Hemp Insect Pests

WHITNEY CRANSHAW – COLORADO STATE UNIVERSITY

Western Colorado Pest Management Workshop

Fruita, CO February 11, 2020

What type of crop is hemp?

There are at least 3 kinds of hemp crops from an Insect Management Perspective

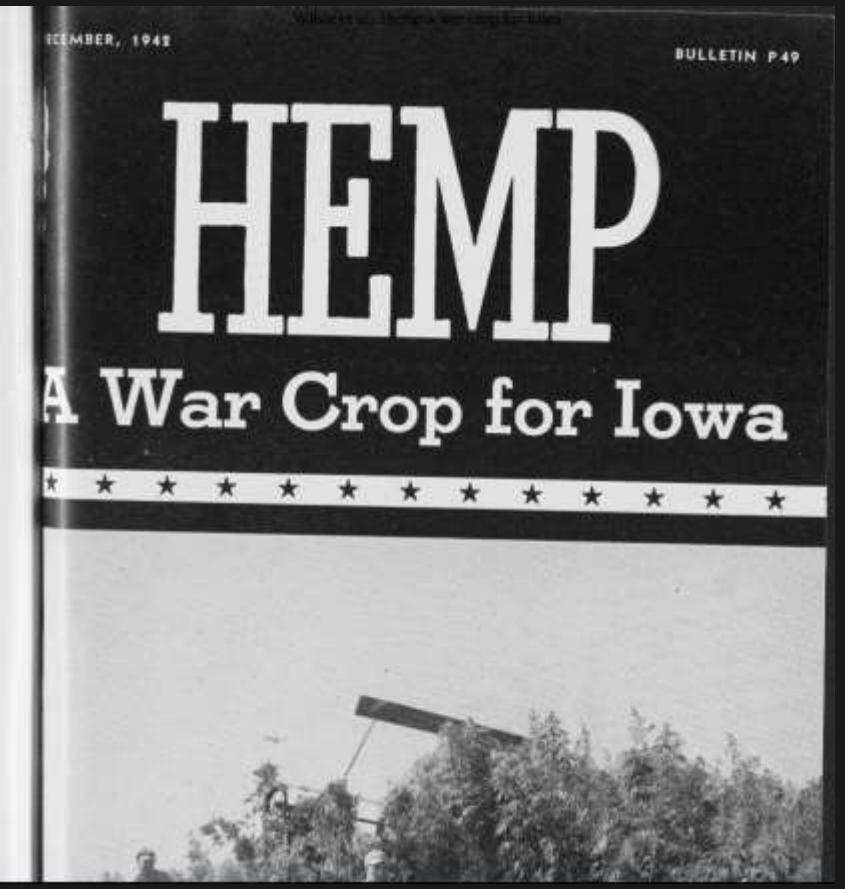
- Hemp grown seed and/or fiber
  - Outdoor culture
- Hemp grown for CBD production
  - Outdoor culture
- Indoor culture of any Cannabis crop

Descriptive Phase

What kinds of arthropods are we finding in North American hemp crops in this new era?

…and what is their association with the crop?

The only university–derived resources that give any mention of hemp insects in the United States date to the **World War II period**



HEMP An Illinois War Crop

By J. C. Hackleman and W. E. Domingo

MORE HEMP must be grown in the United States in 1943 to fill an urgent war need. The war in the Pacific has cut off nearly all the supply of strong fibers previously imported from that area; but hemp, an annual plant adapted to the corn belt, produces good yields of a highly desirable fiber. This fiber is found in the thin outer bark of the stem. It will be used largely to make marine rope, cordage, and thread.

Several mills for extracting the fiber will be constructed in northern Illinois by the Government. Each mill will process the hemp from about 4,000 acres. Since the straw must be transported to the mill, all hemp should be grown within about 12 miles of a plant. Growers will sign a contract to sell their straw to the Commodity Credit Corporation, and will purchase approved seed and rent special machines for cutting and for binding from Commodity Credit.

Previous experience with hemp in the corn belt indicates that it should be considered primarily as a war crop needed to meet an emergency. Its importance after the war cannot now be predicted, tho research on new uses for high-quality fiber may make limited production profitable then.

The entomology details provided were cursory and appear to have little relevance to the present situation

Key Arthropod Pests of Indoor Grown Cannabis

Twospotted spider mite

Hemp russet mite

Photograph courtesy of Karl Hillig

Fungus gnats

Rice root aphid

Cannabis aphid

Onion thrips

Key Arthropod Pests Emerging in Colorado Hemp Production


Corn earworm


Eurasian hemp borer


Grasshoppers


Cannabis aphid


Hemp russet mite

COLORADO STATE UNIVERSITY COLLEGE OF AGRICULTURAL SCIENCES

Hemp Resource Center

Home | Hemp Insect Factsheets | Hemp Insect Images | Regulations and Pesticide Use | Got Bugs? | Recommendations | Future Students | Commencemen

Information collected on insect issues of hemp are made available through the Colorado State University Hemp Insect Website

Insect Management Considerations in Hemp Production

The **Hemp Insect Website** is designed to provide hemp producers a way to recognize and to better understand the insects, mites, and other "bugs" that are present when this crop is grown in North America.

The goals of the Hemp Insect Website are to:

(1) Provide description of all insects and mites observed in production of hemp;

(2) Provide information on the habits of all insects that are associated with hemp production.

