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CULTURE NOTES

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Getting the Right Mix

Dr. Brian Corr

Editor's Note: The following is excerpted from the new cannabis chapter in the recently published 19th edition of the Ball Redbook.

Almost any growing medium can be used for cannabis production. Plants can be grown directly in the ground in soil, or in containers with blended substrates, or in hydroponic or aeroponic culture. As with all crops, your cannabis medium should be free of disease organisms, insects and weeds.

Cannabis roots need a well-aerated medium for maximum growth. A high-porosity growing medium has been shown to increase yield of both dry matter and cannabinoids when all else is equal. For this reason, cannabis in containers is typically grown with substrates that provide large pore spaces for aeration. Common components are coconut fiber (coir), peat moss, perlite, and composted bark. Rockwool blocks are common for hydroponic production. If grown directly in the ground, the soil should be well-drained. Do not grow cannabis in a field if water stands in the field for any period of time.

Proper irrigation

Like any crop, irrigation water for cannabis should be tested for dissolved minerals, alkalinity, the presence of heavy metals and for microbial contamination. Water suitable for irrigation of other crops is suitable to irrigate cannabis. However, water used for spraying pest control products should be potable to reduce the chance of introducing human pathogens to the harvested product.

Many growing media used for cannabis production do not have much water-holding capacity, yet cannabis plants can absorb significant amounts of water each day. Therefore, irrigation must be frequent enough to prevent water stress. However, because the roots require a good supply of oxygen, the medium must not be saturated for an extended time. Use pulse irrigation to thoroughly wet the medium with minimum run-through, then do not irrigate again until the medium has dried.

Decreasing irrigation or even stopping irrigation before harvest will reduce the amount of water that must be removed from harvested material during the drying phase. A moderate drought stress in the last week or two of the flowering period may increase concentration and total yield of cannabinoids. Depending on the

environment, the growing medium and the size of the plants, it may be possible to completely discontinue irrigation several days or even a week before harvest, although the plants should not dry to the point of severe wilting.

The nutrient mix

Each cannabis grower develops a fertilization program that matches their particular combination of growing medium, irrigation strategy, cultivars, etc., but there are some common requirements for a successful nutrition program at each stage of growth.

There are many unsubstantiated claims about fertilization of cannabis. Many traditional cannabis fertilization programs included phosphorus levels well beyond the amount recommended for other crops. There is no evidence cannabis requires phosphorus at levels 10 to 20 times what other crops require. To the contrary, research has shown phosphorus application greater than a commonly accepted basic level did not increase yield or cannabinoid content, and even decreased cannabinoid content in some portions of the plant. Runoff from excess phosphate fertilization leads to eutrophication of rivers and lakes. Excess phosphorus application is environmentally irresponsible.

Ongoing laboratory studies at the Utah State University Crop Physiology Laboratory indicate that levels above 25 ppm P in continuous liquid fertilization do not increase yield or cannabinoid levels. At 120 ppm N, this P level is achieved with a 2:1:2 fertilizer ratio (N-P2O5-K2O).

There is evidence that appropriate nitrogen levels are required to reach maximum biomass production. Therefore, fertilization programs can be based on the nitrogen level, then built up with additional nutrients. Fertilizers with a ratio of approximately 2:1:2 (N-P2O5-K2O) are acceptable (for example 20-10-20). Most pre-blended fertilizers have appropriate levels of micronutrients. The rate of application should be adjusted by stage of growth, with additional nutrients supplemented as noted below.

Additional fertilization notes

Mother stock plants need to have adequate fertilization so cuttings are not nutrient deficient when harvested. For most blended media with low nutrient content, a constant fertigation with a 2:1:2 fertilizer at 150 ppm nitrogen is sufficient.

Fertilization during clonal propagation can prevent deficiency and improve the quality of the plant before it is moved to the vegetative stage. Apply approximately 50 ppm nitrogen from 2:1:2 through the mist until roots develop. Once roots are formed, the plants can be irrigated with 125 ppm nitrogen until transplant. Growth remains very sensitive to poor root aeration at this phase, so allow the medium to dry down between irrigations.

During the vegetative and early flowering stages of growth, constant fertilization with 125 ppm of nitrogen from a 2:1:2 fertilizer is sufficient. At the mid-flowering stage, some growers have found benefits from supplementing with additional potassium. An additional 50 to 100 ppm from a source like potassium sulfate can be beneficial.

More mythbusting

Like high phosphorus levels, another procedure that was common in cannabis production but has since been discounted is the practice of “flushing” before harvest. Flushing (also called leaching) is a heavy irrigation or series of irrigations with clear water shortly before harvest. Flushing was presumed to remove excessive

mineral nutrition from the inflorescence (bud). However, research has shown no detectible difference in nutrient concentration or taste of smoked cannabis resulting from flushing. Regardless, a decrease in fertilization in the last week or two of the flowering phase can reduce chlorophyll content by inducing mild nutrient deficiency symptoms. As discussed in the harvest section, a reduction in chlorophyll is desirable in dried cannabis. Many growers discontinue all fertilization one or two weeks prior to harvest.

Supplemental nutrition

Although a pre-blended 2:1:2 ratio fertilizer with micronutrients is generally suitable for cannabis production, some supplemental nutrients can be beneficial. Most pre-blended substrates contain calcium, magnesium and sulfate if they are amended with dolomitic limestone and gypsum. If these nutrients are not incorporated into the growing medium, supplemental fertilization with Epsom salts (magnesium sulfate) will supply magnesium and sulfate.

Any supplemental fertilizer should be certified by the supplier to be free of heavy metals or tested if a certification is not available.

Even with calcium in the growing medium, and certainly if there is none added to the medium, cannabis plants can become calcium deficient. Foliar applications of calcium chloride dihydrate at 0.5 ounce per gallon provides approximately 1,000 ppm calcium. Weekly foliar sprays, including a wetting agent, can minimize calcium deficiencies and also reduce the incidence of disease.

Although silica is not considered to be essential for plant growth, supplementing the nutritional program with additional silicates has been found to reduce disease incidence. In addition, silicate in the growing medium minimizes uptake of heavy metals. Many common growing media for cannabis production do not contain significant amounts of available silica. Supplement with approximately 60 ppm silicate (SiO_2) from potassium silicate with every irrigation. One commercial source is AgSil. There are several AgSil formulations. If using AgSil16, use 1.5 oz./100 gal. (12 ml/100 L), which results in 60 ppm of silicate and 36 ppm of potassium. Potassium silicate requires a separate fertilizer tank and injector since it precipitates with other common fertilizers. Silicate also can be applied as a foliar spray. Foliar applications can reduce disease incidence, but do not affect heavy metal uptake.

Final notes

Although cannabis will tolerate a wide pH range, the pH of the growing medium is important for optimal growth. The appropriate pH depends on the method of growing. For rockwool, the solution pH should be 5.4 to 5.8. The pH of blended media composed of peat moss, coir, etc. should be 6.2 to 6.5. The pH of the soil for crops grown in field soil should be 6.4 to 6.8. Low pH can increase the uptake of heavy metals, which can lead to contamination of the harvested product.

Monitoring the growing medium during the crop is essential to determine if nutrient and pH levels are appropriate. Sending routine samples to an approved lab is ideal, but on-site measurements of pH and electrical conductivity (EC) are easy and give immediate results.

Measuring the electrical conductivity of the growing medium is a quick estimate of the nutritional status. Although it does not determine which nutrients are present, it is a measurement that can be done on-site, by the grower, with almost immediate results. Electrical conductivity is measured in deciSiemens per meter (dS/m) or milliSiemens per centimeter (mS/cm); the two measurements are equivalent.

The recommended levels by stage of growth, if done using the saturated medium extract (SME) method are:

- Propagation (seed or vegetative): less than 1.0 dS/m
- Vegetative and early flowering: 1.5 to 2.2 dS/m
- Late flowering to harvest: less than 1.0 dS/m