BRITISH COLUMBIA

Ministry of
Environment and
Climate Change Strategy

Integrated Pest Management for Commercial Cannabis in BC

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What is the role of the province in pest management?

Pesticides are used in almost all sectors, including cannabis production. Pesticide use is regulated by both the federal and provincial governments. The federal government evaluates, regulates and registers the pesticides allowed for use in Canada through the *Pest Control Products Act*. Health Canada's Pest Management Regulatory Agency (PMRA) undertakes this work. The provincial government regulates the sale, transport, storage, disposal and application of pesticides in BC through the *Integrated Pest Management Act* and Regulation. This is done through the Integrated Pest Management Program of the Ministry of Environment and Climate Change Strategy. The Ministry relies on the federal *Pest Control Products Act*, and the expertise of the PMRA, to evaluate and determine acceptable uses for pesticides registered for sale in BC. There is some overlap of responsibilities between these two levels as outlined below. Both federal and provincial compliance officers are involved in inspections at cannabis facilities.

Did you know?

Before a pesticide is registered, it must undergo extensive health and environmental safety reviews and evaluations. If the results of the studies meet the standards of PMRA, the product gets registered. The results and information from these studies are written into a pesticide label, usually in the form of safety instructions and directions for use. Once a pesticide is registered, it is given a registration number, also known as a Pest Control Products Number. Products that do not have this number have not been tested by Health Canada and must not be used.

Federal

- Primary Regulatory Tool: *Pest Control Products Act and Regulation*
- Health Canada's Pest Management Regulatory Agency (PMRA) evaluates and registers pesticides and sets basic use conditions
- Enforces product label use and verifies compliance
- Promotes sustainable pest management
- Provides education

Provincial

- Primary Regulatory Tools: *Integrated Pest Management Act* and Regulation
- Regulates the sale and use of pesticides in BC
- Responsible for training and certifying pesticide applicators and dispensers
- Verifies compliance
- Issues authorizations
- Promotes integrated pest management to reduce unnecessary pesticide use
- Provides education

Cannabis Pest Management

Cannabis is susceptible to many pests, including insects, mites, fungi or bacteria. To date, no viruses have been confirmed. The damage from pests can stunt plant growth and decrease the yield and quality of the final product. A number of pesticides are registered for use on cannabis grown commercially indoors in Canada. They are outlined in Table 1 which can be found on pg. 18. These pesticides may be considered in combination with other techniques as part of an integrated pest management (IPM) program to effectively manage pests in cannabis. This document provides guidance on best practices for pest management for commercial cannabis grown indoors and in greenhouses, and outlines the available chemical and non-chemical control options for pests commonly found in this crop.

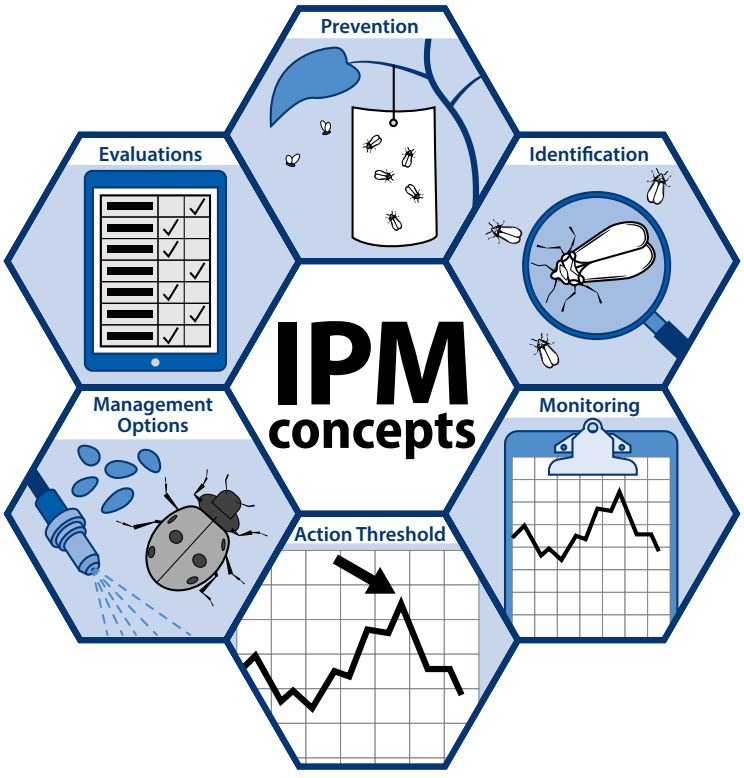

Fig. 1: IPM Components

Integrated Pest Management (IPM)

IPM is a decision-making process for managing pests in an effective, economical and environmentally sound way, which includes six elements:

1) ***Prevention:*** planning and managing production systems to prevent pests
2) ***Identification:*** identifying pests, their damage and their natural enemies
3) ***Monitoring:*** regular monitoring of pest populations, pest damage, beneficial organisms and environmental conditions
4) ***Action Thresholds:*** making control decisions based on potential damage, cost of control methods, value of production, impact on other pests, beneficial organisms and the environment
5) ***Management options:*** may include a combination of behavioral, biological, chemical, cultural and mechanical methods to reduce pest populations and damage to acceptable levels
6) ***Evaluation:*** conducting follow up evaluations to determine the effects and efficacy of management decisions

Prevention

It is essential to focus on pest prevention due to the limited number of registered pesticides for commercial cannabis growers. When pest problems are prevented, the need for other control measures is reduced.