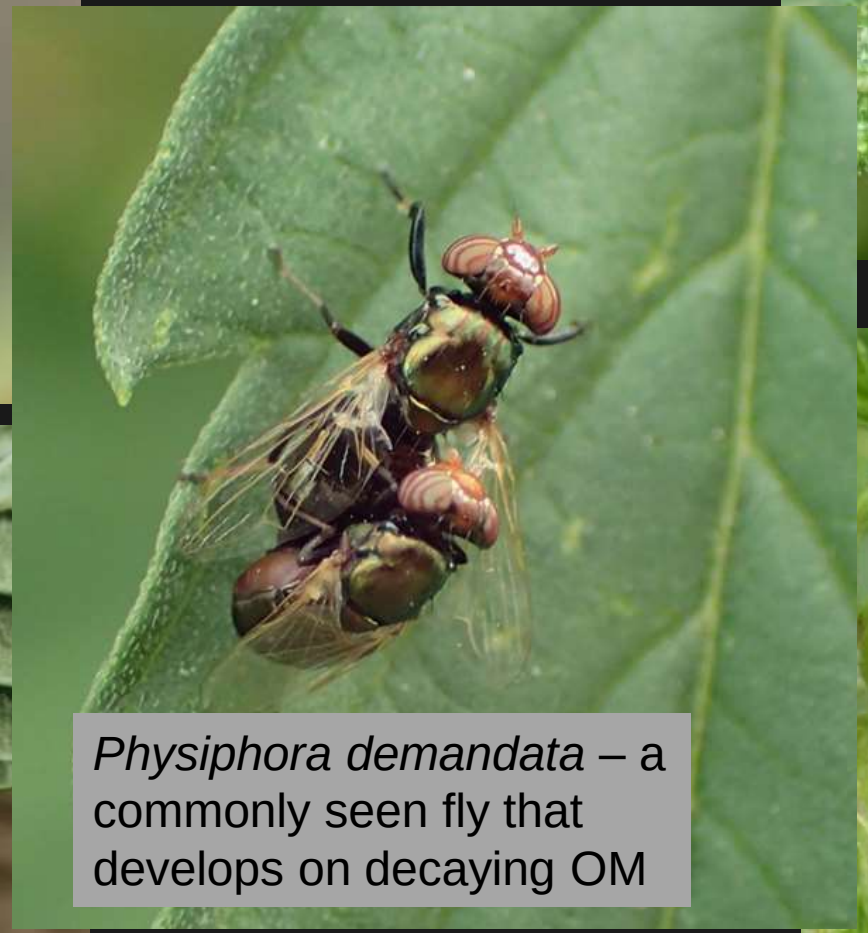
At present the Hemp Insect Website does give particular attention to insects and mites that are present within the High Plains/Rocky Mountain area of the western United States. This is because, to date, the most extensive surveys of hemp insects have occurred in this region, mostly in Colorado from 2015 to the present. However, the goal of this website is to provide progressively more comprehensive treatment of insects associated with hemp production throughout North America. Submission of photos and inquiries about insects observed on hemp is encouraged from anywhere and the website should expand as the field of hemp insect pest management develops in the United States and Canada.

What is a Hemp Insect?

What is a hemp insect?

Zygogramma disrupta – a leaf beetle of ragweed

Western corn rootworm



Physiphora demandata – a commonly seen fly that develops on decaying OM

Argus tortoise beetles pupating on hemp

Diamondback moth

Lady beetles and other Coleopteran predators

Hemp may support a diverse and robust complement of natural enemy species

Green lacewings

Syrphid flies

Spiders and other arachnid predators

Predatory Hemiptera

The most common lady beetles found in hemp fields


Convergent lady beetle


Multicolored Asian lady beetle


Sevenspotted lady beetle

Also common were *Hippodamia parenthesis*, *Olla c-nigrum*, and *Coccinella novemnotata*

Lady Beetle Larvae

Three species of Green Lacewings have been observed in hemp fields

Chrysopa oculata,
Chrysoperla floribunda,
Chrysoperla nigricornis

Some generalist hemipteran predators

Damsel bug nymph (right) and lady beetle

Damsel Bug

Nabis alternatus

A very common insect in hemp fields and a generalist predator of many insects, including caterpillars

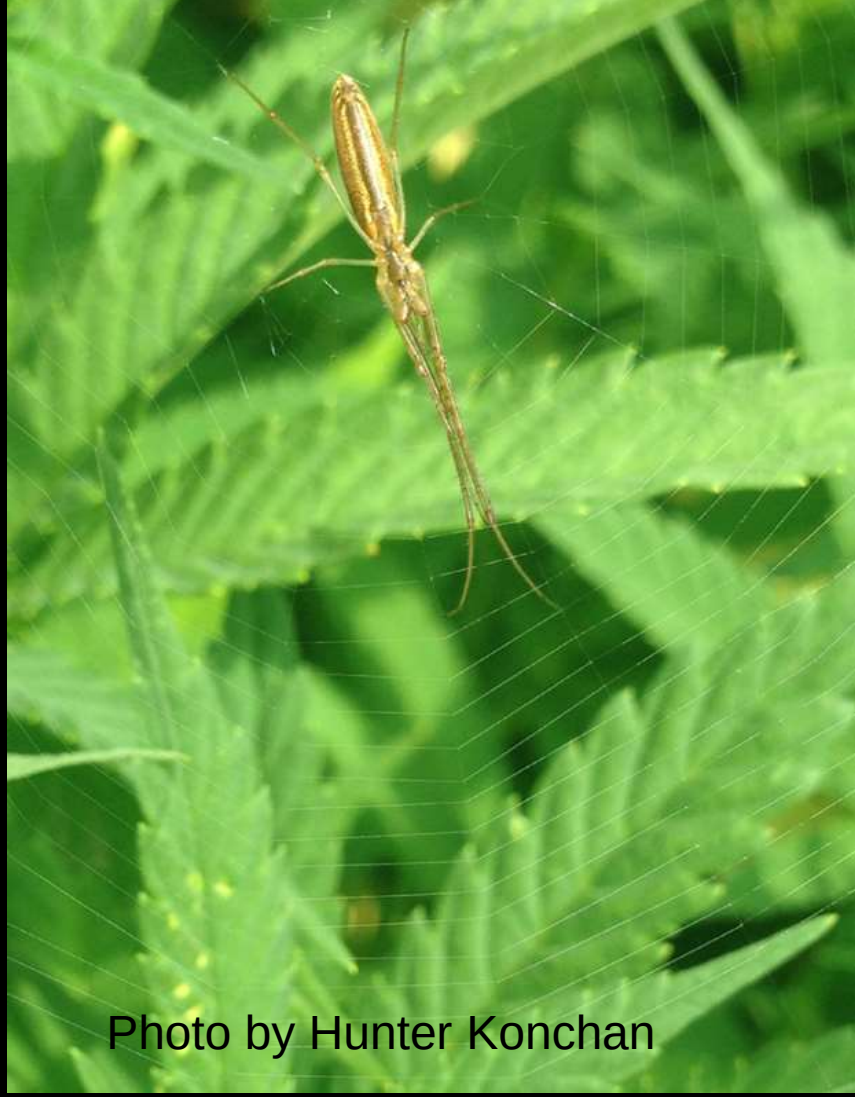


Photo by Hunter Konchan

Spiders may often be very important natural enemies of insects associated with hemp

Hemp pollen can be extremely attractive to many kinds of bees

Colton O’Brien and Dr. Arathi Seshadri just published a paper on the use of hemp pollen by bees

Hemp may be a very heavily used by many kinds of bees as a pollen source late in the season

Honey bee

Many species of native solitary bees

Bumble bees

What is the potential value of hemp as a pollen resources for bees in agricultural regions?

