

Pesticides Allowed for Managing Insects and Mites on Cannabis in Colorado

Characteristics and Potential Uses in Managing Key Pests of the Crop

Background. On April 3, 2015 the Colorado Department of Agriculture (CDA) released an initial list that of pesticides, on an interim basis, it considered allowable for use on Cannabis grown in Colorado. The initial list has since been modified on several occasions and policy criteria related to pesticide use on Cannabis has been more detailed. The present status of pesticides allowable for Cannabis cultivated in the state can be found at the Colorado Department Agriculture website **Pesticide Use in Cannabis Product Information**

<https://www.colorado.gov/pacific/agplants/pesticide-use-cannabis-production-information>

There are many items related to pesticide use policy and regulations at this website. One is a statement by the Colorado Department of Agriculture on policy issues related to determination of pesticide use on all Cannabis crops (marijuana and hemp) that is available at

<https://www.colorado.gov/pacific/sites/default/files/atoms/files/2-2016%20Factual%20and%20Policy%20Issues%20Related%20to%20the%20Use%20of%20Pesticides%20on%20Cannabis.pdf> Also useful in background understanding of this policy issue are

the Pesticide Applicator's Rules and Regulations Part 17. The Use of Pesticides in the Production of Cannabis, effective March 30, 2016

<https://www.colorado.gov/pacific/sites/default/files/atoms/files/3-30-2016%20PAA%20Cannabis%20Rule%20WEB.pdf>

The most recent listing of pesticides allowed to be used on the crop (May 15, 2017) can be accessed at:

<https://www.colorado.gov/pacific/sites/default/files/atoms/files/Pesticides%20allowed%20for%20use%20in%20cannabis%20production%205-15-17.pdf>

This list is modified considerably from the earliest lists and changes regularly. More products are accepted. Also, many formerly allowed products have since been deleted, usually because of additional criteria being considered for allowing use on the crop – notably a required registered use on tobacco. The pesticides that previously were allowed to be used on the crop, but are not longer allowed, is linked on the Colorado Department Agriculture website **Pesticide Use in Cannabis Product Information**.

Potential Uses in Managing Key Pests of the Crop

The following document discusses the active ingredients of products that are allowable in that list as of May 15, 2017.

<https://www.colorado.gov/pacific/sites/default/files/atoms/files/Pesticides%20allowed%20for%20use%20in%20cannabis%20production%205-15-17.pdf>

Also, although effort has been made to summarize the present (May 15, 2017) status of allowable pesticides in Colorado, there may be errors of included/excluded products and this listing is in continuous change. *Before using any pesticides on Cannabis, always refer to the CDA master list of allowable pesticides to confirm its present acceptance.* This list is maintained at the Colorado Department of Agriculture website **Pesticide Use in Cannabis Product Information** <https://www.colorado.gov/pacific/agplants/pesticide-use-cannabis-production-information>

Azadirachtin

This is the primary insecticidally active ingredient extracted from the seeds of the neem tree (*Azadirachta indica*). The primary effect on susceptible insects is to disrupt growth by interfering with molting. Insect groups against which it has been shown to have some effectiveness for control include certain Lepidoptera, Diptera, Hemiptera, Coleoptera, and Thysanoptera.

Potential Use in Colorado Cannabis Pest Management. Soil drenches of azadirachtin have some proven value in control of **fungus gnat** larvae. It is possible that azadirachtin could be useful in suppressing **rice root aphid**, but this is untested. It is also used for control of **cannabis aphid** and **whiteflies**. It has shown some modest effect on some **grasshoppers** and **flea beetles** and may be useful for controlling some **caterpillar pests** of the crop, such as corn earworm. *Azadirachtin has not been found effective for control of spider mites in research trials.*

Azadirachtin-containing insecticides include: Aza-Direct Biological Insecticide, AzaGuard, AzaMax, AzaSol, Azatrol EC, Azatrol Hydro Botanical Insecticide, Azatin O Biological Insecticide, Azera Insecticide, Azera Gardening, BioSafe Insect Control, Debug Turbo, Ecozin Plus 1.2% ME, Ornazin 3% EC Botanical Insecticide, Safer Brand BioNeem, Molt-X, Neemix 4,5 Insect Growth Regulator, The Ecology Works SoluNeem.

Potassium Salts of Fatty Acids (Insecticidal Soaps, Potassium Laurate)

Liquid soaps derived from certain fatty acids produce soaps that are insecticidally active. Diluted with water, typically to a 1-3% solution, they are contact insecticides that can kill certain insects and mites if sprays contact the insect at application. There is no residual activity.

