

Cannabis Pest Management

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A Cannabis Research and Information Company

My Credentials

- I operate an agricultural research company; work on horticultural, agronomic and pest management topics for a wide variety of crops.
- Before that Professor in Department of Entomology at Washington University.
- Before that worked at the US Environmental Protection Agency in Washington, D.C.
- Ph.D. in Entomology and Pesticide Toxicology
- Grew up on a farm in Missouri.
- I currently operate a diversified organic farm.
- Executive Director of the Washington Asparagus Commission and Washington Blueberry Commission.
- Administer Washington ag research funding commission.

All Washington ag commodities (except one) are heavily supported by research and extension activities

- WSU, USDA, IR-4, etc
- Interpretation of federal law precludes all of the traditional sources of research and extension.
- Cannabis suffers from a wide variety of insect, diseases and other pests, as does every other crop.
- Like every other grower, cannabis growers desire to control pests on their crops.
- Due to the potential high value of cannabis, growers have extraordinary motivation to control pests.
- Unlike every other crop, it is illegal to federally register a pesticide on cannabis.

Cannabis Pest Management Challenges

- It is illegal to register a pesticide on cannabis at least at the Federal level.
- It is illegal to certify cannabis as organic; you cannot claim your cannabis is organic-certainly not certified organic. If it is not certified organic, then saying it is "organic" means nothing.
- No pesticide applicator or worker protection training is permitted by the usual mechanisms.
- None of the traditional sources of ag research and extension is allowed.
- As a result, growers are left to figure out how best to control pests... many of which may be new to cannabis or growing cannabis by new methods or on larger scale than they have traditionally.

As a result the cannabis industry faces some tremendous problems.

- Illegal pesticide residues.
- High pesticide residues.
- Several pesticides concentrate in concentrated cannabis to stunningly high levels.
- Consumer risk issues
- Worker protection issues.
- Applicator exposure issues
- Growers are left to each other, the internet and sometimes unscrupulous companies for information.
- Cannabis pest management is a mess and growers need help.

Probably spurred on by reports from Oregon and Colorado of common and widespread detection of illegal pesticides residues detected in cannabis, Washington acted.

- (a) Pesticide screening and heavy metal screening are required at the time of harvest for all marijuana flowers, trim, leaves, or other plant matter.
- (b) Minimum sample size is three grams for every three pounds of harvested product.
- (c) In addition to the pesticide screening required in subsection (1)(a) of this section, additional pesticide screening is required for each batch of finished concentrates and extracts. The minimum sample size for finished concentrates and extracts is two grams.

(i) A sample of any marijuana product shall be deemed to have failed if any measurable and positively verified amount of an unapproved pesticide is detected.

(ii) A sample of concentrate or extract shall be deemed to have failed if more than 1.0 ppm of pyrethrins or 2.0 ppm of piperonyl butoxide (PBO) is detected.

(d) A harvest or batch deemed to have failed pesticide screening must be destroyed. Marijuana flowers, trim, leaves, or other plant matter deemed to have failed pesticide screening must not be used to create extracts or concentrates.

(e) Pesticides containing pyrethrins or piperonyl butoxide (PBO) may not be applied less than seven days prior to harvest.

■ **SECTION WAC 246-70-080 Employee training.** (1) Marijuana producers, processors and retailers that create, handle, or sell compliant marijuana products shall adopt and enforce policies and procedures to ensure employees and volunteers receive training about the requirements of this chapter.

■ Seems odd to me that this applies to medical only and not recreational cannabis; but suspect these rules will eventually be expanded to include this.