Hemp grown for seed production with pollen producing male plants/flowers – potentially excellent resource for many pollinators

Hemp grown for extractable compounds (e.g. CBD) without male plants – not a potential pollen source

What kinds of arthropods will we find feeding on hemp plants in this new era?

Herbivores associated with Hemp

- Leaf feeding species (all crops)
- Stalk borers (all crops)
- Hemipteran seed feeders (seed crops)
- Insects that damage flower buds (CDB crops)

Insect/Mites with Sucking Mouthparts that Feed on Leaves

There are some fluid feeding insects that occur on the leaves

Plus some treehoppers, planthoppers, and spittlebugs

Aphids

Leafhoppers

Most surprising insect associated with the crop?

Cannabis Aphid

Phorodon cannabis

Cannabis Aphid

- ***Cannabis*** **spp. are the only plants on which cannabis aphid can feed and develop**

Outdoors, highest populations are seen late in the season, near harvest. These are often started by migrants that move to the crop in mid-late August and early September.

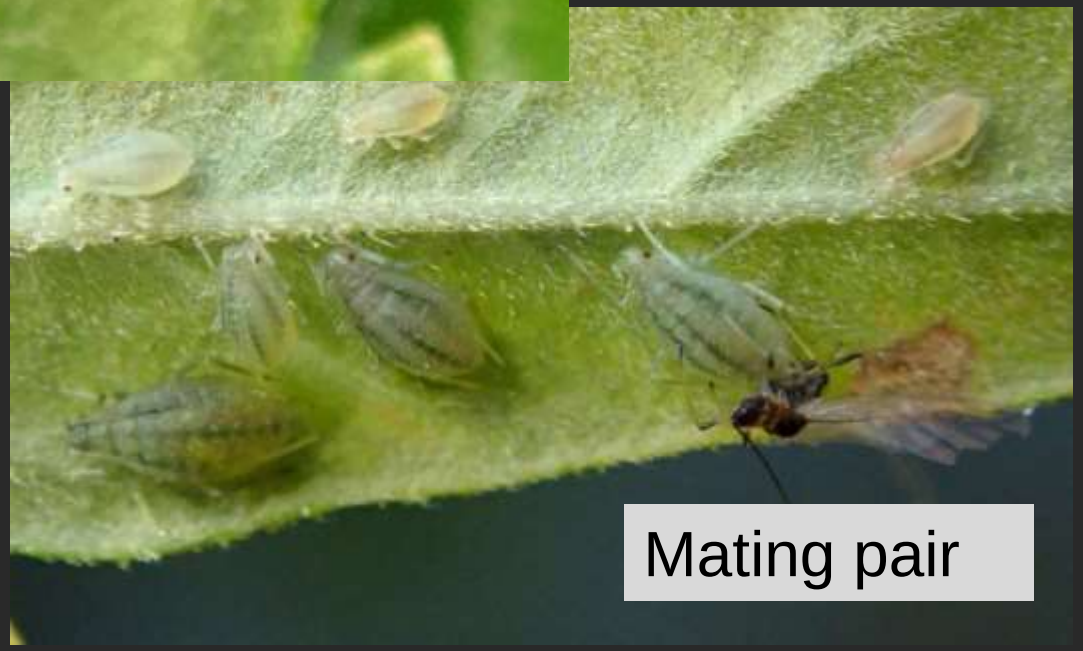
Asexual reproduction – giving live birth to a genetically identical daughter – is the norm for aphid reproduction, including cannabis aphid

No males, no externally laid egg.

Male, female with newly laid egg

Starting in midSeptember special reproductive forms appear on hemp

Cannabis aphid eggs



Mating pair

Sexual forms of cannabis aphid and eggs

Late September
on a hemp leaf

Egg producing form
female mating with
winged male

Winged male

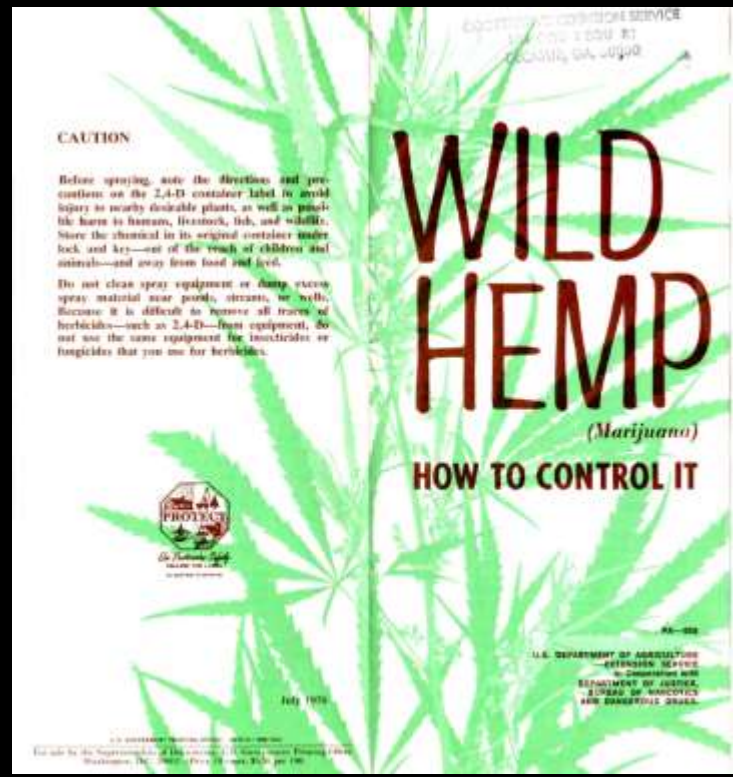
Egg producing form
female with recently
laid eggs

How will cannabis aphid survive between seasons in a place with hard freezing winters?

… mostly on indoor crops?

Photograph courtesy of University of Missouri

Feral hemp - and volunteers - can sustain significant numbers of cannabis aphid between seasons



Volunteer hemp

Cannabis aphids were collected from volunteer hemp sampled in midMay

Prevention of volunteers can reduce early season populations of cannabis aphid

Outdoors, highest populations are seen late in the season, near harvest. These are often started by migrants that move to the crop in mid-late August and early September.