Prevention Strategy: Mother plants

When growing any crop, pest management should start in propagation. Mother plants, also called 'moms' or 'mums', are stock plants used to take cuttings for propagation. Because mother plants are generally kept longer than all other plants in production, they can accumulate pests that are then transmitted through clones or cuttings. A strong focus on keeping mother plants clean is a key pest prevention strategy.

Fig. 2: Mother plants

General prevention strategies

General prevention strategies that can be applied to most pests include the following:

- Choose plant varieties that are resistant to pests and diseases.
- Keep more susceptible plant varieties separate from other varieties to limit the spread of pests.
- Provide good ventilation and air flow in the growing area.
- Use insect netting to screen vented areas to prevent pests from coming in from outside.
- Restrict movement of workers within growing areas to reduce unintentional spread of pests, and always visit areas experiencing the highest amount of pest pressure last.
- Install footbaths at entrances. Maintain them regularly.
- Limit visitors that could unintentionally be carrying pests on their clothing. Provide protective clothing to visitors.
- Inspect all incoming plant materials from outside sources and keep in a quarantined area for a designated period of time to ensure pests do not spread to existing plant material.
- Adopt good sanitation practices. When planting, use sterilized potting media. Tools, pots, trays, pruners, trimmers and any growing shelving should be sterilized between uses.
- Manage nutrients to avoid flushes of lush vegetative growth. This can make plants more susceptible to certain diseases and more attractive to certain pests.
- Maintain a buffer-zone free of weeds and vegetation around the outside of any greenhouse.
- Keep the inside of greenhouses weed-free.
- Avoid bringing house plants into any part of growing facilities.

Fig. 3: Ministry of Environment and Climate Change Strategy compliance staff wearing protective clothing provided by the facility

Identification

Pests must be correctly identified to select appropriate control treatments. Learning about the pest's behaviour and life cycle will guide decisions on when to take action, what techniques to use to reduce the number of pests, and how to prevent pests from entering production facilities. An overview of common pests of cannabis, their characteristics and typical signs of damage can be found throughout this document.

Monitoring

Always monitor for pest populations, beneficial organisms and environmental conditions that can cause pest problems. Regular monitoring allows an early detection of pests and provides the information required to make decisions about the timing and location of treatments and whether they are necessary. Monitoring programs include weekly inspection for pests or signs of their presence. It is also important to monitor for natural enemies of pests to determine if pest control is being achieved. For some insect pests, counts caught in traps are used to estimate pest populations. A person dedicated to IPM monitoring is recommended.

Fig. 4: Loupe/hand lens

Fig. 5: Monitoring for pest and biological control levels

Monitoring Tools

- *Loupe (starting at 10X magnification)*
- *Sticky traps*
- *Sealable sample bags*
- *Flagging tape*
- *Microscope*
- *Scouting record sheets/maps (or app)*

Action Thresholds

Action thresholds are set by determining how much damage is acceptable, and when the best time is to control the pest. This will vary with each pest and the type of control method used. In cannabis, regulatory testing requirements regarding contamination in the final product have resulted in low pest tolerances. Despite this, no official thresholds have been established for cannabis pests in B.C. It is up to the grower to set appropriate thresholds based on the pest and crop combination, their specific conditions and continuous evaluation of their IPM program.

Management Options

Pest management options for cannabis often include a combination of, cultural, physical, biological and chemical controls:

Control Strategies

- **Cultural controls** include choosing resistant varieties, providing proper plant nutrition, pruning and sanitation. *Many cultural control methods are carried out as part of normal crop production operations.*
- **Physical controls** include mechanical methods such as traps, screens or *barriers.*
- **Biological controls** use organisms that are natural enemies of pests, such as beneficial insects, nematodes and mites.
- **Chemical control** includes use of registered pesticides. *These may be synthetic or naturally derived pesticides, insect growth regulators or microbrial products (commonly referred to as biopesticides).*

Fig. 6: Yellow sticky rolls used for mass trapping are an example of a physical control

Fig. 7: Sanitized equipment room with restricted entry is an example of a cultural control

Fig. 8: Burning Sulphur for powdery mildew is an example of a chemical control

Fig. 9 : Commercially available *Orius indisious* is an example of a biological control used for thrips

Pesticide Information

Many pests of cannabis are common agricultural and greenhouse pests with a broad host range. Unlike other agricultural and greenhouse grown crops, pesticide control options in cannabis are more restrictive. There are unique health considerations with pesticide residues on a crop that can be ingested, processed into concentrates, or burned and inhaled. Health Canada has additional data requirements to complete the associated risk assessments before approving a pesticide for use on this crop.

The PMRA considers industrial hemp and cannabis as two distinct crops. Although cannabis and industrial hemp are from the same genus (*Cannabis*) and species (*sativa/indica*), the cultivation practices are very different. The distinction between crops applies to pesticide application. Pesticides registered for cannabis cannot be used on industrial hemp, and vice versa, unless the label indicates such uses are approved. In certain climates, industrial hemp is grown indoors for a part of the crop cycle. Despite this, it is still considered industrial hemp, and products registered for use on cannabis grown commerically indoors cannot be used.