- In order to comply with the quality assurance testing in WAC 246-70-050, pesticide screening must be completed at the time of harvest for all marijuana flowers, trim, leaves, or other plant matter. A certified third-party testing lab must screen for the following unapproved pesticides:
- **Abamectin** - Miticide/Insecticide (Avid, Agri-Mek, several other names)
- **Bifenthrin** - Insecticide/Miticide (Brigade, Capture, lots of others)
- **Chloromequat - chloride** PGR (Cycocel, Citadel)
- **Daminozide** - PGR (B-Nine, Dazide (Alar))
- **DDVP (Dichlorvos)** - Insecticide (No Pest Strips)
- **Imidacloprid** - Insecticide (Admire, Advise, lots of other names)
- **Myclobutanil** - Fungicide (Eagle 20, Rally, lots of other names)
- **Paclobutrazol** - PGR (Bonzi, Piccolo, Paczol)
- **Permethrin** - Insecticide (Lots of other names_)
- **Propiconazole** - Fungicide (Tilt, Orbit, lots of other names)
- **Spinosad** - Fungicide (Success, Blackhawk, Entrust, lots of other)
- **Spiromesifen** - Insecticide/Miticide (Movento)
- **Uniconazole** - PGR (Sumagic, Concise)

In addition, pesticide screening must be completed for each batch of finished concentrates and extracts. A certified third-party testing lab must screen for the following unapproved pesticides:

Same list of products as earlier
Also includes PBO and pyrethrins.

- ### We have some excellent speakers
- Joel Kangiser – Policy Assistant, Pesticide Management Division, Washington State Department of Agriculture. 25 years at WSDA.
 - Allan Felsot - Professor, Entomology & Environmental Toxicology; Interim Academic Director for Arts & Sciences, WSU-TC; Graduate Coordinator, Environmental Sciences Program, WSU-TC
 - Camille Holladay – Analytical Chemist, Synergistic Pesticide Laboratory, Portland, Oregon

- WSDA has done a tremendous job on trying to get pesticides available to cannabis growers.
- Erik Johansen should be considered a state treasure for his work on cannabis pesticides.
 - The good news is that we have a very long list of products that are considered acceptable to use on cannabis.
 - The bad news is that several of these products have minimal or no efficacy; or can be challenging to use.
 - Perhaps a better way of stating things is that we simply have little or no research on how these products work on cannabis that is available to growers.
 - I am very familiar with most of these products and have research data and experience with many of

Pesticide names

- All pesticides have a minimum of 3 names, most of them have several to a tremendous number of names; and this leads to confusion.
- Common name: myclobutanil – there can only be one.
- Brand name: Eagle 20EW Speciality Fungicide, Rally 40WSP, Spectricide Immunox Multi-Purpose Fungicide Spray Concentrate – 31 different brand names!
- Chemical name: 2-(4-chlorophenyl)-2-(1,2,4-triazol-1-ylmethyl)hexanenitrile – there is only one, and not used in our industry.

Washington Cannabis Pests

- Two-spotted spider mite
- Hemp russet mite
- Aphids, root and foliar aphids
- Powdery mildew
- Botrytis (bud rot)
- Pythium (marijuana root rot)
- Fungus gnats
- Thrips
- Whitefly
- Leafminer
- Other pests, such as worms
- More pest species will come
- Abiotic problems that confound figuring out what pest problem you might have.



Leafminer Products Registered in Washington (27 out of 87)