Lady beetles and other Coleopteran predators

Hemp may support a diverse and robust complement of natural enemy species

Green lacewings

Syrphid flies

Spiders and other arachnid predators

Predatory Hemiptera

Insects with sucking mouthparts that feed on leaves

Leafhoppers

Damage potential of Colorado species to crop:
Negligible, at most

Newly identified insect-vectored pathogen of hemp – **beet curly top virus**

Beet curly top virus is transmitted to plants by the beet leafhopper (*Neoaliturus tenellus*)

Beet Curly Top Virus symptoms on hemp

All tested plants were infected with either the “Colorado” and/or the “Worland” strain of Beet Curly Top Virus

A slight chlorosis of the base of leaves, with some mosaic patterning was seen on all plants to some extent

“Classic” Symptoms

Generalized yellowing, stunting, maybe slight leaf curling

Twisting and curling of new growth developed on many plants

A “Trifecta” of symptoms

Original main stem shows strong symptoms

Side shoots develop that are generally healthy looking

A very odd symptom:

Bisymptomatic Plants

Beet Curly Top outbreaks are common in western Colorado. The main crops affected are tomatoes, peppers, squash and beans.

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The only way a plant gets infected with this disease if a beet leafhopper, which has previously fed on a BCTV-infected plant, feeds on the plant.

Essentially all BCTV infections occur from beet leafhoppers, carrying the virus, which migrated into the area in late spring from New Mexico/Arizona

Beet leafhopper spends very little time in hemp and does not breed in the crop. It can transmit the virus after feeding for 10-15 minutes.

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TOMATO CURLY TOP VIRUS

Bob Hammon, CSU Extension, Tri River Area

Curly top is one of several insect-vectored viral diseases that affect tomatoes. Seventy-five percent losses can occur in Western Colorado when conditions are favorable for the spread of the beet leafhopper (*Circulifer tenellus*), the vector of the virus.

Ideal conditions occur when fall and winter rains in the desert areas of New Mexico, Arizona, and Sonora and Chihuahua Mexico allow winter annual mustards to flourish during the winter months. Beet leafhoppers feed and multiply on these plants, then migrate north on storm fronts and with prevailing

Bob Hammon with the Tri-River Extension office spent many years researching all the available options to manage beet curly top on tomatoes

Results of this work can be found at the Western Colorado Insects website of the Tri-River Area Extension offices

Curly Top Research in Western Colorado

TRA Extension conducted research in tomatoes during 2006-2008 to evaluate methods of controlling curly top virus. In 2006, we conducted demonstration trials to evaluate tomato varieties for resistance to the virus. We also evaluated walls-of-water and floating row covers as control tactics. 2007 research research looked at planting dates and row covers as management techniques in trials conducted at the Western Colorado Research Center at Orchard Mesa. Replicated trials were conducted in 2008 to look at the impact of plastic mulch color on curly top incidence. A planting time insecticide and SAR (Synthetic Acquired Resistance) trial was conducted to evaluate control options for commercial growers.

Click the following to view results of those trials.

2006 2007 2008 2009 2012

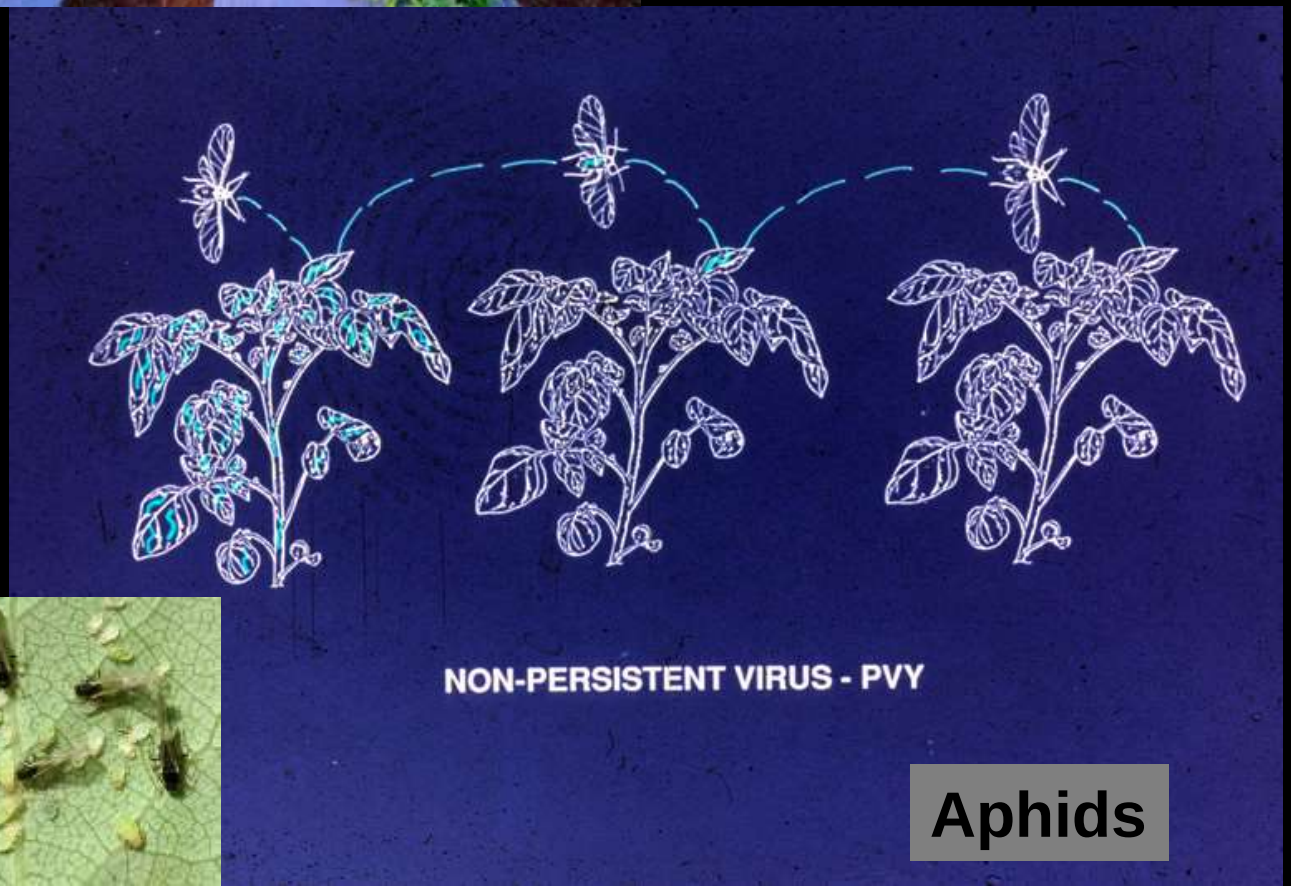
This page was updated on March 3, 2016

Mulch and Insects

- **Mulches can:**
  - alter light around plants
  - affect temperatures on plants
  - provide cover for insects around the base of the plants

Figure 1. Tomato planted on metalized vs. black plastic mulch (back - right).

