

STATE OF MAINE



Guidance on Best Management Practices for Plant Health, Pest Prevention and Pest Management in Maine Hemp Cultivation

**Maine Department of Agriculture, Conservation and Forestry
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This document describes practices for preventing and managing arthropods, rodents, plant pathogens and other pests using combinations of physical, mechanical, biological, cultural and chemical methods in an integrated pest management (IPM) program. The intent of this document is to provide science-based information to assist Maine hemp growers for successful management of pest problems while complying with state and federal pesticide regulations. Maine permits the use of pesticides on hemp only in accordance with best management practices. Information can be found via www.maine.gov/ipm or by contacting the Maine Board of Pesticides Control (207-287-2731 or pesticides@maine.gov). The goal of this guidance document is to guide hemp growers in the production of an uncontaminated product while providing a safe workplace environment for workers.

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What is the Purpose of this Guide?

This document is intended to provide additional guidance to growers of hemp to support compliance with Maine’s pesticide regulations. Pesticides may only be used in the cultivation via specific rules and guidelines laid out in this document. More information can be found at www.maine.gov/ipm or by contacting the Maine Board of Pesticides Control (207-287-2731 or pesticides@maine.gov).

For prevention and management of pests, best management practices can best be described as the widely accepted principles and practices of integrated pest management (IPM). It is State of Maine policy to promote adoption of IPM to minimize reliance on pesticides according to 22 MRSA Section 1471-X. IPM is described in Chapter 413 7 MRSA as ‘the selection, integration and implementation of pest damage prevention and control based on predicted socioeconomic and ecological consequences, including a) understanding the system in which the pest exists, b) establishing dynamic economic or aesthetic injury thresholds and determining whether the organism or organism complex warrants control, c) monitoring pests and natural enemies, d) when needed, selecting the appropriate system of cultural, mechanical, genetic, including resistant cultivars, biological or chemical prevention techniques or controls for desired suppression, and e) systematically evaluating the pest management approaches utilized.’ IPM offers a menu of options. Each grower must select and adapt practices and methods that work best for their situation. The goal of this document is to guide hemp growers in the production of an uncontaminated product while providing a safe workplace environment for workers and to support compliance with state and federal regulations while helping growers prevent and manage pest-associated losses and minimize risks of product contamination.

Note: Throughout this document the term ‘pest’ refers to any living organism posing unacceptable levels of risk and includes but is not limited to insects, mites, plant pathogens, mold and mildew, weeds, birds, and other animals. Furthermore, under Maine law, a pesticide is any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest and includes disinfectants, insecticides, herbicides, fungicides, plant regulators, defoliant and plant desiccants.

About Best Management Practice for Pesticide Use in Hemp in Maine

Under Maine law, a pesticide is defined as any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest and includes disinfectants, insecticides, herbicides, fungicides, plant regulators, defoliant and plant desiccants. Pesticides should be used only in conjunction with non-chemical methods, when non-chemical methods have failed to keep pests below acceptable levels, and only used when and where needed. Use insecticides only against those pests for which effective natural enemies are not available. Ensure any pesticides used are compatible with natural enemies. **Home-made pest control substances (including**

food-based solutions) are not permitted. Use, store and dispose of pesticides only in accordance with state and federal regulations including the following:

- Pesticides may only be used in strict accordance with the product label requirements including, but not limited to directions pertaining to application, storage and disposal of the pesticide product.
- State pesticide regulations can be found at <http://www.maine.gov/dacf/php/pesticides/laws.shtml>.
- Pesticide products must be registered with, and not prohibited for the intended usage by, the Maine Department of Agriculture, Conservation and Forestry Board of Pesticides Control pursuant to Title 7, section 607, and must be used in a manner consistent with these BMPs approved by the Commissioner of Agriculture, Conservation and Forestry.
- Ensure pesticide application equipment is properly calibrated.
- Do not apply any pesticides on flowering plants. Avoid application of any liquid products on late flowering plants to avoid mold and mildew contamination of product.
- Application of nutrients or pesticides through an irrigation system (chemigation) must be performed in accordance with federal, state and local agricultural regulations.
- Disposal of wastewater or growing media containing pesticides or nutrients must be performed in accordance with federal, state and local agricultural regulations.
- Home-made pest control substances (including food-based solutions) are not allowed.

