrient solution. For instance, if the plants show signs of a potassium deficiency (necrotic leaf tips and edges, yellowing of leaves), add potassium. Once the nutrient problem has been corrected, the plant will respond quickly and the improvement should be apparent within a few days.

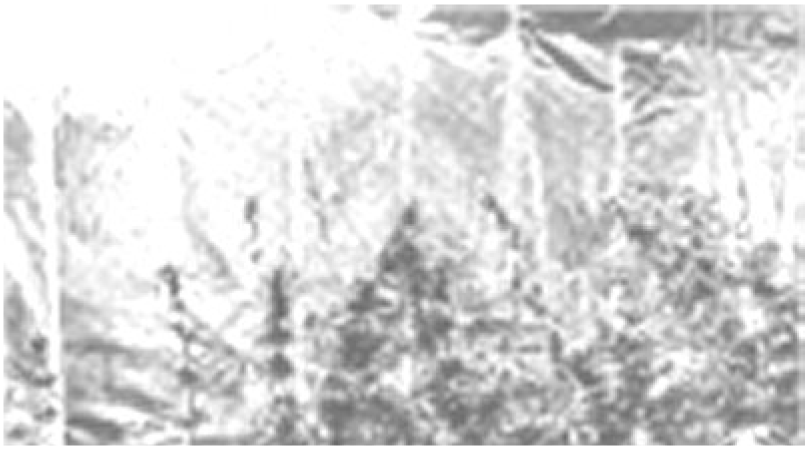
About every month or two, replace the water/nutrient solution. The discarded water makes a good garden fertilizer. Every other time you change the water, rinse the medium with clear water to wash away any salts that have been left before adding new nutrient/water solution.

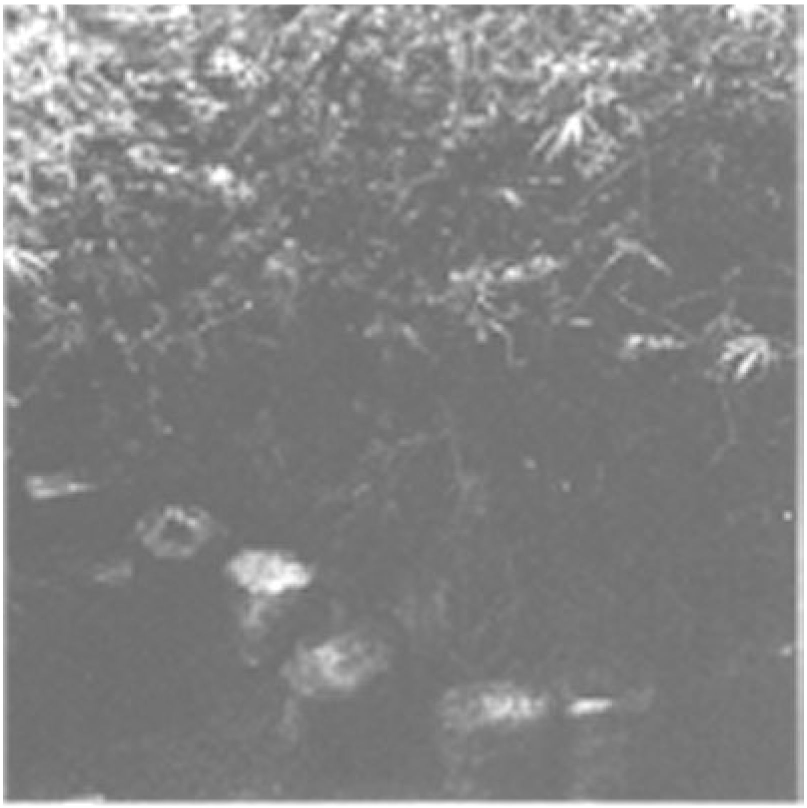
How to Make a Universal Hydroponic Unit

It is easy to make a unit that can be used for all the systems described in this chapter. Take a two-to five-gallon plastic container and cut a hole near the bottom large enough to snugly hold a plastic tube with a minimum inside diameter of 3/8“. Cut the tube three inches taller than the pot. Push 1½” of the tube through the hole from the outside and affix the end to the inside bottom using a silicone or other type of glue, or PVC tape. Caulk the seal with plastic glue or caulk.

Making a tight, leak-proof seal can be difficult if the plastics are incompatible. Roughing out both surfaces sometimes helps. Another way of attaching the tube is to use a piece of threaded plastic pipe, two washers and two nuts. Tighten the two nuts on either side of the container wall.

It is advisable to use clear plastic tubing so that you can see the water level and drainage action. If you’re using a two-container system, such as the wick or reservoir system, it is still easier to use an outer container with a tube, which facilitates draining. (Some commercial units have no drainage, which makes it difficult to change the nutrient/water solution.)





Plastic bags are convenient containers, but care should be taken not to disturb the roots when moving them.

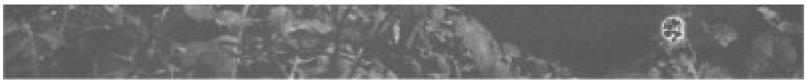
Chapter Five

Good News for Late Planters

Marijuana can be successfully started in late July and still come in early in the fall. This makes it easy for people who have not had a chance to do their planting early, and allows growers to increase the size of their crops. Late plants will not be as big or yield as much as earlier plants, but their quality will be just as high.

Starting plants indoors is probably the easiest way to begin. The plant's initial growth can be spurred by using metal halides and a CO_2 enriched atmosphere. Under good conditions, and depending on the variety planted, the plants should be six inches to one foot high within two weeks, and should grow at a rate of six inches to one foot per week for the next six weeks. A six-week-old plant will be four to six feet tall; a four-week-old plant, two to three feet; a three-week-old plant, one to two feet. Of course, the plants will not fill out as an outdoor plant would. As long as they get enough water, they won't be damaged by the hot August sun.

There is one problem with starting plants indoors. Unless the natural light cycle is modified, they will start to flower almost immediately if they are early-maturing varieties. To modify the light cycle, the night must be interrupted, because the plants determine their flowering time according to the number of hours of uninterrupted darkness. Shining a light over the entire surface of the plant in the middle of the darkness cycle will stop the plant from going into its flowering stage. A powerful flashlight, fluorescent light, or incandescent light will do. Car headlights also work well. The darkness cycle should be interrupted every night, until you wish the plants to go into the flowering stage.



Blackout room. Note opaque plastic used to shield plants from light.

Unless the plants are to be brought indoors for finishing, or there is a long growing season, light modification should be terminated by August 15. The plants will start to flower almost immediately and will mature near their normal time.

The opaque cover is removed to expose plants to light. This way, the photoperiod of the light cycle can be controlled.

Backyard growers may find it convenient to grow plants in portable containers so they can move the plants between the basement or garage and the outdoors. Then they can manipulate the light cycle to their needs, using an artificial source such as metal halides or fluorescents to supplement the natural light. Should there be an overcast or rainy day, the plants will still get plenty of bright light indoors. At night the plants can be locked up safe and sound, away from the greedy hands of thieves. Also, spotting helicopters will be unable to locate the plants while they are sheltered.

To increase outdoor plant growth during the early stages, spray the plants with carbonated water several times a day. Make sure not to use club soda, which contains salt. Instead, make your own with a home soda maker, which uses CO_2 cartridges, or buy seltzer, which has no salt added.

You can also make carbonated water using a CO_2 tank and attached hose emptying into a container of water. If the container can be safely pressurized, the amount of CO_2 dissolved in the water will increase. Dry ice, which is frozen CO_2, can also be used.

If the young plants are sprayed several times a day; their growth can be speeded up considerably. As the plants grow, it becomes less cost-effective to spray them, but it is still worthwhile.

Smaller plants may be started months later than their larger sisters, and will flower at about the same time. Their potency will be about the same, since it is based not on their chronological age, but on their maturity. Although yields on small plants are low, these plants can be placed much closer together. (In Morocco, in many cases, plants are grown by broadcast seeding, which may produce as many as 25 plants per square foot.) A 10’ x 10’ area, a total of 100 square feet, covered with plants one to two feet high in four inch pots, placed nine per square foot, would yield a good stash. Each plant would consist primarily of a main stem with a joint's worth of buds on it — roughly 900 joints.

Chapter Six

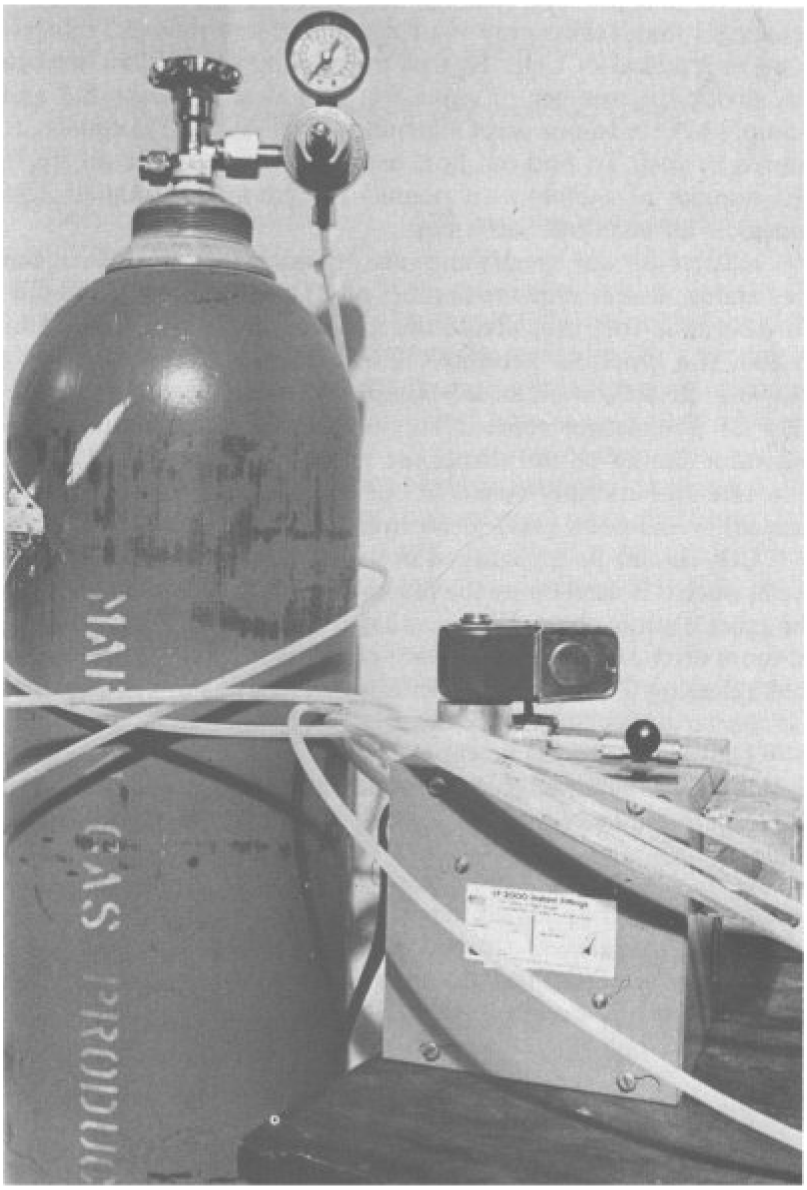
It's a Gas

Plant growth is determined by five factors: heat, water, nutrients, light, and carbon dioxide. An insufficient amount of any one of these can seriously debilitate your crop.

In an indoor environment, heat, water, and nutrients never pose any problem to the cultivator: ample supplies of each are readily available. Light is provided by using natural light and/or a variety of artificial sources (see Chapter 10). This leaves carbon dioxide (CO_2).

CO_2 is a gas that makes up about .03 percent (300 parts per million, or "ppm") of the atmosphere. It is not dangerous. It is one of the basic raw materials (water is the other) used by plants in the act of photosynthesis. And it can make those little buggers grow like crazy. When plants are growing in an enclosed area, there is a limited amount of CO_2 for them to use. When this CO_2 is used up, the plant's photosynthesis stops. Only as more CO_2 is provided can it use light to continue the process. Adequate amounts of CO_2 may be easily replaced in well-ventilated areas. However, a more-than-adequate amount — .2 percent (2000 ppm), or six times the amount usually found in the atmosphere — can increase the growth rate by up to a factor of five. For this reason, many commercial nurseries provide CO_2 enriched air for their plants.

The two most economical and convenient ways to give your plants all the CO_2 they'll ever need are: (1) use a CO_2 generator that burns natural gas or kerosene, and (2) use a CO_2 tank with a regulator.



CO_2 tank with automatic regulation and flow control can more than double the growth in an enclosed grow room or greenhouse.

First, of course, you must find out how much CO_2 is needed to bring the growing area up to the ideal level of 2000 ppm. To do this, multiply the volume of the growing area (length x height x width) by .002. The result represents the number of cubic feet of gas required to reach optimum CO_2 range. For instance, a room that measure 13' x 18' x 12' contains 2,808 cubic feet; 2,808 x .002 equals 5.6 cubic feet.

The easiest way to supply the gas is to use a CO_2 tank. All the equipment you'll need can be obtained from a welding supply store. The tank, which comes in 20-and 50-pound sizes, can be bought or rented. (A 50-gallon tank, filled, has a gross weight of 170 pounds.) To regulate dispersal of the gas, a "combination flow meter regulator" is required. It regulates the flow to between 10 and 50 cubic feet per hour. A solenoid valve turns the flow meter on and off. This can be operated manually, or by a 24-hour timer. The timer should be a multicycle one, so that the valve can be turned on and off several times each day. If the growing room is small, a short-range timer is needed. Most timers are calibrated in ½-hour increments, but a short-range timer can keep the valve open for just a few minutes if necessary.

To find out how long the valve should remain open, divide the number of cubic feet of gas required (in our example, 5.6 cubic feet) by the flow rate. For instance, if the flow rate is 10 cubic feet per hour, 5.6 divided by 10 equals .56 hours, or 33.6 minutes (.56 x 60 minutes 33.6). At 30 cubic feet per hour, on the other hand, the number of minutes would be 5.6 divided by 30, then multiplied by 60, or 11.2 minutes.

Be sure to place the tank in an area where it can be replaced easily. Run a hose from the top of the tank unit to the top of the garden. CO_2 is cooler and heavier than air and will flow downward, reaching the tops of the plants first.

Gas and kerosene generators work by burning hydrocarbons that release heat and create carbon dioxide and water. Each pound of fuel burned produces about 3 pounds of CO_2, 1½ pounds of water, and about 21,800 BTUs (British Thermal Units) of heat.

Nursery supply houses sell CO_2 generators specially designed for greenhouses, but household-style kerosene or gas heaters are also suitable. This apparatus needs no vent. The CO_2 goes directly into the room's atmosphere. A good heater will burn cleanly and completely, leaving no residues, creating no carbon monoxide, If a heater is not working correctly, most likely it will burn the fuel incompletely and create an odor. More expensive units have pilots and timers; less expensive models must be adjusted manually. Heaters with pilots can be modified by using the solenoid valve and timer.

At room temperature, one pound of CO_2 equals 8.7 cubic feet. Remember that it takes only 1/3 of a pound of kerosene (5.3 ounces) to make a pound of CO_2. To find the amount of fuel you need to use, divide the number of cubic feet of gas required by 8.7 and multiply by .33. In our case, 5.6 cubic feet ÷ 8.7 x .33 equals .21 pounds of fuel. To find out how many ounces, multiply .21 by 16 (the number of ounces in a pound) to arrive at a total of 3.36 ounces, a bit less than half a cup.

Heaters do not specify the rate at which they burn fuel, but they almost always state the number of BTUs produced in an hour. To determine fuel use, divide the number of BTUs produced by 21,800. If a generator produces

12,000 BTUs per hour, it is using 12,000 ÷ 21,800, or about .55 pounds, of fuel per hour. However, only .21 pounds are needed. To find the number of minutes the generator should be on, divide the amount of fuel needed by the flow rate and multiply by 60. In our case, .21 (the amount of fuel needed) ± .55 (flow rate) x 60 equals 22.9 minutes.

CO_2 should be replenished every three hours during the light cycle, since it is used up by the plants and leaks from the room into the general atmosphere. Well-ventilated rooms should be replenished more often. It is probably more effective to have a generator or tank releasing CO_2 for longer periods of time, at slower rates, than for shorter periods at higher rates.

The simple process of supplying plants with CO_2 can increase the yield of any indoor garden considerably, so plan on decreasing the turnaround cycle of your garden — or raising the height of the ceiling.

Chapter Seven

The Super Grow Room

American marijuana cultivators are the most sophisticated, scientific farmers in the world. In just a few years they have mastered the techniques of breeding, hybridization, sinsemilla cultivation, and curing. They have doubled and redoubled the yield and potency of their crops. Although the media usually concentrate on outdoor "farmers," most outdoor growers these days raise only their own stash, or operate in a limited area using a controlled environment — i.e., a grow room. The high cost of marijuana and the risk involved in its cultivation have constantly challenged the cultivator to develop techniques that use space most efficiently. The potential for a high profit has also given growers the incentive and ability to experiment, and nowhere is this more apparent than in the indoor garden.