ABAMECTIN (AVERMECTIN B1)	CITRONELLA OIL	GERANIOL	PYRETHRINS
ACEPHATE	NEEM OIL	IMIDACLOPRID	PYRIPROXYFEN
ACETAMIPRID	CLOTHIANIDIN	ISARIA FUMOSOROSEA	ROSEMARY OIL
ALPHA-CYPERMETHRIN	GLOWE OIL	KAOLIN	S-KINOPRENE
AZADIRACTIN	CYANTRANILIPROLE	LAMBDA-CYHALOTHRIN	SEDAXANE
BACILLUS THURINGIENSIS STRAIN	CYFLUTHRIN	METHOMYL	SESAME OIL
BETA-CYFLUTHRIN	CYHALOTHRIN GAMMA	MGK 264	SODIUM SULFATE
BIFENAZATE	CYPERMETHRIN	MINERAL OIL	SOYBEAN OIL
BIFENTHRIN	CYROMAZINE	NALED	SPINETORAM
CANOLA OIL	DELTAMETHRIN	NEEM OIL (COLD PRESSED)	SPINOSAD
CAPSAICIN	DIFLUBENZURON	NOVALURON	SPIROTETRAM SULFUR
CARBARYL	DIMETHOATE	OXAMYL	FLUVALINATE
CARBENDAZIM	DINOTEFURAN	OXYDEMETON METHYL	TEBUCONAZO
CASTOR OIL	EMAMECTIN BENZOATE	PEPPERMINT	TETRAMETHRIN
CEDAR OIL	ESFENVALERATE	PEPPERMINT OIL	THIACLOPRID
CHENOPODIUM AMBROSIACIDES	EUGENOL	PERMETHRIN	THIAMETHOXAM
CHLORANTRANILIPROLE	FENOXYCARB	PERMETHRIN	TRIFLOPROXIFEN
CHLORPYRIFOS	FENPROPATHRIN	PHENYLETHYL PROPIONATE	THYME OIL

Leafminer considerations

- Easy and obvious to diagnosis in larval stage.
- Usually an indoor pest.
- In minor infestations, hand picking and destroying leaves is feasible.
- Has been noted to be more of a pest in greenhouses using Rockwool.
- None of the allowable products are especially good.
- Neem oil and azadiractins are best options; high rate, short intervals; use a penetrating surfactant.
- Cool idea.... Azadiractin can be systemic, add a solution (not too concentrated) to the soil or hydroponic, it should be taken up by the plant. *Would love to do the research on this use pattern!*

Garden whitefly

Adult



Immature



Greenhouse whitefly

- Greenhouse whitefly is a common pest of many crops and ornamental plants all over the world. Eggs are laid individually on leaves, the immature stages remaining on the same leaf throughout development. Therefore, larger whitefly nymphs will be found on mid-canopy leaves. The final immature stage is much like a pupa, with the adult developing inside the cast nymphal skin. Whiteflies have short generation times, with multiple generations per season.
- Adult whiteflies are easy to spot flying within the plant canopy.
- Immature stages are on the underneath side of the leaves.
- Whitefly nymphs are much more difficult to measure – a leaf sampling scheme is required since they are not dislodged during beating sheet/tray sampling.
- No good means to control; prevent it, exclude it.

Management of whitefly

- Apply high rate of Pyganic tank mix of an azadiractin product.
- Do not let populations build up.
- Apply at least every 7 days.
- Continue applications until population is gone.
- Use a surfactant.
- Coverage is critical.
- Critical to get product on underside of the leaves.
- I have heard that hydrogen peroxide might work (Jet Ag). Short residual product. Probably make applications for ever 3 to 4 days until population is under control.

University of California recommendations for GWF

"Most less-toxic products such as insecticidal soaps, neem oil, or petroleum-based oils control only those whiteflies that are directly sprayed. Therefore, plants must be thoroughly covered with the spray solution, and repeat applications may be necessary. Be sure to cover undersides of all infested leaves; usually these are the lowest leaves and the most difficult to reach. Use soaps or oils when plants are not drought-stressed and when temperatures are under 90°F to prevent possible "burn" damage to plants. Early evening, when there is enough light to safely apply products but when the sun is not shining directly on plants, may be a good time to spray."