About Integrated Pest Management

Integrated pest management (IPM) is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. The basic components of IPM are 1) accurate identification of pests and pest-caused damage, 2) pest prevention, 3) systematic pest monitoring, 4) reliance on combinations of biological, mechanical, cultural, or other pest prevention and mitigation methods to keep pests at or below acceptable levels, and 5) documentation and periodic review. Each of the pest prevention and pest management tactics listed in this document have been shown to be effective under certain conditions, however the specific set of tactics selected by a grower may vary depending on the pests encountered, cultivation systems used, economic factors and other conditions.

IPM Step 1: Know Your Pests

Can you tell the difference between a winged green peach aphid and a fungus gnat? Does it matter? Yes! Just as different cultivars of plants have different characteristics, different species of pests vary in their habits so different strategies may be needed to manage them and prevent their recurrence. Knowledge is power when it comes to managing pests.

- Use a good hand-lens to get up close and personal. Take a photo with a macro-lens, then enlarge it for a closer look.
- Learn to recognize common pests and their damage. Compare your pest with images and descriptions on trusted websites or in books to correctly identify insects, mites and plant diseases. A valuable hemp insect fact sheet can be found here: <https://hempinsects.agsci.colostate.edu/hemp-insects-text/>

IPM Step 2: Prevent Pests.

Design and maintain fields and indoor facilities to prevent introduction and spread of pests while promoting good plant health and worker safety. Establish and use sanitation protocols to prevent the introduction and spread of arthropod pests and pathogens within the plot field or facility.

Provide optimal growing conditions to promote healthy plant growth, encourage natural enemies and minimize pest-conducive conditions.

- Design and maintain outdoor grow sites and indoor facilities to provide good moisture control and drainage.
- Design and operate indoor facilities to permit isolation and sanitation processes necessary to minimize the risks of introduction, establishment and spread of pests.
- Control weeds within and immediately surrounding the outdoor grow site or facility. Weeds provide harborage and food for pests and obstruct air movement.
- Keep cultivation and processing areas free of plant debris, empty pots, and unused equipment. Do not use cultivation areas for storage.
- Control mold, mildew and algae in cultivation and processing areas.
- Sterilize propagation tools before each cut by dipping them in disinfectant solution and rinsing with sterile water.
- Train workers in all appropriate biosafety protocols such as inspecting and brushing off clothing, disinfecting shoes and tools, and washing hands before entering or moving between different cultivation areas. Train workers to start in the cleanest, most pest-free plants or sites first, progressing to infested or less protected sites while working. Avoid moving from infested areas into uninfested areas.
- Keep hose nozzles off the floor/ground.
- Avoid reusing growing media. Heat-sterilize any media which has been open or exposed to microbes or other pests. Keep growing media in sterile, sealed containers until used.
- Disinfect pots or other containers before use.
- Select pest-tolerant and disease-resistant cultivars if available.
- Provide adequate spacing around each plant to prevent them from touching one another to prevent pest movement among plants and to allow adequate air circulation. Prune foliage if needed to allow good air movement among plants and to prevent plants from touching one another.
- Avoid foliar applications of carbohydrate-based products such as molasses-based fertilizers, flavorings, leaf washes, leaf shines, and other products that can promote mold and mildew and adulterate the crop.