Insecticidal soaps have primarily been used to control certain small, soft-bodied insects and mites that are exposed on plants.

Potential Use in Colorado Cannabis Pest Management. Label uses include **aphids, whiteflies** and some species of spider mites and rust mites. Sprays of soaps may have some suppressing effect on **twospotted spider mite** and **hemp russet mite**; label uses include some species of spider mites and rust mites. However, in other crops insecticidal soaps are generally considered only marginally effective for mite control.

Potassium salts of fatty acid pesticides (insecticidal soaps) include: Bayer Advanced NATRIA Insecticidal Soap, Bonide Insecticidal Soap, Des-X Insecticidal Soap, Earth-tone Insecticidal Soap, General Hydroponics Exile Insecticide/Fungicide/Miticide, Hydro Worxx Insecticidal Soap, Kopa Insecticidal Soap, Miracle-Gro Nature's Care Insecticidal Soap, M-Pede Insecticidal Soap, Natural Guard Insecticidal Soap, Nuke Em, Ortho Elementals Insecticidal Soap, Safer Brand insecticidal Soap, Sil-Matrix, Schultz Garden Safe insecticidal Multi-Purpose, Whitney Farms Insecticidal Soap, Worry Free Brand Insecticidal Soap.

Bacillus thuringiensis var. kurstaki

This is a strain of the soil bacterium *Bacillus thuringiensis* that produces proteins that, when ingested, are capable of killing susceptible insects by destroying cells of the midgut. The *kurstaki* strain is specific in its effects with certain insects in the order Lepidoptera (caterpillars).

Potential Use in Colorado Cannabis Pest Management. Caterpillars are normally not important in indoor production of Cannabis. However, some **caterpillar pests** are a potential pests in outdoor production, particularly corn earworm which can tunnel into developing buds. Other caterpillars that are pests of the crop that may be managed with appropriately timed applications include beet armyworm, beet webworm, woollybears, and Eurasian hemp borer.

***Bacillus thuringiensis var. kurstaki* pesticides include:** Biobit HP Biological Insecticide, Crymax, Deliver Biological Insecticide, Dipel DF Biological Insecticide, Foray XG Insecticide Flowable Concentrate, Javelin WG Biological Insecticide, Valent Professional Products DiPel Pro DF Biological Insecticide

Beauveria bassiana

Beauveria bassiana is a fungus that is capable of producing disease in a great many kind of insects. Commercial formulations are applied as sprays that contain spores of the fungus. If environmental conditions are favorable, with high humidity being particularly important, the spores will germinate on the surface of the insect then may successfully invade and infect the insect. Infected insects usually will die within a week of application.

Both presently allowed *Beauveria bassiana* insecticides also contain pyrethrins (see below) which has a very different mode of action.

Potential Use in Colorado Cannabis Pest Management: Due to the humidity requirement for spore germination, *Beauveria bassiana* products will likely be most consistently effective in indoor production with high humidity conditions. There are a wide range of Cannabis pests that potentially could be killed by *Beauveria bassiana* (and *Beauveria bassiana*/pyrethrins mixtures) including **aphids, thrips, whiteflies**, and various **caterpillars**.

***Beauveria bassiana* containing pesticides include:** Botanigard Maxx (with pyrethrins), Xpectro OD (with pyrethrins)

Horticultural Oils – (Mineral Oil/Paraffinic Oil/Petroleum Oil)

Several types of oils are available that are designed to be used on plants, collectively known as horticultural oils. These come from many sources but those with widest use are mineral oils derived from petroleum. These are highly refined to produce light oils that distill at low temperatures and that have removed compounds known to produce plant injury (e.g., aromatic hydrocarbons). They are applied as sprays (typically 1-2% dilution) and are contact insecticides without residual activity. A primary mode of action is to smother the insect by blocking the spiracles (external breathing openings).

Potential Use in Colorado Cannabis Pest Management. Horticultural oils are among the more effective treatments available that can be used to suppress **twospotted spider mite**. It is likely that they may also be useful in management of **hemp russet mite** and oils can help suppress **powdery mildew**. Optimal use of these products for mite suppression, and evaluation of their potential to cause plant injury when used in high temperature, high light sites, needs to be further evaluated. **Caution.** Oils used in combination or following applications of sulfur may cause phytotoxicity (leaf burning).

