



LEGAL PEST MANAGEMENT PRACTICES FOR CANNABIS GROWERS IN CALIFORNIA

Department of Pesticide
Regulation

PESTS OF CANNABIS IN CALIFORNIA

Cannabis pests vary according to cultivar (variety), whether the plants are grown indoors or outdoors, and where the plants are grown geographically. The pests included in this review are preliminary and based on the following sources: a presentation given in 2013 by Whitney Cranshaw, an extension entomologist at Colorado State University, and a review article by John M. McPartland, a professor of family medicine at the University of Vermont. We also received input from Kevin Hoffman, former Primary State Entomologist, California Department of Food & Agriculture (CDFA).

PRODUCTS THAT CAN BE LEGALLY APPLIED TO CANNABIS PRODUCTS IN CALIFORNIA

A pesticide product can legally be applied to cannabis under state law if the active ingredients found in the product are exempt from **residue tolerance requirements**¹ and the product is either exempt from **registration requirements**² or registered for a use that's broad enough to include use on cannabis.

Residue tolerance requirements are set by U.S. EPA for each pesticide on each food crop and are the amount of pesticide residue allowed to remain in or on each treated crop with "reasonable certainty of no harm." Some pesticides are exempted from the tolerance requirement when they're found to be minimal risk.

Active ingredients exempt from registration requirements are mostly food-grade essential oils such as peppermint oil or rosemary oil.

GUIDANCE TABLES

Pages 4-8 include tables that provide guidance to cannabis growers seeking information on legal pest management practices in California.

Table 1 lists examples of active ingredients that fit these criteria. This is *not* an exhaustive list of active ingredients that may fit the legal use criteria. **Note** that DPR does not track products that fit the criteria and the user bears the responsibility for ensuring product labels meet the criteria.

Tables 2 and 3 list pests of cannabis grown outdoors and indoors, and **Table 3** shows pests arranged by the portion of the plant they attack. An explanation of the column labels for Tables 2 and 3 follow.

PESTS. The tables show the most likely pests in California based on Cranshaw's presentation and McPartland's list and gleaned from California-based web sites and blogs. Some pests that drew attention on several blogs (e.g., russet mites) may be worse during drought years. Many pests have cyclic population fluctuations and others are mainstays of general greenhouse cultivation (e.g., whiteflies, thrips, and fungus gnats). We'll add weeds to this compendium when we have more information.

DAMAGE. For damage caused by greenhouse pests, we used information from Cranshaw's presentation; for that of outdoor pests when there wasn't any overlap, we used McPartland's list and information from UC IPM for various crops. Accounts of damage by rodents are anecdotal.

PESTS NOT OFFICIALLY IDENTIFIED IN CALIFORNIA

Several cannabis pests in other states are not yet known in California. These pests would add to the russet mites, aphids, cutworms, budworms, borers, and flea beetles already in California. As more and more cannabis is planted throughout the state, collecting potential pests will enable entomologists to identify new species.

THE IMPORTANCE OF CORRECT IDENTIFICATION. It's essential to identify the potential pest or you may launch a futile program for a mite or insect that isn't a pest. And likewise, you need to know the correct species or you may use the wrong management strategy. For accurate identification, bring specimens to an entomologist.

HOW TO PRESERVE SPECIMENS FOR IDENTIFICATION. If the insect specimen is hard bodied (e.g., a beetle or moth), carefully place it in a small pill vial and cushion with crumpled tissue paper. If your specimen isn't yet dead, put it in a jar and place in a freezer overnight. Do not wrap specimens in tissue and seal them in plastic bags or you'll end up with smashed bug parts.

Place soft-bodied specimens (e.g., mites, leafhoppers, aphids, caterpillars) in a jar filled with rubbing alcohol.

¹ 40 C.F.R., § 180, et seq.

² under FIFRA section 25(b) and 3 CCR section 6147.

Include written information such as where on the plant you found the specimen, the general location of the plant, and date captured. Note original color and texture, since these will change once you immerse the specimen in alcohol. Also helpful are photographs of the specimen in its original habitat.