- Use tools such as soil tests and foliar analysis to determine an appropriate nutrient program. Use electrical conductivity (EC) meter to formulate and test nutrient solutions. Use EC readings or the “pour through” method to monitor salt levels in the growing medium.
- Test water source for presence of carbonates and other minerals that can interfere with maintaining proper pH.
- Maintain optimal moisture level in growing medium. Overwatering promotes insect pests and plant disease. Inspect and maintain irrigation equipment to ensure optimal delivery of water and nutrients. Water at the base of the plant taking care to avoid splashing and wetting foliage.
- **In indoor facilities:**
 - If you are a large indoor operation provide facilities for workers to change into clean clothing before entering facility and to shower and change clothing at the end of their workday. Provide hair nets, hats, beard covers, or other effective hair restraints to workers to reduce risk of pests being transported into and within the facility.
 - Operate ventilation, fans, heating/cooling and lighting systems to keep humidity, light and temperatures at optimal levels that support plant growth and natural enemies while discouraging pests. For pre-flowering plants, maintaining relative humidity at 50% or less reduces risk of plant diseases and spider mites while encouraging spider mite predators. Ventilate to minimize condensation and encourage air exchange, at sunset if possible.
 - Create positive airflow to direct air out of growing spaces, not into them.
 - Screen openings where possible. Seal all cracks and crevices to prevent entry by insects, mites, birds, rodents, or other animals. Seal all gaps around exterior doors with weather stripping, door sweeps, and/or properly adjusted thresholds.
 - Design growing spaces to allow them to be periodically emptied and thoroughly cleaned and disinfected between crops.
 - If growing in pots, install tables or benches made of material that allows air flow and which can be cleaned and disinfected, such as wire or mesh, to support pots above the floor.
 - Cover floors with material that can be cleaned and disinfected, permits drainage, and discourages weed and algae growth.
 - Keep floors, tables and benches, and other surfaces clean and dry. Eliminate standing water. Disinfect and repair irrigation/chemigation systems.

IPM Step 3: Systematically Monitor Pests and Plant Health.

Scouting, or methodically checking plants in each section of the outdoor grow site or facility on a regular basis, is a key element of IPM.

- Learn to identify common pests and beneficial organisms. Get an accurate identification of any new insect, mite, weed, disease or other organism encountered.

- Develop pest-monitoring protocol for each section of each outdoor grow site or facility.
- Thoroughly inspect plants at least weekly. Look for insects, mites, and diseases or signs of plant stress and/or damage such as off-color, thin or missing foliage, irregular growth, or holes or stippling on leaves. In a small crop, you can check every plant. In a large crop, walk through the crop in a zig-zag pattern, stopping to look closely at 5 randomly selected plants located in 5-10 representative locations throughout the facility. Pay special attention to plants that tend to get pests early (indicator plants) and those located closest to the outside edge of the plot, or if indoors those closest to doorways and vents.
- Keep records of what you find. Count and record the numbers of each species of pest counted per trap or plant. Record the numbers of natural enemies, such as ladybugs, too. When you find something, record what, where, when, how many and any action taken. Record findings with a tablet, clipboard or camera.
- For indoor cultivation, monitor insects with sticky cards, check cards weekly, record numbers of each insect species found on cards and change when needed. Cards can be used to for early detection and location of pest ‘hot spots’ so that timely action can be taken to more closely inspect for and manage pests.
- Train employees in all pest prevention, detection, identification, monitoring and record-keeping protocols.

IPM Step 4: Use Combinations of Tactics to Keep Pests at or Below Damaging Levels.

Pest prevention and control methods can be grouped into biological, mechanical, cultural, or chemical methods. Using a diverse array of tactics provides the most effective, long-lasting defense against pests. Minimize or eliminate the use of pesticides to avoid pest resistance, protect natural enemies, safeguard workers, and ensure product quality.

- Use appropriate methods for weed control. Outdoors, control weeds within and immediately surrounding cultivation area by hoeing, hand-pulling, mulching, or other appropriate methods. For indoor operations, mow, burn, or hand-pull vegetation or install landscape fabric to keep vegetation 1-2 feet away from building exteriors. Indoors, hand-pull weeds or install weed barrier material.
- Consider biological methods (such as the use of beneficial organisms), cultural methods (such as controlling temperature and humidity to avoid and control pests), mechanical methods (such as pest traps, pruning, or hand removal of pests). If using natural enemies, purchase from reputable source, and release them using recommended rates, intervals and procedures. Some organisms are prohibited in Maine. For a list of allowed and ‘unrestricted’ organisms see <https://www.maine.gov/ifw/docs/unrestrictedspecies.pdf>

IPM Step 5. Evaluate Your Program Regularly.