I have seen the super grow rooms (SGRs), and I believe. These growers have succeeded. SGRs are based on the idea of limiting factors. The plant's rate of metabolism — and subsequently its growth rate, maturation time and yield — are governed by environmental conditions that are linked together in a chain. Metabolism can proceed no faster than permitted by the five limiting factors: light, heat, water, nutrients, and carbon dioxide.

Super grow rooms meet these necessities, automatically or semiautomatically, by using timers that regulate irrigation, lighting, and CO_2 enrichment. Recently I had the pleasure of seeing two automated grow rooms. The first was lit naturally, with supplemental lighting from metal halides. The corrugated sheet-steel roof had been replaced with Filon, a transparent corrugated plastic sheet made especially for greenhouses.

Exec, as he wishes to be called, grows uniform commercial crops which vary according to the season. He has two growing areas: a starting room and a main growing area. His spacious starting room is divided into a germination section, lit by fluorescents, and a seedling section lit by two halides. Seeds are germinated in 4" pots and transplanted 10 days after germination into a 2½ quart container

Exec has designed a planting schedule that matches each plant varieties' seasonal habits with day length. Here is his planting and control schedule:

In November, Exec starts equatorial seeds. He prefers a Nigerian-Santa Marta hybrid. He repots 10 days after germination, keeping the germination room lit 24 hours a day. The plants are removed to the large growing area about 3 ½ weeks after germination. This area is completely roofed with Filon, and has 10 halides for supplementary light. Total area is 1,000 square feet.

When plants are moved to the large growing area, they are repotted again, this time into 2-gallon containers. The lighting is set at 12 hours, to coincide with natural light. These lights burn only when the sun is out, so that suspicion is not aroused by the lit Filon roof.

To control the flowering period, Exec has strung rows of removable incandescents, each 100-watt light bulb illuminating about 9 square feet. For the next three weeks he turns these lights on for 1 minute (the minimum time on his short-range timer) every 90 minutes. This prevents the plants from starting to flower. Around the middle of January, he turns off the incandescents. A week later he turns the halides down to 10 hours, where they remain until the end of flowering. Exec claims to have had varieties that would not ripen until the light was down to 8 hours.

Around March 1 the new crop is planted. This time he uses either a Southern African-Afghani or Mexican hybrid. These plants are replanted around March 15 and then, around April Fool's Day, they replace the earlier crop, which is now ready to be harvested. Exec cuts the plants up and hangs them to dry in his starting room, which he now keeps entirely dark. He manicures them only after they are dry. Exec has a busy schedule transplanting the new residents of the growing area into 2-gallon pots. He keeps the halides on for 13-14 hours and then once again he uses his incandescents nightly, this time for two weeks, until about April 15, when he turns the halides down to 11 hours and covers the roof with long shades made from agricultural shading material. He manually opens and shuts the shades, closing them at dusk, as the lights go off, and opening them late in the morning as the lights come on. In late spring he sometimes uses only sunlight during the brightest part of the day.

On May 15 Exec plants another new crop. This time it is definitely an Afghani-Southern African, which flowers at 14-16 hours of light. By June 15 the Southern African-Mexican hybrid is ready, and the Afghani-Southern African plants are placed in the main garden. They are given only a natural-light cycle, and the halides supplement the natural light only on cloudy days. On July 15 they are shaded, to put them into harvest cycle, receiving no more than 14 hours of light. The plants are ready by August 30, and Exec replaces them with a Northern Mexican-Kush cultivar, or sometimes an Afghani-Kush hybrid that he's planted a month earlier. He uses flashing incandescents until September 30, when he lets the light cycle drop back to day length. The plants are ripe by December 15, a nice bit of Christmas cheer.

Exec gets four crops a year, uses a minimum of electric light, and is able to grow in a large area, arousing few suspicions regarding spinning electric meters.

He uses a propane heater during the cool months. This enriches the air with CO_2 while providing heat. At other times he uses CO_2 from a tank. During the hot months he uses a ceiling fan and several high-powered window fans, but even so, at times the room gets a little too warm for optimal growth. Cannabis grows fastest when the temperature ranges between the 60s and the 80s. If the temperature gets higher, photosynthesis stops; if it is lower, photosynthesis slows down.

With about 500 plants per crop, Exec has no time to water them. Instead, he has a drip emitter attached to each container, and each day he waters his plants by turning on a valve for a few minutes. First he determines how much water the average plant needs. Then, using a simple formula — amount required ÷ flow per hour x 60 — he arrives at the number of minutes needed for watering. His emitters flow at the rate of one gallon per hour (gph). If the plants require 8 ounces, 8 ± 128 x 60 3.7 minutes. When he is not around to take care of things manually, he estimates the plants' needs and then sets his short-term timer, which regulates a solenoid valve.

He adds soluble hydroponic nutrients and other fertilizers and minerals to the water solution several times a month.

These plants are only a month old. They are thriving in a near perfect environment, nutrient, water, and CO_2.

The same plants a month later.

The second garden I visited, administered by Elf, was lit entirely by halides and sodium vapor lamps. Elf's area totals about 225 square feet, of which 175 constitute growing space. He cultivates about 80 plants per crop and claims that he can grow five to six crops per year, but works at a more leisurely pace.

Elf too has a separate starting area. He can start a crop every two months, using the germination area for about one month before setting the plants in the main garden. Plants are started in 2½ quart containers; when they're moved, he transplants them to 1½ gallon containers.

Sometimes he starts from clones, which takes longer than starting from seeds, but is ultimately less effort since there are no males to deal with. Three weeks after the plants enter the main growing area, its light cycle is reduced to 13 or 14 hours from constant light. Six weeks later, the plants are ready to harvest.

Equatorial varieties take longer to mature, but Elf prefers them to the stuff he sells, so he has a growing room for his own stash. It is stocked with exotics.

Elf ventilates his area with two duct fans and open windows (which are covered to seal in light). CO_2 is injected into all three rooms from a CO_2 tank with a timer.

Elf waters his plants by hand, using a 5-gallon container and a ½ gallon pitcher. This takes less than an hour. At maturity the plants require about 1/2 gallon of water every four to seven days, depending on temperature. This saturates the container and partially fills the tray underneath it. Each container holds a mixture of vermiculite, perlite, Styrofoam, and foam rubber. Plants that are bigger than most receive extra water between irrigations. Smaller plants receive less water. He uses a combination of soluble fertilizers, and contends that his own urine, either fresh or fermented, is the best source of nutrients available. His plants were healthy and had no nutrient deficiencies. But the taste...

Chapter Eight

Why Dope Gets You High

Aside from set and setting, the main factors in determining the quality and intensity of the high are the amount, and the particular ratio, of cannabinoids present in the material.

THE CANNABINOIDS

There are more than 40 known cannabinoids, but most of these occur in very small amounts and are not important to the high. The cannabinoids found in greatest quantity are THC, THCV, CBN, and CBC.

THC (tetrahydrocannabinol) is the main psychoactive (mind-bending) ingredient in marijuana, and accounts for most of the high. Actually THC is found in four or five variations with slight differences in their chemical structure. The variants have similar effects. THC occurs in all varieties of cannabis, in concentrations that vary from trace amounts to about 95 percent of all the cannabinoids present.

THCV (tetrahydrocannabivarin) is closely related to THC, and has been found in some varieties of Asian and African grass. Colombians have not yet been tested for THCV, but some varieties are likely to contain this substance. THCV seems to be much faster in onset and quicker to dissipate than THC, but its psychoactivity appears to be somewhat less than that of THC. THCV is usually associated with extremely potent grass.

CBD (cannabidiol) also occurs in almost all cannabis varieties in quantities that range from trace amounts to 95 percent of all the cannabinoids present. In its pure form it is not psychoactive, but does have sedative, analgesic, and antibiotic properties. CBD contributes to the high by interacting with THC to potentiate or antagonize certain qualities of the high. It appears to potentiate the depressant effects and to antagonize the euphoric effects. It also delays the onset of the high, but makes it last considerably longer. Terms such as “knockout,” “sleepy,” “dreamlike,” and “contemplative” are often used to describe the high from grass with sizeable proportions of CBD.

CBN (cannabinol) is produced by the degradation of THC. Fresh samples of marijuana contain very little CBN, but curing, poor storage, or processing can cause much of the THC to be oxidized into CBN. When grass is pressed for shipping, the resin glands that hold and protect THC are sometimes ruptured, exposing the cannabinoids to air and increasing the rate of oxidation. CBN in its pure form has at most 10 percent of the psychoactivity of THC. CBN seems to potentiate THC's disorienting qualities, making one feel more drugged, dizzy, or generally untogether, but not necessarily higher. With a high proportion of CBN, the high may start well and then feel as if it never reaches its peak, and may not last long. Colombian grasses sometimes contain half as much CBN as THC.

CBC (cannabichromine) is inactive in its pure form, but is suspected of potentiating THC. Some tests made for CBD may actually have measured CBC, which is chemically similar.

THE EQUATORIAL THEORY

The ratios of cannabinoids found in different varieties of cannabis differ greatly. Generally, marijuana grown at the equator contains mostly THC, CBN, and THCV, with only traces of CBD. As the distance from the equator increases, the amount of CBD in relation to THC increases. At the 30th parallel (northern Mexico, Morocco, and Afghanistan), amounts of CBD and THC found in adapted varieties are about equal. Above the 30th parallel, cannabis plants are usually considered hemp.

But this is not a hard-and-fast rule. Within any macroclimatic area there are many microclimates, which may show extreme variations in environmental conditions. Since a patch of plants is adapted to the conditions in exactly the area where that patch is located, there may be major differences in the quality of adapted marijuana from several nearby stands. In the American Midwest, the content of CBD in samples of cannabis taken from escaped hemp (plants which had escaped from hemp fields) ranged from trace amounts to 7.1 percent; the THC content, from trace amounts to 2.3 percent. The high THC content indicates that there is potent marijuana growing “wild” in the Midwest. On the other hand, samples of hemp from India and Iran, two countries usually associated with good marijuana, contained (respectively) .11 and .18 percent THC and 2.4 and 1.63 percent CBD.

All this means that over many generations, each population of cannabis adapts to the particular conditions it faces. However, cannabis grown directly from tropical seeds will resemble its parents in growing habits and potency. First-and second-generation descendants will also reach a potency close to that of their tropical ancestors.

Evolutionary theories are predicated on the process of natural selection: that is, the plant that is more fit (for a particular environment) will be more likely to survive and reproduce. Just why the change in THC-CBD ratios occurs is unknown. However, America’s marijuana growers, through selective breeding, have developed high-THC varieties adapted to the temperate environment.

The serious consumer faces two problems: ascertaining where the marijuana comes from, and determining the variety of seeds from which it was grown. Much of the grass now being imported was grown from top-quality seeds given to the grower by the dope exporter. For instance, the quality of Mexican has improved in recent years as Colombian and Southeast Asian seeds have been introduced to the area. Twenty years ago there was virtually no grass grown in Hawaii. Today, almost all of the grass grown there is descended from seeds recently imported to the islands from various sources. This becomes apparent when buds from different Hawaiian growers are compared.

They differ in color, shape, size, as well as potency — factors determined in part by genetics.

Chapter Nine

Techniques for Preparing Soil

Each garden situation is unique: the soil's condition, the garden's size, its location, your commitment, and your personal preferences all play their part in determining which garden techniques you should use. Each technique affects the micro-ecology in its own way, and is useful for some set of conditions. Home gardeners can use techniques that are impractical for a farmer or a guerrilla planter. But all growers have the same goal when they prepare soil for planting: to create a soil environment conducive to the growth of a healthy, vigorous plant.

If you are already growing a vegetable garden, the chances are that your soil is in pretty good shape for growing marijuana. However, vegetable gardens may be a little acidic, particularly east of the 100th meridian. The soil should be prepared in much the same way as it is for corn, with the addition of lime to bring the pH close to neutral.

TILLING

Gardens that have not been planted recently (that is, within the past three or four years) require more work. It is best to begin preparing the soil in the fall before the first frost. This can be done using a spade or shovel. The ground is lifted from a depth of six or eight inches and turned over so that the top level, with its grass and weeds, becomes the bottom layer. Large clumps are broken up with a power hoe or roto-tiller. Conditioners such as fresh leaves, composts, mulching materials, pH adjusters, and slow-release fertilizers are added and worked into the soil so that they can begin to decompose over the winter. It is especially important to add these materials if the soil is packed, mucky, or clayey. Soluble fertilizers should not be added in the fall since they leach to the subsoil with heavy rains.

In the spring, as soon as the ground is workable, it should be turned once again. If it still feels packed, add more conditioners. If you are using manure or other organic materials, make sure that they smell clean and earthy and are well-decomposed. (Fresh materials tie up the nitrogen in the soil while they cure, making it unavailable to the plants.) Commercial fertilizers and readily soluble organics such as blood meal and wood ash are added at this time.

The ground can also be seeded with clover or other legumes. Legumes (clover, alfalfa, vetch, etc.) are plants which form little nodules along their roots. The nodules contain bacteria which live in a symbiotic relationship with the plant. As part of their life process, these bacteria absorb gaseous nitrogen from the air and convert it to chemical forms that can be used by the plant. During its life, the legume uses up most of the nitrogen, although some leaks into the surrounding soil. However, when the plant dies (or when any of its leaves die), its contents become part of the soil. The process of growing a cover crop and turning it into the soil is called “green manuring.”

After the last threat of frost, at about the same time that corn is planted, the soil should be worked into rows or mounds, or hoed, and the seeds planted. If any concentrated fertilizer is added to the soil, it should be worked into the soil first, rather than coming into direct contact with the seeds.

The actual amount of tilling that a soil requires depends on its condition. Sandy soils and light loams may need no turning, since they are already loose enough to permit the roots to penetrate. Since turning breaks up the soil structure, damaging its ecology, it should be done only when necessary. These soils are easily fertilized using soluble mixes or by the layering technique described below. Soils which are moderately sandy can be adjusted by "breaking" them with a pitchfork: the tines are pushed into the ground and may be levered, but the soil is not turned. This is done about every six inches and can be accomplished quickly. Farmers can loosen sandy soil by disking at five or six inches.

Some gardeners mulch the soil with a layer of leaves or other materials to protect it from winter winds and weather. This helps keep the soil warm so it can be worked earlier in the spring. In states west of the 100th meridian, this is helpful for preventing soil loss due to erosion from dry winds. Soil often drains well in these areas and the soils' ecology is better served when they are not turned. At season's end, the marijuana's stem base and root system are left in the ground to help hold the topsoil. The next year's crop is planted between the old plant stems. Some gardeners prefer to plant a cover crop such as clover or alfalfa, which holds the soil while enriching the nitrogen supply.

LAYERING

Layering is another method of cultivation. The theory behind this program is that in nature the soil is rarely turned, but builds up, as layer after layer of compostable material fails to the ground. This material, which contains many nutrients, gradually breaks down, creating a rich humus layer over a period of years.

The layering method speeds up the natural process. Since gardens are more intensely cultivated than wild fields, new material is required to replenish the soil nutrients. Some gardeners sheet-compost: that is, they lay down layers of uncomposted material and let it decompose while serving as a mulch at the same time. Most gardeners, however, prefer to mulch with material that is already composted. The compost shrinks and builds the topsoil layer about an inch for every six inches of compost. After several years, the soil level will be raised considerably, and the top layers will constitute an extremely rich, porous medium which never needs turning. In order to prevent a spillover of the soil, gardeners usually construct beds which contain the garden areas. These are simply constructed with boards.

Layering is most successfully used on porous soils, especially sands, which contain little organic matter. It can also be used with clay soils, but experienced growers say that clays should be turned several times before the technique is used, or the first few harvests will be small.

Planting a cover crop such as clover will give the soil structure. As more compost is added, the clover will be covered and the new seed planted. The clover, with its nitrogen-fixing properties, remains as a permanent cover crop. When marijuana seeds are to be planted, a planting row can easily be tilled with a hoe. The clover protects the soil from sun-baking and resultant water loss, and makes it harder for weed seeds to get started.

Tilling and layering are basic methods, and are used in many variations. There are almost as many gardening techniques as there are gardeners. For instance, one gardener bought three cubic yards of topsoil and a cubic yard of composted steer manure. He mixed the material and filled raised beds with it to a depth of 1½ feet, creating an instant high-power garden. Another grower made compost piles in his raised troughs during the winter. By planting time the compost was complete and filled with earthworms. The beds became warm earlier, enabling him to plant sooner. A Midwestern gardener uses marijuana as a companion crop in much the same way as Indians used corn: between the rows of marijuana, she planted string beans and squash. She didn't get many beans, and only a few squashes, but she points out that the beans gave the plants extra nitrogen, especially during the first six weeks, and that the broad squash leaves protected the soil from the hot August sun.

A gardener in Georgia had such a sticky clay soil that a shovel had once become stuck in it. He used a power auger to dig holes two feet deep and two feet wide, and filled them with a fertile mix of two parts sand, one part clay, three parts topsoil, and one part chicken manure. He claimed that his plants grew six feet in 2½ months.

Chapter Ten

Artificial Lighting

Greenhouse gardeners are used to harvesting summer crops one or two months earlier than their neighbors. Later in the season, the greenhouse environment allows them to harvest one or two months after other gardens have closed for the winter.

With just a small investment of time and energy, any greenhouse can be used to grow summer as well as winter crops nearly all year round, or until freezing temperatures kill summer plants.

In temperate zones the amount of light reaching sea level can vary considerably. In midsummer at noon on a clear day, I've recorded over 10,000 lumens at the 40th parallel. (A lumen is a measure equal to one footcandle per square foot.) In midwinter at noon, the same area received only 950 lumens. Fruiting plants require 2,000 to 3,000 lumens to produce, and 1,000 to 2,500 lumens to maintain life processes and slow growth. Non-fruiting plants, such as greens and root crops, generally require from 1,000 to 2,500 lumens.

Many greenhouses are already insulated and solarized to take advantage of the "greenhouse effect." The only thing that stops their plants from producing "summer" crops throughout the year is an adequate amount of light to support rapid growth.

Standard fluorescent fixtures are not the answer. The fixtures themselves block all sunlight that would reach the plant directly. Only ambient light, coming from the sides, gets through. The light is distributed unevenly, since the ends of a fluorescent emit considerably less light than its center area.

One way of increasing the efficiency of fluorescents is to build your own fixtures so that the spaces between the tubes are not blocked, and more direct light reaches the plants. Aluminum foil can be shaped to make reflectors, so that light that normally escapes from the top or sides of the tube is reflected downward. Use the dull side of the foil as the reflective surface. It reflects as much light as the bright side, but distributes it more evenly.

Lighting technology has increased the options of the home gardener. Besides the standard fluorescent, he/she can choose from Very High Output (VHO) fluorescents, mercury vapor lamps, metal halide lamps, high-pressure sodium vapor lamps, and low-pressure sodium vapor lamps.

VHO fluorescents look just like the standard fluorescents, but use about three times the energy and emit about 2½ times the light. Although they are not as efficient as the standard lamps, they are much more convenient to use. Two of them replace a bank of five standard tubes. VHO tubes require a different ballast than do standard ones, but are the same size, so that more natural light is allowed to reach the garden. The tubes are positioned 6 to 12 inches from the tops of the plants.

A fruiting garden lit entirely by fluorescents requires about 20 watts per square foot of growing space. For example, a 4 x 8 foot garden (32 square feet) needs about 640 watts. At 72 watts for an eight-foot standard tube, this means that about nine tubes would be required. Most ballasts light pairs of tubes, so eight or ten would be the actual number. Eight tubes would be spaced at two per foot of width. A VHO fluorescent, on the other hand, uses 215 watts, so only three would be required. Even if four were used, there would be only one per foot of width.

Almost all gardens have bright spots and darker areas. Plants that require less light can be placed in the darker areas: for example, beneath the ends of the tubes, where the light emissions decrease dramatically.

Since greenhouse gardeners can count on some natural illumination, they do not need as many lamps. Almost all naturally lit gardens can get by on about 10 watts of electric light per square foot, so that the 4 x 8 foot garden in a greenhouse actually requires only half the number of tubes calculated above. Of course, if more light is used, the growth rate increases.

Fluorescents come in a number of different spectra, such as daylight, warm white, cool white, deluxe warm white, or deluxe cool white, as well as purple grow tubes. Many other spectrum choices are available. Each of these tubes is coated on the inside with a slightly different phosphor, which glows when it is activated by electric current. Each phosphor emits a unique spectrum of light, with the cool whites tending toward the blues, and the warm whites toward the reds. The term "deluxe" indicates that more redemitting phosphors have been added. Although a garden using only one kind of tube will do fine, for best results the tubes should be mixed.

Grow tubes emit relatively high amounts of red and blue light. They were developed after it was discovered that chlorophyll uses red and blue light most efficiently. These lights were designed to approximate the photosynthesis (or chioroplast synthesis) curve. However, they emit less than 65 percent the light of other tubes (1,950 lumens). In experiments and informal inspections, I have observed that the responses of plants vary more with respect to the total lumens received than to the particular spectral pattern of the light. As long as the plants receive some light from each part of a broad spectrum, they will adjust and grow well. In practice, grow tubes do not work as well as other fluorescents.

Fluorescent tubes emit a lessening amount of light over the course of time. After a couple of years, they may emit less than 65% of their initial output. On-off cycles wear the tube out faster than continuous use.

Fluorescent lights are adequate to bring plants into profuse ripe flowers. However, the light intensity goes down quickly as the distance from the tube decreases.

Fluorescent lights use a ballast to convert electricity to a high-voltage, low-power current. Older ballasts were often insulated in PCBs, so it pays to buy new equipment, rather than risk a health hazard. Usually it is cheapest to buy a unit and rewire it onto the new frame. Every ballast has an easy-to-follow wiring diagram attached to it. The ballasts are the heaviest part of the fluorescent unit. For easy handling, it is best to separate the ballast from the lights. The ballasts can be placed on a board in a remote location, and the lights attached when the setup is in place.

A convenient way to light the garden is with a bank of U-shaped tubes, or with 8-inch round fluorescent converter fixtures. These units are designed to change a standard light fixture to a fluorescent one with a built-in ballast. A 2 x 3 foot board can be used to mount standard fixtures, and then the fluorescents can be screwed in. They can also be hung independently from a rafter or frame, using a thin string, with each fixture attached to its own electric cord. I grew a garden in which I suspended these lamps so that they hung between the plants, not directly above them. This brought the lights very close to the flowers.

Metal halide lamps are the white-light street lamps used to illuminate everything from parking lots to night events. They are available in a number of wattages, but the two most convenient ones to use are the 400 and 1,000 watt sizes. They emit a mean of 32,000 and 92,000 lumens respectively, and are slightly more efficient than a standard fluorescent. Mean lumens are used because the the lamp output changes as it wears out. 400 and 1,000 watt metal halide lamps have an initial output of 40,000 and 110,000 lumens respectively. A 400 watt metal halide lamp can be used as a supplementary source of light for an area of about 7 foot x 7 foot, or about 50 square feet. A 1,000 watt halide can provide illumination for about a 10 foot x 10 foot area, or a garden of about 100 square feet.

Plants seem to respond better to strong sources of illumination which are dispersed rather than to a moderate source which is emitted over a wider area. More light penetrates to the inner foliage. A metal halide’s efficiency is increased when the halide shuttles back and forth, illuminating each garden spot brightly for a limited period of time. The area that the lamp can illuminate may be increased by about 30%, or the lamp can cover the same area with more light.

This garden was illuminated with a metal halide lamp (front) and a low pressure sodium lamp (rear). Low pressure sodium is not ideal for marijuana but halides provide optimal intense light.

Metal halides promote vigorous growth. Fruiting patterns, which are somewhat slower using fluorescents, quicken; fast growth can be maintained even in midwinter. When I lived in an apartment, I grew tomatoes and herbs using halides in an unused hallway. I was eating juicy, ripe tomatoes 120 days after planting the seeds.

Sodium vapor lamps are the amber or orange-looking lamps used to illuminate streets and roads. Their spectrum is centered in the orange to red bands, but they emit some blue light. These lamps, too, come in 400 and 1,000 watt sizes. The 400 watt size emits 50,000 lumens initially, and has a mean rating of 445,000 lumens. The 1,000 watt lamp emits about 140,000 lumens initially, and about 126,000 mean lumens. It is about 1½ times as efficient as a fluorescent.

I have grown plants from seed using these lamps as the sole source of illumination, and the growth rate was about the same as with metal halides. Some gardeners claim that flowering and fruiting are increased because of the emphasis on the red spectrum. When the lamps are used as a supplemental light source, their spectrum becomes less important, since natural light will supply an adequately wide spectrum.

Low-pressure sodium vapor lamps emit an orange light that covers only a narrow portion of the visible spectrum (680-690 nanometers). They are very efficient. The largest size, a 180 watt unit, emits about 33,000 lumens, and is more than twice as efficient as a standard fluorescent. The lamp is encased in a three-inch-wide glass cylinder and consists of a U-shaped tube with the diameter of a neon light. It is powered using a ballast.

This lamp cannot be used as a primary source of light because plants grow stunted at first and eventually die. Low-pressure sodium lamps do work well as a secondary light source, though, and are an efficient way to increase the total number of lumens reaching the plant. They are especially good at brightening up dark spots in the garden.

Mercury vapor lamps also come in 400 and 1,000 watt sizes, and emit 12,800 and 47,700 lumens respectively. They emit a white light similar to a metal halide's, but are not nearly as efficient, so they should not be purchased new. If they are available used, though, they may be worth having.

For the most efficient use of any of these lamps, the reflectors should direct the light to the plants, not to the walls or ceiling of the room. Some commercial reflectors do not cover the lamps entirely, so that much of the light is directed horizontally rather than vertically or diagonally. Reflectors can be modified and customized using aluminum foil. It is easily held on by tying down with thin wire such as picture-hanging wire, which is not affected by the high temperatures.

Artificial light should be provided while natural light is present, so that the plants get as high-intensity a light as possible. If the garden is partially shaded, for instance, in the early morning or late afternoon, the lighting system may be used on a multi-cycle each day, being turned on and off several times, to supplement the natural light during the darker periods.

It is almost essential to put the lamps on a timer, so that they go on and off with regularity. As the natural light cycle changes with the seasons, the electric lights should be adjusted. During the late spring, supplemental lighting may be appropriate only at the beginning and end of each day. The lamps are generally not needed during summer. In early fall, they may be used during cloudy weather and at the beginning and end of the day. By late fall they may be used to supplement the weak sunlight all day, and may continue in this fashion until early spring.

Metal halide, low and high pressure sodium lamps, as well as accessories to shuttle the lights, are available from a number of horticultural supply companies.

Chapter Eleven

Four Ways to a Better Grow Room

I know a person with a very observant eye and a keen sense of the possible. One day we were walking through a commercial area where men were unloading boxes from a truck. 'Fred' asked to see the manager, and told him that he could improve the effi- ciency of the operation by 30 percent if he was paid $100. The manager agreed to pay if it worked. Fred showed the manager that the men were loading only two boxes on each truck, while, if the boxes were loaded sideways, the trucks could hold four. The man- ager reluctantly wrote a check.

On the way out, Fred said, “I can still cut unloading time by 30 percent for $50.” The manager shook his head, but as we began to leave he called us back and agreed. Fred told him to increase the length of the platform on the hand trucks by attaching a board to them. The manager handed Fred a President Grant, shaking his head with an ‘I should have known’ look. A study of any operation will reveal many areas for improve- ment. Even seasoned experts can overlook fundamental principles. For example, take two gardens, “A” and “B”, maintained by experienced cultivators:

Garden A is lit by two vertical 1000-watt metal halide (MH) lamps with wide reflectors on a rotating light mover. There is an aisle between the wall and the garden. The plants grow in 3-inch cups filled with expanded clay, placed in 9-inch tubes. They are irrigated by two constant-flow sprayers aimed at each cup.

Each plant in this growing tube is irrigated by 2 dripper-sprayers which keep the roots moist.

Garden B is lit by two horizontal high-pressure sodium (HPS) lamps and one 1000-watt MH lamp. The lamps' mover has three arms and the light circles the garden. The plants grow in five-gallon buckets, each outfitted with three 3-inch plastic cups filled with expanded clay pellets. Each cup is irrigated by a constant drip.

This garden uses 4 gallon recirculating drip containers.

Both gardens will lose yield because the growers neglected to apply some basic principles when setting up the grow rooms. Here are four ways to bring these gardens to full potential:

1. *Maximize light distribution to the plants*. Plants use light to power photosynthesis, the process by which carbon dioxide and

water are turned into sugar and oxygen. The more light the plants receive, the more sugar is produced, and the faster they grow. Both Gardens A and B waste light. In garden A, as the horizontal lamps travel around, much of the light is used to illuminate the aisles around the perimeter. In garden B, the bottom of the vertical lamp hangs below the reflector and much of the light travels horizontal- ly across the room, hitting the walls.

- In both grow rooms, the walls are covered with black plastic, which absorbs light and emits heat. Placing a reflec- tive curtain around the garden perimeter could increase the amount of light received by the plants by as much as 20 percent. Curtains can be hung from the ceiling or from rods. Moveable reflective panels can also be used. Panels can be made from 4’ x 8’ Styrofoam pieces coated in a reflective material. Most growers prefer Mylar, but aluminum foil, silvered gift wrap, aluminized greenhouse white paint and flat white paint all work.

Vertical lamps emit most light horizontally. To reflect light vertically to the plants, they require deeper relectors; these are too shallow so much light is lost to the wall.

1. *Provide adequate support to each of the plants*. When shaded, plants lose the energy they need for fast growth. If plants are properly supported, they won't shade each other. This ensures that each plant has the necessary light and space to grow to its full potential.

    - The plants in Garden A are supported with an appropri- ate bamboo stake, but the plants in Garden B have no support. Neighboring plants are crowding over onto one another, shading the canopies and lowering growth rate and yield. The problem can be solved in several ways. Each plant can be supported by a bamboo stake secured with twist ties to keep the central stem erect. Alternatively, a small cage, such as a tomato cage, can be placed around each cup. A third option is to run a small fence along the length of each tube, attaching the plant stem with twist-ties. Rows of strings can be hung from the ceiling or overhead rods and connected to the plants.

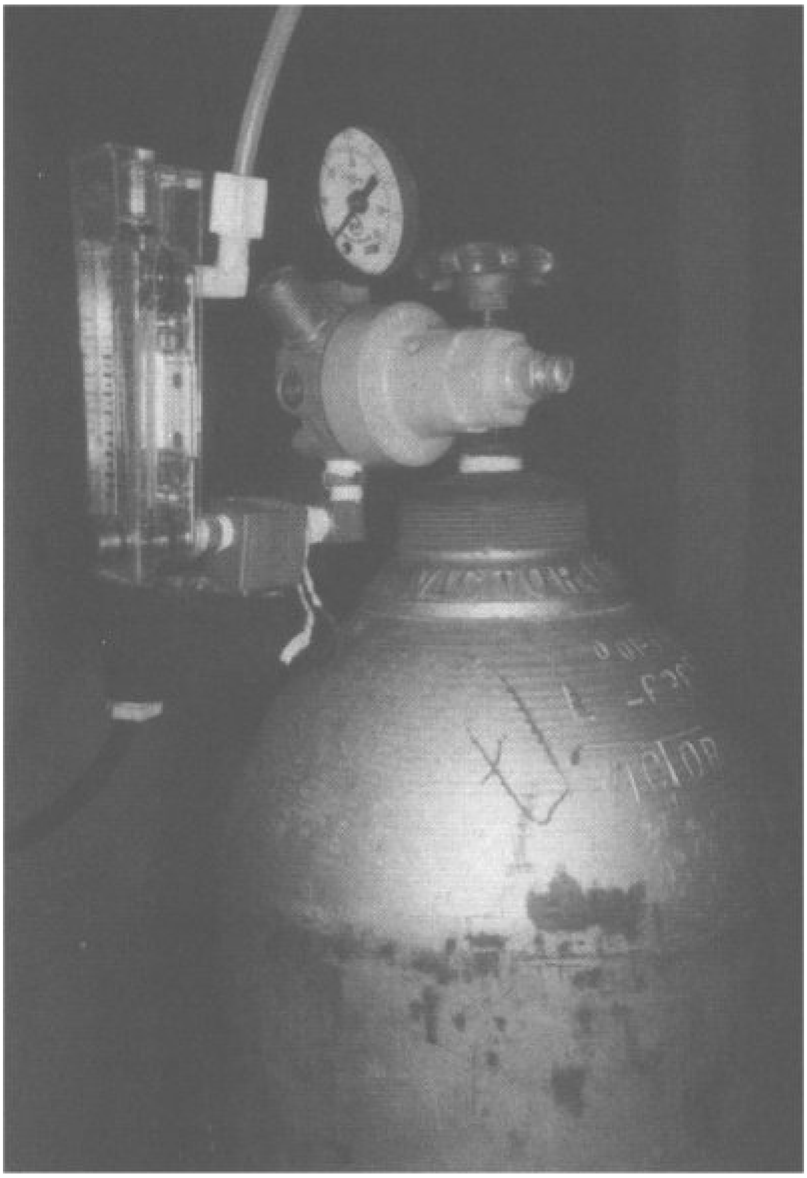
2. *Focus light where it is needed most*. Stretching can occur when plants crowd each other for canopy space. Lower parts of the plant tend to stretch as a higher ratio of infrared light, rather than direct red

light, reaches the lower canopy. Light can be reflected back from the floor to target the lower plant sections. This unfil- tered light is higher in red, counteracting the stretching effects of the infrared light.

- The floors of both gardens are covered with dull-colored plastic tarps, and because of the plant spacing, much of the light hits the floor. Covering the floor with white plastic, Mylar or bright white posterboard, increases the amount of light received by the plants, and prevents stretch- ing by targeting the lower canopy.

3. *Use CO_2 to increase yield*. The addition of a CO_2 source can dramatically increase yield. Photosynthesis uses light to power a complex reaction in which hydrogen (H), carbon (C) and oxygen (0), from water (H_20), and carbon dioxide ($C0_2$) combine to form sugar ($C_6H_{12}0_6$). The ambient level of CO_2 in air is about 400 parts per million. In a closed environment under bright light, the plants quickly lower the CO_2 levels as the 0 levels increase. When levels of CO_2 go down to 200 ppm, photosynthesis stops.

   - Plant growth increases in a direct ratio to CO_2 levels until another limiting factor (usually light) is encountered. Indoors, with bright lights, plants can use 1000 to 1500 ppm CO_2. This is most easily supplied using a CO_2 tank and regulator. Some of these regulators are time based, others work in conjunction with the ventilation; the most sophisticated measure the amount of CO_2 in the air. Plants grow much faster, and produce heavier yields, when they receive CO_2-enriched air right up until the last two weeks of flowering.



A CO_2 regulator adjusts the pressure of the gas and controls the flow.

Chapter Twelve

Sensi's Little Helpers

Indoor plant growers have always lived under the threat that infections and pests can quickly destroy an entire crop. Yet growers were hesitant to use commercial pesticides because of fears of residues on the smoke. This left them with few options and difficult choices. That has all changed in the last few, as federal government required re-registration of virtually all chemical pesticides. Many were dropped from registration and others were modified to meet stricter government guidelines. This shakeup spurred the development of innovations in pest control. "Integrated pest management" is the new buzzword fore those in the know.

Instead of relying on massive amounts of toxic chemicals, strategies now include physical disruption, fire, hormonal attractants and baits, companion planting, repellents and encapsulated baited poisons. Of more interest to indoor marijuana growers are technological developments using non-toxic, ecologically friendly chemicals, microorganisms and insects for plant protection. These products offer convenience and reliability in preventing and dealing with plant disease and pests. All of the products listed here can be used on fruit and vegetable crops and are compatible with organic gardens.

STERILIZERS

Organic and hydroponic growers both face the problem of replacing or cleaning the medium after each crop. Usually potting mixes and rockwool are replaced, while clay pebbles are washed. These measures are taken to prevent the cross-generational spread of disease. Some new products have been scaled down to give gardeners the same tools that were once only available only to large greenhouse growers. Several new chemicals used for greenhouse and grow room sterilization, pose less of an environmental or toxicity threat than pesticides or chlorine.

The Electric Soil Sterilizer holds a cubic foot (about 7.5 gallons) of soil or other planting medium. The unit works using heat controlled by a thermostat with a range of 100-200 degrees Fahrenheit. At 160 degrees Fahrenheit the material is pasteurized, which kills most harmful organisms, but not beneficials. Sterilization, which kills most organisms and weeds, occurs at 180 degrees. It takes about 30 minutes for sterilization to occur once loaded. It is rated at 500 watts or 4-1/2 amps, weighs 27 lbs. and costs $280 from Charley's Greenhouse Supply. Phone: (800) 322-4707. Web site: www.charleysgreenhouse.com.

Physan 20 (TM) is a broad-spectrum disinfectant made from a salt, double quaternary ammonium chloride. It leaves no residue and breaks down into nitrogen, which plants use. It can be used a soil drench and to sterilize trays, walls and equipment. It can also be used to prevent seedling and plant diseases when it is placed into irrigation water. Physan 20 has been used for over 25 years and is considered very safe. It can be used in the same way as Zero-Tolerance (described below), and is excellent for clean-up between crops and irrigation water sterilization. Physan 20 can also be sprayed on plants to kill pathogens. A pint costs $12 from Maril Products, Inc., 620 South E St. Suite A, Tustin, CA 92780. Phone: (800) 546-7711.

Zero Tolerance (TM), is a sterilization approach to plant protection: rather than using friendly organisms as plant protectors, water and plant surfaces are kept pathogen-free by adding small amounts to all irrigation water. Zero Tolerance can be used as a one-time soil sterilizer or as an additive to keep water sterile. It is a solution of hydrogen superoxide (HO_2), which is a very powerful oxidant. When this chemical comes in contact with insects, eggs, bacteria or viruses, it oxidizes them. Zero Tolerance can be used to wipe down trays, pots, walls or any other pathogen-containing surface. It sterilizes used soil and other planting mediums when used as a drench.

Zero Tolerance cannot be used with any of the biologicals mentioned below, but is a convenient substitute for bleach or hydrogen peroxide (H_2O_2) to sterilize equipment and media before planting. It takes about 2 days to degrade to water and oxygen. It can be used in fog and misting systems to stop the spread of bud rot by killing the mold and spores. A little goes a long way; 2-1/2 gallons costs $110 from BioSafe Systems. Phone: (888) 273-3088. Web site: www.biosafesystems.com.

PEST CONTROLS

The pests that are most likely to attack marijuana indoors are aphids, fungus gnats, mites, thrips and whiteflies. Outdoor plants are subject to being munched on by rabbits, deer, rodents, caterpillars, slugs and snails, as well as attacked by insects. Organic growers have an arsenal of plant-pest predators and controls to choose from.

Aphids:

Aphids are prolific, 1/16 to 3/8 inch-long, pear-shaped insects. They come in many colors including white, green, pink, red, yellow and black. They mature in 7-10 days and start birthing live young. They suck the plant juices and are often herded by ants which milk them for the "honeydew" or sugar concentrate, which they release.

Aphidius colemani is a tiny non-social parasitic wasp that lays it eggs in living aphids. The adult wasp emerges from the aphid's mummy in two weeks ready to mate and start laying eggs. It prefers temperatures below 80 degrees Fahrenheit. One introduction is all that is required. $24 + shipping from 1PM Labs. Phone: (315) 497-2063. Email: ipmiabs@baldcom.net.

Aphidoletes aphidimyza is a predatory midge. The midge lays about 250 eggs over a 10-day period near aphid colonies. The bright orange larvae, about 1/10" long, eat 10 aphids but attack many more. Then they pupate in the soil, emerge as adults and lay eggs. Predatory nematodes kill them and they don't do well in hydroponic mediums. The total cycle takes about three weeks. One release of 250 midges is enough to get the colony started. The insect goes dormant during flower-forcing with 12 or fewer light hours. 1PM ships the "ready to eat" midge larvae for $27 + shipping. Adults ready to lay eggs are available (250 predators cost $25) from Nature's Control, P0 Box 35, Medford, OR 97501. Phone: (541) 899-8318. Email: bugsmc@teleport.com.

Aphidius matricariae is a small, parasitic wasp that lays eggs in aphid pupae. The adult wasp emerges from the mummified aphid and continues the cycle. Its life cycle is about three weeks. This insect does not provide total control but works well with aphid predators. Recommended use is one parasite per 3 sq. ft. One release will start the colony. Outdoors, the release rate is 5,000 per acre. Five hundred parasites cost $59 from Nature's Control.

Gnats:

Fungus gnats are tiny black flies that hover near the planting medium. Their larvae feed on dead organic matter. They are vectors for plant diseases and should be eliminated from the indoor garden. There are several biological controls for this.

Gnatrol (TM) is a strain of bacillus thuringiensis that attacks only fungus gnats. The bacteria are mixed in water and applied to the medium three times weekly. It kills the larvae, so the gnats are eliminated over several weeks, as the adult population dies off. $39 + shipping from 1PM Labs.

Nemasys (TM) is a strain of predatory nematodes, which attack gnat in the larval stage. One pack of 50 million nematodes covers an area of 3,600 sq. ft. The nematodes should be introduced weekly for three consecutive weeks to eliminate infections. Contact Bioscape, Inc., 4381 Bodega Ave. Petaluma, CA 94952. Phone: (707) 781-9233. Web site: www.bioscape.com.

Scanmask (TM) is Steinernema feltros, a hybrid strain of nematodes, which uses chemical cues to find its prey. The nematodes enter the gnat and release bacteria that kill it. The nematode feasts on the multiplying bacteria. It is available as a spray that can be watered into the medium or as a granular that can be mixed in medium. One application is all that is needed, as the nematodes are persistent. $29 + shipping from IPM Labs.

Spider Mites:

To destroy spider mites, Stethorus

punctillum is a type of tiny ladybug that eats both eggs and hatched spider mites. Each bug eats about 40 mites a day and many more eggs. About 100 bugs are needed to get a colony going. 100 bugs cost $67 from Nature's Control.

Snails and Slugs:

Snails and slugs can be controlled using Sluggo, a new environmentally friendly blend of bait and iron phosphate. The snails are attracted to the bait. They stop feeding immediately and die within a few days. The active ingredient, iron phosphate, decomposes naturally in the soil. Two lbs., enough for about 5,000 sq. ft., cost $90 from Bioscape, Inc.

Thirps:

Thrips are plant feeders that feed on leaves, leaving a trail of damaged tissue and fecal matter. They are so small that they can barely be seen by the naked eye. They mature after seven to 10 days and lay 200 to 250 eggs, so the population increases quickly. The larvae feed on leaves.

Onus insidiosus, the minute pirate bug, is a small insect that pierces thrips with its mouth and sucks out their liquids. They reproduce quickly—every 10 to 20 days—and rapidly decimate the adult population. Available from IPM Labs and Nature's Control.

Whiteflies:

Whiteflies are tiny (about 1/32" long), four-winged, white-colored flies that are easily seen fluttering about disturbed vegetation. Whiteflies have four distinct stages: the egg, crawler, which settles down to become immobile scale, which goes through several states before maturing as the whitefly. After about three weeks, the adult whitefly emerges, ready to eat and start laying eggs. At all stages, whiteflies feed by sucking plant juices, which slows plant growth and attracts disease.

Encarsia formosa is a tiny non-social wasp which feeds only on whiteflies. The adult female feeds on whitefly scales and lays hundreds of eggs, each one killing a whitefly scale. These wasps are very effective, but go into dormancy under a forcing regimen. Three to six weekly introductions are suggested at first sign of infection. $15 per 1,000 from 1PM Labs and Nature's Control.

Deiphastus pusillus is a tiny (1/32" long) black ladybug that eats whiteflies at all stages of development. Each beetle eats 10 scales or 150 eggs daily, quickly controlling the whitefly population. Only one introduction should be required. Available from IPM Labs and Nature's Control.

Nature's Control also sells two kinds of predatory nematodes, ***Steinernema fehiae*** and ***Heterorhabditis heliothedis***, both species of tiny worms. They attack and kill almost all soil-dwelling insects. The company recommends reinoculation every 6 weeks, but they usually eliminate the problem so that no reintroductions are needed. One million of the worms, which are shipped on a sponge, treat up to 2,500 sq. ft. They are rinsed into water from the sponge and then sprayed, watered or irrigated into the medium. One million nematodes cost $16.

Herbivores:

Deer, rabbits and other herbivores can be a vexing problem for outdoor gardeners. During early spring, when there is little vegetation available, young plants are especially vulnerable. In addition, some predators develop a taste for marijuana and its high. Keeping these predators away can be a daunting task.

In a four-year study at Rutgers University, researchers found that **Deer Off** was the most effective preparation at deterring deer. An added benefit is that the product also deters squirrels and rabbits. The product is EPA-approved and is appraised by environmentalists. The spray uses two deterrents, smell and taste. It is made from eggs, hot pepper and garlic. It is safe for both humans and pets and is environmentally friendly. An application lasts several months and cannot be washed away by rain. A pint bottle of ready-to-use spray costs $10 from Deer Off, Inc., 1127 High Ridge Rd., Suite 204, Stamford, CT 06905. Phone: (800) 333-7633. Web site: www.deer-off.com.

BETTER GROWTH AND DISEASE PROTECTION

Gardeners have an arsenal of friendly microbes they can use to protect their crops from pests and disease. These organisms use plant pests as their food source, but their diet does not include larger organisms so they are completely harmless to humans and animals. Many of these products are used to prevent disease rather than cure it. Their presence acts somewhat like a vaccine: they attack invading disease organisms without harming those that are helpful to plants. The organisms below are all registered for vegetable use and are a pure form of organics: using living organisms to keep other organisms under control.

Bio-Plex (TM) is a liquid biostimulant consisting of vitamins, enzymes, hormones, micronutrients and growth regulators. It encourages root growth and plant vigor. Its combination of ingredients include a ferment of fish and kelp, cold processed kelp, humic acids, chelated iron and zinc, and a soil and tissue penetrant. The manufacturer claims that this is a superior product because the penetrant allows nutrients to be absorbed more easily and quickly by plants, making them more resistant to stress and disease, requiring less fertilizer, and creating an environment at the root level that encourages the growth of beneficial microbes. One gallon goes a long way and costs $120 from Turf Chemicals Plus, Inc., 2213 Huber Dr., Manheim, PA 17545. Phone: (800) 441-3573.

Eco Sane (TM) is an "enzymic activated stabilized biologic catalyst." It promotes increased plant growth and yield, as well increased tolerance to stress, especially in cold conditions. It has increased production on many crops from 20 to 500 percent when used every 2 to 4 weeks. It works directly on the plant and also promotes beneficial microorganisms. Use one ounce in two or three gallons of water for every 1,000 sq. ft. One gallon is $42.50 from The EKMA (TM) Companies, POB 560186, Miami, FL 33256. Phone: (305) 256-5456. Fax: (305) 256-0689.

Maxicrop is a product made from ascophyllum nodosum, Norwegian kelp. Kelp contains large amounts of trace elements, as well as hormones, enzymes and sugars, which stimulate plant growth and health. In addition to working on the plant directly, kelp encourages beneficial microbial life. Supplementation with Maxicrop results in stronger plants more resistant to stress. The enzymes encourage stronger root growth and more vigorous leaf growth. The supplement is added to the water periodically. One gallon of liquid costs $16. Powder (10.7 oz.), which makes 1 gallon of liquid, costs $13. Available from Maxicrop, U.S.A., Inc., POB 964, Arlington Heights, IL 60006. Phone: (800) 535-7964. Web site: www.maxicrop.com.

Mycor Flower Saver (TM) is a mixture of four strains of vesicular-arbuscular mycorrhizal fungi and growth-promoting bacteria with organic biostimulants. The fungi develop a symbiotic relationship with the roots, providing them with nutrients in return for sugars produced by the plant. This relationship promotes faster growth and enhanced resistance to stress and pathogens. The dry powder is mixed into the medium at the rate of 3 lbs. per 100 sq. ft. at planting. It can be used indoors or out. A six-pound box costs $40 from Plant Health Care, Inc., 440 William Pitt Way, Pittsburg, PA 15238. Phone: (800) 421-9051. Web site: www.planthealthcare.com.

PHC Biopak (TM) is a biostimulant containing several strains of bacteria that live in symbiosis with the plant roots. PHC Biopak promotes fast root development (which increases plant growth and uptake of fertilizer), increases bioactivity in the medium and reduces plant susceptibility to disease. A one-pound jar costs $25 from Plant Health Care.

PHC Healthy Start (TM) 3-4-3 is derived from bone, blood and kelp meal, rice bran and other natural fertilizers. The formula, 3-4-3, is a good mix for start-ups and clones as it promotes rooting. The natural ingredients provide complete micronutrients for soil and soilless media. What makes this blend truly unique is the addition of nitrogen and phosphorous-dissolving bacteria, which release nutrients to the roots as needed. Humic acid in the form of leonardite, a mined mineral, is added to encourage growth of beneficial microbes. As a result, plants require less fertilizer and are less likely to suffer from nutrient deficiencies. Twenty-five pounds treats about 250 sq. ft. One treatment per crop is needed, indoors or outdoors. A 25-lb. bag costs $15 from Plant Health Care.

RootShield is a biological fungicide that protects roots from pythium, rhizoctonia and fusarium—fungi that cause root and stem rot as well as die-off in seedlings and clones. The fungus in RootShield quickly forms a barrier against pathogens and attacks pathogens trying to break through. One application is all that is needed to “infect” the roots with this symbiotic organism, which feeds on nutrients secreted by the root system. RootShield comes as a dry powder that is mixed with water and applied as a drench at the rate of 6 oz. per cubic yard of medium or as a granular for dry-dipping cuttings. It is sometimes mixed into the planting medium at the rate of 1 lb. per cubic yard. The active ingredient is Trichoderma harzanum strain T-22, developed at Cornell University. It is recommended for vegetables and is non-toxic to humans, birds and other animals and safe to use around water sources. A one-pound bag costs about $37. It is not available from retailers but is sold by wholesalers, such as McCalif, (800) 234-4559. For other suppliers, contact the manufacturer, BioWorks, Inc. Phone: (800) 877-9443. Web site: www.bioworksbiocontrol.com.

Roots Transplant 1-STEP is an enhanced 2-2-2 transplanting fertilizer. In addition to nutrients it contains 13 species of mycorrhizae, which colonize the roots and develop symbiotic relationships with them. Together they increase fertilizer absorption, bioactivity and resistance to disease. In addition, the powder contains a biostimulant to promote root growth and a water-holding gel to increase water retention. One pound treats about 250 six inch or 125 ten inch containers. Treat plants every 2 to 4 weeks. 25 lbs. cost $23 from Roots Inc., 3120 Weatherford Rd., Independence, MO 64055. Phone: (800) 342-6173.

Chapter Thirteen

Easy Organics

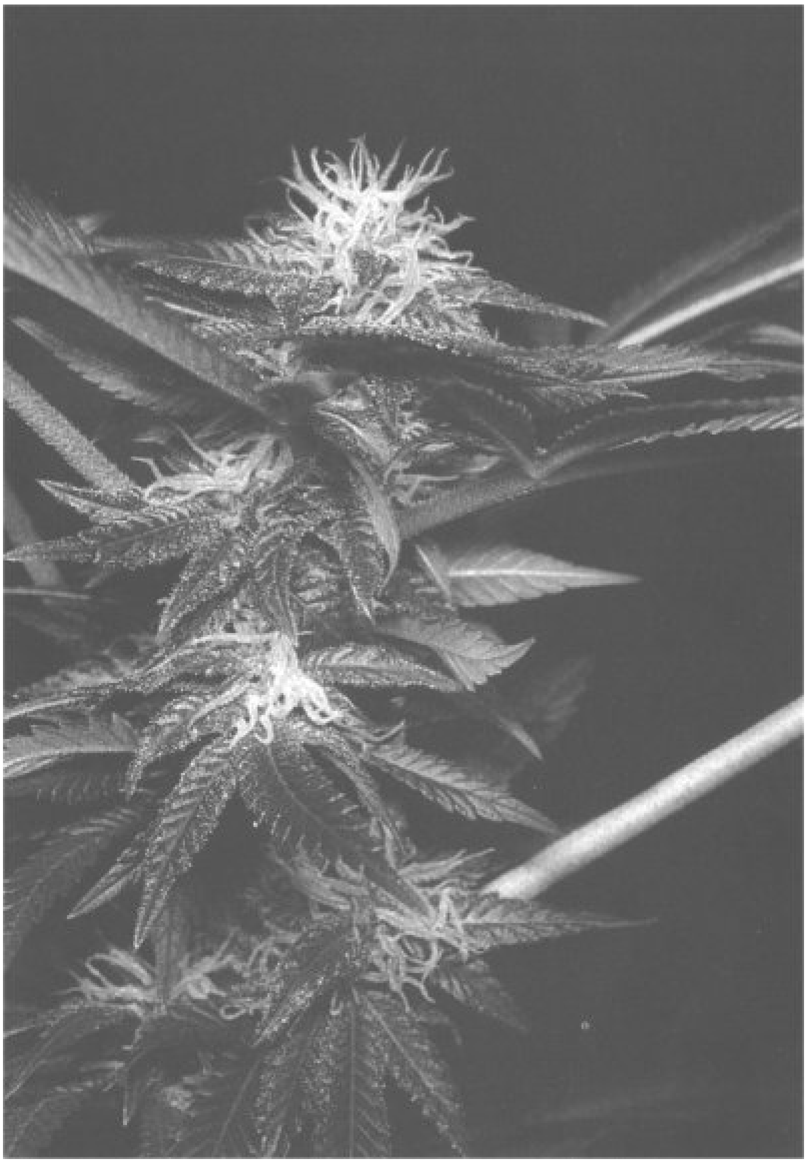
Organic indoor gardeners must choose between two growing methods: using either a hydroponic medium or a planting mix. Hydroponic gardeners use a medium such as clay pellets, foam rubber or spun rock, all of which are virtually nutrient-free, and add nutrients by using water-soluble fertilizers. Planting mixes can also be fed with water, but quite often they are composed of nutrient-rich ingredients. Each growing method has its advantages and disadvantages.

Gardens grown using planting mixes are more forgiving, because the ingredients and micro-organisms they host buffer the plants in extreme conditions. They are also generally easier to get started than hydroponic gardens and do not require a large investment of time or money. The hydroponic method, on the other hand, offers automated care, higher yield and faster growth.

The hydroponic method is particularly advantageous in large systems, where handwork can be very time-consuming. In smaller gardens, where hand-watering takes only a few minutes, automated systems may not save time, but they will eliminate the need for the gardener to be continuously on hand to water the plants.

The other advantage of hydroponics—higher yield—is alluring to the ganja-growing hobbyist. Hydroponic gardens are more finicky and react more intensely to change, like the Porsche as compared to the Toyota mentality of planting mixes. Planting-mix gardens are the way to go for growers who do not wish to become garden experts, but would like to grow an ample harvest of good bud.

Setting up the planting mix garden seen here is quite easy. if seeds are being used, each is planted in a single 2 inch to 4 inch container. After a few weeks of growth, a branch is clipped from each one and marked. The clipped branches are kept in a jar with water and a few drops of houseplant fertilizer, then placed under a regimen of 10 hours of light and 14 hours of uninterrupted darkness. Within 7 to 10 days the plants will grow flowers, indicating whether they and their clone mothers are male or female. Remove and destroy the male plants.



This bud's stigmas scan the air for pollen. It is halfway on its journey to maturity.

Sexed seedlings and rooted clones are ready for the second stage. In this garden, 10 inch containers were filled with a high-quality planting mix recommended for all plants. This special mix is composed of 50 percent worm castings, peat moss and rock phosphate. This mix needs no fertilizers until forcing flowering, about a month after planting. Then high-phosphorous bat guano, such as 1-10-1 or 3-8-1, is added to the water at the rate of 1 tablespoon per 2 gallons (a cup per 30 gallons) with each watering.

This garden is located in a 10 x 10 x 8 foot room built in a basement. The door leads to the aisle flanked by 4 x 8 foot trays on both sides. These trays were built from wood and then coated with epoxy for water resistance. Only one of the trays was used this time. This tray rests on several stacks of industrial pallets, about 30 inches above the floor. The tray has a drainage hole on one side and was installed at a 1:40 ratio slant, 2 inches over the 8 foot length, for fast water return. Twelve 10 inch, standard flowerpots (obtained used for free from a local garden shop), which hold 3 gallons of medium, are spaced evenly on the tray. The garden is illuminated by two 400 watt lamps, an HPS lamp and an MH lamp, in old-style vertical reflectors which were salvaged from one of the mysterious recesses in the basement. Thick Mylar sheets, purchased for pennies each at a flea market, are staple-gunned to the walls on three sides. On the fourth side, shutters (flea market cheap because of broken slats), also covered with Mylar, can be extended for reflectivity or closed for easy access to the garden.

Two 20 inch window fans hang from the ceiling at either end of the grow space. They are on constantly to circulate the air. A 50 lb. CO_2 tank opens for about 30 seconds several times a day. This occurs whenever the garden's owner, the former First Mate, now Captain, happens by when the lights were on.

The Captain was not planning to grow at all and this garden was unexpected. He tells it best: "I hadn't thought about starting this garden until a friend came over with a Christmas present of cute little clones and five bags of 'special' soil." The clones included Jack Herer, White Rhino, White Widow, Bob Marley, Skunk #1 and X-l0.

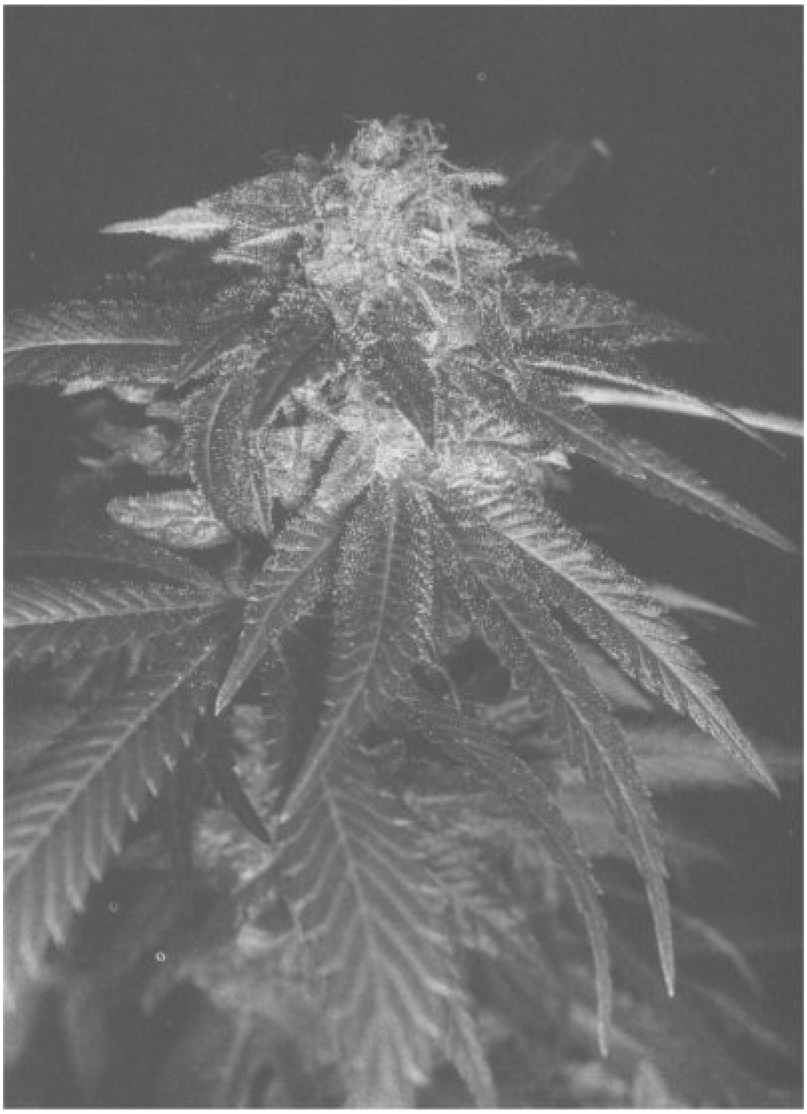
"I generally discourage my friends from bringing live presents. But these rooted clones were so cute and very special, and they smelled good too, unlike a puppy, which is likely to smell poopy and entails a longer time commitment. I decided to take in these 24 orphans and give them a good home for a season. The 24 plants seemed like a lot for such a small space, so when a friend came over, I gave him 12 plants for his bare-looking empty space. He had helped me with my garden in the past, and we often share herb together."

"I kept some Bob Marleys, the Jacks, and White Rhinos and gave my buddy the other plants. The gift included several bags of soil that the gifter read about in High Times and had tried. He said he found it to be the easiest system he had ever used. I took the clones, potted them in the soil mix and watered them. It was almost a week before they needed water again."

"I let the plants grow vegetatively under continuous light for six weeks, when they averaged about 18" tall. Then I pruned them and set the timer to 12 hours of light/12 darkness, and began using one cup of 3-8-1 bat guano in a 30 gallon reservoir. Each time I watered a plant it got about 1/2 gallon of water from a plastic jug. Actually, although I was advised to start fertilizing at forcing flowering, I didn't start for the first 25 days of flowering. The plants were watered with this every four to six days, freeing up long weekends."

Stigmas start to dry and turn color as the bud enters the final stage of maturity.

"Seventy-five days after forcing, the plants were ripe. The Jacks and White Rhinos formed tight buds ranging from medium to large. They each had excellent distinctive odors, tastes and highs. I found that I used the Jacks during the day and the White Rhinos at night. The Bob Marleys were tall, gangly plants with loose buds that never matured properly. I gave most of that pot away. The garden yielded a little less than a pound. After tasting the Skunks and X-10s my friend grew, I decided to try some of them in my new grow since they both have great flavor and highs, too."

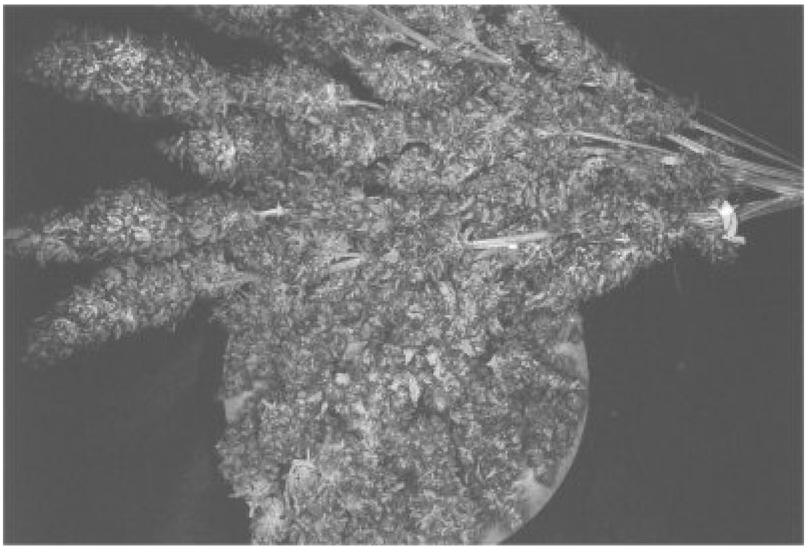


This bud is ready to pick. The stigmas have dried, false seed pods have swollen and all the gland heads are bulging with resin.

Chapter Fourteen

Pruning for Giant Yields

One of the easiest ways to improve the quality of your yield is by pruning plants so they produce fewer, but much bigger buds. The genetics of your plants and your goals for harvest should determine the type and style of the trim. Recently I observed a garden in which different trimming techniques were used, depending on when the plants were ready for harvest.



Here are both branched and manicured plants.

The gardeners determined that the plants did best when the garden held about four branches, or leads, per square foot. Regardless of how big the plants grew, the size of the containers, or the growing method used, this figure did not change. In previous gardens, the growers had used a variety of materials, including a mixture of vermiculite, perlite and potting mix; coated and uncoated horticultural clay pellets; and rich potting mix.

These plants in 12" containers were pruned back to six branches; each 10 days before forcing and then 15 days after. Each branch was twist-tied to a bamboo stake.

The new garden was filled with 10 inch black containers in two trays. One tray held 44 containers in 11 rows lined 4 deep, side to side. It was lit by four 600 watt horizontal HPS lamps. The 4 x 10 foot area was lined with white polyethylene plastic on three sides and Styrofoam boards, which were easily moved around, on the fourth. The other tray held 52 containers in 13 rows four deep. It was lit by five 600 watt HPS lamps, and was also surrounded by polyethylene and Styrofoam reflectors.

The planting mix was completely organic, consisting of 10 percent each peat moss and worm castings and 40 percent each vermiculite and perlite. Rock phosphate was added at roughly 1/2 tablespoon per container.

The plants were placed in the containers as rooted clones about 6” high, with two or three sets of leaves. The original intent was to grow White Widow clones in their vegetative state under the four-light tray for about 10 days—

until the Soma Jack clones were ready for the five-light system. That way, the Widows would be 18” to 24” tall when they were placed into flowering, approximately 10 days after the Jacks were planted.

That plan fell through for two reasons. First, the Jack clones were not ready on time. Secondly, there was a great demand for the clones and the gardeners decided to keep the plants in vegetative growth for an extra 20 days while taking cuttings from the undergrowth. By the time the plants were forced to flower, the Widows had been in vegetative growth for a total of 40 days and the Jacks for 20.

The plants were originally supported using bamboo stakes, but they grew too tall and heavy for them. The Widows were 3’ tall when they were finally placed in flowering. At ripening, they had grown 3 1/2 foot long stems that supported only the top canopy and were between 5’ and 6’ tall. The bamboo was eventually replaced by 6 foot wood strips and plastic-coated metal stakes, both of which worked well. The stakes were pushed to the bottoms of the containers to maximize support. Then the plants were tied to them using 8 inch paper-coated twist ties commonly used in nurseries.

The plants were pruned three times, at intervals of 10 to 15 days, before they were forced into flowering. Rather than cutting the tops and causing the plants to branch more, the lower growth was removed. Then, at forcing and again about two weeks after, all but six main branches were cut off. With the staking and removal of extraneous vegetation, each lead had direct access to light and adequate growing space.

The growers experimented with fertilizers to determine which one worked best during vegetative growth. The White Widows received

Miracle Gro, (N-P-K ration 18-18-21) fish emulsion, (5-2-2) and Wonder Grow, a methanol-containing fertilizer which is unregistered but traded underground by orchid growers. During the flowering cycle the plants received Wonder Bloom, Miracle Gro (15-30-15) and Fish Emulsion Bone Meal (0-12-0). The fertilizers that performed best on this system were the fish emulsion and Fish Emulsion Bone Meal. The Wonder Grow produced the worst results and actually caused visible burning of the leaves. All of the fertilizers were measured to an electrical conductivity of 1000[1].

The Jacks received different fertilizers: Bill's Perfect Fertilizer (65-11-5), General Hydro (5-5-6) and Max Sea (16-16-16 vegetative, 3-20-20 bloom). With these plants, the differences were visible but less striking. Bill's Perfect Fertilizer produced the tightest buds and the highest yield.

The containers were fed by hand as needed, usually every three to five days. Need was determined by feeling the planting mix 2" below the surface in several containers. If it felt moist it was not watered, based on the assumption that there was more moisture in the bottom third of the container than in the top. Only when the top of the container was dry was it ready to be watered. Watering was accomplished using a two-quart water pitcher. It was filled from a five-gallon bucket of water-nutrient solution, then poured into the plant container.

In each garden the lights were evenly spaced, averaging 60 watts input per foot squared for the Widows and 57.7 for the Jacks. The horizontal HPS lamps were screwed into Hydrofarm reflectors, which are very efficient. The lamps were hooked to a 2 x 4 inch board that was bolted to the ceiling. The lamps had a

V holder on either side, ending in an S hook. The S hooks on either side of the lamp were moved up or down the chain to raise or lower the light.

The reflectors were stationary, but with the close spacing of the lamps and the 2 foot distance between the top of the canopy and the bottom of the bulbs, light from the lamps crossed quite a bit. Also any light which hit the white Styrofoam or polyethylene plastic was reflected back to the garden. There was enough room between the evenly spaced leads for light to penetrate a foot or more down from the top of the canopy.

CO_2 was provided using a CO_2 generator. It was kept at 1,600 parts per million using an on-line meter connected directly to the generator. The generator created a lot of heat and some moisture in the room. A humidistat set at 60 percent humidity drew excess humidity from the room.

The nine lights and a CO_2 generator produced a lot of excess heat: 3,200 BTUs per 1,000 watts. About 17,300 BTUs were created by the lights and an average of 2,200 by the generator. The temperature would quickly rise to 90-100 degrees Fahrenheit on a 70 degree day. On a 90 degree day the room temperature would climb to 110 degrees.

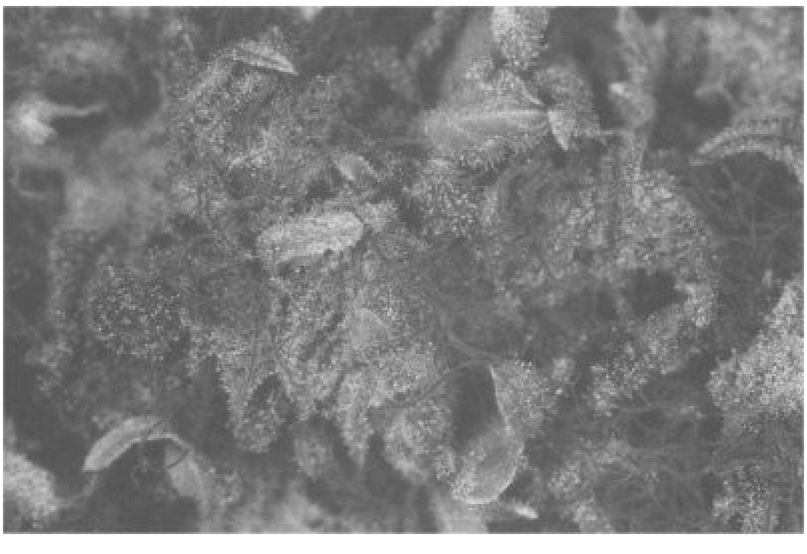
To prevent an extreme heat scenario, the room was cooled using an external air-conditioner that pulled in cool air from a ceiling vent. This system was not completely effective. The gardeners complained that they were lured to purchase a ‘bargain,’ a used furnace/air-conditioner that proved to be unreliable. Internal air circulation was provided by an overhead fan, several window fans mounted from the ceiling and two turbo fans placed close to each other on the floor blowing air up to the ceiling. One improvement the gardeners suggested was to use enclosed, ventilated, reflectors with fans to prevent heat buildup in the room. This would reduce the need for air conditioning. The nine light ballasts were kept in a separate space, a closet with a small vent fan to move the heat from the ballasts to the attic.

Three weeks after forcing, new branch growth tapers off. The plant puts all of its energy into reproduction, producing clusters of flowers all along the branches. As long as they remain unpollinated, the clusters continue to grow. The clusters often link up, forming a solid bud consisting of the female flowers' stigmas, to which any floating pollen will adhere. Since these plants were all female, there was no stray pollen, so all of the flowers remained unpollinated.

The Jacks in the larger tray had a different experience than their neighbors across the aisle. They were placed into the garden 20 days later and received only two 'haircuts', one at forcing and the other three weeks into flowering. They were only 15" to 18" tall at flowering and matured at under three feet. At the first trimming, all but three to five leads were removed. The plants were staked and tied to hold the leads in position. The second trim removed branches that had grown since forcing. These cuttings were also cloned, but took an extra three weeks to revert from flowering to vegetative growth. They were not ready to transplant until five weeks from cutting.

A lot of hard work goes into pruning and staking plants, but it results in bigger, higher grade buds that require less manicuring.

The pruning given these plants at forcing and two or three weeks later is similar to the ones wine grapevines and fruit trees undergo. All branches extraneous to the plants' needs were removed. Before the final pruning a plant might have 16 or 20 branches; after it, only four or five branches remained. These were chosen for best development, spacing and diameter. The small branches and buds under the canopy were clipped, along with less-developed branches. Buds under the canopy are small, don't mature well and take energy from the upper buds. The top buds weighed a little more than 8 lbs—a disappointing return. This was attributed to improper use of the CO_2 unit and the malfunctioning air conditioning unit.



This fresh, dried bud has all of its glands sticking out.

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[1]EC is a rough approximation of the parts per million of total dissolved solids in the water. To start, the water in this garden had an EC ranging from about 80-125, which is considered fair. When water has an EC of 200 or more the dissolved solids may start affecting plant growth.

Chapter Fifteen

Harvest Tips

Whether you are growing indoors or out, the anticipation of harvest starts about three weeks before the plant is ripe. The buds are in the home stretch. Every day they are a little closer to ripeness, but not quite there. By this time the buds have almost finished growing. Although a few more flowers will appear, the major change will be in appearance, from a young bud with thousands of tender stigmas vainly searching the air for pollen grains, to a mature bud.

At the start, the stigmas are a pale, translucent color, white or cream, sometimes tinged pink or purple. When they catch the light, the translucent stigmas glow. These structures begin to dry out by the time the bud is ripe, they will turn orange, red or purple. The ovaries behind them will swell and seem to absorb the stigmas. The glands develop taller structures and stand erect from the tissue. Precursors are manufactured into THC on the inner surface of the membrane. As ThC builds up in the gland, its shape changes. The thin stalk, which holds the head, swells and strains the membrane. The gland begins to look like a mushroom.

Using a photographer's loupe, you can get a better look at the bud and its glands. If the gland head membrane looks like it could be stretched, the bud still has a way to go before ripening. If the gland head membrane looks taut, like a filled balloon, the bud is probably ready. When the glands look clear, the THC is still accumulating. When they start to turn cloudy, the THC is deteriorating to cannibinol, which is only one-tenth as psychoactive as THC.

Indoors, plants are certain to receive light and moderate temperature. Their maturation adheres to a fairly rigid schedule. Outdoors, bud growth is subject to the vagaries of the weather. The size and development of the bud, its maturity and ripening time are all dependent on the environment. This is one reason why all farmers throw the dice each time they plant. For marijuana growers, the stakes are higher; tomato farmers rarely worry about thieves or bullies in blue. Despite the gamble, hundreds of thousands of ganja gardeners harvest beautiful plants each Autumn.

No matter how big the plants are, the initiation of flowering and the maturation date are determined by the number of hours of uninterrupted darkness they receive each night. Any interruption of the dark period results in delayed flowering and may affect the bud's growth pattern, making them lanky. Plants use red light to measure day length.

This is most relevant to people in urban areas, who might consider growing near a street or outdoor light. Gardeners who wish to examine their plants at night should also be concerned. Most of a flashlight's light is the yellow, orange and red spectra. Even fluorescent ones emit some red light. The solution is to place a green filter over the light source, as plants are not sensitive to this color. If you are gardening out in the woods at night, a green flashlight is an essential tool. It gives you sight, but is unobtrusive, hard to see from a distance and blends into the background.

A green filter can easily be made from a stage-light filter, or, more conveniently, from four or five layers of green plastic from an appropriately sized pop bottle. Choose a size that slides over the flashlight top, but is not too loose. Cut the bottle about four inches from the bottom. Then cut four pieces from the side of the bottle. These should be small enough to fit inside the pop bottle bottom. Slide the bottle bottom with the extra green pieces in it over the flashlight and tape it on.

Plants in the South, which have shorter days throughout the summer and fall than the North, mature earlier. Plants grown at high altitudes mature faster than those in the valley. Varieties also differ in maturation dates, and the buds exposed to the most light grow larger and mature faster. Buds grown in the shade don't reach their full potential. In very shady locations they may never fully mature.

Marijuana buds grow fat fat and juicy under an intense sun. How ironic that they flower just as the suns strength wanes in the fall. Every sunny day speeds the plant to maturity. Overcast days do nothing. The plant just sits there, in suspended animation, waiting for some ripening energy. The worst are the cool rainy days, which promote mold and fungi. A season's efforts can be spoiled in hours. Beautiful buds are turned to mush; white or gray molds are visible or turn brown and crumble when touched.

Outdoors, gardeners often face hard choices. The buds are a few sunny days from harvest, but the weather predictions are for rain and overcast days for the next week. Neighbor's kids have already clipped a few immature buds from the plants. Helicopters are active in the next valley. Hunting season begins next week. That's why a lot of outdoor bud out there is often slightly immature.

Harvesting situations vary a lot. Guerrilla growers who often make incursions into parks or other people's property must work quickly and efficiently with no time wasted. Although it is a joyous moment, it may also be a time of extreme vulnerability, with valuable contraband and no good excuses. These people should quickly cut all the branches with buds, stuff them into a knapsack or bag, and leave the scene as quickly as possible. The proper tools make the job easier. Make sure to have a high-quality clipper.

For example, I viewed a 1,000 square meter greenhouse in Holland, where seven foot plants were harvested with the help of a hedge pruner. As on most naturally growing plants, there were branches on four sides. Starting from the top, the pruner clipped through one line in a few seconds. The branches fell in a neat pile. Then the other three sides were harvested. When the plants were lined up by the growing tip, it was easily seen that each branch had the same amount of foliage. The longer branches just had more bare area where they had all been hidden by from the light by the canopy. Guerrilla growers who have a space or weight problem in their knapsack or bag should consider this. By lining the branches up, they can easily eliminate a good part of the bulk.

Backyard and indoor gardeners who do not feel threatened may wish to harvest on a bud-by-bud basis, cutting them only as they mature. The outside buds mature first. When they are removed, it opens the inner buds to light, giving them energy to grow and mature. Larger plants are more likely to mature in stages. Smaller plants usually mature uniformly.

Once the branches have been harvested, they should be hung to dry. This should be in a space with dim light, constant air circulation, low humidity and temperature no higher than the low 70s. This allows the buds to cure a bit before they dry. The curing, which should last two or three days, creates a smoother smoke. After the buds have dried for a few days, it is time to increase the drying speed by raising the temperature to the low 80s. The buds will dry within a day or two.

There are many opinions about the best time to manicure. When the plants are left unmanicured until they dry, they dry slower and keep the room humid because of all the extra leaf. However, manicuring dried marijuana is faster than working with wet material. Some gardeners remove only the fan leaves and work on the smaller trim leaves after drying. The fan leaves are simply pulled down. They break easily from the stem. This is very fast and speeds up drying. However, one connoisseur told me he thought this interfered with the curing, hastening it.

Whether manicuring wet or dry, growers gravitate to either scissors or hands. The correct method is the one you like, that feels comfortable and results in efficient bud processing. Scissors make a big difference. Find a pair that is not tiring, is sharp and helps with precision work. Professional growers gravitate to small scissors with springs, so they need only push them closed, not pull them open.

There are also some other tools you may

want to use. A small garden's yield can be dried in a closet, basement, spare room or attic. To minimize odor, use a negative-ion generator or two, or an ozone generator. Chemical odor neutralizers are available at some indoor garden shops. Dehumidifiers remove moisture from air and add heat. Room air conditioners also remove humidity. Fans keep the air circulating.

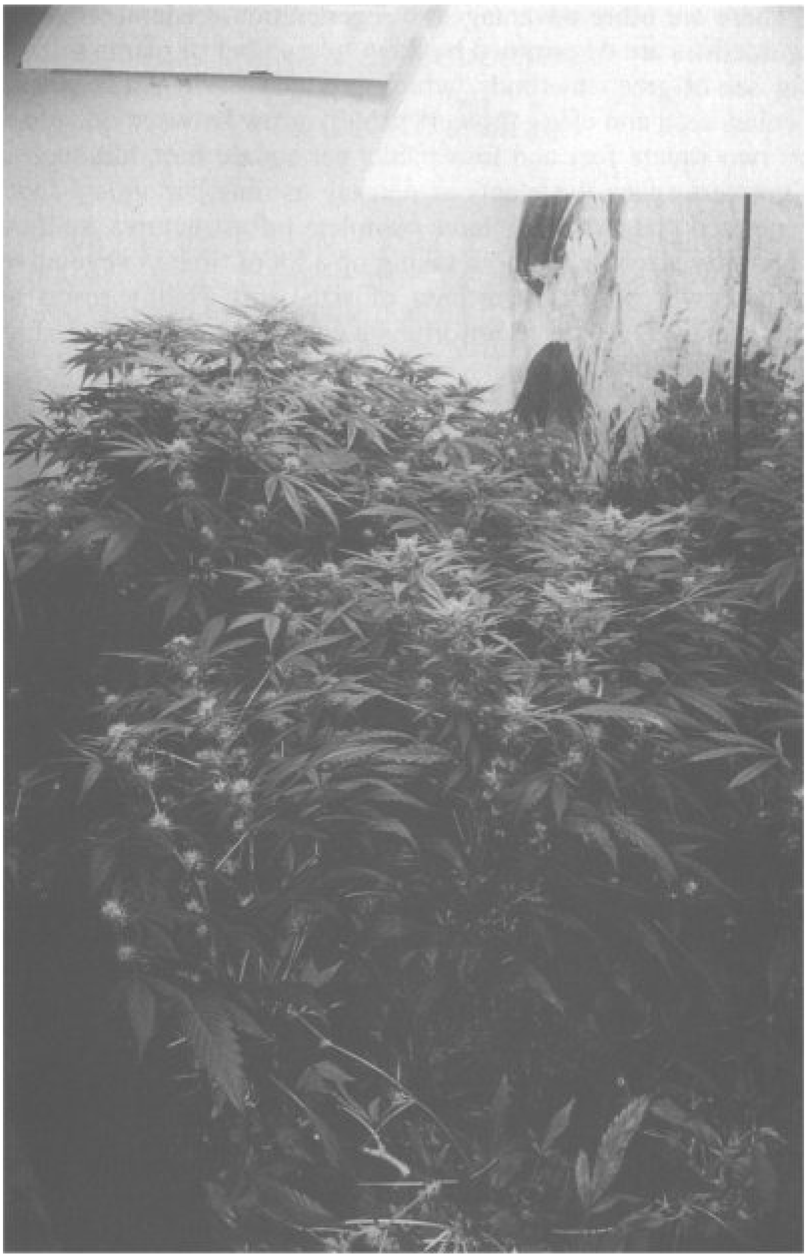
Chapter Sixteen

Regeneration

When restarting a garden, marijuana growers often believe that they are limited to choosing between seeds or clones.

Seeds present many disadvantages to the indoor gardener. Approximately half of the plants will be male, and the final results are uncertain. Using seeds gives growers more control over evolution and selection, but indoor growers often 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. They will grow in the same way, ripen at the same time and have the same taste and potency. The problems with clones are that they can be decidedly tedious to prepare and are subject to heavy failure rates. Taking clones from different varieties at the same time can be frustrating—they grow at different rates yet all must be closely monitored. Additionally, taking clones from clones from clones may cause the plants to suffer from 'genetic drift,' a result of mutations, which constantly occur in living organisms.



This is a garden of regenerates.

There is a third way to restart your garden: regeneration. Regeneration is faster, easier and requires less labor than cloning or starting with seeds. Yields also tend to be greater since regenerated plants have much of their infrastructure intact, including the root system and part of the stem.

Everyone has probably pruned a plant at some time. Within a few weeks, new leaves, stems and branches appear. Marijuana gardeners can do the same thing with their plants. Plants that have already been harvested and are known to be high-yield females can be forced back into the vegetative cycle and then into flowering.

A small leaf with growing tip was left on the lower stem of this plant after harvest.

The regeneration process begins at harvest. There is no seed preparation or cutting required and no planting or repotting involved. Rather than cutting the whole plant down at the stem, you leave it intact with a few branches. Each of these branches will sprout many small branches with leaves. As a result, regenerated plants tend to be bushier, with more, smaller buds than clones or seed plants.

Remove the other branches at the stem. Leaves should be left on the branches you choose to keep. Leaves will grow more quickly, dramatically increasing the plants' chance of survival. Gardeners who wish to grow single-stem plants should remove all but one branch or leaf site on the stem and remove other leaf sites. All of the plants' energy will focus on this remaining growth sites.

This close-up shows new growth on a cut stem. In order to regenerate, some vegetation and growing tips must be left on the plant.

Once the plants are pruned, the lights should be left on continuously. The plants will switch to the vegetative cycle and start to grow in about 10 days. They can be forced to flower when they reach the desired size.

Left unpruned, dozens of branches grow from an old stalk at the regenration point.

Most people practice regeneration only once or twice and then start again with new plants. One popular method is to harvest an indoor plant and then place it outdoors in the spring. The plant regenerates and produces a fall harvest. In wanner climates you can place plants outdoors for a winter or spring harvest and then let them regenerate.

One woman who wrote me claimed to have a four-year-old plant that had flowered and regenerated a number of times both outdoors and indoors. One spring she said she cut it back to make clones and left it on the porch. When she returned from a month-long trip, the plant had grown into a 3 foot wide bush.

I do have some concern about growth rate when the roots are pot-bound or make up a very large mass in a hydroponic system. It might be better to trim them as well to encourage new growth. If this were helpful, it would only be done following the second or third harvest.

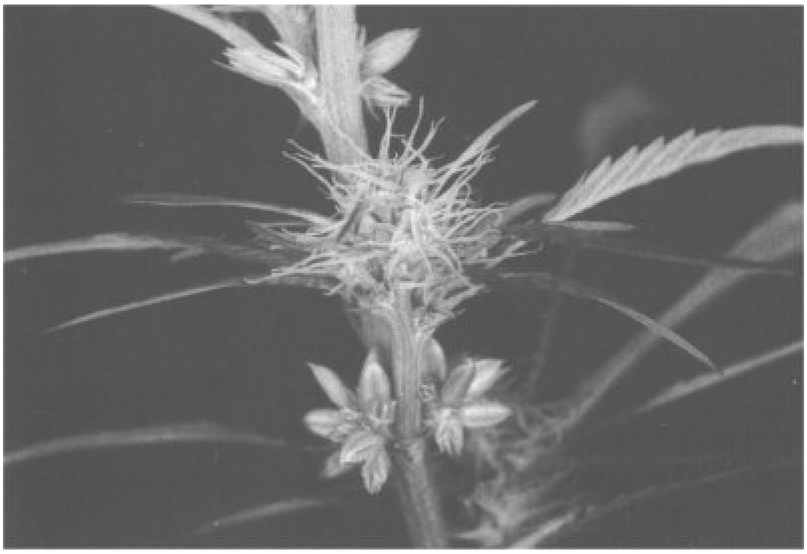
After harvesting, the light is left on continuously to force the plants back into vegetative growth.

There are other advantages to regeneration. Federal sentencing guidelines are determined by the total number of plants seized. Using sea-of-green methods, which produce short, dense plants and colas, seed and clone growers usually grow between one plant every two square feet and four plants per square foot, although a few growers space the plants as densely as nine per square foot. Regenerated plants already have complete infrastructures, so they can be fairly sizeable, without taking up a lot of time in vegetative growth. Fewer plants, regardless of size, will usually result in lighter sentences if you're unfortunate enough to be arrested after the second or third harvest.

Chapter Seventeen

Going Male

Why would a grower want a potion that makes female marijuana plants develop male flowers? These male flowers, hormonally produced, would contain no Y-chromosomes, the ones that make plants male. All plants fertilized by pollen from these plants would be female.



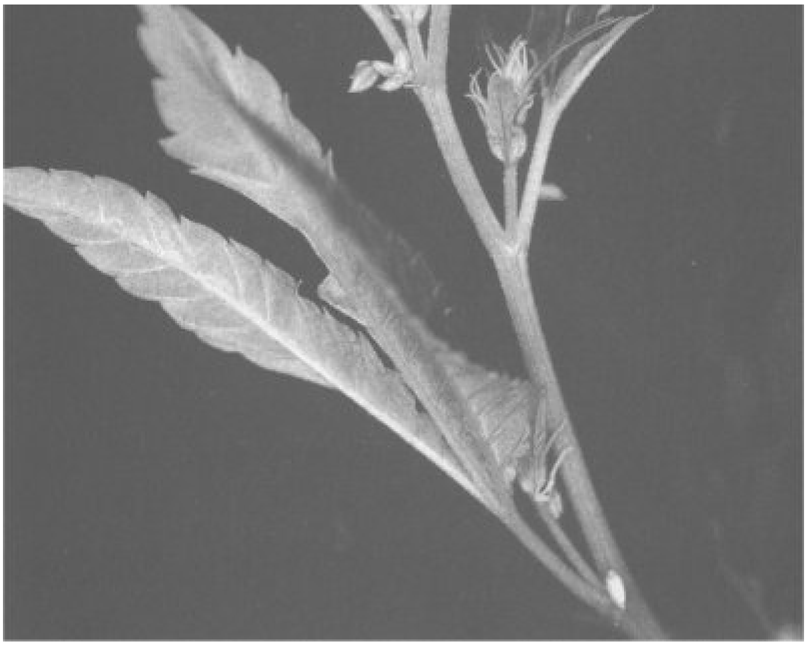
A close-up of this female branch shows clusters of male as well as female flowers.

Breeders would appreciate a method of creating female x female crosses. Think about it. Growers spend inordinate amounts of time choosing the best females to seed and then pick a male without too much consideration. The parameters for selecting the male are somewhat limited, because many of the characteristics being selected for are more pronounced in the female. If a reliable method of inducing male flowers on a female plant existed, breeders would never have to face that dilemma. Such a method does exist—using gibberellic acid.

This female branch turned hermaphrodite from gibberellic spray.

Just as in primate societies, marijuana males create havoc in the marijuana garden. Think how peaceful a garden would be without the unwanted seeds created by stray males. In Holland I met a fellow who grew large amounts of marijuana in a greenhouse. He said that the way he spotted males was by standing on a tower and looking at the garden with binoculars. If a certain plant showed signs of turning male or hermaphroditic, the surrounding females would all turn to face it. Unfortunately, by the time this occurred, some of their buds could already be pollinated.

One male can spoil a good thing. They just have no respect for a grower's sinsemilla desires. What every grower needs is the peacefulness and tranquility of an all-female society, where there are no 'unplanned events.' Seeds from female-to-female crosses have absolutely no maleness in them to spoil a good season.



This stretched branch produced male flowers which dropped pollen.

I have often reported on the quest for these elusive ‘forced’ males. Readers have reported induction of male flowers on female plants by using aspirin and irregular light regimens during flowering. More growers reported failure trying these techniques, which were, at best, unreliable.

The application of gibberellic acid, a hormone found naturally in plants, has also been cited as a method of inducing male flowering. However, virtually all the growers I have interviewed have been disappointed by the results. They have reported stretched plants with running female flowers, but no males. However, induction of males using gibberellic acid has been reported in the scientific literature.

This plant was sprayed with gibberellic acid causing it to stretch and possibly turn hermaphrodite.

We decided to try an experiment to see whether there was a way of inducing male flowers in female plants using gibberellic acid. We used potassium gibberelate, 0.005 by weight, in a spray form. Using several varieties of plants, including many hybrids from Holland, we drenched the stems and branches of those plants about to be placed in flowering. The result was running buds. That is, sparse buds with wide gaps between individual flowers.

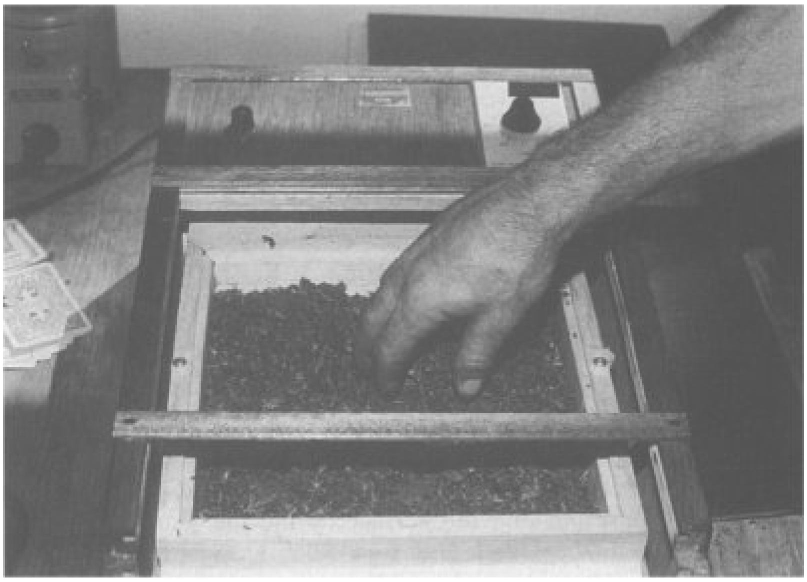
The experiment was performed on clones cut from known female clone mothers, both rooted and in vegetative growth. It was only when the plant or plant part was sprayed two weeks before inducing flowering and again when flowering was forcibly induced (by increasing the dark regimen from 0 to 12 hours), that male flowers were produced. All of the plants under this regimen exhibited male flowering. We also found that the effect was localized: It only affected the areas that were sprayed. The pollen from these flowers was fertile, and was successfully used to produce seeds. No attempt was made to germinate the seeds. Expect an update soon.

Chapter Eighteen

From Trash to Stash

Gardeners who romance the bud know that the leaves, the natural by-product of their work, present an interesting paradox. It is bud with perhaps 5% THC that is typically the focus of their obsession. Commercially this jewel is valued by consumers and it sells for several thousand dollars a pound. The fan leaves, which contains 1% or more THC but provide a much harsher smoke, are often thrown away by these connoisseurs, and has a very small commercial value. Trim, which contains 2% or more THC, commands only a little more respect, and is also moderately priced.

Mature marijuana plants typically yield half as much or more leaf as bud by weight. The result is that 10-15% of the plant’s total THC production is often thrown away. Most gardeners have been content to sacrifice these glands to poor relatives, high bakers or the trash. Recently, Milla's "Pollinator" has regenerated interest in a solution to the leaf conundrum. A few years ago, the late John Gallardin developed the Sifter and Master Sifter. Both of these devices are based on the silkscreen used worldwide.



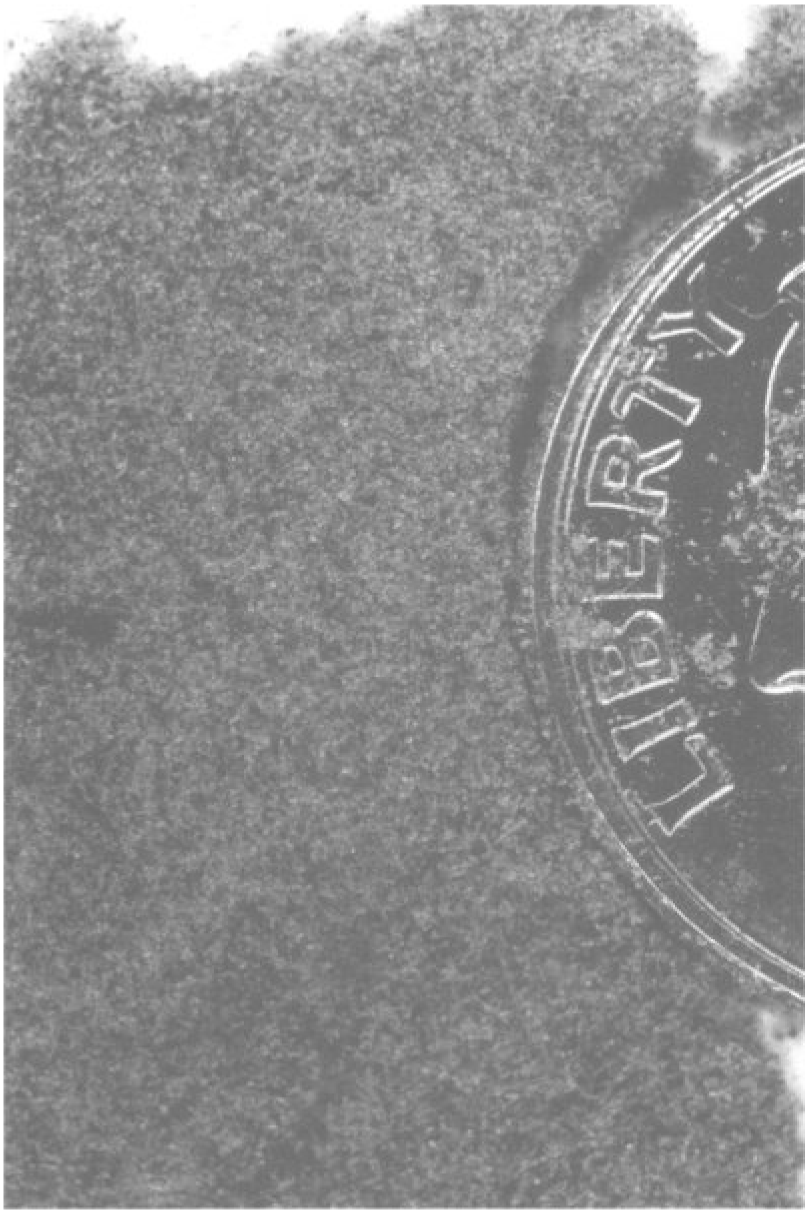
The "Master Sifter", no longer available, vibrated the screen plate to jiggle the glands off the leaves. Similar devices are available in Europe.

Mila's device looks and operates much like a front loading washing machine. John's is a frame which holds a screen and glass plate. His Master Sifter used a vibrator similar to a paint mixer to shake the grass.

Once the public understands the basic concept behind silk screening, many new devices to separate glands from vegetation will be developed. They will range from simple to sophisticated, but all of them will effectively separate the stash from the trash.

THC IS EVERYWHERE

Tetrahydrocannibinol (THC) is the psychoactive component of marijuana. It is produced on the stems, leaves, and vegetation surrounding the flowers, and it is stored in glands which emerge from the surface. On the stems and the early fan leaves these glands are small and hug the surface, while the glands on more mature plants are stalked and look like a mushroom with a bulbous cap.



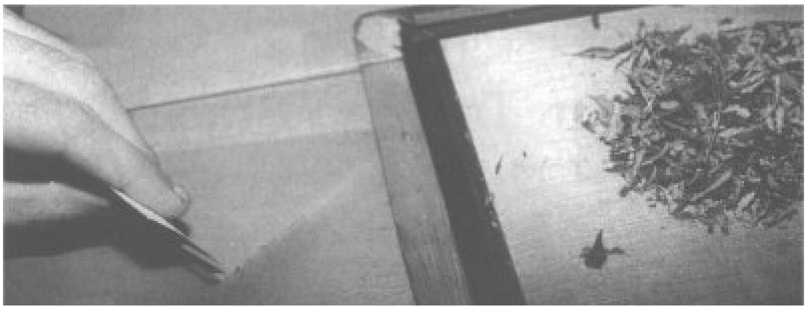
The glands produce a very potent dense smoke. Rather than inhaling burning vegetation, the glands are a THC concentrate.

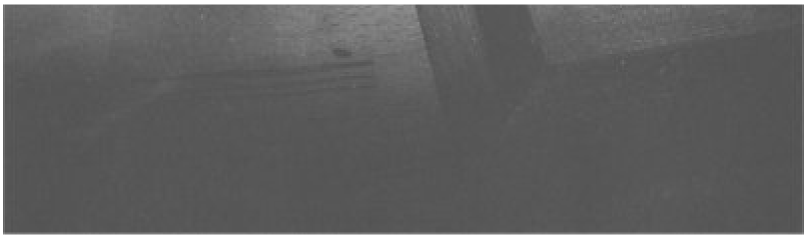
The flowering areas of the female plants and the small leaves surrounding them contain the most THC. However, all the leaves from the female plant contain retrievable THC. Male plants contain THC as well, and they are most potent at the budding but preflowering stage. In both cases, the small leaves near the flowers are the most potent, followed by the younger and then older fan leaves.

ANOTHER FINE MESH

In countries close to the 30th parallel, such as Nepal, Afghanistan and Lebanon, THC glands have traditionally been separated from the plant and concentrated into hashish. The glands are separated mechanically from the grass using a silk scarf stretched tightly over a bowl. Some hash makers have switched to metal screens instead of the scarves, since they are very durable and easy to frame.

John used a wire mesh with a 100 strands per inch. The material which falls through the mesh has a greenish color, which indicates that vegetative material containing chlorophyll has fallen through. A 120 mesh screen produces a tanner color, indicating fewer impurities. A 150 mesh screen produces an even cleaner mix which has a gray-tan color.





This rolling tray has a glass plate beneath the 100 per line inch mesh screen. Glands that fall through the mesh are collected on the glass plate.

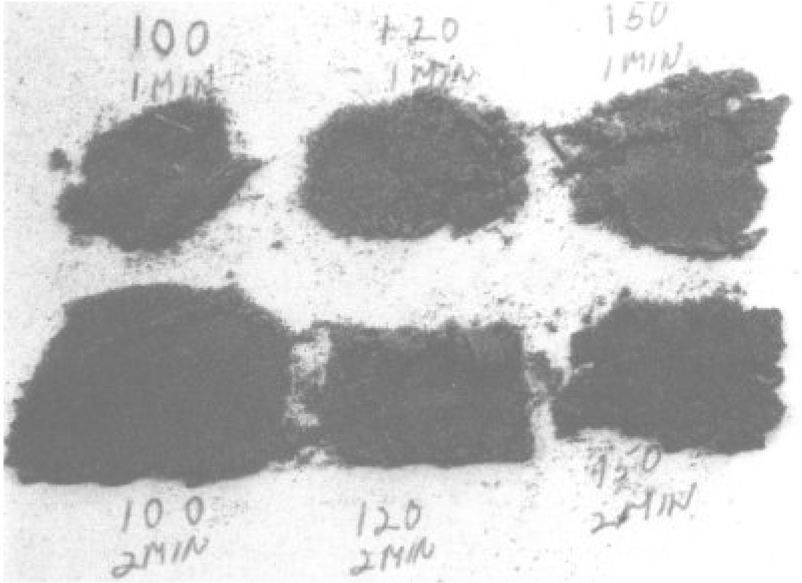
The Moroccan rating system for hash, starting with double zero, then zero, and so on referred to the stage of sifting from which the glands were collected. Zero zero came from the first pass, zero from the second and lesser grades from subsequent passes over the screen. With each screening a higher proportion of impurities mixes with the glands.

NOT ALL GLANDS ARE CREATED EQUAL

The quality of the marijuana affects the quality of the hash, too. Moroccan hash is made from plants of marginal potency. A Moroccan gland does not contain as much THC as a Nepalese gland.

Within a specific variety, individual plants vary in the number of glands they have per square centimeter. The result is that some plants are more potent than others.

In Holland several growers told me that they observed that gland size differed by variety. One observed that "hash plant" hybrids were covered with large sized glands as compared with some Sativas, which he said, had smaller bulb heads.



The longer that leaves are rubbed, the more glands that drop through the screen. However, more vegetative material drops through too. Different varieties glands are different sizes; each has an ideal mesh size. Here the same variety was screened using three different sized meshes. The 150 line per inch screen yielded the least, but it was the purest.

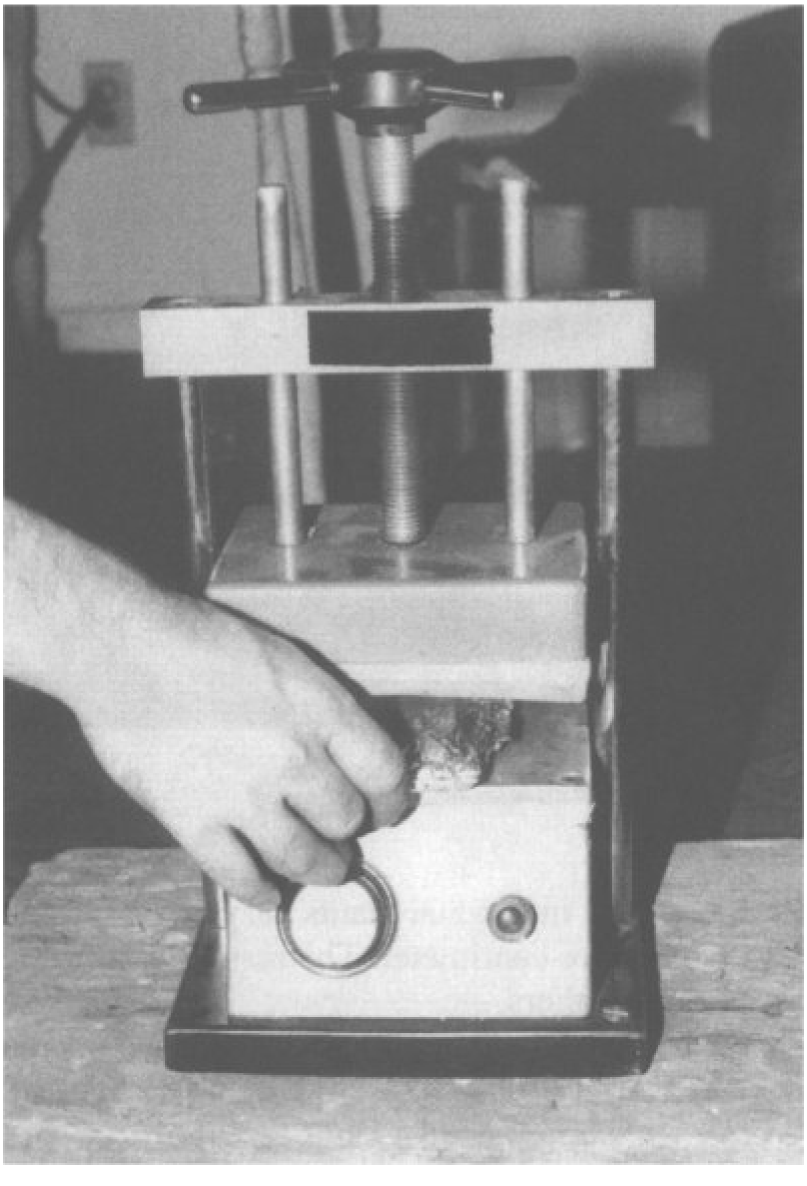
COOLER HEADS PREVAIL

In Morocco, the grass is harvested in mid to late August, dried and then placed in unheated sheds. It is not until winter, when the temperature drops below freezing and the air loses its moisture, that hash making begins.

Milla recognized the value of dry weed in cool dry air. One of the pollinator models is designed to be placed in a refrigerator. When either the leaf or air is warm or moist the glands become pliable rather than brittle. When everything is dry and crisp the glands glide through the screen much easier.

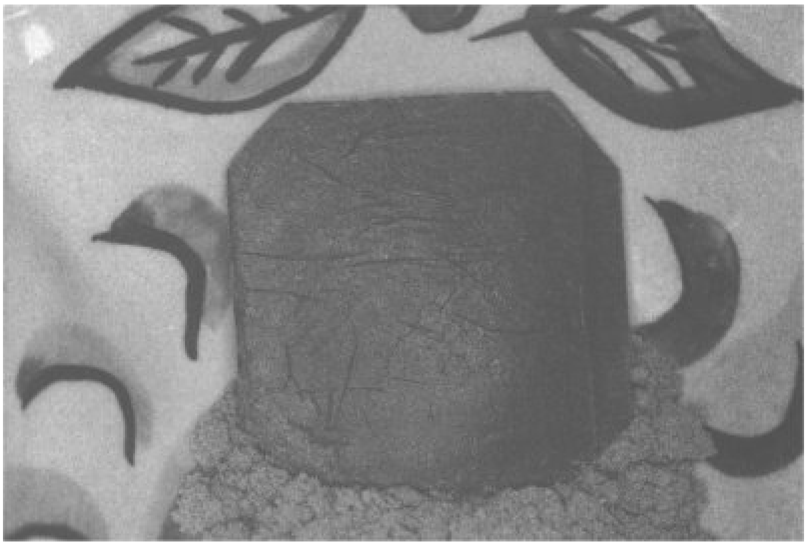
A PRESSING ISSUE

The glands are delicious smoked fresh and loose. However, some traditionalists insist that they be pressed into hash. John’s attempts at it using a press were only semi-successful. The glands pressed together, sort of like sandstone; the individual grains had not congealed. The problem was the lack of heat. In order to metamorphose into hash. The glands must become viscous enough so that their membranes break and the liquid inside can flow.



A hydraulic press provides the pressure to press the kief (unpressed glands) into tight hash.

Joop, who makes a press sold at Positronics in Amsterdam, solved the heat problem by placing the weed in a cellophane bag, putting the bag inside a waterproof plastic bag and heating the glands in boiling water, then pressing. This yielded hashish.



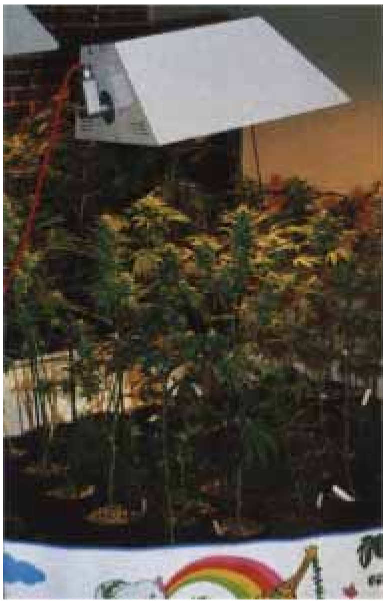
Hash and the kief from which it was pressed.

The grower has waited too long to plant these seeds. They can still be salvaged with gentle hands.

Here a seedling is emerging from soil. A few hours later, it’s cotyldon leaves have opened and its seed shell has dropped.

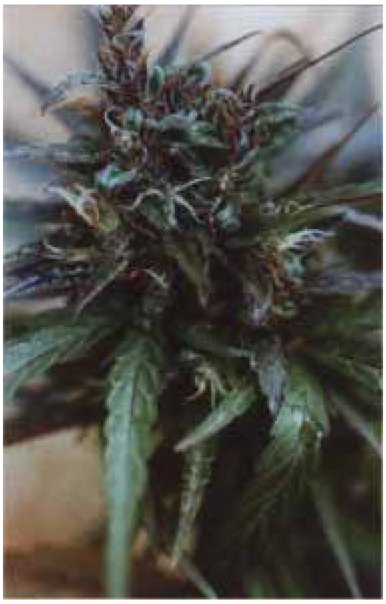
Plants in tubes using drip emitters grow excellent root systems.

Plants in this garden were kept upright and positioned using bamboo stakes.

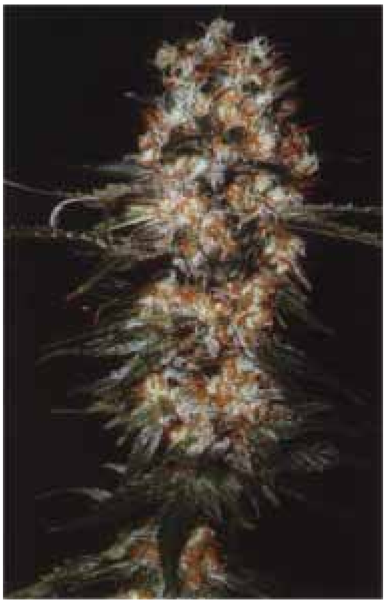


This wick garden in a kiddie pool uses an industrial pallet to keep the containers above the resevoir and 3/8” nylon wick rope to draw the water to the plants.

Here, 4” rockwool cubes were placed on top of 8” rockwool slabs and a drip emitter was placed where the cubes meet.



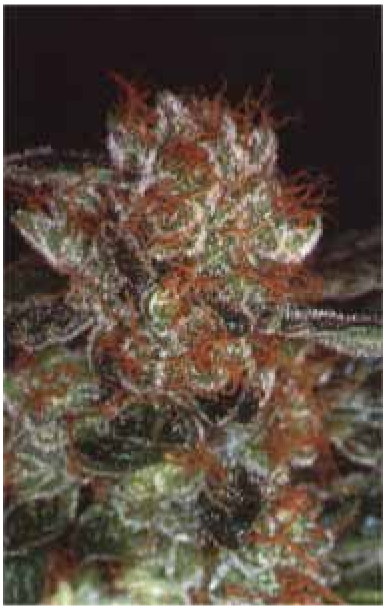
This small ripening bud is loose and airy because of low light conditions.



This dense bud is just beginning to ripen.

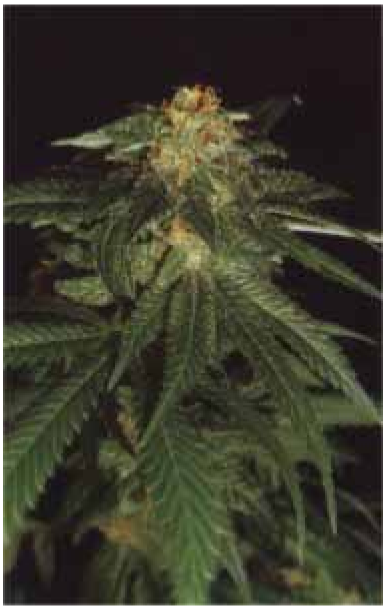
This ripe bud is filled with crystals.

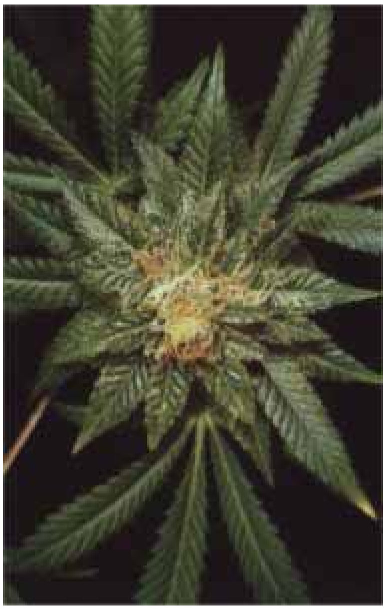
Staking buds upright keeps them from interfering with each other.



This ripe flowers' stigmas have dried, false seed pods have enlarged, and the glands are swollen.

The plants in this garden were trimmed to 4-6 branches. Each branch was staked and the remaining buds grew immense.



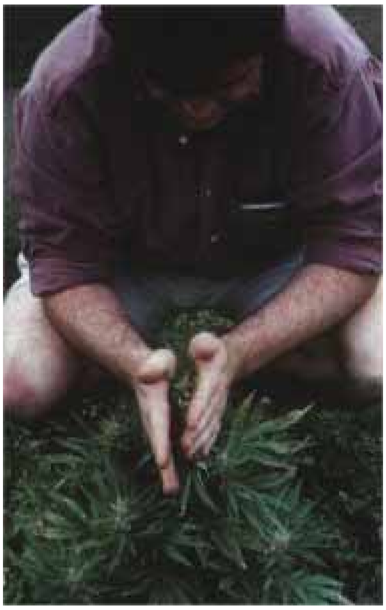


This sativa flower is about one week from harvest. (side and top views)

The buds in this garden are half way through the ripening cycle.

This greenhouse has roof vents which open automatically to keep the plants cool. The plants are growing in 3 1/2 gallon containers, and the buds are kept upright using 6" square greenhouse screen.

This outdoor garden uses 6” high metal arches to support either clear row covers (left) which are used during rainy or cool weather, or black row covers (right) which are used to limit daylight to 12 hours, forcing plants to flower early.

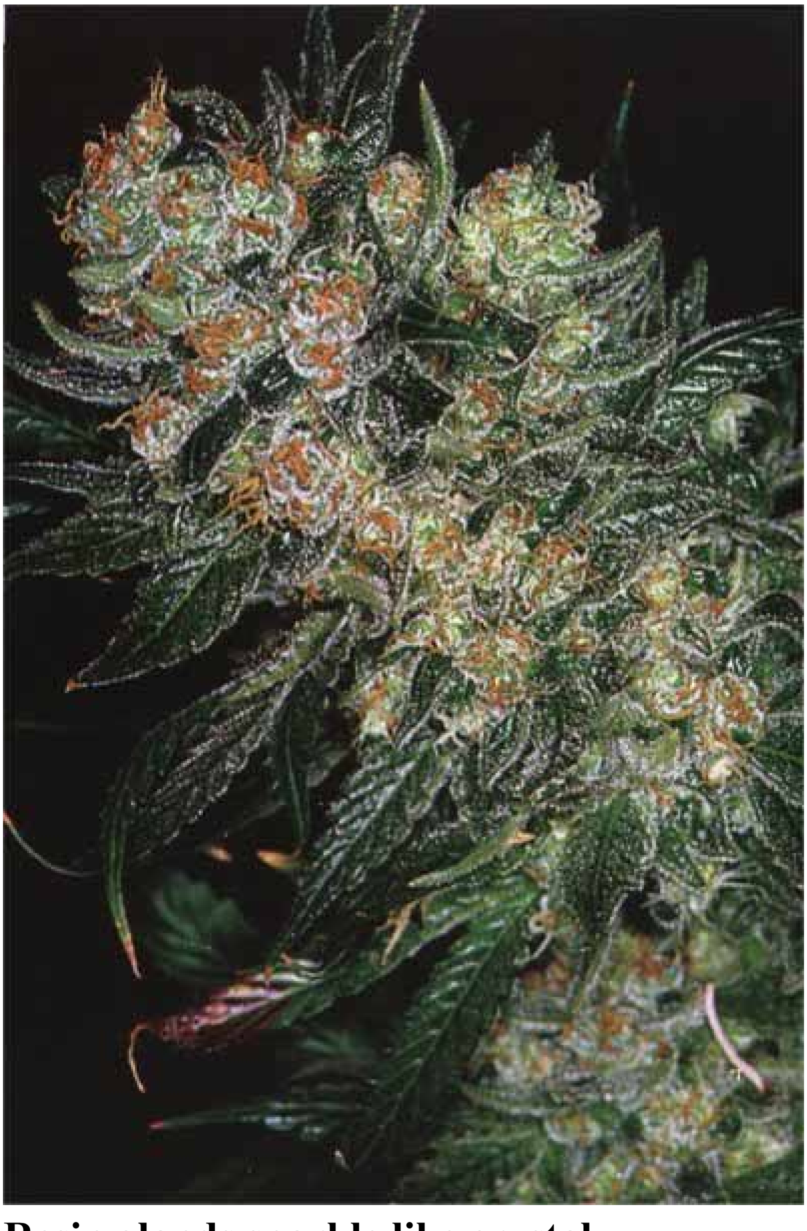


To hand press hashish, resin is first collected on the palms by rubbing the outer leaves of the plant.

After 20 minutes, enough resin has collected on the hands to start rubbing.

Resin can be scraped from the palms and gradually pressed together. Body heat softens the resin powder, making it easier to mold.

Task complete: A ball of hash.



Resin glands sparkle like crystal mushrooms and the pistils have turned mostly orange; this kind Skunk Big Bud is ready to harvest.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