IPM PRACTICES. Most of these are standard practices for pests on plants other than cannabis. For more detailed explanations, see information compiled by the University of California Statewide IPM Program (UC IPM) at www.ipm.ucdavis.edu. You can enter a pest name in the search box (e.g., cutworm) and read about IPM practices for the pest on crops other than cannabis. For cannabis grown indoors, go to the UC IPM [home page](#), click on [Agricultural Pests](#) and scroll down the alphabetical list until you reach [ornamental nurseries](#).

Some practices were excluded because they apply to nearly all of the pests. For example, when targeting aphids, whiteflies, and thrips on crops grown outdoors, growers can attract predaceous and parasitic

arthropods by planting strips or borders of cover crops (e.g., California buckwheat) and insectary plants—especially those in the carrot, mustard, and sunflower families (Pickett & Bugg, 1998).

LEGAL PESTICIDES. These are covered above in the Table 1 description and are **exempt from residue tolerance requirements** and either **exempt from registration requirements** or **registered for a use that is broad enough to include use on cannabis**.

REFERENCES

- Cranshaw, Whitney. 2013. Challenges and opportunities for pest management of medical marijuana in Colorado. Presentation.
- McPartland, J.M. 1996. *Cannabis* pests. *J. Internatl. Hemp Assoc.* 3(2): 49, 52–55.
- Pickett, C.H. & R.L. Bugg, eds. 1998. *Enhancing Biological Control: Habitat management to promote natural enemies of agricultural pests*. UC Press, Oakland, Calif.

Table 1. Active ingredients that are exempt from residue tolerance requirements^a and either exempt from registration requirements^b or registered for a use broad enough to include use on cannabis. [updated on September 22, 2017]

| | ACTIVE INGREDIENT | PEST OR DISEASE |
|----|---|--|
| 1 | azadirachtin ^a | aphids, whiteflies, fungus gnats, leafminers, cutworms |
| 2 | <i>Bacillus amyloliquefaciens</i> strain D747 ^{a1} | root and crown diseases, powdery mildew, Botrytis |
| 3 | <i>Bacillus subtilis</i> QST ^{a1} | root diseases, powdery mildew |
| 4 | <i>Bacillus thuringiensis</i> ^{a4} subsp. <i>kurstaki</i> | moth larvae (e.g., cutworms, budworms, borers) |
| 5 | <i>Bacillus thuringiensis</i> ^{a4} subsp. <i>israelensis</i> | fly larvae (e.g., fungus gnats) |
| 6 | <i>Beauveria bassiana</i> ^{a5} | whiteflies, aphids, thrips |
| 7 | <i>Burkholderia</i> spp. strain A396 ^{a4} | mites, leafhoppers, aphids, whiteflies, thrips, moth larvae |
| 8 | capsaicin ^a (= capsicum oleoresin) | repellent (insects + vertebrates); mites, leafhoppers, whiteflies, thrips, moth larvae |
| 9 | castor oil ^b | repellent (moles, voles, gophers) |
| 10 | cinnamon, cinnamon oil ^b | slugs and snails, mites, leafhoppers, aphids, whiteflies, moth larvae |
| 11 | citric acid ^b | bacteria, fungi, mites, insects |
| 12 | cloves and clove oil ^b | bacteria, fungi |
| 13 | corn oil ^b | fungi, mites, insects |
| 14 | cottonseed oil ^b | fungi, mites, insects |
| 15 | garlic and garlic oil ^b | mites, leafhoppers, aphids, whiteflies, moth larvae |
| 16 | geraniol ^b | fungi, rodent repellent, mites, insects |
| 17 | <i>Gliocladium virens</i> ^{a2} | root diseases |
| 18 | horticultural oils ^a (petroleum oil) | mites, aphids, whiteflies, thrips, powdery mildew |
| 19 | insecticidal soaps ^a (potassium salts of fatty acids) | aphids, whiteflies, cutworms, budworms |
| 20 | iron phosphate ^a , sodium ferric EDTA ^a | slugs and snails |
| 21 | <i>Isaria fumosorosea</i> ^{a5*} | mites, aphids, whiteflies, thrips |
| 22 | neem oil ^a | mites, powdery mildew |
| 23 | peppermint, peppermint oil ^b | bacteria, fungi, mites, leafhoppers, aphids, whiteflies, moth larvae |
| 24 | potassium bicarbonate ^a ; sodium bicarbonate ^a | powdery mildew |
| 25 | potassium silicate ^a | powdery mildew, mites, aphids |
| 26 | potassium sorbate ^b | fungi, mites, insects |

