



 HAWTHORNE™

# INTEGRATED PEST MANAGEMENT

for U.S. CBD Hemp Growers in Controlled Environments



Plant depicted is hemp.





Plant depicted is hemp.

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Plant depicted is hemp.

## HAWTHORNE GARDENING COMPANY AND INTEGRATED PEST MANAGEMENT

A definition of **Integrated Pest Management (IPM)** was first adopted in 1975 by a Food and Agriculture Organization Panel of Experts. IPM was defined as *“a pest management system that, in the context of the associated environment and the population dynamics of the pest species, utilizes all suitable techniques and methods in as compatible a manner as possible and maintains the pest population at levels below those causing economic injury.”*

Pest control—namely of insects, diseases, and mites—can be a challenge when growing in grow rooms and greenhouses, as pests can flourish in these environments much more than outdoors given the highly consistent conditions present. Good pest control starts with Integrated Pest Management. Today, the basic concept is to use several tactics to control insects and diseases, rather than the previous thinking of only a single solution such as chemical products.

A team of Hawthorne pest control experts created the following Technical Guide to help growers succeed with CBD Hemp pest management. Here we applied IPM principles to CBD Hemp and provided sound practical advice and recommended products that a grower can use immediately to address pest problems. This program has been developed for U.S. commercial growers and

hobbyists and will continue to evolve building upon the latest insights, product facts and testing results for insect and disease management.

Hawthorne Gardening Company is North America’s largest, most comprehensive provider of controlled environment, hydroponic products and services. Hawthorne manufactures and provides lights, nutrients, growing media, sanitation, pest control, airflow, hardware and many more products with best-in-class brands including Gavita®, General Hydroponics®, Botanicare®, Hurricane® and Grower’s Edge®. Our supply chain, sales force and technical services team enable us to serve growers of various sizes, from commercial professionals to hobbyists. Our goal is to enable all growers to seize today’s unprecedented opportunities and build the industry of tomorrow.

*Hawthorne Gardening Company*

**Disclaimer:** When using this guide for recommendations on treating plant pest issues, you must always verify and follow any and all product label directions for use as required by federal and state laws.

# 5 STEPS OF INTEGRATED PEST MANAGEMENT (IPM)

As the name suggests, an Integrated Pest Management program does not solely rely on the use of pesticides to control pests, but rather it combines a variety of cultural practices and tools to more efficiently manage insects and diseases while minimizing the use of chemicals and their related costs. A successful pest control program focuses on the following 5 areas:



## 1. PLANT GROWTH ENVIRONMENT

Maintaining conditions for optimal plant growth while also discouraging pest development. Accounts for proper: light, airflow, temperature, humidity, irrigation and fertilization.

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## 2. SANITATION AND PEST BARRIERS

Effective use of tools and actions that keep the growing environment clean and free of pests.

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## 3. CULTURAL PRACTICES THAT HELP WITH PEST PREVENTION AND CONTROL

Growing methods that reduce pest levels or decrease the rate of pest development.

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## 4. PEST SCOUTING AND MONITORING

Process of identifying and assessing pest pressure over time and corresponding crop performance to evaluate economic risk.

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## 5. PESTICIDES AND CBD HEMP GROWTH STAGES

Use of appropriate pesticides to repel, kill or inhibit pest development.



# 1. PLANT GROWTH ENVIRONMENT

Providing an optimum environment that favors healthy plant growth and discourages pests is a critical tactic of IPM. Many growers underestimate the role that temperature, humidity, and airflow have on pests and their ability to attack and thrive.

## LIGHT

CBD Hemp is a high light-intensity plant. Having appropriate light is essential to growing healthy plants. Growers typically target photosynthetically active radiation (PAR) between 800-1000  $\mu\text{mol}/\text{m}^2/\text{s}^2$  at the plant level to get vigorous plant growth. Light deficiency weakens the plant defense system and makes the plant more susceptible to pests.



Gavita Pro 1700e LED



Gavita Pro E-Series 1000e DE Slim Line

## TEMPERATURE

Maintaining an appropriate range of temperature during the plant cycle is important to avoid plant stress and increased plant susceptibility to pests. Generally, air temperatures of 78° F to 85° F in the vegetative and flowering stages are best during the day, while temperatures of 68° to 75° F are best during the night. Soil temperatures of 72° F to 75° F are best for healthy rooting clones. Temperatures that are too high or too low will reduce photosynthesis, which will decrease growth and productivity as well as make plants less able to tolerate pests. Some arthropod species such as the two-spotted spider mite (*Tetranychus urticae*), which is a typical pest of CBD Hemp in controlled environments, is known to increase its reproductive rate under hot conditions. If plants are also drought-stressed, this pest will further thrive and potentially damage growth irreversibly.



Quest IQ Unitary HVAC Compressor Wall Series



Quest IQ Unitary HVAC Evolution Series





## HUMIDITY

Carefully controlled humidity is fundamental to preventing plant diseases. Plants transpire significantly, especially toward the end of the growing cycle. Maintaining balanced humidity in the room can help prevent disease from growing in damp environments. For example, high humidity within the plant canopy can promote spores of powdery mildew to germinate and grow on the leaf. University researchers suggest the optimal temperature and humidity ranges which encourage powdery mildew outbreaks are 68° F to 77° F and >55% RH. In general, disease-causing fungal pathogens are more active and cause greater damage as humidity increases.

## AIRFLOW

Constant airflow, especially within the plant canopy, affects many critical aspects of plant growth. Airflow around the leaf increases transpiration rates, nutrient uptake, humidity and carbon dioxide levels at the leaf surface. Airflow modeling, adequate fans, and proper plant spacing are critical to provide good, uniform airflow when growing thousands of plants side by side in greenhouses and indoors.

## CO<sub>2</sub> ENRICHMENT

CO<sub>2</sub> enrichment is a common practice in commercial production that is used to increase plant photosynthesis. As a result, plants show increased dry weight, plant height, number of leaves and lateral branching. The optimal CO<sub>2</sub> concentration for growth and yield seems to lie between 800 and 1000 ppm during the vegetative stage and between 1000 and 1200 ppm during flowering. To be effective, CO<sub>2</sub> enrichment must be appropriately coupled with light, fertility and irrigation. The majority of growers use bottled CO<sub>2</sub> for purity and consistency, but some use CO<sub>2</sub> generators that burn fuel to produce the gas. If the air/fuel mixture is off, it can create contaminants (i.e. ethylene) that can cause strange symptoms in the crop and potentially significant damage.

Consult with your Hawthorne Gardening Company technical services representative for further information, tips and recommended products.



Titan Controls® Atlas® 3



Titan Controls® Atlas® 1



## 2. SANITATION AND PEST BARRIERS

Sanitation is the process of keeping places inside and outside the growing space free from insects and diseases by removing weeds, dirt, algae, debris, waste, trash and garbage. Pests can come into the growing facility through a variety of means such as the ventilation system, small openings or by hitching a ride on visitors. Insects, mites, fungal spores and other disease pathogens can find refuge in weeds around or inside the growing space as well as in discarded plant material, growing media and on dirty surfaces. Proper sanitation will help remove these unwanted pests, and help prevent them from ever entering your grow in the first place. Consider taking the following precautions to maintain proper sanitation in your space.

### TO PREVENT PESTS FROM ENTERING YOUR FACILITY:

- Wear personal protective equipment (PPE) when working, to protect people and plants from transporting unwanted materials such as fungal spores or minute insects like mites or aphids from one grow room to another.

#### → RECOMMENDED PRODUCTS:

- Grower's Edge® Bodysuit
- Grower's Edge® Nitrile Gloves
- Grower's Edge® Shoe Covers

- Clean your pruning devices or any equipment coming into your growing area, including pots and trays.