Mineral oil-type horticultural oils include: Omni Oil, Omni Supreme Spray (outdoor applications only), Bonide All Season Horticultural & Dormant Spray Oil (Concentrate and Ready-to-Spray Formulations), Leaf Life Gavicide Green 415, Mite-E-Oil, Monterey Horticultural Oil, Prescription Treatment brand Ultra-Pure Oil, SuffOil-X, Summit Year-Round Spray Oil, TriTek

Horticultural Oils - Vegetable (Canola, Cottonseed, Corn, etc.)

Several types of oils are available that are designed to be used on plants, collectively known as horticultural oils. Most widely used have been mineral oils, highly refined petroleum-based

oils, but several plant derived oils are also used including cottonseed oil, canola oil, soybean oil and neem seed oil. They are applied as sprays (typically 1-2% dilution) and are contact insecticides without residual activity. A primary mode of action is to smother by blocking the spiracles (external breathing openings).

Potential Use in Colorado Cannabis Pest Management. Horticultural oils are among the more effective treatments available that can be used to suppress **twospotted spider mite**. It is likely that they may also be useful in management of **hemp russet mite** and oils can help suppress **powdery mildew**. Optimal use of these products for mite suppression, and evaluation of their potential to cause plant injury when used in high temperature, high light sites, needs to be further evaluated. Among the seed oils there is a range in characteristics, including ability to mix with water, evenness of flow on the plant surface, and odor. **Caution.** Oils used in combination or following applications of sulfur may cause phytotoxicity (leaf burning).

Vegetable oil-type horticultural oils include: #1 Pest Bully, 420 Pest Bully, Garden Guard Pre-Flower, Fruit Fly Bully, Wizards Brew Concentrate (castor oil), Pure 3-Way, Pure Kapow! (lemongrass and castor oil) BushDoctor Force of Nature, Eco-Mite Plus Botanical insecticide, GC-Mite, Nature-Cide All Purpose Commercial Concentrate, SaferGro Pest Out, Spider Mite Control (cottonseed oil), #1 Fungus Bully, Drench Bully, Fungus Bully (corn and castor oil), SaferGro Mildew Cure (cottonseed, corn and garlic oils), PureAg Pest Control Food Grade, Thyme Bomb (thyme and corn oil) Dr. Earth Final Stop, Organocide 3-in-1 Garden Spray (sesame oil), Root Cleaner Concentrated (soybean oil), Green Cleaner (corn and soybean oil), Captiva, Ecologic Garden Insect Killer (soybean and garlic oils, capsaicin), General Hydroponics Prevasyn Insect Repellent/Insecticide (capsaicin and garlic oil), SaferGro Pest-Out (Cottonseed, clove and garlic oils), Earth Tone Insect Control Concentrate (canola oil plus pyrethrins - *not for commercial use*), Hydro Worxx Mite & Insect Killer, Mighty, Ortho Elementals Garden Insect Killer, Spider Mite Killer, Take Down Garden Spray, (canola oil) Worry Free Garden Insect control Ready-to-Use (canola oil plus pyrethrins)

Horticultural Oils - Neem (Clarified hydrophobic extract of neem oil)

Several types of oils are available that are designed to be used on plants, collectively known as horticultural oils. Most widely used have been mineral oils, highly refined petroleum-based oils, but several plant derived oils are also used including cottonseed oil, canola oil, soybean oil and neem seed oil. Neem seed oils, typically described on labels as "clarified hydrophobic extract of neem oil", comprise the oil fraction recovered from pressed neem seeds. The primary insecticidal compounds of extracts from neem seed (particular azadirachtin) *have been removed* in neem oil products. (Products that contain azadirachtin are discussed separately, above.) As with other horticultural oils, neem oils are applied as sprays (typically 1-

2% dilution) and are contact insecticides without residual activity. A primary mode of action is to smother the insect by blocking the spiracles (external breathing openings).

Potential Use in Colorado Cannabis Pest Management. Horticultural oils are among the more effective treatments available that can be used to suppress **twospotted spider mite**. It is likely that they may also be useful in management of **hemp russet mite** and oils can help suppress **powdery mildew**. Optimal use of these products for mite suppression, and evaluation of their potential to cause plant injury when used in high temperature, high light sites, needs to be further evaluated. Neem seed oils are often more viscous than some other horticultural oils and some have an associated odor. **Caution.** Oils used in combination or following applications of sulfur may cause phytotoxicity (leaf burning).