| | | |
|----|---|--|
| 27 | predatory nematodes ^a | fungus gnats |
| 28 | putrescent whole egg solids ^b | squirrel, rabbit, and deer repellent |
| 29 | rosemary, rosemary oil ^b | bacteria, fungi, leafhoppers, aphids, whiteflies, moth larvae |
| 30 | sesame and sesame oil ^b | mites, leafhoppers, aphids, whiteflies, moth larvae |
| 31 | sodium chloride ^b | [minor active ingredient in some fungicide and insecticide formulations] |
| 32 | soybean oil ^b | mites, insects |
| 33 | <i>Reynoutria sachalinensis</i> extract ^{a3} | powdery mildew |
| 34 | sulfur ^a | mites, flea beetles |
| 35 | <i>Trichoderma harzianum</i> ^{a2} | root diseases |
| 36 | thyme oil ^b | mites, leafhoppers, aphids, whiteflies, moth larvae |

^a 40 CFR (Code of Federal Regulations)

^b FIFRA §25(b) and 3 CCR §6147 [FIFRA = the Federal Insecticide, Fungicide, and Rodenticide Act; CCR = California Code of Regulations]

* *Isaria fumosorosea* was formerly *Paecilomyces fumosoroseus*

¹ Bacterial-based fungicide

² Fungal-based fungicide

³ Plant-based fungicide

⁴ Bacterial-based insecticide

⁵ Fungal-based insecticide

Table 2. PEST MANAGEMENT PRACTICES FOR CANNABIS GROWN OUTDOORS

| PEST | DAMAGE | IPM PRACTICES (monitoring; cultural, physical, mechanical, biological) | PESTICIDES |
|--|---|--|--|
| MITES & INSECTS | | | |
| two-spotted spider mites <i>Tetranychus urticae</i> (and other Tetranychidae) | Suck plant sap; stipple leaves | <ul style="list-style-type: none"> ▪ Keep dust down by hosing off plants (if dust is a problem) ▪ Release predatory mites | neem oil, horticultural oil |
| broad mites <i>Polyphagotarsonemus latus</i> | Distort leaves and buds | <ul style="list-style-type: none"> ▪ Inspect plants; disinfest or dispose of infested plants ▪ Release predatory mites and sixspotted thrips | — |
| russet mites <i>Aculops</i> spp. | Suck plant sap; kill leaves and flowers | <ul style="list-style-type: none"> ▪ Release predatory mites | neem oil, horticultural oil, sulfur |
| crickets (field & house) | Eat seedlings | <ul style="list-style-type: none"> ▪ Use floating row covers or cones on individual plants | — |
| termites | Eat roots | <ul style="list-style-type: none"> ▪ Flood nests | — |
| leafhoppers | Suck plant sap; weaken plants | <ul style="list-style-type: none"> ▪ Encourage natural enemies by planting nectar sources | horticultural oil or insecticidal soaps for nymphs |
| whiteflies <i>Trialeurodes vaporariorum</i> , <i>Bemisia tabaci</i> , <i>B. argentifolii</i> | Suck plant sap; weaken plants | <ul style="list-style-type: none"> ▪ Hang up yellow sticky cards ▪ Use reflective plastic mulch | azadirachtin, horticultural oil, insecticidal soaps, rosemary + peppermint oils, <i>Beauveria bassiana</i> |
| thrips <i>Heliethrips haemorrhoidalis</i> , <i>Frankliniella occidentalis</i> , <i>Thrips tabaci</i> | Stipple and scar leaves ; vector viruses | <ul style="list-style-type: none"> ▪ Hang up yellow or blue sticky cards | horticultural oil, insecticidal soaps, rosemary + peppermint oils, <i>Beauveria bassiana</i> |
| aphids <i>Myzus persicae</i> , <i>Aphis fabae</i> | Suck plant sap; weaken plants | <ul style="list-style-type: none"> ▪ Hang up yellow sticky cards (alates) ▪ Hose off plants | azadirachtin, horticultural oil, insecticidal soaps, <i>Beauveria bassiana</i> |
| leafminers <i>Liriomyza</i> spp. | Bore into roots and leaves | <ul style="list-style-type: none"> ▪ Remove older infested leaves ▪ Use biocontrol: release <i>Diglyphus</i> parasitoids | azadirachtin |