Pesticides must be registered by Canada in order to be used in Canada. All updated registrations for pesticides for use on cannabis in Canada can be found on the PMRA site by searching "cannabis." To search all labels, please use this link: *http://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php* or download the PMRA label search app. An overview of the current registered products for cannabis grown commerically indoors can be found in Table 1 at the end of this document.

Fig. 10: PMRA label search app

Considerations when working with Biological Controls

Biological controls work well in contained areas and are commonly used in indoor and greenhouse cannabis production. As these are living organisms with unique characteristics, follow the use requirements and application instructions to ensure success. Some considerations when working with biological controls include:

- Mode of action: Many biological controls only work for certain species or life stages of the pest, so correct pest identification is required for success. To control the various stages of a pest, more than one type of biological control will often be necessary.
- Prevention: It is much easier to control pests when they are present in low numbers. While some biological controls are used curatively, many are preventive.
- Dispersal: flying biologicals can readily move about, but wingless species will need to be released where the pests are, and their dispersal is more limited. If plants are not touching, do not expect them to move easily from plant to plant.
- Conditions: As these are living organisms, release as soon as possible after they arrive and follow the provided temperature guidelines.
- Release rates: Suppliers of biological controls will provide the recommended release rates, usually per meter squared. Unlike some other long term greenhouse crops where biological controls can have the opportunity to reproduce and develop over the course of the crop, successive weekly releases of biologicals are necessary in cannabis due to the short growing cycle.
- Compatibility: When pesticides are used, they should be chosen for compatibility with biological controls. Refer to the pesticide label or check with the biological control supplier for compatibility information.

Biological controls can come packaged in many forms. Loose biologicals in bottles or buckets come with carriers that serve to protect the live product while shipping. Typical carriers include sawdust or vermiculite. When spread on the crop, carriers can develop fungal growth that spreads to the plant, or get caught in the buds. Here are some examples of how to keep carrier off of plants:

Fig 11: Product bottle design for application of *Phytoseiulus persimilis* (for two spotted spider mite control) without the carrier.

Fig 12: Boxes with hooks can be filled with loose product and hung on plants.

Fig 13: Rolls of sachets. Sachets contain predatory mites and feeder mites. They come in various forms including rolls/strips to cover large areas and save on labour of application; on a stick/stake to put into growing medium; and on a hook to be hung on the plant.

Evaluation

Conduct follow-up monitoring or inspections to find out how successful the controls have been. Record what worked and what didn't, when pests entered and from where, and keep the records to review and help plan future pest prevention and management activities.

Pests found on foliage and flowers

Pest Damage Terms

Stippling – spotted damage on leaves

Russeting – bronzing or dulling of plant material

Distortion – unusual growth patterns including twisting or curling of leaves

Pests may vary between locations in British Columbia, and also between indoor and greenhouse grown crops. This section highlights the key pests that are likely to be found on the foliage or flowers of the plant, description of the damage to the plant, key identification features of the pest, and options for how to prevent and control the pest.

Aphids

Description: Aphids range in size depending on species, but generally they are between 1-4 mm in length. They can be seen without the help of a hand lens. Aphids come in a variety of colours. Their bodies are soft and pear shaped. They have 6 legs and long antennae. Aphids also have 2 tubes that stick out of their abdomen called cornicles. They can be winged or wingless.

The cannabis aphid, *Phorodon cannabis*, is found on cannabis. Other aphid species with large host ranges may also be found on cannabis.

Damage: Aphids use their long, straw-like mouthpiece to pierce into the plant and suck out plant sap. This reduces plant vigour and may cause leaf distortion. While feeding, aphids will secrete a sticky substance called honey dew. Honey dew can lead to the development of sooty mold. Aphids can become a problem quickly due to their rapid reproduction.

Monitor: Aphids can be found on the upper leaf, underside of the leaf, in the bud, or on the stem. Look for skin castings, sticky residue or leaf distortion. Use yellow sticky traps to detect winged adults.

Prevention: Do not over apply nitrogen fertilizers as excess nitrogen produces flushes of new growth that are attractive to aphids. Use insect screening when growing in a greenhouse.

Controls:

Physical/cultural: Prune out and dispose of plant tissue with aphids.

Biological: Biological controls commonly used for a broad range of aphid species include both green and brown lacewings, *Chrysopa carnea* and *Micromus variegatus*, the gall midge, *Aphidoletes aphidimyza*, and some species of ladybugs. Specific parasitic wasps can also be used if you know which aphid species is present.

Chemical: Registered pesticides include the active ingredients: canola oil, potassium salts of fatty acids and *Beauveria bassiana*.

Fig. 14: Cannabis aphid

Fig. 15: Aphid skins

Fig. 16: Cornicles

Thrips

Description: Thrips are slender bodied and quite small (around 1-1.5 mm), making them difficult to see. A hand lens will help to see this pest and their key features. Adults have fringed wings. Immature thrips (larvae) are wingless. Eggs are laid within the plant tissue and cannot be seen. Western flower thrips (*Frankliniella occidentalis*) are commonly found in B.C. production facilities, however other species may be present.