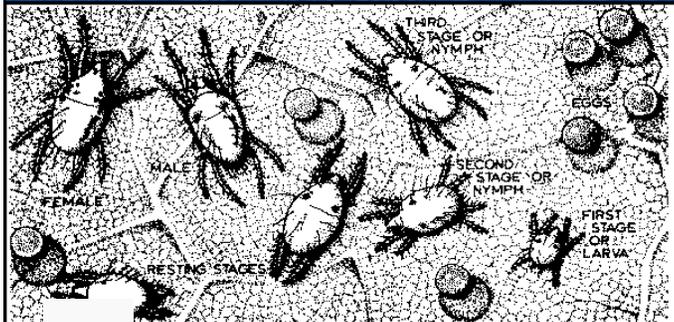


Thrips Considerations

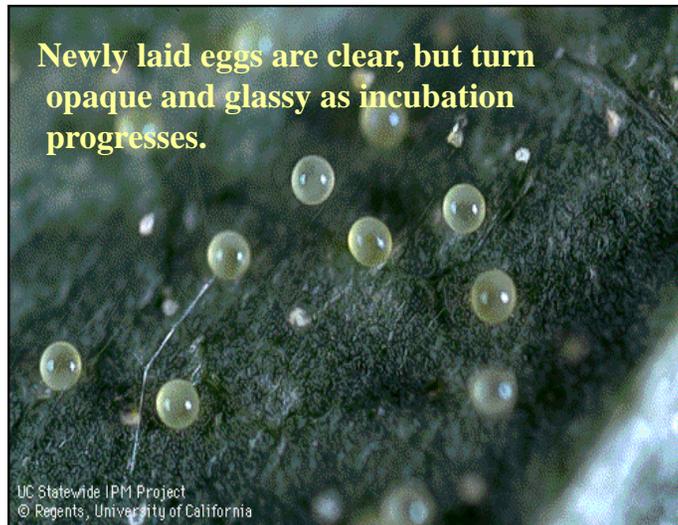
- Several different kinds of thrips have been found on cannabis, there is a cannabis specific thrips.
- Some species have 1 or 2 of four life stages off of the plant -has management implications.
- Thrips can vector a disease on cannabis-not sure if this has happened in Washington.
- 2 to 10 thrips per leaf is considered a heavy infestation. This is not a hard level for thrips to get to.
- Certain commercially available insect and predatory mites are known to feed on thrips-would love to establish if this is viable.
- Diatomaceous earth, neem, azadiractin, and pyganic are potential options; high rates, short intervals, tank mix. 3 to 4 day intervals may be necessary, as many as 10 applications needed to bring heavy infestation under control.



There are 5 stages of development for spider mites egg, larva, protonymph, deutonymph, and adult.



Each stage is followed by a quiescent period.





Quiescent protonymphs transform into deutonymphs

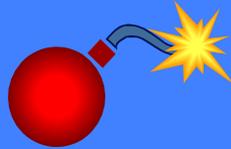


Deutonymph

Mature female

Egg

Population Explosion



- 5 to 10 eggs are laid on average each day for about 10 days.
- After 10 days the number of eggs laid per day declines.
- Each female can lay between 100 & 200 eggs
- Morbidity sets in after ~25 days

With two-spotted spider mites, it's a woman's world!

- Females can 'choose' the sex of their eggs! Male eggs are produced parthenogenetically (sex not required). Virgin females can produce male eggs.
- A female can mate with her own son (this is important for a colonizing species)
- Populations are female biased -- With optimum conditions up to 7/8 of the eggs laid by a female can be daughters.

Reproductive consequences- or 'a world of mites in 80 days'



- 1 female lays 150 eggs of which 131 are female in 20 days.
- 131 females lay 150 eggs of which 17,194 are female in 20 days.
- 17,194 females lay 150 eggs of which 2,256,712 are female in 20 days.
- 2,256,712 females lay 150 eggs of which 296,193,515 are female in 20 days.
- *This is why mites can blow up into such a problem so quickly.*

A list of miticides registered in Washington : products marked in red are allowable for use on cannabis, products marked in yellow are illegal to use on cannabis