| PEST | | DAMAGE | IPM PRACTICES (monitoring; cultural, physical, mechanical, biological) | PESTICIDES |
|---|--|---|---|---|
| LEPIDOPTERA | cutworms <i>Agrotis ipsilon</i> , <i>Spodoptera exigua</i> (Noctuidae) | Eat seedlings | <ul style="list-style-type: none"> Use pheromone traps to detect adults. Remove weeds, which serve as a reservoir for cutworms and other noctuids | Vegetative stage only: Use <i>Bacillus thuringiensis kurstaki</i> if egg-laying adults found, insecticidal soap; azadirachtin |
| | budworms <i>Helicoverpa zea</i> (Noctuidae) | Eat flowering buds | <ul style="list-style-type: none"> Shake plants to dislodge larvae Remove infested buds Plant corn as trap crop | Vegetative stage only: Use <i>Bacillus thuringiensis kurstaki</i> , insecticidal soap |
| COLEOPTERA | flea beetles (Chrysomelidae) | Bore into stems (grubs); feed on seedlings and leaves of larger plants (adults) | <ul style="list-style-type: none"> Use reflective mulches Plant trap crops (e.g., radish or Chinese mustard) | sulfur |
| | scarab grubs (Scarabaeidae) possibly other beetles) | Bore into stems | <ul style="list-style-type: none"> Use parasitic nematodes | — |
| MAMMALS | | | | |
| mice (e.g., house mice) | Eat young sprouts and seeds | <ul style="list-style-type: none"> Double wrap a 3'-tall chicken wire fence around plants Trap (minus rodenticides) Mount barn owl boxes | rodenticides* | |
| roof rats , <i>Rattus rattus</i> wood rats , <i>Neotoma</i> spp. | Strip bark from stems to build nests | | | |
| pocket gophers , <i>Thomomys</i> spp. | Tunnel through planting areas; feed on plants; gnaw on irrigation lines | | | |
| Columbian black-tailed deer , <i>Odocoileus hemionus columbianus</i> | Knock over plants; leave dander, droppings, and ticks behind | <ul style="list-style-type: none"> Install deer fencing | — | |
| black bears , <i>Ursus americana</i> | Knock over plants | <ul style="list-style-type: none"> Install electric fencing | — | |

* If using a rodenticide always read and follow the label and check to make sure that the target rodent is listed. Second-generation anticoagulant products (contain the active ingredients brodifacoum, bromadiolone, difenacoum, and difethialone) are DPR-restricted materials **not labeled for field use and should never be used in or around cannabis cultivation sites**. Permits for the use of DPR-restricted materials **will not be issued to cannabis cultivators**. Any federally restricted use pesticide must be applied by a certified applicator consistent with the registered labeling.