Reflective Mulches for Control of Insect Vectored Plant Diseases



Aphids

Thrips

Leafhoppers

Photograph courtesy of Karl Hillig

Photograph courtesy of Karl Hillig

Hemp russet mite

Aculops cannabicola

We will come back to this when discussing bud feeders

More obvious can be insects that chew leaves of the plant **(defoliators)**

Grasshoppers

Caterpillars

Beetles

Various caterpillars chew leaves of the plant (defoliators)


Yellowstriped armyworm


Yellow woollybear


Beet webworm


Thistle caterpillar


Beet armyworm


Zebra caterpillar

Two late season “woollybear” caterpillars are most common

Saltmarsh caterpillar

Yellow woollybear

Leaf Feeding Beetles

Palestriped flea beetle

Western black flea beetle

Southern corn rootworm adult and damage

Grasshoppers (at least five species)

Two species of grasshoppers appear to be particularly damaging to hemp, twostriped grasshopper and differential grasshopper

Stem feeding seems to cause the most injury by grasshoppers

These two species roost on stems of the plants through the night – *and gnaw on stems*

Grasshoppers that damage hemp lay pods of eggs below ground in late summer. These hatch the following spring

Egg pods of grasshoppers.

These are destroyed if the ground is tilled.

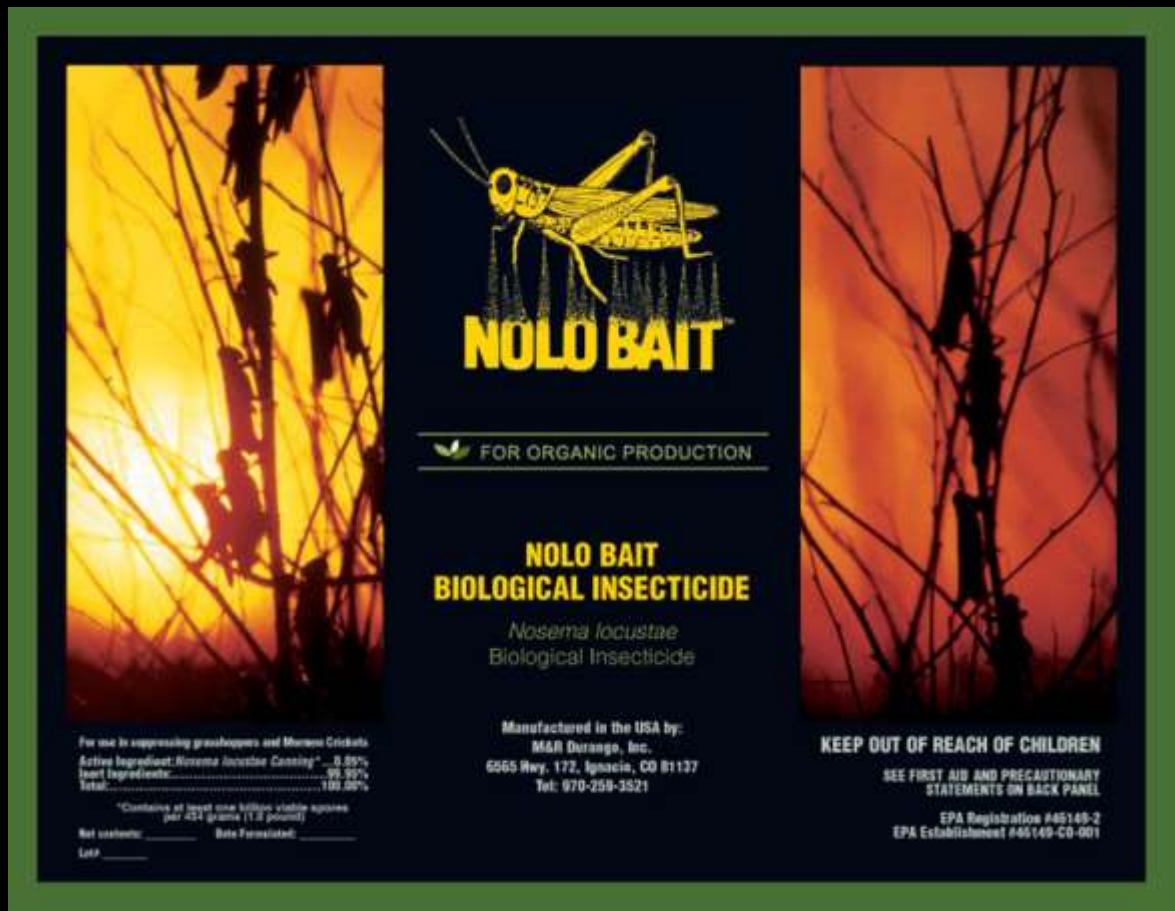
In most agricultural settings grasshopper problems originate from undisturbed field edges.