Fig. 17: Adult thrips

Damage: Adults and larvae have piercing/sucking mouthparts which they use to suck out the contents of the outer layer of the leaf surface. This feeding damage on leaves causes pale spots called stippling or flecking. At first, it may resemble two spotted spider mite damage. While feeding, thrips will also leave excrement which appears as little black dots. The presence of this excrement allows you to differentiate between thrips and two spotted spider mite damage. Thrips damage can also look like a silver sheen on the leaf. If thrips are feeding on young, tender growth, leaves can appear scarred or distorted as they grow out of the damage.

Fig. 18: Leaf stippling cause by thrips

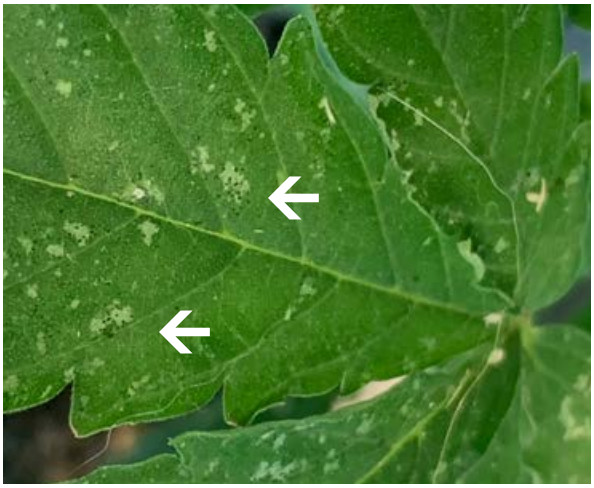

Fig. 19: Close up thrips damage with presence of thrips excrement

Monitor: Use yellow or blue sticky traps to monitor for adults. To monitor for both larvae and adults on a plant, hold a white piece of paper under an area of the plant and tap the plant several times. If thrips are present on the plant, this will dislodge thrips onto the paper where they can then be seen more easily.

Prevention: Do not reuse potting mix between crops as many thrips species pupate in the soil. Generally adult thrips fly in through vents or are carried into the greenhouse on plant material. Use screens on vented areas and inspect new plant material entering the greenhouse. Do not wait until you see the first signs of the pest; use biological controls preventively.

Controls:

Physical: Yellow or blue sticky traps can also be used for mass trapping if levels are high. Pheromones for western flower thrips are available and can be used in conjunction with sticky traps. Alternatively, sticky traps embedded with the pheromones are also available. These can be used in enclosed spaces to aid with mass trapping.

Biological: For the young larval stages of thrips, the predatory mites, *Amblyseius cucumeris* and *Amblyseius swirskii* can be used. The minute pirate bug, *Orius insidious*, can be used for adults. For thrips that pupate in the soil, *Stratiolaelaps scimitus* (*Hypoaspis miles*) and *Dalotia coriaria* (*Atheta coriaria*) can be used. Nematodes (*Steinernema feltiae*) can be drenched into the soil to help control thrips pupae. Generalist predators, such as both green and brown lacewings (*Chrysopa carnea* and *Micromus variegatus*) will also feed on thrips.

Chemical: Registered pesticides include the active ingredient, *Beauveria bassiana*.

Rule of Thumb: Achieve pest control prior to flower

It is difficult to control pests once the plants are in the flowering stage. Cannabis pest control programs should aim to control pests prior to this stage for the following reasons:

- *Both pests and biological controls can get stuck in the sticky trichomes during flowering. This results in reduced mobility and efficacy of the biologicals.*
- *If certain pests, such as spider mites, are established prior to flowering, biological controls will struggle to catch up prior to harvest. If the two spotted spider mites move into the buds, they can become an issue during drying and result in contamination of the final product.*
- *Foliar pesticides can leave residues on the final harvested product or change the desired flavour profile (for example, sulphur can change flavour of the product).*
- *Water soluble pesticides that are applied as foliar applications can create moist conditions on plant surfaces that could lead to the development of fungal diseases.*

Two Spotted Spider Mites (*Tetranychus urticae*)

Description: Two spotted spider mites are very small; a hand lens will help to see them. They have 8 legs. Their oval body is a cream-yellow and they have 2 dark spots on either side of their abdomen. Eggs will often be found alongside the two-spotted spider mites. The eggs are perfectly round.

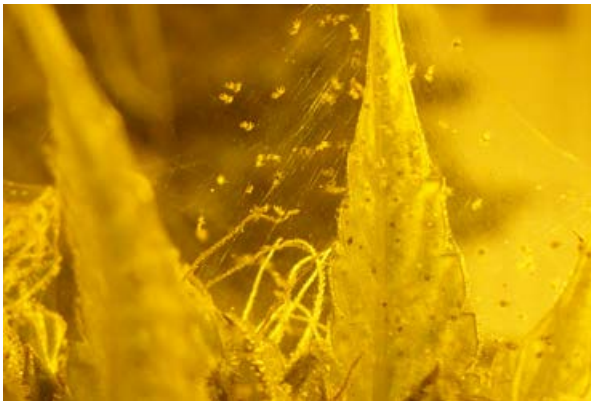

Fig. 20: Two spotted spider mites and webbing

Fig. 21: Two spotted spider mites on underside of leaf

Damage: Two spotted spider mites cause stippling damage to the leaf. As damage progresses, leaves turn yellow or start to bronze. Severe spider mite damage is generally marked by the presence of webbing on various parts of the plant including the bud.