Review your records often to determine where your trouble spots are, when they tend to occur, what processes were effective in preventing and controlling pests and where improvements are needed.

- Keep detailed insect and disease monitoring records. Record dates and numbers of each species of pest and beneficial organism found while scouting the crop.
- Record dates, and numbers of each species of pests caught in traps or on sticky cards.
- Record all steps taken to manage pests. If beneficial organisms are released, record species, source, release dates, numbers released, and release methods used.
- Fertilizers, watering, potting soil, and environmental conditions can be important to your pest management program. Record all cultivation processes used including nutrient records, seed and clone sources, disinfectant records, watering records, type and source of growth media used, types, sizes and sources of pots and other growth containers. Include fertilizers used (rates, nutrient analysis, product name, method of application) and daily environmental conditions (temperature, humidity and lighting regimes). Track and evaluate what methods worked and which didn't. Modify practices and adapt new strategies as needed.

About Chemigation/Fertigation Practices

Chemigation is the application of any substance or combination of substances intended as a pesticide, plant or crop protectant or a system maintenance compound applied with irrigation water. **Fertigation** is the application of any commercial fertilizer, nutrient soil amendment, or reclaimed water with irrigation water.

Two common irrigation systems are:

- **Drip irrigation.** This is a method of “micro-irrigation,” meaning low pressure and low volume. Water is applied to the soil surface or below the soil surface as drops or small streams through emitters.
- **Hydroponics.** With this method plant roots are immersed in a mineral nutrient solution or in an inert medium, such as perlite, gravel, sand, growstones, biochar, mineral wool, expanded clay pebbles, or coconut husk, referred to as a medium culture. System design can vary, ranging from periodic injection with a manually controlled system to a continuous-flow solution monitored by sensors. Regardless of the method, applying pesticides or plant nutrients through an irrigation system is subject to rules and laws that govern chemigation and fertigation.

What to consider when using chemigation/fertigation

The benefits of chemigation and fertigation can include:

- Increasing the efficiency of how plants absorb many chemicals.
- Decreasing chemical use.
- Increasing the uniformity of chemical application.
- Increasing fertilizer availability.
- Applying amount and at a time based on plant need.
- Reducing risk to pollinators and other beneficial organisms.
- Increasing safety to the operator, workers and bystanders.

However, there are also drawbacks. The most serious threat from these practices, especially chemigation, is contamination of the water supply. To prevent groundwater and surface water contamination, install backflow prevention and spill-containment equipment, and take precautions to avoid runoff and leaching. Other considerations include:

- More safety equipment and required training.
- Corrosion of irrigation equipment by chemicals.
- Need for additional irrigation water to apply chemicals or to flush the injection/irrigation systems.
- Algae growth, iron-metabolizing bacteria, and other factors that can plug emitters.
- Risk of surface runoff or deep leaching without proper management resulting from water applied during chemigation and fertigation.

Operators of chemigation and fertigation should have a high competency level and skill set. Operator skill is needed to detect and avoid:

- Chemical incompatibility that can change solution solubility, increase plant phytotoxicity, or jeopardize chemical effectiveness;
- Change in nutrient availability; and
- Mineral precipitates from poor water quality or product solubility.

The operator must be able to calibrate and operate equipment, manage wastewater discharge, salinization (electrical conductivity) of the solution requiring specialized treatment or disposal, and acidification of the (inert or soil) substrate. Operators may also be required to keep Maine pesticide application records and comply with the federal Worker Protection Standard.

The goal of a chemigation or fertigation system is to apply the proper amount of a chemical at the appropriate time to the target area in a safe, effective, and uniform manner. However, not all irrigation systems are suitable for applying chemicals. An effective application system depends on uniformly applying the recommended amount of water throughout the application site. Furthermore, safety devices must be properly designed, installed, and maintained to prevent contaminating the source water and injection site. Take precautions to avoid surface runoff or deep infiltration, to minimize exposure from chemical residue, and to manage hazardous waste.

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