ABAMECTIN	CYFLUMETOFEN	KAOLIN	PYRETHRIN
ACEQUINOCYL	DIAZINON	LAMBDA-CYHALO	PYRIDABEN
AZADIRACTIN	DICOFOL	LIME SULFUR - CA	ROSEMARY OIL
BIFENAZATE	DIMETHOATE	MALATHION	ROSEMARY OIL
BIFENTHRIN	ETOXAZOLE	MILBEMECTIN	SESAME OIL
BIFENTHRIN	FARNESOL	MINERAL OIL/PET	SPINET ORAM
CARBARYL	FENAZAQUIN	NALED	SPINOSAD
CHENOPODIUM OIL	FENBUTATIN-OX	NEEM OIL	SPIRODICLOFEN
CHLORFENAPYR	FENPROPATHRIN	NEROLIDOL	SPIROMESIFEN
CHLORPYRIFOS	FENPYROXIMATE	OXAMYL	SPIROTRERAMAT
CHROMOBACTERIN	FLUAZINAM	PEPPERMINT	SULFOXAFLOR
CHROMOBACTERIN	FORMETANATE	PEPPERMINT OIL	SULFUR
CINNAMON OIL	GARLIC OIL/PON	PERMETHRIN	TAU-FLUVALINA
CITRONELLA OIL	GERANIOL	PIPERONYL BUT O	TETRAMETHRIN
CLOFENTZINE	BURKHOLDERIA	POTASSIUM LAUR	THIAMETHOXAM
CLOVE OIL	HEXYTHIAZOX	PROPARGITE	ZETA-CYPERMET
COTTONSEED OIL	IMIDACLOPRID	PROPYLENEGLYCOL	MONOLAURATE

Controlling Mites on Cannabis is a Challenge

- 23 active ingredient are registered as pesticides that have mites on the label and are allowed for use on cannabis in WA.
- These actives are formulated in to 106 products, half of which are sulfur or oils.
- Most of these products have no activity, little activity or are unknown whether they have activity against mites.
- None of these products are considered great for controlling mites.
- Best legal options for control of mites are mineral oil, sulfur, neem oil and azadiractin.
- Obtaining better miticides should be a top priority for the cannabis industry.
- Trying to convince company A to register their product.

Mite Control in Cannabis

- Best strategy is to not get mites in the first place.
- Do not bring in plant material contaminated with mites.
- Do not allow anyone to enter your operation that has been exposed to mite infested crops.
- Sample your crop, survey often. Use a hand lens.
- If you have an outbreak, your best hope to control mites is to treat as early as possible.
- Use an appropriate oil, then sulfur or neem oil or azadiractin based products.
- Not sure of risk from phytotoxicity from these products on cannabis. Test this yourself prior to application.
- Sulfur might influence quality; it can in winegrapes; sulfur and neem are likely to cause phyto.

Inundative releases of beneficials is something that the industry needs to do

- Produced commercially for years, predatory mites, *Phytoseiulus persimilis*, can be an effective biological control for two spotted spider mite. Control of a light infestation should occur in two to three weeks.
 - On heavier infestations multiple releases may be required.
 - On severely infested plants (webbing and feeding marks will be noticed) it is important that you reduce the pest infestation prior to releasing predators. Consider spraying with an insecticidal soap or other non-residual insect control. If only a few plants are infested, consider removing them.
- 1-2 per infested leaf
 - 20-30 per medium sized plant
 - 2,000 per 700 square feet

At the Olympia meeting, several growers talk about using releases of mites and rove beetles successfully to control a number of pests.

Including

- Various mite species
- Fungus gnats
- Root aphids.
- Not an endorsement but a commonly mentioned name was Evergreen Growers Supply..... (bear in mind most beneficial organisms are produced by two companies globally.)
- Anecdotally have heard that some Spokane area growers are successfully using release of beneficials.
- The problem is that most growers are unfamiliar, untrained, unwilling or simply need a nudge in this direction.

Predatory mites

- If I felt was at risk, I would start releasing mites automatically and continue until 3 to 4 weeks before harvest.
- Suited for indoor uses.
- Does not work in rescue situations.
- Does not always work.
- You can buy 2,000 for \$20.
- *Amblyseius swirskii* 25k for \$97.85
50k for \$146.85



Hemp russet mite – a new pest to me