#### → RECOMMENDED PRODUCTS:

- Alchemist® H2O2 Liquid Oxygen 34%
- Alchemist® Isopropyl Alcohol 99.9%
- Scissor Fix - tool cleaner w/ 70% Isopropyl Alcohol
- Fiberlock Technologies Shockwave Disinfectant & Cleaner

- Use physical barriers to prevent pests like aphids, beetles, leafminers, moths and more from entering the facility.

#### → RECOMMENDED PRODUCTS:

- Black Ops® Bug Screens (Refer to page 11 for an in-depth description)

- Place a compost pile at least 30 ft away from the growing facility to prevent pests from infesting or re-entering the grow facility.

- Maintain a weed-free environment inside and surrounding the growing facility to help prevent pests as well. Mites and aphids tend to feed on a variety of weeds so applying herbicides as needed is important to reduce the risk of major outbreaks.



## TO PREVENT THE SPREAD OF PESTS WITHIN FACILITIES:

- Clean all surfaces of the growing facility at the end of each growth cycle because insects, eggs, fungal spores and other diseases can survive on surfaces and will infest your next crop.

### → RECOMMENDED PRODUCTS:

#### *Hard Surfaces*

- Alchemist® H2O2 Liquid Oxygen 34%
- Alchemist® Isopropyl Alcohol 99.9%
- Fiberlock Technologies Advanced Peroxide Cleaner
- Fiberlock Technologies Shockwave™ Disinfectant & Cleaner

#### *Tools / shoes*

- Scissor Fix - tool cleaner w/ 70% Isopropyl Alcohol
- Harvest More® Scissor Scrubber (add your own cleaner)
- Grower's Edge® Cleanroom Sticky Mat

- Drain, clean and flush irrigation lines regularly. Lines and reservoirs that are not kept clean will develop a build-up over time.

### → RECOMMENDED PRODUCTS:

- Alchemist® H2O2 Liquid Oxygen 34%
- General Hydroponics® FloraKleen®
- Botanicare® Clearex® Salt Leaching Solution

- Clean each pruning device before use on a new plant. Diseases can be transferred by the blades, and insects can travel via tool handles.

### → RECOMMENDED PRODUCTS:

- Scissor Fix tool cleaner w/ 70% Isopropyl Alcohol
- Fiberlock Technologies Shockwave™ Disinfectant & Cleaner




- Properly isolate and remove infested plants and all debris so that your crop will remain healthy and you can prevent outbreaks.

# HAWTHORNE SANITATION PRODUCTS




PRODUCT	WHAT	WHEN	WHY
 <p><b>Alchemist® H2O2 Liquid Oxygen</b></p>	<p>Concentrated Hydrogen Peroxide for cleaning hydroponic equipment, materials and grow areas.</p>	<p>Use when crop cycle has ended and grow room needs to be cleaned of all dirt and debris.</p>	<p>Versatile product with strong oxidizing properties that make it a powerful cleaner. Reacts instantly through an oxidation process that produces a high foaming action which lifts the material to the surface.</p>
 <p><b>Alchemist® H2O2 Isopropyl Alcohol</b></p>	<p>Concentrated isopropyl alcohol that will aid in removal of saps and grunge from scissors, blades and equipment quickly and easily.</p>	<p>Use when crop cycle has ended and grow room needs to be cleaned of all dirt and debris.</p>	<p>Isopropyl alcohol dissolves a wide range of non-polar compounds and evaporates quickly and leaves nearly zero oil traces.</p>
 <p><b>Fiberlock Technologies Advanced Peroxide Cleaner</b></p>	<p>Aggressively removes stains.</p>	<p>Use when crop cycle has ended and grow room needs to be cleaned of all dirt and debris.</p>	<p>Aggressively removes stains and odors on porous, semi-porous, and non-porous materials. Reacts instantly through an oxidation process that produces a high foaming action which lifts the material to the surface.</p>
 <p><b>Fiberlock Technologies Aftershock</b></p>	<p>EPA registered antimicrobial coating designed to kill residual mold and mildew that remains after pre-cleaning contaminated surfaces.</p>	<p>Use when mold and mildew are a concern.</p>	<p>Inhibits the future growth and spread of mold and mildew on the cured film surface. This extremely durable, easy-to-apply, 100% acrylic sealant offers the ultimate in durability in combination with excellent fungicidal characteristics.</p>
 <p><b>Fiberlock Technologies Shockwave™ Disinfectant &amp; Cleaner</b></p>	<p>EPA registered disinfectant, sanitizer and cleaner.</p>	<p>Between grow cycles, but after all surfaces have been cleaned but are in need of disinfecting and sanitizing.</p>	<p>Specifically formulated to be used on both porous and non-porous materials. It has over 130 organism kill claims including many pathogenic and environmental microbial organisms.</p>
 <p><b>Harvest More® Scissor Scrubber</b></p>	<p>A tool scrubber that lets you use your choice of cleaner.</p>	<p>Whenever you use hand tools, especially scissors and pruners on plants.</p>	<p>Your scissors and snips work best when they're clean.</p>
 <p><b>Grower's Edge® Cleanroom Sticky Mat</b></p>	<p>36" x 24" sticky door mat for capturing dirt, dust, and debris from shoes.</p>	<p>Every time you enter a grow room.</p>	<p>Effectively captures dirt and dust from foot traffic and equipment wheels before they enter a cleanroom or controlled environment.</p>



## HAWTHORNE SANITATION PRODUCTS (CONTINUED)

PRODUCT	WHAT	WHEN	WHY
 <p><b>General Hydroponics® FloraKleen®</b></p>	A flush solution for removing nutrient residues from hydroponics systems.	Monthly to purge your hydroponic system or potted plants of excess salts. Also excellent for final flush.	Removes fertilizer residues that can accumulate over time in hydroponic systems, growing media and potting soils.
 <p><b>Botanicare® Clearax® Rinsing Salt Solution</b></p>	Isotonic drenching solution that unlocks the ionic bond between the nutrient and the soil or soilless grow substrate	<p><b>Soil Containers and Gardens:</b> Every seven to 21 days.</p> <p><b>Hydroponic Systems:</b> Use Clearax with every one to two reservoir changes.</p>	Correct the problem of nutrient salt toxicity and lockout.
 <p><b>Black Ops® Bug Screens</b></p>	Active carbon inserts to keep most bugs and pollutants from entering grow rooms.	Use at any phase of plant growth	Easy fix to prevent insects from entering the growth space.

## HAWTHORNE PPE PRODUCTS

PRODUCT	WHAT	WHEN	WHY
 <p><b>Grower's Edge® Bodysuit</b></p>	Full body suit	Every time you enter a grow room.	Protect people and plants from transporting unwanted materials from one grow room to another.
 <p><b>Grower's Edge® Nitrile Gloves</b></p>	Disposable nitrile gloves (latex and powder free) that are highly resistant to puncture, solvents and grease.	Every time you enter a grow room.	Protect people and plants from transporting unwanted materials from one grow room to another.
 <p><b>Grower's Edge® Shoe Covers</b></p>	Disposable covers for boots and shoes.	Every time you enter a grow room.	Ideal for keeping contaminants out of your grow room.



### 3. CULTURAL PRACTICES THAT HELP PEST PREVENTION AND CONTROL

A successful pest management program does not solely rely on the use of chemical products. There are a few cultural practices that, if properly and constantly implemented during the entire plant cycle, can have a significant role in helping to prevent pest problems from starting or reduce their rate of development and spread.

#### IRRIGATION

Maintaining optimal levels of irrigation encourages healthy sustained plant growth which aids the plant in defending against or recovering from pest attacks. Avoid wetting plant foliage when watering to minimize the spread of diseases. Some disease spores must have moisture on the leaves for a certain period of time in order to germinate, grow and infect plant tissue. Keeping leaves dry helps stop this. If leaves must be wet due to watering, for example, do it at a time of day when leaves can dry quickly.



#### FERTILIZATION

Maintaining proper fertility also encourages healthy sustained plant growth, which makes the plant more tolerant to pests. Plant stress can occur from underfeeding as well as overfeeding. Thus, balancing inputs to plant growth is important to one's IPM strategy. If underfed, plants may not be able to develop natural defenses to sufficiently cope with pest infestations, while overfeeding may promote the insurgence of some insect and mite outbreaks due to the greater availability of nitrogen.



#### ELECTRICAL CONDUCTIBILITY (EC) AND PH MONITORING

Electrical conductivity (EC) is the measure of total dissolved salts in a solution, which influences a plant's ability to absorb water and nutrients. Monitoring the EC level is a common practice in controlled environments that ensures fertility levels are where they need to be to maintain healthy plants. Lower-than-optimal EC readings typically indicate a nutrient deficiency, especially low levels of nitrogen. High EC levels can indicate you are supplying too much fertilizer or that your plants are not absorbing the nutrients, both of which can lead to a salt-toxicity leaf burn. The presence of too high or too low salt levels is a sign that adjustments are needed before damage shows up in plants and pests take advantage of stressed and less vigorous plants. Recommended EC ranges depend on the growth stage, the growing system, irrigation level, and water quality.

Measuring the pH or relative acidity or alkalinity of soils is important because the pH influences the availability of essential nutrients to the plant. The recommended substrate pH for CBD Hemp plants varies widely. A recommended substrate pH of 5.5 to 6.5 is typically cited as an acceptable range for many plants including CBD Hemp. Substrate pH levels below 5.0 result in increased micronutrient availability that can lead to iron toxicity or manganese toxicity, or both. When the substrate pH becomes too high, plants can develop interveinal chlorosis on the youngest leaves due to unavailability of certain micronutrients such as iron.

#### PLANT VARIETIES / STRAINS

Growing CBD Hemp strains that are known to be more tolerant to common pests of controlled environments may help with preventing the rise and development of infestations. Stay informed of new varieties with pest resistance through Hawthorne and local university extension services.



## PLANT SPACING

Spacing plants will help optimize light reception and air circulation while decreasing chances of pests spreading from a hot spot to neighboring, healthy plants. On the other hand, growers want to push productivity by using high plant densities, so it's a trade-off between pest prevention, risk and plant productivity. Plant spacing varies with growing style—vertical racking is usually around 1 plant per square foot, whereas indoor bench systems commonly have 1 plant per 2 square feet.

## PRUNING

In addition to properly spacing plants, pruning on a recurrent basis will further promote light distribution within the canopy and airflow. Removal of sections of a plant that have been infested by a pest will also help decrease the spread of it to other sections of the plant and to neighboring plants. Make sure to sterilize the pruning devices when moving from one plant to a new one as they can vector insects and diseases from unhealthy to healthy plants.

## BIOLOGICAL CONTROL

Encourage natural control of insects and mites by preventatively releasing predatory insects or parasitoids. The former kills the pests by feeding on them, whereas the latter lives in close association with its host at the host's expense, eventually resulting in the pest's death. To decrease soil-borne insects such as fungus gnats and pupating thrips larvae, early releases of the predatory mite *Stratiolaelaps* will help as it feeds on these insects at their larval stage. *Amblyseious fallacis* is another predatory mite which instead feeds on broad mites and other eriophyid mites, pests that typically infest the plant canopy. To name a few other beneficials, if you experience aphid problems, use the predatory midge *Aphidoletes aphidimyza*. To kill whiteflies instead, perform early releases of the parasitic wasps *Encarsia formosa* or *Eretmocerus eremicus*. As a rule of thumb, make sure to take advantage of beneficial insects at the starting of the plant vegetative phase as, once plants' buds have become sticky in late flowering, beneficial insect application becomes tricky and inefficient. If relying on beneficials to keep pest populations low but there is a need of pesticide application to quickly decrease the pest infestation level, it is recommended to do a hot spot treatment rather than spraying the whole crop. Use sprays with low residual such as insecticidal soaps (General Hydroponics Exile), bioinsecticides (General Hydroponics Defguard, Marrone Bio Innovation Regalia CG Biofungicide) or oil-based pesticides (Nuk Em, General Hydroponics Azamax).



Adult predatory mite *Stratiolaelaps* (top)  
Adult parasitic wasps *Encarsia formosa* (bottom)

## INOCULUM OF BENEFICIAL MICROBES

The microbes associated with plant roots are in two classes: disease-causing pathogens and plant-beneficial types. The beneficials can aid plants in many ways, some help break down organic matter and deliver nutrients, some produce hormones which increase rooting, certain types can rapidly colonize soil and outcompete pathogens for resources, while others even produce compounds that protect plants by inhibiting pathogens.

## MOTHER PLANT CARE

A mother plant is a plant that is grown specifically for cloning purposes and is kept in the vegetative state. Mother plants can harbor pests which can go unnoticed and be vectored to a new production cycle by using infested cuttings collected from an infested mother plant. It is recommended to not take cuttings from a mother plant which is showing symptoms of a pest infestation as this has a high likelihood of transmitting the pest to the offspring. Also, avoid keeping the mother plants alive for longer than 3-4 months prior to swapping it out as they become woody, loose vigor and become more susceptible to pests. Finally, it is best to use smaller mother plants to obtain more vigorous and uniform cutting material. Younger and smaller plants are also easier to scout for presence of pests.



## 4. PEST SCOUTING AND MONITORING

Two of the most important practices in IPM are frequently looking for early signs of insects and diseases (scouting) and tracking the severity of the infestation over time (monitoring). These are accomplished by random plant inspections throughout the production area and by the use of sticky card traps. Scouting and monitoring help make it possible to identify pest issues and catch them early, when combined with quickly taking action with the most appropriate control measures.

### TIPS AND RECOMMENDED PRODUCTS FOR SMART SCOUTING:

- Know the pests that commonly affect CBD Hemp grown in controlled environments, their life cycles, symptoms and the injury they cause to the plants. We've included a description and images of major insects and diseases of CBD Hemp and their symptoms on the next few pages for reference.
- Scout for the presence of pests on a daily basis. Search for typical plant injury and symptoms caused by a pest infestation. Randomly select plants across the room and lift a few leaves from the bottom, middle and upper third of the plants. Closely check for presence of pests. Special attention should be paid to buds and blooms. Use a hand lens or a microscope to help identify the pest.

#### → RECOMMENDED PRODUCTS:

- Grower's Edge® Illuminated Magnifier Loupe 40x
  - Grower's Edge® Illuminated Microscope 60x-100x (Greater magnification level than the model above)
  - Grower's Edge® Universal Cell Phone Illuminated Microscope with Clip 60x
- Walk every aisle and move from bench to bench in a snake-like or zig-zag pattern. At least 10 minutes should be spent inspecting 20 or more plants for every 1,000 square feet of production area. Follow the same pattern every time scouting occurs.
  - Scouting should start at a main doorway, as this is often where disease and pest problems begin. Special attention should also be paid to plants around any other openings.
  - If necessary, mechanically remove and dispose of infested sections of plants. Sanitize any pruning device before using on a new plant. Consult pages 10-11 for recommended Hawthorne sanitizing products.





## TIPS AND RECOMMENDED PRODUCTS FOR SMART MONITORING (CONTINUED):

- Use sticky card traps to monitor the severity of infestation from flying insects such as fungus gnats, winged aphids, thrips, whiteflies and adult leafminers. Yellow sticky card traps tend to be more attractive to aphids, whiteflies and fungus gnats, while blue traps are more effective for trapping thrips and adult leafminers.

### → RECOMMENDED PRODUCTS HAWTHORNE STICKY CARD TRAPS:

- Sensor Cards Yellow Monitoring and Trapping Cards
  - Grower's Edge® Aphid Whitefly Sticky Traps
  - Grower's Edge® Thrips & Leafminer Sticky Traps
- Traps should be placed in a grid-like fashion, with at least one card per 1,000 square feet of production area. Place traps just above the plant canopy and maintain the same position every time old traps are replaced by new ones. This allows for accurately determining the increase or decrease of pest populations as the production season ensues.
  - Check the cards at least twice a week and replace them approximately every 1-2 weeks, depending on the severity of the infestation. Make sure to identify, count and record the number of captured insects prior to discarding the cards.
  - Keep track of the severity of the pest infestations over time. Take note of where in the growing space the infestation arises and its corresponding spread to neighboring plants.

# MAJOR CBD HEMP PESTS IN CONTROLLED ENVIRONMENTS

Since greenhouse conditions allow rapid development of pest populations, early detection and diagnosis of pest insects are necessary to make control decisions before the problem gets out of hand and you suffer economic loss. Some common and important greenhouse arthropod pests to keep a close watch for are: aphids, fungus gnats, thrips, whiteflies, root aphids and mites. The most frequently observed diseases are: powdery mildew, botrytis, pythium and fusarium. Below is a description of each pest and corresponding symptoms to look for.



## APHIDS

Aphids (Hemiptera: Aphididae) are a typical insect pest of greenhouses which feed on a wide variety of plants by piercing leaf cells and sucking out their contents by means of their stylets. Aphids are commonly small (3 mm - 5 mm in length), most have a pear-shaped body and may or may not have wings. Winged individuals increase when there is the need to leave the plant due to overcrowding or a decline in food quality. Aphids are also known for vectoring plant viruses and releasing relatively large amounts of honeydew waste product, which is fairly visible on plant leaves as translucent, wet spots, which feel sticky when touched. Aphids usually occur in colonies located mainly on the undersides of leaves, on stems or clustered nearby buds. If a Hemp plant becomes heavily infested, its leaves can turn yellow and/or wilt due to the excessive stress and leaf damage. Presence of translucent honeydew spots also can be found, as well as white skin residue left behind by nymphs. Development of fungal diseases can also occur in correspondence to honeydew accumulation spots.

Adult and juvenile aphids (top) and aphid exuviae, the cast-off outer skin of aphids after a moult (bottom).



## THRIPS

Thrips (Thysanoptera: Thripidae) are a severe insect pest of greenhouses which feed on a wide variety of plants by piercing surface cells of leaves and sucking out the cell contents by means of their stylets. Thrips are also known for vectoring plant tospoviruses such as the impatiens necrotic spot and tomato spotted wilt virus. Females have a high reproductive capacity, a rapid life cycle which allows for multiple generations per year, and tend to reside in cryptic habitats such as unopened terminals, making control practices difficult. Thrips are minute, slender-bodied insects (1 mm - 1.2 mm long) with four narrow wings folded flat over the back and fringed with hair. Toward the end of the second larval stage, the thrips stop feeding and drop or enter the soil or leaf litter. Winged adults then emerge from the pupal stage in 1 to 3 days, depending upon temperature. Thrips like to feed on buds and new leaves, where they pierce plant cells with their mouthparts and suck out their contents, but they can also be found at the bottom of the plant. Contrary to spider mites, thrips tend to feed more often on the upper leaf surface of plants. Bronze or silvery leaf scars and tiny black spots of fecal excrements are evident on leaves with heavy-feeding injury.

Adult and juvenile thrips



## WHITEFLIES

Whiteflies (Diptera: Aleyrodidae) are white, soft-bodied, winged insects with a triangular shape, and are often found in clusters on the undersides of leaves. Whiteflies use their piercing, needlelike mouthparts to suck sap from phloem, the food-conducting tissues in plant stems and leaves. Large populations can cause leaves to turn yellow, appear dry, or fall off plants. Like aphids, whiteflies excrete a sugary liquid called honeydew, so leaves may be sticky or covered with black sooty mold that grows on honeydew.



Adult whiteflies (left) and crawlers (right)

## ROOT APHIDS

Root aphids (some Pemphigus, Phylloxera, and Rhopalosiphum species) vary in color, but most are white, whitish yellow or brown. Root aphids have piercing, sucking mouthparts that extract sugar-rich sap from underground structures such as roots, bulbs and rhizomes. They can produce a white, waxy secretion that covers their body and some is left behind as they move through the growing medium. This is often mistaken for mealybugs that are also covered with a white waxy or threadlike substance. It is best to use a hand lens and observe the roots to see the actual insect. Minor infections of root aphids do not cause significant plant damage, however, as the populations increase, wounds in plant roots can become entry points for root disease pathogens. Plant roots cannot take up nutrients and therefore can exhibit nutrient deficiencies in the leaves. Plants often have a lack of vigor, are smaller and can wilt, especially during the heat of the day. Root aphids do not travel rapidly, so infections are often restricted to a few plants and spread slowly initially.



Adult root aphids infesting a plant (left) and root aphids emerging from the soil as resources become more limited (right)

## FUNGUS GNATS

Fungus gnats (Bradysia species) are small, delicate-bodied flies that develop in the growing medium. Adults are 3 mm long, delicate, black flies with long legs and antennae. Adults do not feed while larvae primarily feed on fungi, algae and decaying plant matter as well as plant roots. The larvae are wormlike and translucent, with a black head capsule. Larvae usually are located in the top 2 to 3 inches of the growing medium, depending on moisture level. Larvae develop rapidly and are fully grown in two to three weeks. Moist growing media containing high amounts of peat moss are particularly attractive to adult females. Plants infested by numerous fungus gnat larvae can have stunted growth. The best way to determine if you have a fungus gnat infestation is by using sticky card traps and monitoring the number of captured adult individuals.



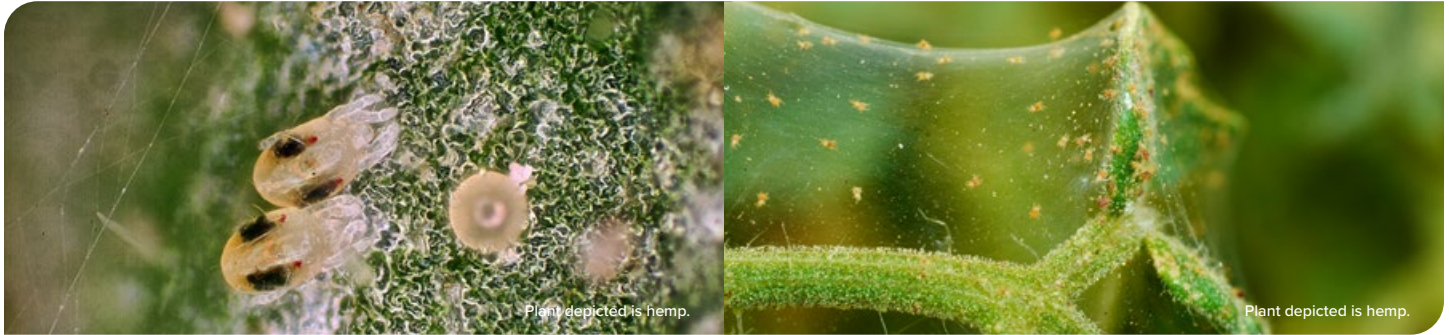
Fungus gnat adult (left) and larvae (right)



## MAJOR CBD HEMP PESTS IN CONTROLLED ENVIRONMENTS (CONTINUED)

### SPIDER MITES

Spider mites (Acari:Tetranychidae) such as the two-spotted spider mite (*Tetranychus urticae*) are arthropods that feed on a variety of plant species by sucking the plant cell content through a pair of sharp stylets. Spider mites are tiny (approximately 0.5 mm in length) arachnids with 8 legs and a cream color appearance. Populations can develop exponentially in a very short period of time. Eggs are laid in clusters on the underside of leaves. The initial stage of colonization commonly starts from the bottom third of the plant. Injury initially appears as stippling or yellowish-reddish brown spots on the leaves which are located in correspondence of the colony clusters typically found on the underside of the leaf. Leaves initially turn yellow and, with high population density, desiccate and die. On mature plants, branches above the main canopy and directly under growing lights are more likely to become infested with spider mites.



Adult two-spotted spider mite (left) and webbing (right).

### HEMP RUSSET MITES (HRM)

HRM (Acari: Eriophyidae) is a specialist pest of Hemp and it feeds primarily on petioles and leaflets. HRM specifically feed on the surface layer of plant cells, piercing them with their minute mouthparts and feeding on the cell fluids. HRM have a very different appearance than spider mites; they do not produce webbing nor are visible with a naked eye. HRM are soft-bodied, sausage-shaped, exceptionally tiny, with two pairs of legs and no wings. Contrary to spider mites, which can be seen with the naked eye, HRM require a higher level of magnification to be visible (15-20x). In enclosed areas, fans or even splashing water can quickly spread mites. No visible symptoms are produced when HRM are in low populations, but a range of subtle symptoms develop during outbreaks. Leaflets generally curl at the edges and may have a glossy wet look similar to heat stress. Leaves may have yellow or bronze spotting. Petioles become brittle and leaflets break off easily. In bad infestations, the mites crowd plants by the thousands and give leaflets a beige appearance. HRM also infests flowering tops.

### BROAD MITES (BM)

BM (Acari: Tarsonemidae) are an important pest of a wide variety of plants, including CBD Hemp. The mite commonly attacks young, growing plant parts and, similar to HRM, is very difficult to detect. They are colorless at first but become a rich amber when fully developed. Dispersal occurs through crawling, air currents and water. BM are often found on young leaves and feed mostly on the under-surface of leaves. Infested plants become unthrifty. Leaves curl downward due to the mite's saliva being toxic to plants, and take on a glossy, almost plastic-like appearance. Eventually affected leaves turn yellow or bronze and die. Internodes shorten and lateral buds break more than normal. This new growth may also be stunted or killed, which forces out additional shoots. Sometimes the symptoms can be confused for tobacco mosaic virus. Similar to HRM, leaf symptoms from BM are also commonly misdiagnosed as overwatering, a nutrient deficiency or heat damage.

### POWDERY MILDEW

Powdery mildew is the most destructive CBD Hemp pest. It is an obligate pathogen meaning it only lives on the plant and cannot be grown on a culture plate. When it begins, this disease is often invisible to a grower. It tends to emerge, sporulate and spread any time from early vegetative growth phases through flowering, thus destroying very mature crop with severe economic consequences. It is believed to travel in clones, and it is not known if it travels in seeds. It appears as patches of white spores on the surface of leaves, thrives at temperatures between 68° to 77° F and >55% RH, and can cause early leaf drop and reduce flower bud quality.



White patches of powdery mildew





## BOTRYTIS / GREY MOLD

Gray mold is caused by *Botrytis cinerea*, a necrotrophic fungus that can cause severe damage to CBD Hemp and thrives at 68° to 77° F and relative humidity greater than 55%. *B. cinerea* produces several cell wall-degrading enzymes and toxins that degrade tissues and can also infect plant wounds caused by insects or pruning. The fungus produces gray-white masses of mycelium and spores on the surface of affected tissues. Gray mold can cause brown, water-soaked lesions on all portions of the plant, including stems, leaves, and especially flowers. Leaves and flowers start to shrivel and turn tan, red or brown as severity increases and masses of gray spores may become evident.

Gray-white masses on a diseased flower and spores

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## PYTHIUM

The pathogens that are responsible for Pythium root rot, also known as water mold, are present in practically all cultivated soils and attack plant roots under wet conditions. There are many species of Pythium that vary widely. These fungi can be spread by fungus gnats and shore flies, and soil moisture conditions of 70% or higher are conducive to infection by Pythium. Pythium infects juvenile tissues such as the root tip and may spread to the entire primary root, which eventually dies causing the plant to wilt and stop growing. Sanitation is important because Pythium spp. can survive in dust, planting media, or soil particles on greenhouse floors and in flats and pots. Pythium causes young cuttings and seedlings to wilt even when watered and eventually collapse and die.

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## FUSARIUM

Fusarium wilt is caused by two closely related fungi, *Fusarium oxysporum* f. sp. *vasinfectum* and *Fusarium oxysporum* f. sp. *Hemp*. Spores are most often found in soil, and can be spread by contaminated water or infected seeds. Once it infects a plant, it travels through the vascular system where the spores and mycelia clog up the xylem, causing the plant to wilt and die from lack of water. Symptoms include leaf yellowing, spots on lower leaves and wilted stems appear brown inside.







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Grower's Edge® Thrip and Leafminer Sticky Traps (see page 20)



Plant depicted is hemp.

# PRODUCTS FOR PEST SCOUTING AND MONITORING

PRODUCT	WHAT	WHEN	WHY
 <p><b>Grower's Edge® Illuminated Magnifier Loupe 40x</b></p>	<p>Powerful 40x lens with an on/off switch for two LED lights.</p>	<p>Useful at any time of the plant cycle.</p>	<p>Helps to quickly scout for pests.</p>
 <p><b>Grower's Edge® Illuminated Microscope 60x-100x</b></p>	<p>A very powerful illuminated pocket microscope offering adjustable magnification from 60x-100x.</p>	<p>Useful at any time of the plant cycle.</p>	<p>Ideal for a more in-depth observation of pests.</p>
 <p><b>Grower's Edge® Universal Cell Phone Illuminated Microscope with Clip 60x</b></p>	<p>This microscope can be clipped onto any smartphone or mobile phone that is equipped with a camera. Images can be taken with your camera and stored in your smartphone's photo library.</p>	<p>Useful at any time of the plant cycle.</p>	<p>Images can be taken with your camera and stored in your smartphone's photo library.</p>
 <p><b>Grower's Edge® Aphid Whitefly Sticky Traps</b></p>	<p>Yellow sticky card traps to monitor flying insects such as fungus gnats, aphids, and whiteflies.</p>	<p>Use during plant growth and flowering.</p>	<p>Yellow traps are more attractive to fungus gnats, aphids, and whiteflies.</p>
 <p><b>Grower's Edge® Thrip and Leafminer Sticky Traps</b></p>	<p>Blue sticky card traps to monitor flying insects such as thrips and leaf miners.</p>	<p>Use during plant growth and flowering.</p>	<p>Blue traps are more attractive to thrips and leaf miners.</p>
 <p><b>Sensor Cards Yellow Monitoring and Trapping Cards</b></p>	<p>Yellow sticky card traps to monitor flying insects such as fungus gnats, aphids, and whiteflies.</p>	<p>Use during plant growth and flowering.</p>	<p>Yellow traps are more attractive to fungus gnats, aphids, and whiteflies.</p>





## 5. PESTICIDES AND CBD HEMP GROWTH STAGES

The use of pesticides to repel, kill or inhibit the development of pests depends on the plant growth stage and the type of pest that is being targeted. The majority of the active ingredients that are currently federally approved for use on hemp or are allowed by the states work best when used at the first signs of pest infestations. Insects and diseases are difficult to control once they spread widely, as more disease spores are produced and more insects hatch Hawthorne offers product solutions that can be used preventatively or to cure existing infestations.

When choosing to use pesticides to prevent or treat insects or diseases, it is a good rule of thumb to switch to a different pesticide after 3 consecutive product applications to reduce the risk of pest acquired resistance. When the label allows tank mixing, make sure to check the product label for pesticides that are not compatible.

If no information is available regarding compatibility, perform a jar test to evaluate the compatibility of different pesticides. If the materials are physically compatible, the jar will be cool to the touch and there will be no separation of materials or forming of clumps or emulsions. If the mixture is incompatible, the jar may be warm or hot to the touch; layers may form in the mixture; or sludge, clumps or grains may form in the mixture. If the mixture passes the jar test, spray the treatments on a small number of plants and look for symptoms of phytotoxicity for at least 7 to 10 days. If no injury is observed, the mixture can be applied to all plants. The most appropriate chemical management of pests is discussed below for each of the following plant growth stages:

### PROPAGATION



Plant depicted is hemp.

Method of generating new plants from seeds, cuttings, stems or leaves to create clones genetically identical to the donor plant. This process ensures an all female, genetically uniform crop.

### VEGETATIVE GROWTH



Plant depicted is hemp.

The period of growth between germination and flowering during which plants are busy carrying out photosynthesis and accumulating resources that will be needed for flowering and reproduction.

### MOTHER PLANTS



Plant depicted is hemp.

A plant that is grown specifically for cloning purposes and is kept in the vegetative state.

### FLOWERING








Plant depicted is hemp.

Plants begin flowering when the light cycle changes from 16+ hours of light to 12 hours of light and 12 hours of complete darkness. In this stage, buds form and ripen, and pistils darken in preparation for harvest.

## PERSONAL PROTECTIVE EQUIPMENT FOR PESTICIDES

Growers should always wear the recommended and required personal protective equipment as defined by the product label when mixing, applying and discarding pesticides. Below is a list and a brief description of Hawthorne Personal Protective Equipment.

PRODUCT	WHAT
 <p data-bbox="253 982 418 1035"><b>Grower's Edge® Bodysuit</b></p>	<p data-bbox="483 911 899 936">Protection against Type 4/5/6 chemicals:</p> <p data-bbox="483 940 911 966">Type 4 = Spray-tight type liquid chemicals</p> <p data-bbox="483 970 943 995">Type 5 = Airborne solid particulate chemicals</p> <p data-bbox="483 999 954 1024">Type 6 = Limited protection against liquid mist</p>
 <p data-bbox="99 1142 261 1194"><b>Grower's Edge® Nitrile Gloves</b></p>	<p data-bbox="483 1136 1468 1188">Disposable nitrile gloves (latex and powder free) that are highly resistant to puncture, solvents and grease.</p>
 <p data-bbox="272 1352 435 1404"><b>Grower's Edge® Shoe Covers</b></p>	<p data-bbox="483 1356 889 1381">Disposable covers for boots and shoes.</p>
 <p data-bbox="185 1724 370 1776"><b>Grower's Edge® Respirator Masks</b></p>	<p data-bbox="483 1577 954 1602">NIOSH-approved N95 disposable respirators.</p>
 <p data-bbox="123 1944 399 1997"><b>Grower's Edge® &amp; Method Seven Safety Glasses</b></p>	<p data-bbox="483 1799 1430 1852">Spectrum specific safety glasses with full UV protection which meet ANSI Z87.1 American National Standards.</p>

## RECOMMENDED PESTICIDES IN PROPAGATION

Propagation can be a vulnerable time for your facility, as you are bringing in new plants and material. It is a good rule to quarantine any plant material brought in from outside the facility prior to being introduced into the growing room, and to conduct a treatment application against insects, mites and diseases even if you don't see any pest or related injury. Some insects hide in the soil, other insects and spores from fungal disease are so tiny that they cannot be detected with a hand lens, and some insects like thrips even embed eggs inside the leaf tissues.

### → RECOMMENDED PESTICIDES FOR DISEASE CONTROL:

*Via drench application (for the control of soil-borne pests)*

- General Hydroponics® Defguard
- Blacksmith Bioscience Armory Beneficial Bacillus
- Actinovate® L & G Fungicide

*Via foliar application*

- General Hydroponics® Defguard

### → RECOMMENDED PESTICIDES FOR INSECT AND MITE CONTROL:

*Via drench application (for the control of soil-borne pests)*

- The Amazing Doctor Zymes Eliminator
- SNS 209 Systemic Pest Control

*Via foliar application*

- NPK Mighty

### → WE RECOMMEND THIS ALL-IN-1 PESTICIDE FOR INSECT, MITE AND DISEASE CONTROL:

*Via drench for soil-borne insects and foliar application*

- Green cleaner

### → WE RECOMMEND ANY OF THESE MICROBIAL INOCULANTS TO ENHANCE PLANT UPTAKE OF CERTAIN NUTRIENTS:

*Via drench application*

- Xtreme Gardening Azos
- Blacksmith Bioscience Nytrix Nitrogen Fixing Bacteria
- Blacksmith Bioscience Megaphos

## RECOMMENDED PESTICIDES FOR MOTHER PLANTS AND VEGETATIVE GROWTH STAGE

Proper pest prevention is also achieved by using pesticides to avoid major outbreaks of insects and diseases. It is recommended to apply pesticides at the first signs of pest infestations as small infestations can be more easily controlled than large ones. It is also recommended to conduct the majority of the treatment applications during this growth stage, as plants become more susceptible to phytotoxicity from pesticides and the risk of residue in the final product increases during flowering. Growers must refer to product labels when spraying during the vegetative growth stage to ensure the harvest date is not impacted by the pesticide application. Hawthorne offers product solutions that can be used preventatively or to cure existing infestations.

- Pesticides for Preventing and/or Repelling Pests:

### → FOR THE PREVENTION OF DISEASES:

*Via drench application*

- General Hydroponics® Defguard

*Via foliar application*

- General Hydroponics® Defguard
- Actinovate® L & G Fungicide
- Marrone Bio Innovations Regalia CG Biofungicide



→ **FOR THE PREVENTION OF INSECTS AND MITES:**

*Via foliar application*

- Marrone Bio Innovations Grandevo CG Insecticide
- Marrone Bio Innovations Venerate CG Bioinsecticide
- NPK Industries Mighty

*Via foliar and drench application (for soil-borne pests)*

- General Hydroponics® AzaMax
- SNS 203 Concentrated Pesticide Soil Drench/Foliar Spray
- SNS 209 Systemic Pest Control
- PyGanic Specialty

→ **FOR THE PREVENTION OF ALL THE PESTS MENTIONED ABOVE:**

*Via foliar and drench application (for soil-borne pests)*

- Green Cleaner
- Flying Skull Nuke Em
- The Amazing Doctor Zymes Eliminator

■ Pesticides for Reducing Pest Infestations:

→ For the control of insects and mites:

*Via foliar and drench application (for soil-borne pests)*

- General Hydroponics® AzaMax
- PyGanic Specialty

→ For the control of diseases, insects & mites:

*Via foliar application*

- General Hydroponics® Exile

*Via foliar and drench application (for soil-borne pests)*

- Green Cleaner
- Flying Skull Nuke Em

## RECOMMENDED PESTICIDES FOR FLOWERING PLANTS

Treating flowering plants for pests can be more complicated than treating vegetative plants, as plants in bloom are more susceptible to injury from pesticides and there is a greater risk of contamination and/or alteration of the properties of the final product. **It is common practice to not spray past the second or third week of flowering.** If using pesticides during flowering, avoid spraying the blooms while using a fine droplet size, or use an atomizer, which can help mitigate potential phytotoxicity of the flowers.

■ We recommend any of the following products during flowering to control existing pest infestations:

→ **FOR THE CONTROL OF INSECTS AND MITES:**

- General Hydroponics® Defguard

→ **TO CONTROL INSECTS AND MITES VIA FOLIAR AND DRENCH APPLICATION (SOIL-BORNE PESTS):**

- General Hydroponics® AzaMax

→ **TO CONTROL ALL OF THE PESTS MENTIONED ABOVE:**

*Via foliar application*

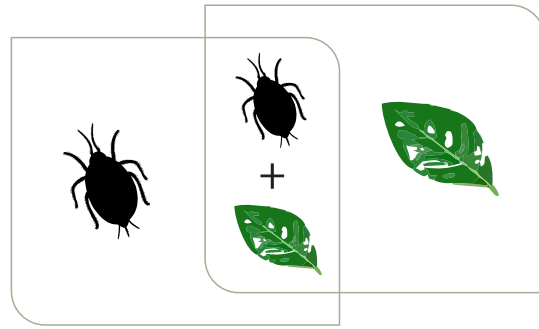
- General Hydroponics® Exile
- Flying Skull Nuke Em
- The Amazing Doctor Zymes Eliminator

*Via drench application for soil-borne pests*

- Flying Skull Nuke Em
- The Amazing Doctor Zymes Eliminator

# SUMMARY OF PESTICIDES BY GROWTH STAGE

## TREATMENTS



- ▶ The Amazing Doctor Zymes Eliminator
- ▶ SNS 209 Systemic Pest Control
- ▶ NPK Industries Mighty

- ▶ Green Cleaner

- ▶ General Hydroponics® Defguard
- ▶ Actinovate L & G Fungicide
- ▶ Blacksmith Bioscience Armory Beneficial Bacillus

## SEEDLING/CUTTING STAGE



Plant depicted is hemp.

## VEGETATIVE STAGE

- ▶ General Hydroponics® AzaMax
- ▶ Marrone Bio Innovations Grandevo CG Insecticide
- ▶ Marrone Bio Innovations Venerate CG Bioinsecticide
- ▶ SNS 203 Concentrated Pesticide Soil Drench/Foliar Spray
- ▶ SNS 209 Systemic Pest Control
- ▶ PyGanic Specialty
- ▶ NPK Industries Mighty

- ▶ Green Cleaner
- ▶ Flying Skull Nuke Em
- ▶ The Amazing Doctor Zymes Eliminator

- ▶ General Hydroponics® Defguard
- ▶ Marrone Bio Innovations Regalia CG Biofungicide



Plant depicted is hemp.

## FLOWERING STAGE

- ▶ General Hydroponics® AzaMax

- ▶ General Hydroponics® Exile
- ▶ Flying Skull Nuke Em
- ▶ The Amazing Doctor Zymes Eliminator


- ▶ General Hydroponics® Defguard
- ▶ Marrone Bio Innovations Regalia CG Biofungicide




Plant depicted is hemp.




## HAWTHORNE PESTICIDE PRODUCT HIGHLIGHTS / SNAPSHOT

PRODUCT		WHAT					WHEN			WHY		
 <p><b>General Hydroponics® AzaMax</b></p>		<p>OMRI listed insecticide, miticide and nematicide that kills a wide variety of pests and acts as an antifeedant, growth inhibitor and anti-oviposition. Works best against immatures.</p>					<p>Apply at any plant growth stage as a preventative or a curative treatment every 7 to 14 days.</p>			<p>EPA registered product that is labeled for use on hemp as a foliar or drench application.</p>		
Federally approved for hemp	OMRI listed	Spider mites	Broad mites	Russet mites	Aphids	Root aphids	Whiteflies	Thrips	Fungus gnat larvae	Fungus gnat adults	Powdery mildew	
YES	YES	YES	YES <sup>1</sup>	YES <sup>1</sup>	YES	NO	YES	YES	YES	YES	NO	

<sup>1</sup>The label does not cite the pest species name but it does cite the generic group “mites.”

PRODUCT		WHAT		WHEN		WHY	
 <p><b>General Hydroponics® Defguard</b></p>		<p>An IPM foundational product, this broad spectrum biofungicide has been extensively tested and used across many plant types. Multiple modes of action work to protect against different foliar and soil pathogens of CBD Hemp.</p>		<p>Best applied preventatively every 3 to 7 days when disease pressure is high and at 10 to 28 days when pressure is low.</p>		<p>EPA registered disease control product labeled for use on hemp as a foliar application or drench. Colonizes soil to provide a favorable and competitive addition to the microbial community.</p>	
Federally approved for hemp	OMRI listed	Powdery mildew	Botrytis	Pythium			
YES	YES	YES	YES	SOME			

PRODUCT		WHAT					WHEN			WHY				
 <p><b>General Hydroponics® Exile</b></p>		<p>OMRI listed contact insecticide, miticide and fungicide kills a wide variety of pests and powdery mildew through desiccation (rapid drying). Works best on immatures and soft-bodied insects.</p>					<p>Apply curatively at any plant growth stage every 7 to 14 days consecutively up to three times. Additional applications may occur if no injury is observed during previous applications.</p>			<p>EPA registered product that is labeled for use on hemp as a foliar application.</p>				
Federally approved for hemp	OMRI listed	Spider mites	Broad mites	Russet mites	Aphids	Root aphids	Whiteflies	Thrips	Fungus gnat larvae	Fungus gnat adults	Powdery mildew	Botrytis	Pythium	
YES	YES	YES	NO	NO	YES	NO	YES	YES	NO	YES	NO	NO	NO	

## TARGETED INSECTS, MITES AND DISEASES BY PRODUCT

This table shows the insects and mites targeted by each of the insecticides recommended in this document. Before using this table, make sure to always read the product label and ensure that the pesticide is federally approved for use on hemp. If the pesticide is not federally approved for use on hemp, it has to be registered in your state and allowed for use on hemp. Also, read the product label to validate if you are lawfully allowed to use the product as some pesticides are registered for residential use only, while others are registered for commercial use and cannot be utilized by non-licensed applicators. Visit [hawthornegc.com](http://hawthornegc.com) for a more detailed summary of regulatory state and federal requirements.







<b>PRODUCT</b>	<b>OMRI listed</b>	<b>Spider mites</b>	<b>Broad mites</b>	<b>Russet mites</b>	<b>Aphids</b>	<b>Root aphids</b>	<b>Whiteflies</b>	<b>Thrips</b>	<b>Fungus gnat larvae</b>	<b>Fungus gnat adults</b>	<b>Powdery mildew</b>	<b>Botrytis</b>	<b>Pythium</b>
<b>General Hydroponics® AzaMax</b>	YES	YES	YES <sup>1</sup>	YES <sup>1</sup>	YES	NO	YES	YES	YES	YES	NO	NO	NO
<b>PyGanic Specialty</b>	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	NO	NO	NO
<b>Marrone Bio Innovations Grandevo CG Insecticide CG</b>	YES	YES	NO	YES	YES	NO	YES	YES	NO	NO	NO	NO	NO
<b>Marrone Bio Innovations Venerate CG Bioinsecticide CG</b>	YES	YES	YES <sup>1</sup>	YES <sup>1</sup>	YES	YES	YES	YES	NO	NO	NO	NO	NO
<b>SNS 203 Concentrated Pesticide Soil Drench/ Foliar Spray</b>	NO	NO	NO	NO	NO	YES	YES	YES	NO	YES	NO	NO	NO
<b>SNS 209 Systemic Pest Control</b>	YES	YES	NO	NO	NO	YES	YES	YES	YES	YES	NO	NO	NO
<b>NPK Industries Mighty</b>	NO	YES	NO	NO	YES	NO	YES	YES	NO	YES	NO	NO	NO
<b>General Hydroponics® Defguard</b>	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	SOME
<b>Actinovate® L&amp;G Fungicide</b>	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	NO
<b>Marrone Bio Innovations Regalia CG Biofungicide CG</b>	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	YES
<b>General Hydroponics® Exile</b>	YES	YES	NO	NO	YES	NO	YES	YES	NO	NO	YES	NO	NO
<b>Green Cleaner</b>	YES	YES	YES	YES	YES	NO	YES	YES	NO	NO	YES	NO	NO
<b>Flying Skull Nuke Em</b>	YES	YES	NO	NO	YES	NO	YES	NO	NO	NO	YES	NO	NO
<b>The Amazing Doctor Zymes Eliminator</b>	YES	YES <sup>1</sup>	YES <sup>1</sup>	YES <sup>1</sup>	YES	YES	YES	YES	YES	NO	YES	NO	NO

<sup>1</sup> The label does not cite the pest species name but it does cite the general group “mites”



APPENDIX

# PESTICIDES FOR INSECT, MITE AND DISEASE CONTROL AND FOR THE ROOTZONE BIO-ACTIVATION

PRODUCT	WHAT	WHEN	WHY
 <p><b>General Hydroponics® AzaMax</b></p>	<p>OMRI listed insecticide, miticide and nematocide that kills a wide variety of pests and acts as an antifeedant, growth inhibitor, anti-oviposition. Works best against immatures.</p>	<p>Apply at any plant growth stage every 7 to 14 days.</p>	<p>EPA registered product that is labeled for use on hemp as a foliar or drench application.</p>
 <p><b>General Hydroponics® Defguard</b></p>	<p>An IPM foundational product, this broad spectrum biofungicide has been extensively tested and used across many plant types. Multiple modes of action work to protect against different foliar and soil pathogens of CBD Hemp</p>	<p>Best applied preventatively every 3 to 7 days when disease pressure is high, and at 10 to 28 days when pressure is low.</p>	<p>EPA registered disease control product labeled for use on hemp as a foliar application or drench. Colonizes soil to provide a favorable and competitive addition to the microbial community.</p>
 <p><b>General Hydroponics® Exile</b></p>	<p>OMRI listed contact insecticide, miticide and fungicide that kills a wide variety of pests and powdery mildew through desiccation (rapid drying). Works best on immatures and soft-bodied insects.</p>	<p>Apply curatively at any plant growth stage every 7 to 14 days consecutively up to three times. Additional applications may occur if no injury is observed during previous applications.</p>	<p>EPA registered product that is labeled for use on hemp as a foliar application.</p>
 <p><b>SNS 203 Concentrated Pesticide Soil Drench/Foliar Spray</b></p>	<p>Minimum risk pesticide that uses clove and rosemary oil to repel and suppress soft bodied insects.</p>	<p>Apply as a foliar or a drench treatment every 2 to 3 days. Works best as a preventative treatment.</p>	<p>Use the properties of essential oils to repel and suppress insects.</p>
 <p><b>SNS 209 Systemic Pest Control</b></p>	<p>Minimum risk pesticide that uses rosemary oil to repel and suppress soft bodied insects including mites.</p>	<p>Apply as a foliar or a drench treatment every 3 to 4 days. Works best as a preventative treatment.</p>	<p>Use the properties of essential oils to repel and suppress insects.</p>
 <p><b>PyGanic Specialty</b></p>	<p>OMRI listed insecticide and miticide that interferes with the neuronal system of the pest and provides quick kill.</p>	<p>Works well as a preventative or a curative treatment. Use no more than 10 times per season.</p>	<p>EPA-registered product that provides quick knockdown and kills the typical greenhouse pests.</p>

APPENDIX (CONTINUE)

# PESTICIDES FOR INSECT, MITE AND DISEASE CONTROL AND FOR THE ROOTZONE BIO-ACTIVATION

PRODUCT	WHAT	WHEN	WHY
 <p><b>NPK Industries Mighty</b></p>	<p>Fast-killing, ready-to-use insecticide and miticide with ovicidal properties.</p>	<p>Works well as a preventative or a curative treatment. Use as needed but no more than 10 times per season.</p>	<p>EPA registered product that quickly kills by smothering eggs and providing longer control.</p>
 <p><b>Marrone Bio Innovations Venerate CG Bioinsecticide</b></p>	<p>Biological insecticide and miticide that kills many foliar-feeding pests by degrading the exoskeleton and interfering with the molting process leading to mortality by contact or ingestion.</p>	<p>Best if applied as a preventative foliar treatment every 3 to 10 days.</p>	<p>EPA-registered product that uses a living microorganism to suppress pest populations. Works best against immatures.</p>
 <p><b>Marrone Bio Innovations Regalia CG Biofungicide</b></p>	<p>Unique fungicide works by activating a plant's defenses to protect before disease occurs. In addition to combating disease it also strengthens the plant's cell walls and increases chlorophyll production to improve overall quality.</p>	<p>Use every 7 to 14 days before disease occurs. Frequency depends on conditions and disease pressure.</p>	<p>EPA registered product label that offers a different strategy for disease control. Rather than attacking the pathogen, it prepares the plant to ward off infection before disease occurs.</p>
 <p><b>Marrone Bio Innovations Grandevo CG Insecticide</b></p>	<p>Biological insecticide and miticide that functions primarily as a stomach poison for use in the suppression of many foliar-feeding pests.</p>	<p>Best if applied as a preventative foliar treatment every 4 to 10 days.</p>	<p>EPA-registered product that uses a living microorganism to suppress pest populations. Works best against immatures.</p>
 <p><b>Actinovate L &amp; G Fungicide</b></p>	<p>This unique type of soil microbe called an actinobacteria creates a plant-protective barrier to combat fungal and bacterial pathogens.</p>	<p>Apply at establishment and any plant growth stage every 7 to 14 days.</p>	<p>Unique activity works to colonize soil and suppress harmful pathogens from infecting plants.</p>
 <p><b>Green Cleaner</b></p>	<p>Minimum-risk contact insecticide, miticide and fungicide for the suppression of soft-bodied insects and powdery mildew. Kills eggs.</p>	<p>Apply at any plant growth stage as a preventative, or as a curative treatment every 1 to 2 days.</p>	<p>Soybean oil-based pesticide that also is effective against insect and mite eggs. Ideal for preventative pest control.</p>



APPENDIX (CONTINUE)

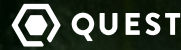
# PESTICIDES FOR INSECT, MITE AND DISEASE CONTROL AND FOR THE ROOTZONE BIO-ACTIVATION

PRODUCT	WHAT	WHEN	WHY
 <p><b>Flying Skull Nuke Em</b></p>	<p>Minimum-risk contact insecticide, miticide and fungicide for the suppression of soft-bodied insects and powdery mildew. Kills eggs.</p>	<p>Apply as a preventative foliar spray or as a drench every 5 to 7 days. Can be used as a curative treatment for minor pest infestations.</p>	<p>Harnesses the excellent properties of citric acid to kill and prevent a variety of pests.</p>
 <p><b>The Amazing Doctor Zymes Eliminator</b></p>	<p>Minimum-risk pesticide that uses citric acid to kill insects, mites and some diseases.</p>	<p>Apply at any plant growth stage as a preventative or a curative treatment.</p>	<p>Uses the properties of essential oils to kill insects, mites and diseases.</p>
 <p><b>Blacksmith Bioscience Megaphos</b></p>	<p>Phosphorus solubilizing bacteria.</p>	<p>Use through all growth phases.</p>	<p>Increases phosphorus availability to plants for better growth and improved yield.</p>
 <p><b>Xtreme Gardening Azos</b></p>	<p>Root-enhancing bacterium, produces plant hormones and fixes nitrogen for aiding growth.</p>	<p>Use at propagation and through vegetative stages.</p>	<p>Increased rooting for growth.</p>
 <p><b>Blacksmith Bioscience Nytrix Nitrogen Fixing Bacteria</b></p>	<p>Nitrogen fixing bacteria can convert atmospheric nitrogen into plant-available forms.</p>	<p>Use through all growth phases.</p>	<p>Better plant nitrogen-use efficiency.</p>
 <p><b>Blacksmith Bioscience Armory Beneficial Bacillus</b></p>	<p>Blend of beneficial microbes designed to optimize growth.</p>	<p>Use through all growth phases.</p>	<p>Colonizes the rootzone with beneficial microbes for disease suppression and nutrient cycling.</p>



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