Monitor: Check for spider mites on the underside of the leaf. Look for stippling, yellowing or bronzing on the leaf surface. Watch for webbing on leaves and on the bud.

Fig. 22: Stippling caused by spider mites

Prevention: Two spotted spider mites are easily carried on people and clothing, so ensure proper sanitation measures. Organize work flow from the cleanest areas to the areas with the highest amounts of pests. Avoid hot, dry conditions. Monitor mother plants closely. Do not wait until you see the pest or signs of the pest; use predatory mites preventively.

Controls:

Physical: Remove leaves with spider mites and remove heavily infested plants.

Biological: Controls include the predatory mites, *Neoseiulus (Amblyseius) californicus, Neoseiulus (Amblyseius) fallacis, Amblyseius andersoni* (used preventively), and *Phytoseiulus persimilis* (most often used curatively). A gall midge, *Feltiella acarisuga* is also available. The predatory beetle, *Stethorus punctillum* can also be used.

Chemical: Registered pesticides include the active ingredients: canola oil, potassium salts of fatty acids and mineral oil.

Broad Mites (*Polyphagotarsonemus latus*)

Description: These mites are translucent and very small. They are not visible with the naked eye. A microscope will aid in identification. The eggs of broad mites are studded with white dots. Eggs are the easiest stage to identify.

Damage: Broad mites will feed on new growth, causing distortion and thickening of leaves.

Monitor: The size of this pest means that their presence often goes unnoticed when levels are low. Damage is often the first indicator of the pest, and at this point, populations are often quite high. Focus on prevention and sanitation practices. If you suspect broad mites, examine impacted plant parts under the microscope.

Prevention: If bringing in cuttings from outside sources, keep quarantined from all other plants until you are certain they do not contain any broad mites. Sanitize all tools between uses. Have biosecurity policies in place to prevent the accidental spread of this pest from visitors as they are a pest of many ornamental plants. Preventive controls for thrips pests often will also help in broad mite control. Rates may differ between thrips and broad mite control, so ensure you confirm with your biological control supplier.

Controls:

Physical: Remove and destroy plants with broad mites.

Biological: *Amblyseius cucumeris* and *Amblyseius swirskii* can be used to help control this mite.

Chemical: Registered pesticides for control of mites include the active ingredients: canola oil and mineral oil.

Fig 23: Broad mites and broad mite eggs

Caterpillars

Caterpillars are typically only an occasional pest in greenhouse-grown cannabis. Caterpillars are the larval stage of moths and butterflies.

Description: Many species will feed on cannabis. They vary in colour and in size. They will have a distinct head capsule. Caterpillars will have 3 sets of true legs (on the thorax right behind the head) in addition to up 5 pairs of prolegs on the abdomen. The number of prolegs is a key identification feature. Loopers are a type of caterpillar with prolegs set back on their abdomen, which causes them to 'inch' when they walk (also called inchworms).

Caterpillars can be confused with sawfly and syrphid larvae. Sawflies will also have a distinct head capsule, but will have 6+ pairs of prolegs on the abdomen compared with caterpillars. Syrphid larvae are naturally occurring aphid predators that will only typically be found in greenhouse cannabis operations if aphid levels are high and if screens are not present. Syrphids do not have any legs, nor do they have a distinct head capsule. It is important to confirm you have caterpillars because both the chemical and biological controls available will not work on sawflies. No action is required if syrphids are present.

Damage: Caterpillar larvae will feed on plant tissue, including the flower. Feeding damage can look different depending on the size and species of caterpillar. Caterpillars can chew leaves, roll leaves and also leave webbing. In addition to feeding damage, frass will also be present. Frass is the black-brown excrement that they leave during feeding. Frass can become a harvest contaminant. Caterpillars can also bore into stems of plants.

Monitor: Watch for adults (moths) on sticky traps. Look for frass, chewed leaves, webbed or curled leaves. These signs of the pest will often lead you to the caterpillars.

Prevention: Screen vents in greenhouses to prevent entry of this pest into growing areas from outside.

Controls:

Physical: Species specific pheromones can be used in conjunction with traps to attract adults. Light traps can also be used to attract adults.

Biological: *Trichogramma* spp. are tiny parasitic wasps that are commercially available. They parasitize caterpillar eggs, so timing of introduction of *Trichogramma* spp. must correspond with egg laying of the caterpillar. *Trichogramma* is very host specific, so correct identification of your caterpillar species is required. It is unlikely that this biological will provide adequate control alone, so must be used in conjunction with other pest control options. Certain generalist biologicals such as lacewings that you may have in your system might feed on the youngest and smallest larval stages of some species of caterpillars, but will not achieve control.

Chemical: Registered pesticides for control of caterpillars include the active ingredient, *Bacillus thuringiensis* subspecies *kurstaki*. This is most effective on young stages of caterpillars and can break down quickly under UV light.