Field edges and grasshopper management

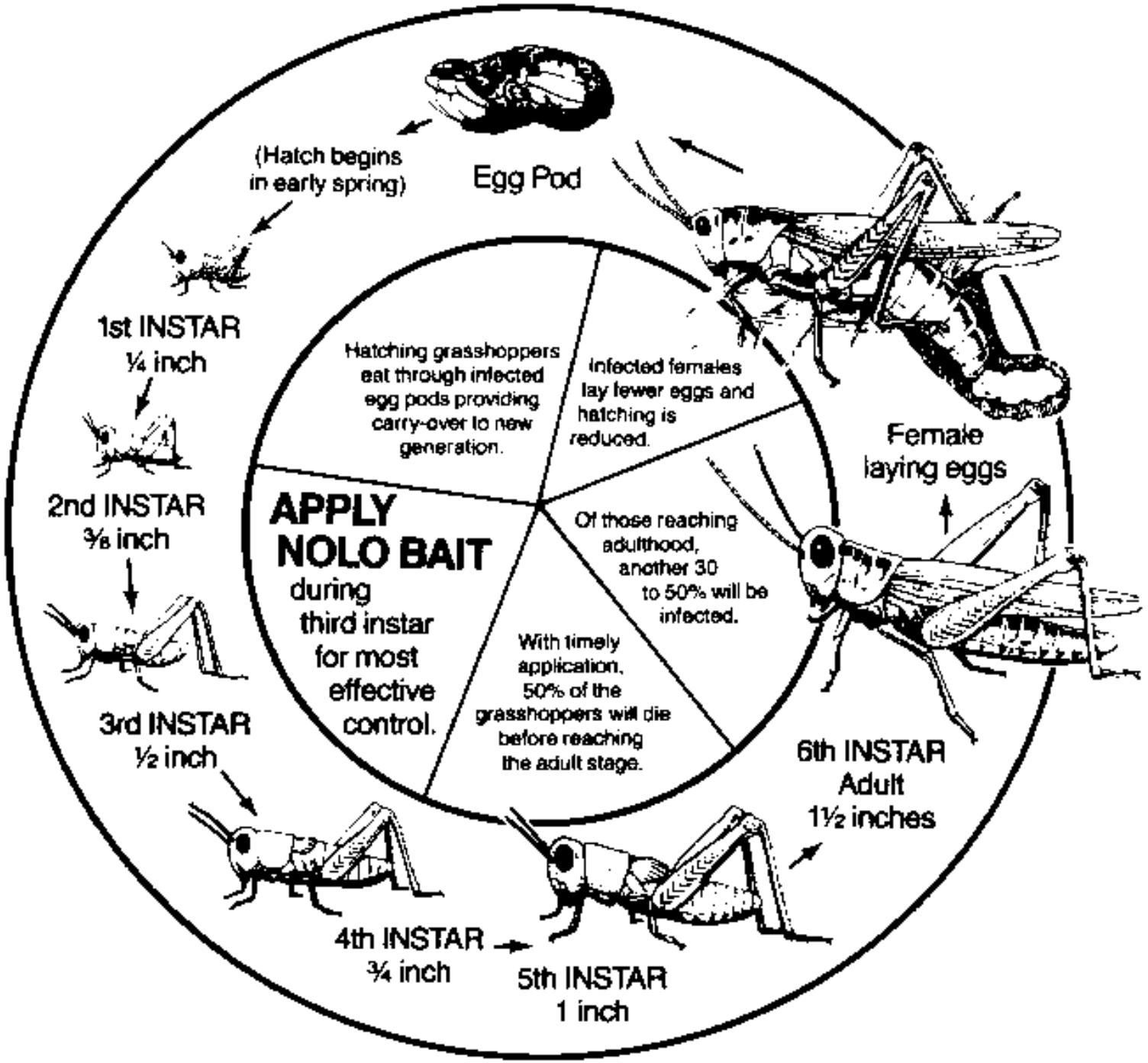
- Locate hemp some distance from field edge
- Manage grasshoppers in the field edge, before they move into the crop

Grasshopper baits can be used in off-crop sites (e.g., field edges).

They can not be used in hemp fields!



Nosema locustae
A microsporidian (fungus) disease of grasshoppers



If you use *Nosema locustae*, make sure the material is fresh

Apply it when the young grasshoppers are present

Poultry for management of grasshoppers?

Handpicking (or sweeping) early in the morning?

I got 247 in under 25 minutes when I tried it

Hemp response to hail injury can give some insight on how the crop may respond to grasshopper injuries

Research questions: What is the relationship between leaf loss (defoliation) and yield? Do plant injuries affect production of important compounds produced by the crop (e.g. THC, CBD)?

Perhaps hail simulation trials can also answer questions about effects of insect defoliators in hemp

Photograph from the website of the Canadian Hemp Trade Alliance

Stem/Stalk Boring Insects

How important is European corn borer to hemp in the modern era?

Probably not very important anywhere –
and it does not occur in western Colorado

Photgraph by Shuresh Chimire

Photograph by Daniel Gilrein

An insect that surprised me a lot when found in Colorado

Eurasian hemp borer

Grapholita dilineana

This is most important to flower buds and developing seeds

Eurasian hemp borer stalk tunneling in hemp in Wisconsin.

Photograph by Steve Tomlins.

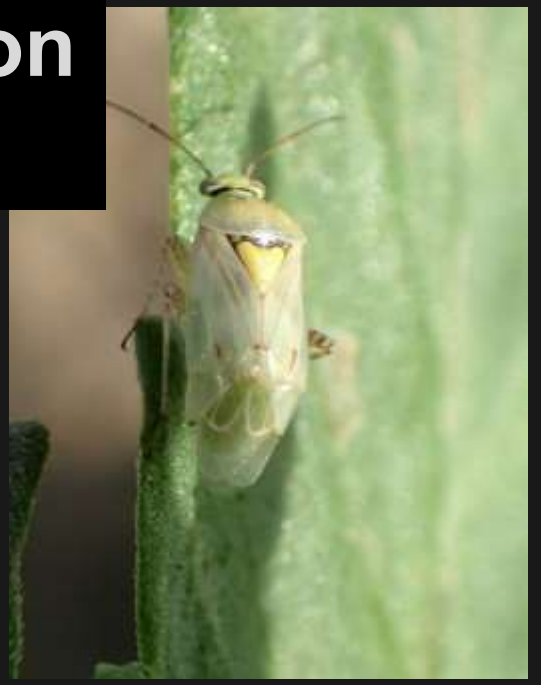
Adults were found in fields from 5 of the 6 eastern Colorado counties visited in 2018

These constitute a known range extension to the west of 600+ miles

Recent reports of it in Western CO! – from human assisted transfers

Several hemipterans (“true bugs”) feed on flowers and developing seeds of hemp

Stink bugs (4 species)



Lygus bugs (2-3 species)

Hemipteran seed feeders

False chinch bugs

Hyaline grass bug

Species of interest where there is continuous culture of seed-producing crops?

Seed Feeding Bugs and Hemp

- Feeding concentrated on flowers and developing seed
- Potential damage
  - Aborted seed, damaged seed
- Significant damage??

Insects that Damage Flower Buds

A particular issue of crops grown for CBD production

Photograph courtesy of Karl Hillig

Hemp russet mite

Aculops cannabicola

Photograph courtesy of Karl Hillig

Is an upward leaf curl a symptom of hemp russet mite injury?

Yes – and no. Some cultivars seems to produce an upward leaf curl in response to hemp russet mites. Some do not.

Some genotypes normally produce upward leaf curling in the absence of mites (“taco leaf”).