Table 3. PEST MANAGEMENT PRACTICES FOR CANNABIS GROWN INDOORS
(e.g., greenhouses, sheds, and grow rooms)

| PEST | DAMAGE | IPM PRACTICES (monitoring; cultural, physical, mechanical, biological) | PESTICIDES |
|--|---|--|--|
| DISEASES | | | |
| powdery mildew <i>Sphaerotheca macularis</i> | Grow on leaves as white and gray powdery patches | <ul style="list-style-type: none"> Use fans to improve air circulation | horticultural oil; neem oil; sodium bicarbonate, potassium bicarbonate; <i>Bacillus subtilis</i> |
| pythium root rots <i>Pythium</i> spp. | Attack root tips and worsens when plants grow in wet soil | <ul style="list-style-type: none"> Avoid hydroponic production or wet soil conditions | Incorporate biocontrol agents into root-growing media (e.g., <i>Gliocladium virens</i> , <i>Trichoderma harzianum</i> , <i>Bacillus subtilis</i>) |
| MITES & INSECTS | | | |
| two-spotted spider mites <i>Tetranychus urticae</i> (and other Tetranychidae) | Suck plant sap; stipple leaves | <ul style="list-style-type: none"> Disinfest cuttings before introducing to growing area Release predatory mites (<i>Amblyseius</i> spp., <i>Phytoseiulus persimilis</i>), or lacewings (<i>Chrysoperia</i> spp.) | neem oil, horticultural oil, sulfur |
| broad mites | Distort leaves and buds | <ul style="list-style-type: none"> Inspect plants; disinfest or dispose of infested plants Release predatory mites (<i>Amblyseius</i> spp.) and six-spotted thrips | |
| leafhoppers | Suck plant sap; weaken plants | <ul style="list-style-type: none"> Encourage natural enemies by planting nectar sources | horticultural oil or insecticidal soaps for nymphs |
| whiteflies <i>Trialeurodes vaporariorum</i> , <i>Bemisia tabaci</i> , <i>B. argentifolii</i> | Suck plant sap; weaken plants | <ul style="list-style-type: none"> Hang up yellow sticky cards Use biocontrol: <i>Amblyseius swirskii</i>, <i>Encarsia formosa</i>, <i>Delphastus catalinae</i>, <i>Steinernia feltiae</i> | azadirachtin, <i>Beauveria bassiana</i> , cinnamon oil, horticultural oil |
| thrips <i>Heliethrips haemorrhoidalis</i> , <i>Frankliniella occidentalis</i> , <i>Thrips tabaci</i> | Stipple and scar leaves ; vector viruses | <ul style="list-style-type: none"> Sterilize soil and pots before growing Hang up yellow or blue sticky cards Use biocontrol <i>Stratiolaelaps scimitus</i>, <i>Amblyseius cucumeris</i>, <i>Amblyseius swirskii</i>, <i>Orius insidiosus</i> | azadirachtin, horticultural oil, insecticidal soaps, rosemary + peppermint oils, <i>Beauveria bassiana</i> |

| PEST | DAMAGE | IPM PRACTICES (monitoring; cultural, physical, mechanical, biological) | PESTICIDES |
|--|---|--|---|
| <p>rice root aphid <i>Rhopalosiphum rufiabdominalis</i></p> | <p>Feed on roots; stunt and weaken plants</p> | <ul style="list-style-type: none"> ▪ Dispose of weakened infested plants ▪ Mix in sharp soil amendments such as diatomaceous earth ▪ Use biocontrol: <i>Stratiolaelaps scimitus</i>, <i>Dalotia coriaria</i>, <i>Steinernema feltiae</i> | <p><i>Beauveria bassiana</i></p> |
| <p>dark-winged fungus gnats (Diptera: Sciaridae) <i>Bradysia</i> spp.</p> | <p>Damage roots and stunt plant growth</p> | <ul style="list-style-type: none"> ▪ Avoid overwatering ▪ Use growing media that deters gnat development ▪ Hang up yellow sticky cards ▪ Use biocontrol: <i>Stratiolaelaps scimitus</i>, <i>Dalotia coriaria</i>, <i>Steinernema feltiae</i> | <p><i>Bacillus thuringiensis israelensis</i> (BTI); predatory nematodes; azadirachtin soil drenches</p> |