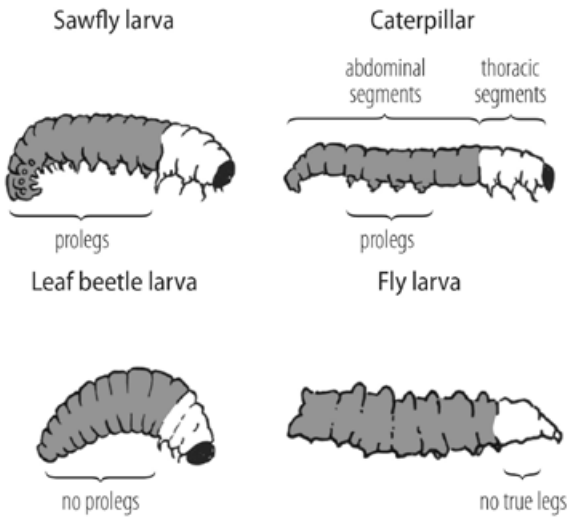

Fig. 24: Larvae comparison chart

Powdery mildew

Description: Powdery mildew is a disease that impacts many plant species. Infections first appear as small white spots on either upper or lower leaf surfaces. It can spread to a powdery white growth covering all leaf surfaces. It is especially problematic if it develops on the flowers of cannabis plants due to a visual quality reduction. Powdery mildew can develop under low light and high relative humidity. The asexual spores, however, can germinate and impact plants in low relative humidity. The varying humidity and temperature ranges required for spore germination can make management difficult. The pathogen spreads by spores released during air movement, plant pruning, and on worker's clothes.

Damage: Powdery mildew weakens the plant, can cause plant stunting, and will compete with the plant for nutrients. It reduces yield, decreases quality of the final product and can render it unsaleable.

Monitor: Look for powdery mildew developing on leaf surfaces.

Fig. 25: Powdery mildew

Prevention: Avoid over fertilizing with nitrogen as tender new growth is more susceptible to infection. Choose varieties that are less susceptible to powdery mildew. Space plants and prune to promote good air circulation and aid in light penetration. Spores are sensitive to UV light exposure.

Control:

Physical: Remove any infected plant material. Powdery mildew requires living plant tissue to grow. Routine exposure to UV light may help in minimizing powdery mildew.

Biological: None available.

Chemical: Registered pesticides for control of powdery mildew include the active ingredients: potassium bicarbonate, sulphur, garlic powder, citric acid/lactic acid, *Reynoutria sachalinensis* and hydrogen peroxide. They should be applied at the early stages of disease development.

Fig. 26 High levels of powdery mildew

Bud Rot

Description: *Botrytis cinerea* is a fungal disease that impacts many other types of plant, and is commonly associated with bud rot on cannabis. It develops under high humidity conditions. In other crops is it often called grey mold. In addition to *Botrytis cinerea*, *Penicillium* spp. have been found to also contribute to bud rot, particularly after harvest.

Damage: With *Botrytis cinerea*, sugar leaves begin to turn yellow and wilt. Buds eventually turn brown and can develop a fuzzy grey growth which renders them unusable.

Fig. 27: Bud rot

Monitor: *Botrytis cinerea* generally develops within the buds, so is difficult to monitor and catch early. Prevention strategies should be used.

Prevention: Avoid overhead watering and getting water onto the plant, especially during flowering. Space plants to encourage air flow. Maintain plant nutrient needs and do not over fertilize. Choose varieties that have a loose bud structure. Varieties with a dense bud structure can hold and trap moisture.

Control:

Physical: Sterilize all tools, pruners, trimmers between uses. Sanitize shelves or pots between crop cycles. Remove any infected plant material.

Biological: None available.

Chemical: Registered pesticides for control of *Botrytis cinerea* include the active ingredients: hydrogen peroxide and *Gliocladium catenulatum*.

Pests to watch for:

Depending on the physical structure of the cannabis operation, other greenhouse pests such as whiteflies may become an issue in cannabis. Leafhoppers, stinkbugs and lygus can become pests in greenhouse grown cannabis if insect screens are not present. In addition to this, hemp russet mite is of concern for cannabis growers, although has not become a common pest yet.

Hemp Russet Mites (*Aculops cannabicola*)

This mite is different than the russet mite found in tomatoes. These microscopic mites have not yet become a common pest in British Columbia, however, with the movement of plant material across the country, it is possible that it could develop as a pest. They also can be lifted and spread on the wind, and can be carried on certain pests, tools or clothing.

Description: Russet mites can be seen under the microscope. They are elongated and cream to pale yellow in colour.

Damage: They will feed on the stem, flowers and leaves and cause russeting and distortion on these plant parts.

Monitor: Damage tends to be first noticed when populations of russet mites are high. Focus on prevention and sanitation practices, but if you suspect hemp russet mites, examine impacted plant parts under the microscope. Consult with an industry expert to confirm identification. Samples can also be sent to the Provincial Plant Health Laboratory for a fee. For more information on lab services, please visit *https://www2.gov.bc.ca/gov/content?id=4E2E13325E2B4AB583F063B0C3352583*

Prevention: If bringing in cuttings from outside sources, keep them quarantined from all other plants until you are certain they do not contain any russet mites. Sanitize all tools between uses. Have biosecurity policies in place to prevent the accidental spread of this pest from visitors. Many of the predatory mites that feed on hemp russet mites are used in cannabis for other pests such

as spider mites and thrips. Preventive controls for these pests often will also help for hemp russet mites.

Controls:

Physical: Remove and destroy plants that have been confirmed to have russet mites. Remove leaf litter.

Biological: *Neoseiulus (Amblyseius) californicus, Neoseiulus (Amblyseius) fallacis, Neoseiulus (Amblyseius) Cucumeris, Amblyseius swirskii* and *Amblyseius andersoni* may help in controlling this pest.

Chemical: Registered pesticides for control of mites include the active ingredients: canola oil and mineral oil.

Fig. 28: Russeting (caused by hemp russet mite)

Fig 29: Hemp russet mites

Root pests

Root aphids (*Rhopalosiphum rufiabdominalis*)

Description: These aphids look similar to foliar aphids but are found within the soil or growing medium. They are capable of surviving in hydroponic systems as well. Rice root aphid, *Rhopalosiphum rufiabdominalis*, has been most commonly seen in British Columbia cannabis. These aphids are dark green with red/brown colourations on the abdomen. They are 1.6-2.2 mm long. They often go unnoticed and are difficult to see as they blend in with the growing medium.

Fig. 30: Typical colours of the rice root aphid

Damage: These aphids will feed on the plant roots. Their feeding inhibits water and nutrient uptake by the roots, so symptoms of water stress and nutrient deficiencies can be associated with this pest if root aphid levels are high.

Monitor: Inspect any incoming plants, including the soil. This will involve removing the plant from its pot. Watch for aphids after irrigation. Place a tray under the new plant and water to check for any aphids that are flushed out when watered. Winged adults can be caught on yellow sticky cards if they are placed close to the soil/growing medium. Look for signs of water stress in the plant.

Fig. 31: Winged root aphid

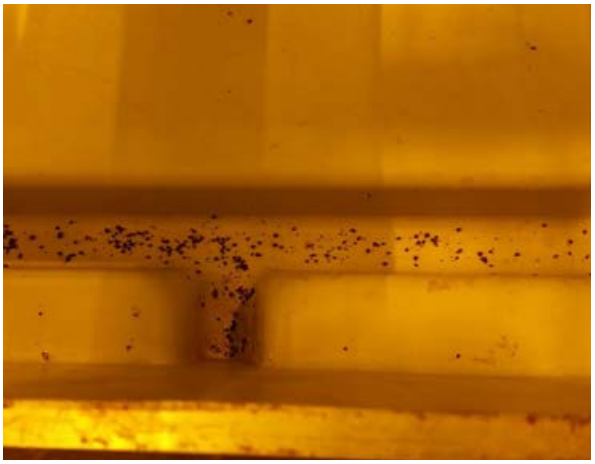

Fig 32: Root aphids after irrigation

Prevention: These aphids are very difficult to get rid of once present, and no effective biological control or chemical control is currently available. The best method for control of this pest is to prevent the aphids from entering into your operation. If bringing in cuttings from outside sources, keep quarantined from all other plants until you are certain they are free of root aphids.

Controls:

Physical: If detected in your operation, plants should be removed and rooms sanitized. Leave rooms empty (host free) for a week.

Biological: No effective biological controls are available. The predatory rove beetle, *Dalotia coriaria* (*Atheta coriaria*) may feed on some root aphids, but will not achieve control of this pest. Beneficial nematodes, applied as a soil drench, have been tried with limited success.

Chemical: There are currently no pesticides registered for control of root aphids on cannabis grown commercially indoors.

Fungus gnats

Description: Fungus gnat adults look similar to small mosquitoes. They are approximately 3-4 mm long and have gangly legs. They have 1 set of wings and have a dark coloured body. The larvae are clear, legless maggots with a dark head capsule. They are about 5 mm in length.

Damage: Adults do not cause plant damage, but this stage is easiest to monitor and to see. The presence of adults indicates that larvae are also likely present. Larvae can feed on plant roots, weakening the plant and preventing full water uptake. Young plants are most susceptible to damage. While adults do not do any feeding damage, they are capable of spreading fungal spores. Larvae are also capable of spreading root diseases. Controlling fungus gnats is important for the control of other fungal diseases.

Monitor: Monitor for adults with yellow sticky traps. If numbers are high, larvae can be monitored by sticking a potato wedge into the soil so that the cut sides come into contact with the soil or growing medium. After 24 hours, the potato can be pulled up and checked for fungus gnat larvae.

Prevention: Fungus gnats are associated with moist soil conditions. Good water management is important for the prevention of this pest. Do not over water. Provide good drainage. Avoid the incorporation of new, uncured compost into any potting mix as this can increase the occurrence of fungus gnats. Use sterilized growing media.

Control:

Physical/Cultural: Clean up and eliminate any wet areas in production areas.

Biological: The predatory mite *Stratiolaelaps scimitus* (*Hypoaspis miles*) and the predatory rove beetle *Atheta coriaria* (*Dalotia coriaria*) will also feed on larvae. The beneficial nematodes *Steinernema Feltiae* can also be applied for control of the larval stage of this pest.

Chemical: There are currently no pesticides registered for control of fungus gnats for cannabis grown commercially indoors.

Fig. 33: Fungus gnat adult on sticky trap

Root Rot

Description: Root Rot is a broad term that generally captures several diseases that impact the roots of many plants and can include *Phythium* spp., *Rhizoctonia* spp., *Fusarium* spp. and *Phytophthora* spp.

Damage: Symptoms differ between diseases, but typically root rot symptoms include stunting, wilting or reduced root growth. Roots are often discolored and can be red or brown. Healthy roots are typically white. Spores of some of these diseases could result in unacceptable microbial levels in finished products.

Monitor: Watch for plant stunting or wilting. Examine plant roots for discoloration and rotting.

Prevention: Ensure healthy and clean stock plants and do not take cuttings from diseased plants. Use sterilized potting mixes and coir. Sterilize tools, pots and trimming equipment. Most pesticide options registered for root rot are to be used preventively. Choose disease resistant varieties. Avoid over-fertilizing and high soil moisture levels. Manage fungus gnats and shore fly levels.

Control:

If possible, send samples to be properly identified. Because root rot encompasses many potential diseases, control will be most successful if samples are taken and identified.

Physical: Remove any infected plant material. Clean and sanitize all pots, trays and tools between uses.

Biological: None available.

Chemical: Registered pesticides include the active ingredients: *Trichoderma harzianum* (strain KRL-AG2), *Trichoderma virens* (strain G-41) and , *Gliocladium catenulatum* (strain J1446).

Table 1: Listing of Registered Products for Cannabis Grown Commercially Indoors

At the time of writing, these products are registered for the control of pests on cannabis, but always check with Health Canada to determine the currently available registered options. To search all labels for current registrations, please use this link: *http://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php*.

Active Ingredient	Product Trade Names	Target Pest
Bacillus thuringiensis subspecies *kurstaki* (strain EVB113-19)	Bioprotec Plus, Bioprotect Caf	Cabbage looper
Beauveria bassiana (strain ANT-03)	Bio-Ceres G WB, Botanigard 22 WP, Botanigard ES	Whitefly, aphids and thrips
Canola oil	Doktor Doom Formula 420 Professional Use 3-in-1, Vegol Crop Oil, SuffoCoat	Aphids, mites and whiteflies, and suppression of powdery mildew
Citric acid, lactic acid - present as fermented products of *Lactobacillus casei* (strain LPT-111)	Cyclone, Lacto-San	Powdery mildew
Garlic powder	Influence LC	Powdery mildew
Gliocladium catenulatum Strain J1446	Prestrop	*Botrytis cinerea*
Hydrogen peroxide	ZeroTol	*Botrytis cinerea* and powdery mildew
Mineral oil (dormant and horticultural spray oil)	Purespray green spray oil 13E	Powdery mildew and mites
Potassium salts of fatty acids (soap salts) (47%)	Neudosan Commercial, Opal, KOPA INSECTICIDAL SOAP, Exile	Aphids, spider mites, and whiteflies
Potassium bicarbonate	Milstop Foliar Fungicide, Sirocco	Powdery mildew
Reynoutria sachalinensis	Regalia Maxx	Powdery mildew and suppression of *Botrytis cinerea*
Sulphur	Agrotek Ascent Vaporized Sulphur, Bartlett	Powdery mildew
Trichoderma harzianum strain T-22 (KRL-AG2)	Rootshield (R) WP Biological fungicide, Rootshield HC Biological Fungicide Wettable Powder	Root Rot (*Pythium* spp., *Rhizoctonia* spp. and *Fusarium* spp.)
Trichoderma harzianum (strain KRL-AG2), *Trichoderma virens* (strain G-41)	BW240 WP Biological Fungicide, Rootshield Plus WP Biological Fungicide	Root rot (*Pythium* spp., *Rhizoctonia* spp., *Fusarium* spp. and *Phytopthora* spp.)

Available Resources

Due to the recent legalization of recreational cannabis in Canada, and state-by-state legalization in the USA, research is still catching up with this industry. As a result, there are not as many reputable and well-referenced support documents available for pest control in this crop. When searching for additional resources on pest control in cannabis, you might come across blogs, information on hemp, and information from the USA. Please note the following considerations for each of these sources:

Blogs

Currently, blogs are the most abundant source of information, but should be read with discernment. They are not always written by people with training in this subject area. Government and university sites are the preferred reference material.

Cannabis grown in the USA

When searching for resources, you can look to states where cannabis is legal. The best sources of this information can be found on university extension websites. This information on pests can be helpful, but note that pesticide registrations will differ between USA and Canada. Pesticides must be registered in Canada to use in Canada.

Hemp

Hemp has a longer history of legal growing in North America. As a result, there are more published resources available for control of pests in hemp. Hemp growing regions offer a good starting point for pest control information, especially for identification of outdoor pests that might make their way into greenhouses. Pesticides labeled for use on industrial hemp cannot be used on cannabis unless it is specifically identified on the label.

Greenhouse and ornamental IPM sources

For both greenhouse vegetable and ornamental production, the guiding IPM principles and general information on pests and their lifecycles can be used to guide cannabis. In Canada, seek out provincial agricultural websites, Pest Management Regulatory Agency (PMRA) and the Canadian Food Inspection Agency (CFIA).

Questions?

Please email the Integrated Pest Management Program at *bc.ipm@gov.bc.ca* for any questions about pest control on commercial cannabis or check out the BC IPM website *www.gov.bc.ca/PestManagement*

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