Symptoms of hemp russet mite infestation on developing buds of hemp

Reduction in bud size and quality is the effect of HRM injury

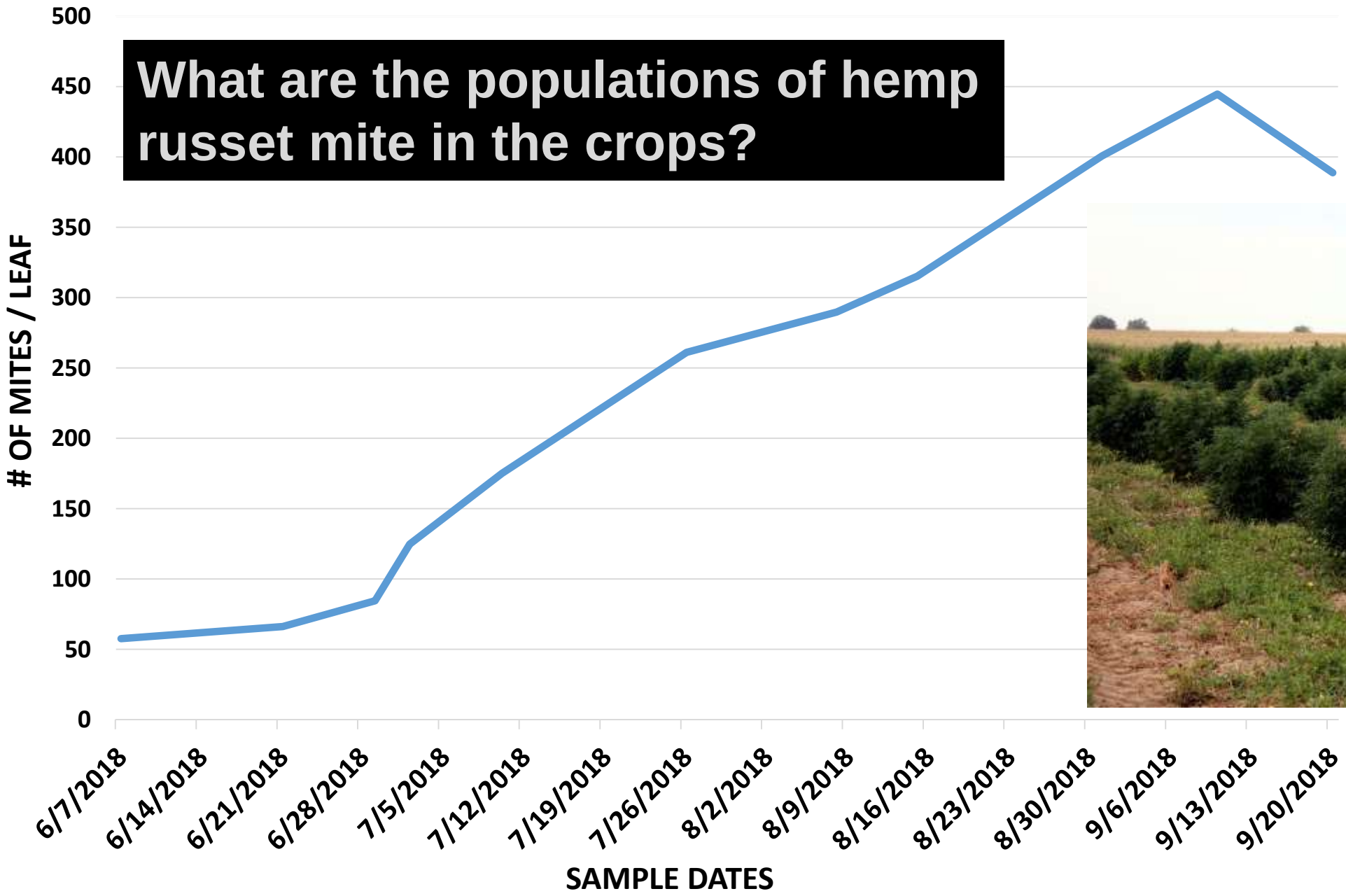
Dispersal

Hemp russet mites could be collected from glass slides placed above the crop canopy

Wind-blown dispersal occurs, as with other eriophyid mites

HEMP RUSSET MITES # / LEAF

What are the populations of hemp russet mite in the crops?



What is eating hemp russet mites in the field?

Minute pirate bugs were the only species regularly observed that could credibly be considered a hemp russet mite predator

Predatory Mites?

University of California IPM Program

Extremely low populations were present in fields

Attempts to augment populations with **releases of several species of predatory mites *were not promising***

Direct release on plants

Release with hanging sachet

No. Russet Mites/Terminal following 3 applications at one week intervals

- SuffOil-X 12.8
- TetraCURB 61.4
- Green Cleaner 67.7
- Untreated Check 239.4

Hemp russet mite is a problem in indoor production – and in field plantings using HRM infested transplants

Key to control:

Eliminate HRM from mother plants

Sulfur is an excellent product for eliminating hemp russet mite from hemp

- Only two, retail products are allowed for use on the crop (in Colorado)
- **Key HRM pesticide registration need:**
  - **Commercial producer formulation allowable for use on hemp (young plants, well before flowering)**
    - Indoor use is critical
    - Outdoor use would be a bonus
  - Certified organic formulation would be nice

Eurasian Hemp Borer

Grapholita delineana

Volunteer hemp examined June 18 were infested with larvae in late stages of development

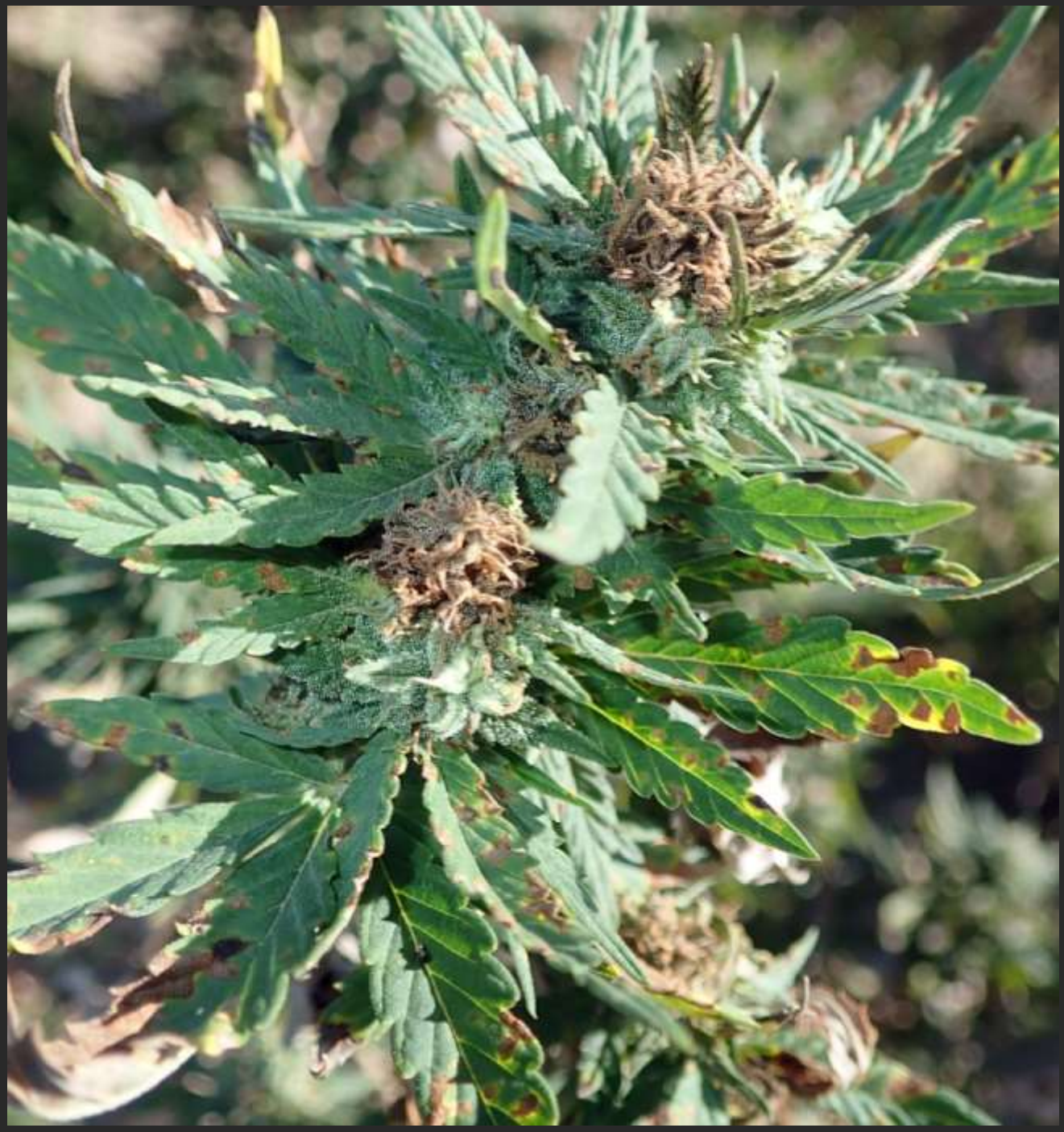
The last stage larva changes from cream colored to pinkish, as do some other *Grapholita* species

Exterior symptom of stalk tunneling – leaf flagging

Eurasian hemp borer stalk tunneling in hemp in Wisconsin.

Photograph by Steve Tomlins.

Serious damage to buds has been repeatedly observed in northeastern Colorado



Eurasian Hemp Borer – Potential key pest of crop in North America on cultivars grown for seed?

Photograph by Steve Tomlins

Management Options for Eurasian Hemp Borer at Present

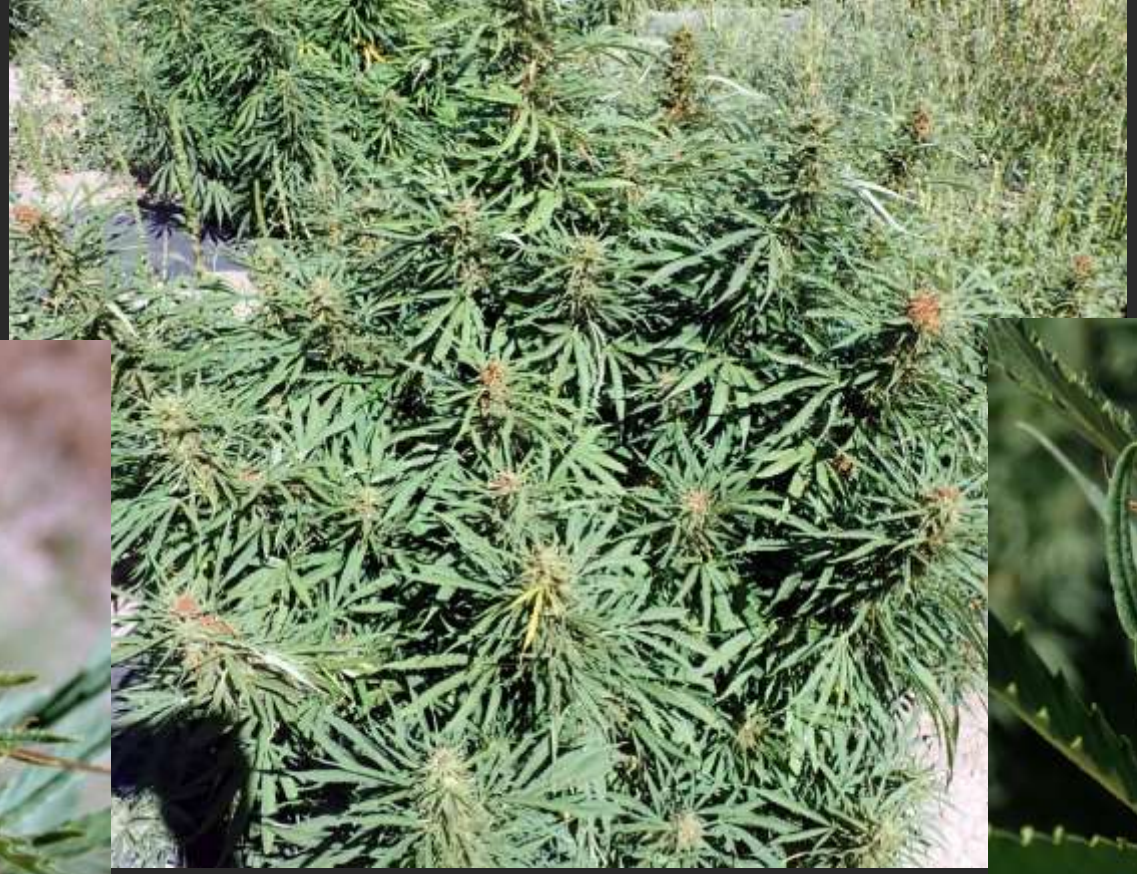
- Destroy all crop residues at the end of the season that could contain living stages that survive between seasons
- Rotate the location of consecutive hemp crops a considerable distance
- