

Biotic and Abiotic Factors in Medical Cannabis Production and Preservation: A Nurse's Perspective

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Introduction: Cannabis sativa x indica is a plant composed of hundreds of different chemical compounds including over 60 cannabinoid molecules. Cannabis that is grown for patient use must be free of biological or chemical contamination and of specific cannabinoid profile and concentration to effectively treat a medical condition. This defines medical-grade cannabis. The standards of practice of the nursing profession combined with direct patient care, place nurses in an ideal position to teach patients how to grow, preserve and use cannabis safely. Anyone who intends to cultivate cannabis for medical use should educate themselves by purchasing a text like "*Marijuana Grower's Guide*" by Mel Frank. As an addendum to this paper, the "*Cautionary Statement for the use of Horticultural Products on Medical Marijuana*" has been attached. (1)

There are three issues of particular concern for any cannabis grower or user.

- Influences of *non-living* (abiotic) agents. (*chemicals, fertilizers, heat, cold*)
- Influences of *living* (biotic) agents. (*molds, parasites*)
- Preservation, curing and storage considerations.

The production, processing and preservation of marijuana is a balance between biotic and abiotic influences. Every component of these two divisions contributes to, or detracts from the medicine quality. The complexity of balancing these energies is compounded by the large number of strains available, the variation of environmental conditions in indoor or outdoor gardens and the inputs used during cultivation. Medical marijuana is, by definition, intended for patient use.

In California, where dispensaries distribute medicine, patients have a wide selection of different strains from which to choose. As well, cannabis is tested and certified at Harborside Lab in Oakland, California (1840 Embarcadero, Oakland, CA 94606, www.harborsidehealthcenter.com/lab.html) Cannabis is tested for impurities, chemical residues and basic cannabinoid constituents including Cannabidiol (CBD) and Δ -9 tetrahydrocannabinol (THC). The exciting possibilities include matching these cannabinoid ratios to different strains. Patients are able to choose those which produce the desired effect for a particular condition. This complexity is far beyond the scope of most physicians, who [are trained to] prescribe a standardized pharmaceutical to treat a symptom or disease.

(1) This information is supplied with thanks to the Advisory Committee on Medical Marijuana of the OMMP, Todd Dalotto and Don Wolf.

1. Influences of abiotic agents.

There are a large number of chemical agents which may potentially be used on cannabis. These include chemical and organic fertilizers, pesticides, soil amendments, foliar (leaf) sprays, growth stimulators (hormones) and preservatives. This paper is limited to basic description of fertilizers.

The vegetative (non-flowering) growth of cannabis requires fertilizers high in Nitrogen (N). Flowering plants require increased Phosphorus (PO₄) and Potassium (K₂O). All fertilizers have an NPK label on the package.

The use of chemical fertilizers like Miracle Grow® has some justification because they are purified chemical compounds created with precise quality controls that make them very standardized and simple to use. This may be advisable for persons suffering from immune compromise or who lack the physical ability to deal with smelly, bulky materials. One drawback with so-called commercial fertilizers is that they often contain heavy metal ions like mercury, cadmium and lead, which are elements not used by the plant. These metal ions will eventually find their way into rivers and lakes. Another includes the effect these contaminants have on the soil biology. The higher concentration and lower dosage of chemical fertilizers makes them more prone to misapplication and overdose. Over-dosing of commercial fertilizers can quickly kill a plant. Choice of fertilizer should be guided by an understanding of label directions-especially with dosage recommendations- and observation of effect. Other factors include cost, ease of use and physical abilities. If a plant suddenly wilts soon after applying commercial fertilizer, overdosing of the fertilizer is likely the problem. The plant might be saved by flushing with a large quantity of water, but probably it will be weakened and unable to produce quality flowers. Over dosing near harvest time will contaminate flowers with unacceptable fertilizer metabolites and render them useless. If using commercial fertilizers:

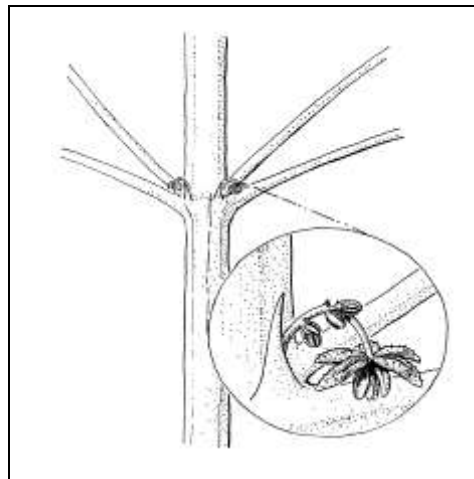
- *Do not exceed manufacturer's dosage recommendations for fertilizer application.*
- *Discontinue use three weeks before harvest.*

Most medical cannabis growers, however, use “organic” products like fish emulsion fertilizer, bat guano, kelp, seabird guano, compost tea, lime (calcium carbonate for pH adjustment). Matching fertilizer to plant is much less problematic using organic products. Organic fertilizers like fish emulsion fertilizer or compost tea have a wide dosage latitude. It is difficult to overdose with organic fertilizers because they are taken up by the plant as needed. Commercial fertilizers are readily soluble and can be taken up in quantities that far exceed the plants immediate need. It is generally accepted that use of organic fertilizers produce superior cannabis. Cannabis plants require frequent fertilizing, depending on the size of the plants. Plants that are ten feet tall require heavy feedings; small plants under 400-watt High Pressure Sodium (HPS) lights require dilute dosing. Ideal dosing depends on strain, plant size, location (indoor or outdoor) and medium (hydroponic or soil based). It is worth noting that organic hydroponic products are sterilized which eliminate the microbes that contribute to the growth and development of the plants grown in soil.*

*Hydroponic growers also produce high quality medicine. This description of soil—based horticulture is not meant as criticism of hydroponics, rather a process that most patients probably are more suited to.

The use of pesticides carries important safety considerations for growers and patients. As is the case with fertilizers, there are many products that are used on horticultural and food crops. There is little research on interaction of commercial pesticides with cannabis especially as it is often incinerated directly into lung tissue. Therefore, it is advisable that growers not use commercial pesticides on cannabis plants. Even products labeled safe for food crops HAVE NOT been tested for incineration and inhalation.

Pyrethrum sprays or Neem oil are generally safe for aphids and mites if applied weeks before harvest. Nothing except water should be sprayed or applied to plants for at least two weeks prior to harvest. Clean water and time allow the plant to metabolize fertilizer residues in the plant tissues. Gross contamination of flowers with parasites or mold renders the the flowers worthless. Discard the plants, clean the grow room, and begin again. Indoor or outdoor humidity elevations near harvest can quickly destroy thick flower clusters- called cola's- as mold spores proliferate in warm, moist, dark environments. Do not allow water to penetrate colas that are near harvest.



Male cannabis plants should be removed from the garden as soon as the plants are identified as male. This will prevent pollination of the female plants. (Illustrations by Peter Branson)

2. Contamination by biological agents

Biological organisms like aphids, mites, molds, bacteria are ever present in most indoor and outdoor environments. Indeed, they are part of the “food web” which contributes greatly to plant health- as long as these different creatures are in dynamic balance. When conditions change, there will be some organism that thrives on the change. Spider mites, a common problem in indoor environments, proliferate on the undersides of leaves in warm grow rooms with little fluctuation in temperature. The objective, indoors or out, is to maintain the “living equilibrium” of the growing environment. This is more difficult in an indoor growing environment because the plants are not exposed to ever changing conditions. Additionally, indoor environments often have inadequate ventilation which allows heat and humidity to build up. These are the perfect conditions for growth and reproduction of many different pests, especially aphids, mites and molds. Any appearance of mold should be immediately addressed by removing contaminated material and decreasing humidity. Cannabis showing any sign of mold, pests or contamination should not be consumed.

Maintaining the vigor and health of plants is the greatest single measure which prevents biological contamination. Careful observation during all stages of growth will aid in early detection of problems. Growers should buy (and use) a magnifying loupe of 10X to 16X to examine leaves, especially the undersides where aphid and mites often congregate. Gardeners should also look around the base of the plant at, and just below soil surface for evidence of chewing damage caused by cutworms or soil predators. Unexplained wilt of potted plants sitting on bare ground is often caused by soil organisms that migrate into the container, drawn there by water. If plants are placed outdoors for a period of time, place them on an impermeable surface

like a plastic tray or even plastic.

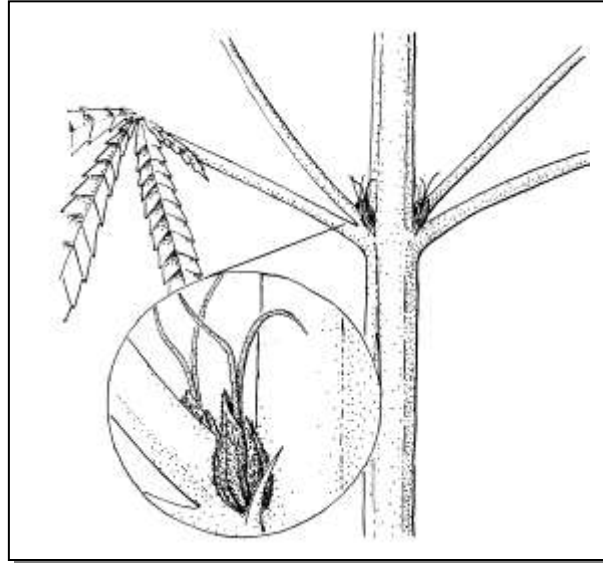
Growers should use cultural techniques and benign biological agents to rid plants of biological contamination. These include use of clean soil, predatory mites for mite infestations, lady bugs for aphids, dipping plants in diluted soap suds, aggressive spraying of plants to wash off parasites, use of Neem oil, Safer™ Horticultural Soap or pyrethrum (chrysanthemum), and environmental change that stresses parasites. Ultimately, the best way to “treat” plants is to maintain healthy plants.

The benefits of bringing indoor plants outside include exposure to intense full-spectrum sun light, increased fresh air flow, variable temperatures and exposure to beneficial insects. The constantly changing environmental conditions also interfere with established life cycles of predators that thrive on a narrow range of conditions. Leaving non-flowering plants in a private area overnight during cool or wet weather will diminish problem pests. However, some medical grade gardens are so clean, that exposing the plants to the outdoors could introduce a pathogen. If the plants are being grown in “laboratory” conditions, they should never leave that protected environment.

In any indoor grow room, do not allow animals or unauthorized people into the growing space. Remove fallen or dying leaves and clean up spills when they occur. Indoor growing rooms should be cleaned regularly. For gross contamination this means removal of plants and the use of “bug bombs” to kill all living organisms. (DO NOT use “bug bombs” in the presence of living plants, only after the plants have been removed.) The room should then be thoroughly washed using a cleaning product like Simple Green, and ventilated. As with plant health, maintaining a healthy indoor environment will minimize the need to rely on extreme measures.

3. Flowering, preservation, curing and storage

Different strains mature at different times. The grower should carefully monitor the floral progress as there are morphological changes in the flowers that indicate maturity. Generally, when 2/3rds of the pistils have turned brown the cola is ready to harvest. Most seed strains list the number of flowering days to harvest. Growers who produce clones will also know the number of flowering days. Outdoors, the sun intensity is evenly distributed throughout the open space between leaves. Large buds can develop anywhere if the sun intensity is not diminished by leaf shade. Indoors, the light intensity is decreased by half as the distance is doubled. This means that flowers closer to the artificial light source will have greater floral development than the flowers further away. Cannabis initiates flowering when the length of the dark period approaches 12 hours-called “short-day” flowering. Indoor growers switch to a 12 hour dark period when they wish to initiate flowering. Outdoor growers either cover the plants with dark cloth or allow plants to flower naturally as the late summer sun exposure decreases. Different strains initiate flowering at different rates that are based on the latitude of the strain’s historical range. Equatorial strains need only minimal decreases in photoperiod to initiate flower production.



Female plants initiate production of pistils when the light cycle approaches 12 hours of darkness. Masses of pistils form the actual buds. Pistils can be observed 1 week after flowering begins, usually in the branch internode.

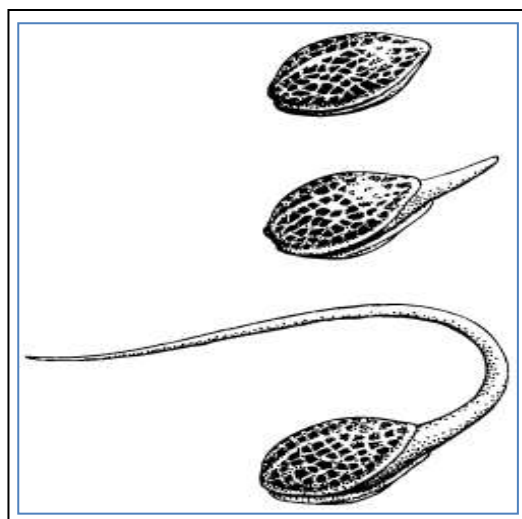
By using a 10X Loupe, it is easy to see the progression of floral development. Unless male pollen is desired for breeding, males should be removed from the garden before flowering in order to not interrupt the female plants production of pistils. The rate of floral development increases over time, until layer upon layer of unfertilized flowers create thick colas. Plants are harvested by removing the flowering tops and trimming the small leaves that project out of the cola. This “trim” is often saved to make bubble (ice) hash or medicated oil extracts or keif (screened trichomes). There are a number of ways to dry and cure cannabis. Drying is the removal of water, curing is the enzymatic and metabolic change that occurs in the presence of oxygen. The flowers are often hung in a warm room for 2 days on 10 inch stems, then carefully trimmed into popcorn sized buds for final drying and curing. Once the buds are trimmed to final size, they are placed in a clean paper bag to finish drying and curing. Buds **SHOULD NOT** be placed into airtight bags or containers as there is still water in them that will stimulate bacteria growth. Paper bags allow for continuous, slow drying down to about 15% moisture, or where the stems snap when bent. Once most of the water is removed, the buds begin curing.

Curing is a chemical degradation process where the acids in the buds combine with oxygen to form bases. This process increases potency and stability of the resins, and changes the cannabinoids from non-psychoactive to psychoactive form. Chemically called “*decarboxillation*,” the cannabinoids become psychoactive when the temperature is increased to 200⁰ F. Heating or drying also eliminates the sharp hairs-called *cystoliths*. Raw or uncooked cannabis should not be eaten as these cystoliths can be very irritating to the stomach. Curing can be accomplished using a number of methods like water, sun and heat. Each process allows the metabolic processes to continue using up enzymes, chlorophyll and nutrients in the plant. The plant continues to “respire” giving off carbon dioxide. The key is to slowly cure the buds until they change to a darker green or brown, without allowing any rot to occur. Many growers place

mostly-dry buds into large paper bags and the curing process becomes part of drying. Storing dried or cured cannabis can be for short or long-term preservation. Packing buds into clean, preheated quart mason jars is an ideal way to seal them in a vacuum as long as the buds are dry. As the hot jar cools, the screw-on cap and lid vacuum seal. Placing jars in a cool and dark location preserves them for many months. Freezing the buds in freezer bag or containers also reduces biological activity to a very low level and prevents rotting. The preserved buds do still continue to have some biological activity, and year old cannabis will have lost potency and taste if improperly stored. Write the strain and the date on any cannabis that is preserved, and, as with any medicine, a label indicating that this is cannabis for medical use only, should be applied to the outside of the container.

Finally, patients should also be aware that there are many different formulations into which dried cannabis can be incorporated. These include medicated oils using olive oil, tinctures using vodka, ghee (clarified butter), capsules, salves, lotions, lozenges, and herbal compounds. Anyone wishing to use cannabis in a non-smoked form should buy a cook book like *“The Feel Good Cookbook for Medical Marijuana Patients”* by Robert Appleton and Sue Watson. In addition, vaporizing cannabis as an alternative to smoking provides inhaled rapid-onset route without inhaling carcinogenic combustion compounds. There are many different vaporizers on the market, ranging from the “Volcano®” vaporizer (\$669) to the “Vapir Genie®” (\$59). There is no amount of smoking that can be considered benign, and many different vaporizers are marketed today. Since cannabis that is ingested (eaten) passes through different metabolic processes in the liver than when it is inhaled. Patients should carefully titrate the lowest effective dose of any “medible” through careful dosing.

Finally, storage should include keeping the cannabis away from all unauthorized users. Secure storage reduces unintended access by animals, children or thieves. In addition, anyone growing cannabis should incorporate security precautions that prevent unauthorized access to the plants or medicine.



Healthy seeds should sprout in about a week. Resist the urge to dig up the seed to check it. Pre soaking seeds in water or nutrient solution promotes sprouting.

Cautionary Statement for the use of Horticultural Products on Medical Marijuana

Todd Dalotto, Chair, Horticulture and Safety Committee of the Advisory Committee on Medical Marijuana

Don Wolf, Fertilizer Program Specialist, Oregon Department of Agriculture

It is important to be aware how marijuana (*Cannabis sativa x indica*) is grown may affect both the quality and **safety** of the medicine. There are important safety considerations with the use of horticultural products such as fertilizers, pesticides, growth regulators, and other chemical agents. This is a special concern for medical patients with compromised immune systems.

Little information is available on how various horticultural products affect human health after combustion, vaporization, and ingestion. Nor do we know what types of drug interactions may occur. Even products that are safe for vegetables may not be safe to inhale via smoke or vapor.

The safest course of all would be to avoid use of pesticides by growing healthy plants and monitoring frequently for pests and disease. Many types of problems can be mitigated if detected early and treated by removing infected parts of the plant, spraying with soap and water or other non toxic solution. In case of severe infestation, discard plants and soil and sanitize all containers and equipment.

Predatory insects can be used to keep pest populations below an acceptable threshold. Natural fertilizers are best used as a soil amendment. All treatments should be avoided within two weeks of harvest. Growth regulators are mainly intended for ornamental crops and are unnecessary and potentially hazardous when used with *Cannabis*.

Most importantly, there currently is no pesticide or fungicide product approved as safe for use on medical marijuana. If you do decide to use a product to help you with a disease or pest problem, **READ THE LABEL**, paying particular attention to warnings and intended use of the product. Consider whether all plants need to be treated. Use the smallest amount of the product required. Read and follow all label instructions. Label safety recommendations are the minimum needed for safe use. Consider ways to be safer than that minimum. Dispose of unused materials safely.

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