Cannabis Control Commission
COMMONWEALTH OF MASSACHUSETTS

Guidance on Best Management Practices for Water Use

Approved by the Commission: April 4, 2019

This guidance is not legal advice. It is meant to assist licensed Marijuana Establishments with developing best practices in water management and to comply with state laws and regulations. Please consult an attorney if you have any questions regarding the legal requirements that apply.

Introduction

Cannabis, whether in the form of industrial hemp or marijuana, has varying requirements in water and nutrient levels based on the method of cultivation. This document aims to compare the water needs and differences between all methods of cultivation, including removing the plant entirely from natural systems and growing in sealed indoor environments, and the considerations that a grower should be taking into account when locating their facility and establishing watering operations for plant growth and facility maintenance.

***It should be noted that given the lack of research on hemp and marijuana growth in the United States, there is conflicting information on cultivation practices, and the vast differences between methods leads to high amounts of variability. The following numbers are cited but subject to change upon the release of more current regional data.*

Location of Facility and Source of Water

An important consideration for siting of a facility is the availability of water for production. Typically, water for a greenhouse or indoor facility would come from local municipal water or from a regional water supplier like the Massachusetts Water Resources Authority (MWRA). In the case of local municipal water, attention should be paid to whether the water supplier has enough capacity to supply the water both from a source and infrastructure perspective. Depending on the watershed and the specific town the facility is located in, the additional volumes may not be available within the town's registered or permitted amounts, or an Interbasin Transfer[1] approval may be required.

Increased demand on the system may cause a community to seek a new permitted volume which may have additional mitigation requirements. If a grower chooses to develop their own local

[1] For information about the Interbasin Transfer Act and Application materials: https://www.mass.gov/interbasin-transfer-act

water supply such as a new well, it is recommended that they contact the local Massachusetts Department of Environmental Protection (MassDEP) office for guidance on new source approval. A marijuana cultivation facility could trigger the Water Management Act's permitting requirements if it pumps from its own water sources more than an average of 100,000 gallons per day or more for three consecutive months of the year, or more than nine million unregistered gallons over any three-month period. In addition, a marijuana establishment that is supplying its own potable water and has a restroom that is accessible to 25 or more people 60 or more days per year is considered a Public Water System and would need to obtain an approval. A permit application will need to be filed with MassDEP before operations commence.

Water Use

It is also important to know and understand that prior to establishing your facility you will need to consider how much water you may use. If your water source is public then you must consider that the city or town you are operating in has a limited amount of water it is allocated to use per year.[2] This information may be useful when you are preparing for and going through the state licensing process and local permitting and/or licensing process.

Seeds vs. Clones

Literature does not currently provide an in-depth analysis of the water necessities of an individual plant, but there is significant evidence to indicate that seeds require less water than clones regardless of the cultivation setting. Seeds are hardier and more resistant to stress and disease, and even though they need more water initially, the growing period for seeds is shorter than that of clones. Clones, while providing insurance for an exact chemical profile upon maturity, require more nutrients which are usually mixed in a water solution.

Outdoor Cultivation

Water requirements for outdoor cultivation vary widely by region, variety, and planting date. As outdoor large-scale cultivation of cannabis is new to Massachusetts, there is no data yet to confirm exact amounts of water required. Studies have shown, however, that the ranges can vary between 12-15" in British Columbia to 20-30" in Europe.[3] This equates to about 6 gallons per plant per day,[4] which is about twice as much as is required by grapes in California, but not as much as cotton in Georgia (10 gallons/day).[5]

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[2] https://www.mass.gov/lists/massdep-water-management-act-laws-regulations-policies-and-guidance

[3] Nelson, R. A. (2000). *Hemp Husbandry*, https://www.hempbasics.com/hhusb/hh2cul.htm

[4] Bauer S, Olson J, Cockrill A, van Hattem M, Miller L, et al. (18 March 2015) Impacts of Surface Water Diversions for Marijuana Cultivation on Aquatic Habitat in Four Northwestern California Watersheds. Plos One 10(9): e0138935. https://doi.org/10.1371/journal.pone.0137935

[5] Bednarz, C., et. al. (2003). *Cotton crop water use and irrigation scheduling*, http://www.ugacotton.com/vault/rer/2003/p72.pdf

Notably, cannabis requires that most of its water be received by the plant within the first six weeks of cultivation, while metrics generally list watering averages over the lifespan of the plant. Flowering of the plant significantly decreases water uptake. Within that six-week period, it is critical that the plant experience neither drought nor flooding. Dry conditions hasten maturity and stunt the growth of the plant, whereas puddled areas of a field will kill seedlings within two days if not drained appropriately. Soil composition and conditions play a critical role in this.

It should also be noted that varieties respond differently across agricultural regions, with variability in height, biomass, and chemical composition. It has been found that it may take up to three years to develop a localized strain that is acclimatized to the conditions set forth in the region.

Indoor Cultivation

Indoor cannabis cultivation is generally referred to as the process of removing the crop completely from natural conditions such as sunlight, soil, and air and substituting those elements with artificial alternatives. The benefit of indoor growing lies in being able to control the elements of the plant's environment and be able to produce multiple harvests in a year. This method of growing is much more intensive in its usage of energy, water, and chemicals. There are many different methods of cultivating the plants themselves. These methods include:

- Hydroponics (water medium)
- Pots/trays (soil medium)
- Aeroponics (plant suspended on wall, not as common)

In the more typical methods of cultivation (namely soil and hydroponics) medical marijuana studies have estimated that indoor grows require watering in quantities of 98"/room-year, or 40 gallons/room-day (one room = 250 sq. ft.).[6] Hydroponically grown cannabis is much more water intensive than other crops. When grown indoors, however, facilities have the capacity to set up recycling systems that clean and filter used water to be recycled back into irrigation; which helps negate the amount of fresh water input into the system. Treating water and reusing treated water are activities that are regulated by MassDEP and require permits.[7] This water would need to be changed periodically, and nutrient levels can reach unusable points for the plants if not applied correctly.

Generally, for non-cannabis crops, indoor cultivation facilities with natural sun and/or ventilation present appear to provide a more balanced method of cultivation, as they are less energy and water intensive than a sealed indoor facility.

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[6] O'Hare, M., et. al. (7 September, 2013). *Environmental Risks and Opportunities in Cannabis*, https://lcb.wa.gov/publications/Marijuana/SEPA/5d_Environmental_Risks_and_Opportunities_in_Cannabis_Cultivation.pdf

[7] https://www.mass.gov/lists/massdep-wastewater-discharge-and-reuse-regulations

Monitoring and Reporting

Water is a crucial resource in the growth of cannabis and in the functioning and operations of cannabis growing facilities. In addition to plant needs, water is also used for heating, processing, sanitary purposes and landscaping on the property. Minimizing water loss from leaks as well as monitoring total water use as a compliment to instituting best management practices help advance the water conservation goals of the Commonwealth.

Growers should:

- install water meters,
- conduct regular water audits to determine the amount and location of water use,
- develop and implement a water savings strategy, and
- repair all leaks as quickly as possible.

Water Application Methods

Several different methods of water application are used as standards in the horticultural industry. Whereas outdoor fields rely mostly on rainfall or irrigation in cases of drought, indoor facilities must install their own application systems. The most commonly used methods are as follows:

Flood Tables utilize large, shallow tables that flood usually on an automated system and provide a layer of water and/or nutrients to plants growing in hydroponic mediums. Large amounts of water are used for this method but the water can be recycled through the system and used again after treatment via filtration and cleaning.

Drip watering involves irrigation systems that feed directly to each plant through thin drip tubes. The amount of water can be controlled directly or on an automated schedule and virtually eliminates excess water waste or runoff from the plants.

Wick systems employ a reservoir that provides water and nutrients for a plant via capillary action through wicking material. Seedlings and newly vegetating plants are occasionally watered with this method since it is a simple system that does not require machinery or electricity. However, it is insufficient in supplying large plants with greater water needs.

Hand watering is one of the most common practices used since it requires relatively little equipment and expense initially or in maintenance. However, the amount of applied water varies greatly between applicators and there is a much larger potential for water being wasted through either over application or by missing the plant root systems. If hand watering is being used, the facility should have a good operating procedure on how to hand water.

Aeroponics uses spray nozzles to mist the stem or roots with nutrients. Larger operations will put the stem/root in a channel and have the spray nozzles line the channel, while others may use the bucket system in which the nitrified water and air are maintained in buckets

NFT Systems use very shallow nutrient solution that runs downward in a tube or tray toward the reservoir where it is reused. It is best used on smaller plants with short crop cycle.

Water Culture Systems are systems where plants are suspended so roots hang down in nutrient solution and the reservoir is continually aerated.

Waste Water Disposal

Many indoor facilities utilize water recapture methods to save money and energy in their operations. Depending on the system in place this could be done through drain pipes and lines, ditches, dehumidifiers or condensation recapture modules. The recaptured water requires treatment if it is to be reapplied to plants to prevent the growth and spread of microbial pathogens and to reduce the amount of ionic and toxic elements that can be introduced to the water through the addition of nutrients. Common practices include carbon filtration, which neutralizes salinity and other inorganic materials in the water, and reverse osmosis, which allows for close to 97% reuptake but produces a brine that is difficult to dispose of. Other chemicals may be added to clean the water before reapplication to reduce microbe levels. Facilities may also employ the use of an aerobic treatment unit to reduce chemical and microbial levels in the returned water to a satisfactory level.[8] Studies have shown that there is no significant difference in plant growth between the use of recycled water versus the use of fresh water.

Even with recapture methods, however, systems need to be flushed on occasion and new water introduced, especially in the event of pathogen outbreaks or from the presence of high levels of salts or ions that could be detrimental to crop growth and development. Water which is not reused must be discharged to a sewer or collected and stored in a certified holding tank for disposal at an approved facility. Note that water which is being disposed of cannot be discharged to an on-site septic system. If wastewater is being discharged out of the facility (e.g., to a Title 5 system, a sewer system, the ground or surface waters), the proponent must contact their local MassDEP office to determine if a discharge permit is required. If wastewater is being stored, it must be kept in a holding tank that is permitted by MassDEP (Transmittal Form DEP01).

In other states, this waste has traditionally been disposed through landfills (often with unused cannabis waste material such as leaves and stems chopped up and mixed in to form a slurry) or is considered industrial waste, depending on the method the waste was created and the definition of industrial/hazardous waste by law. In Massachusetts, however, this waste may not be disposed in a landfill. If the waste is combined with unused cannabis waste, it may be composted or sent to

[8]Oyama, N. (2005). *Recycling of treated domestic effluent from an on-site wastewater treatment system for hydroponics,* https://www.ncbi.nlm.nih.gov/pubmed/16104424

an anaerobic digester. As a last resort, if such slurry is sufficiently dewatered, it may be disposed at a landfill so long as the remaining sludge does not contain free-draining liquids and contains a minimum of 20% solids. (Note that the disposal facility will need advance notice in order to submit the required documentation to MassDEP.) If wastewater is being discharged out of the facility (e.g., to a Title 5 system, a sewer system, the ground or surface waters), the proponent must contact their local MassDEP office to determine if a discharge permit is required. If wastewater is being stored, it must be kept in a holding tank that is permitted by MassDEP (Transmittal Form DEP01). For more information on waste disposal, please refer to the Commission's Guidance on Cannabis Waste Management Requirements.

Best Management Practice Guides

Water use on a crop should strike an appropriate balance between both agricultural needs for water and the need to conserve water. Examples of conservation approaches include proper irrigation scheduling in both timing (daily and seasonal) and volume, control of runoff, the uniform application of water, irrigation technologies, such as drip irrigation (where appropriate), and automated irrigation systems. The Massachusetts Water Conservation Standards[9] (WCS) outline many approaches and best management practices that an agricultural entity should adopt that are environmentally and economically appropriate for their specific operation and site conditions. In addition, the WCS also outlines standards and best approaches for indoor water use to ensure high levels of efficiency in structural items such as toilets and other water fixtures.

Based on the information gathered above, there are three best management practice categories, listed below that are considered high priority and should be implemented, to the greatest extent practicable, by all cannabis growers. These practices along with some others can help reduce or mitigate strains to disposal and environmental systems and improve water and energy efficiency as a whole.

1. Soil Health
    - Determine the soil needs and develop a soil health management system to improve the health and function of the soil. Soils are an ecosystem that can be managed to provide nutrients for plant growth, absorb and hold rainwater for use during drier periods, filter and buffer potential pollutants from leaving fields, serve as a firm foundation for agricultural activities, and provide habitat for soil microbes to flourish.
    - Consider using compost to help promote the health of the soil.
    - Maintain adequate soil moisture based on crop needs for optimum plant growth without causing excessive water loss, erosion, or reduced water quality.

[9] Massachusetts Water Conservation Standards (2018), Water Resources Commission. https://www.mass.gov/massachusetts-water-conservation-standards

2. Watering Methods
    - Use water in a targeted, planned, and efficient manner with appropriate amounts and frequency to meet the needs of the crop without excessive water loss.
    - Automation of watering systems is critical to reducing water waste and decreasing variability in plant health through overwatering. If automation is not financially feasible, water nozzles and other flow reducing systems should be put in place to monitor and check flow rates.
    - Micro-irrigation systems, such as subsurface drip irrigation, should be adopted if the facility is designed to be compatible for it.
    - Establish an irrigation schedule based on the specific needs of the crop.
    - Irrigation system efficiency should be evaluated on an annual basis.
    - Where sprinkler systems are used for irrigation, the systems should be capable of uniform application of water with minimal evaporative loss and minimal surface run-off.

3. Water Capture and Reuse
    - A water recapturing system should be used to recycle and reuse water so as to reduce the total amount of water used. Systems can include ones that capture water from watering the plant and reusing and/or capturing water condensation from the HVAC system.
    - Explore the options of capturing and using rainwater.

4. Other
    - Be knowledgeable of the municipal and state laws relative to water use.
    - Choose a site that is capable of managing the amount of water that will be used and will not impact other water users.
    - Cultivators should consider utilizing greenhouses and outdoor settings to reduce the amount of energy and water required to maintain plant health.
    - Monitor and document your water use.
    - If cultivating outdoors, growers should be mindful of all other relevant agricultural and environmental protection regulations in place regarding watershed areas, buffer zones, irrigation runoff, erosion control, and soil amendments.
    - Ensure that the appropriate dilution rates and application schedules are followed for any nutrients or cleaning solutions that are being used during cultivation or in treating water. Over application can lead to unnecessary contaminant levels in the water or poor plant health and require further treatment, more frequent system flushes, and loss of expensive chemicals.

Questions?
If you have additional questions regarding types of Marijuana Establishments, please contact the Commission at CannabisCommission@State.MA.US or (617) 701-8400.