Neem seed oil containing products include: 70% Neem Oil (Monterey), Monterey Neem Oil RTU, Natural Guard Brand Neem, Neem Concentrate, Neem Oil 3n1, Rose Rx 3 in 1 Concentrate, Triact 70, Trilogy, Garden Safe Brand Neem Oil Concentrate, Safer Brand Garden Defense Multi-Purpose Spray Concentrate, Schultz Garden Safe Fungicide 3 Concentrate, Bayer Advanced NATRIA Neem Oil Concentrate, Triple Action Neem Oil. **Cold-pressed neem oil products include:** Debug Turbo, NimBioSys, Plasma Neem Oil EC Biological Insecticide, TerraNeem EC. **Neem oil/pyrethrins combinations include:** Bonide Neem Oil Concentrate, Bonide Bon-Neem II Fungicide-Miticide-Insecticide Concentrate, Ferti-lome Triple Action, Fruit Tree Spray Plus, Ortho Tree & Shrub Fruit Tree Spray

Essential Oils - (Rosemary, Thyme, Clove, Cinnamon, Peppermint, Geraniol, Garlic, etc.)

Essential oils are volatile, aromatic oils extracted from plants. Many are familiar as compounds that give aroma and flavor to herbs, spices and foods. Several different types of essential oils also appear as active ingredients in insecticides, including rosemary, citronella, thyme, clove, garlic, cedar and peppermint. As most essential oils are generally considered safe, they are typically exempt from most requirements normal for pesticide registration under Section 25b. Because of this minimal requirement for registration, many of these products make broad claims for effectiveness based on little research support.

Studies on the mode of action of the essential oils as pesticides indicate many act by disrupting nerve functions in some insects. However, available information does not allow one to generalize too broadly about how these compounds act on insects and/or mites, including all of those that are associated with cannabis. It can be expected that individual essential oils (e.g., rosemary oil, garlic oil) have different modes of action and different potential to affect crop pests. **Caution.** Oils used in combination or following applications of sulfur may cause phytotoxicity (leaf burning).

Potential Use in Colorado Cannabis Pest Management. These products are applied as sprays to foliage. It is difficult to estimate the potential value of essential oil products for cannabis pests since they are typically blends of several oils, of varying concentrations and each may have a different spectrum of potential activity. Furthermore, there has been very little efficacy testing to support label claims, which often are broad and sometimes clearly extravagant. (These products are allowed for use under Section 25b labeling, which does not require that the manufacturer have any research support to back claims made on labels.) There is a fair body of research to support the potential effectiveness of some essential oils (e.g., rosemary oil, thyme oil) to control some pests that occur on cannabis, particularly **spider mites**.

Potential phytotoxicity has occurred with some essential oils (e.g., cinnamon) on some crops. Phytotoxicity evaluations are lacking on cannabis.

Essential oil containing products include: Captiva Prime, General Hydroponics Prevasyn, Garden Guard Pre-Flower Concentrate, #1 Pest Bully, 420 Pest Bully, 420 Pest Bully Powder, Nature-Cide, GrasRoots, Dr. Earth Final Stop, Ed Rosenthal's Zero Tolerance Herbal Pesticide, Liquid Ladybug Organic Spider Mite Killer, No Spider Mites, BacStop, Nature-Cide All Purpose Insecticide, Phydura, SNS 203 Concentrated Natural Pesticide Soil Drench/Spray, SNS 244C All Natural Concentrated Fungicide, SaferGro Mildew Cure, BushDoctor Force of Nature Miticide & Fungicide, BushDoctor Force of Nature Insect Repellent, GC-Mite, SaferGro Pest Out, Eco-Mite Plus Botanical insecticide Miticide, BioLink Insect Repellent, Budda Pest, Banish, Mildew Control, Powdery Mildew Killer, Smite, Spider Mite Control, No Powdery Mildew, AllPer-Plus, Mitey Sauce, ELEmonateM, Pure Green Thumb, Pure 3-Way, Pure Kapow!, EcoSmart Organic Insecticide Organic Garden Insect Killer2, SNS 209 All Natural Systemic Pest Control, Insect Annihilator, Dr. Earth Final Stop ProActive Yard & Garden Insect Killer, SNS 217C All Natural Spider Mite Control, TetraCURB, Ecotec, Essentria All Purpose Insect Concentrate, Ecologic Garden Insect Killer, Ecologic Houseplant & Garden Insect Killer, 86 Mites & Mold, Dr. Earth Final Stop OMRI Disease Control Fungicide, Brandt Ecotec Plus, KeyPlex Ecotrol Plus, Spider Mite Eggsterminator, Dr. Earth Final Stop OMRI Fruit Tree Insect Killer, Dr. Earth Final Stop OMRI Rose and Flower Insect Killer, Dr. Earth Final Stop OMRI Vegetable Garden Insect Killer, Dr. Earth Final Stop OMRI Yard and Garden Insect Killer, Dr. Earth Final Stop ProActive Vegetable Garden Insect Killer, Mantis EC Botanical Insecticide/Miticide, Eco-PM Botanical Fungicide, SNS 244 All Natural Ready to Use Fungicide, Spore Control, Thyme Bomb, EcoVia 3-in-1 Emulsifiable, PureAg Pest Control Food Grade, Trifecta Crop Control, Spider Mite Killer.

Sulfur

Elemental sulfur is one of the oldest pesticides in use. It is usually formulated as a flowable formulation for sprays of foliage. Sulfur has activity against many types of pests including fungi,

some mites and some insects, but is usually sold for control of foliar fungi such as powdery mildew.

Potential Use in Colorado Cannabis Pest Management. Sulfur is labeled for use in control of certain foliar fungi, such as powdery mildew. It may have some suppressive effect on spider mites. Presently the only sulfur containing product allow for use on Cannabis is limited to home growing operations, not for commercial production. **CAUTION. *The use of sulfur on a crop can cause phytotoxicity if oils are used, either in co-application or within 2-3 weeks of a sulfur application.***

Sulfur containing products include: Safer Brand 3-in-1 Garden Spray II, Safer Brand Concentrate II, Hi-Yield Snake Eyes Dusting Wettable Sulfur, Safer Brand Garden Fungicide for Flowers, Fruit, and Vegetables; Safer Brand Garden Fungicide II for Flowers, Fruits, and Vegetables; Bonide Eight Insect Control Home & Garden Ready to Use, Earth-tone 3n1 Disease Control.

Pyrethrins

Pyrethrins are naturally derived insecticides extracted from the flowers of the pyrethrum daisy *Tanacetum (=Chrysanthemum) cinerariifolium*. This insecticide has a very long history of use and has activity against many insects. Advantages useful for control of some insects include fast 'knock down' activity, repellency, and very short residual effects. Pyrethrins are most widely used for control of various flies (including mosquitoes) and caterpillars.

Pyrethrins products are often formulated with piperonyl butoxide, which acts as a synergist that can greatly increase the activity of pyrethrins. Pyrethrins are also sometimes combined with various oils (e.g., canola, neem); the oils may provide control of some species (e.g., mites) that are not controlled by pyrethrins.

Potential Use in Colorado Cannabis Pest Management. Pyrethrins appear to have little potential value in pest management of the pests found in Cannabis. Claims for use in control of spider mites are very questionable and it is unlikely to have any value for control of this pest on the crop.

Pyrethrins products include: Azera Gardening & Insecticide, Earth-tone Insect Control, Take Down Garden Spray, WorryFree brand Garden Insect Control (with canola oil), Ferti-lome Triple Action, Fruit Tree Spray Plus (with neem oil), Bonide Bon-Neem II Fungicide-Miticide-Insecticide, Ortho Tree & Shrub Fruit Tree Spray, Bayer Pyrenone Crop Spray, Prescription Treatment Brand Pyrethrum TR Micro Total Release Insecticide, Pyronyl Crop Spray, TyGRO Insect Fogger I, Safer Brand Yard & Garden Insect Killer II, Bug Buster-O, Evergreen Pyrethrum Concentrate, Lynx EC 1.4, Lynx EC 5.0, Pyganic Crop Protection EC 1.4 II, Pyganic Crop Protection

EC 5.0 II, PyGanic Gardening, Pyganic Specialty, Tersus Insecticide, Botanigard Maxx (with *Beauveria bassiana*), Xpectro OD (with *Beauveria bassiana*), Hydro Worxx Mite & Insect Killer, Mighty, Ortho Elementals Garden Insect Killer, Shield-All Plus Broad Spectrum Insecticide, Fungicide, Miticide; Evergreen Crop Protection EC 60-6, Evergreen Pro 60-6, PestXpert Pyrethrum PBO Plus, Prescription Treatment brand Pyreth-It Formula 2, Pyrethrum TR Total Release Insecticide, Ferti-lome Fruit Tree Spray, Bonide Eight Insect Control Home & Garden Ready to Use, Earth-tone 3n1 Disease Control (with sulfur).

Potassium Sorbate

Potassium sorbate is a common food additive used primarily to suppress growth of molds.

Potential Use in Colorado Cannabis Pest Management. There is very little - if any - data to support label claims of potassium sorbate to be able to effectively control mites or insects on growing crops, including those that affect Cannabis. Given the primary use of this product in food preservation it may have some value in suppression post-harvest fungi, but this is neither been tested nor is among label claims.

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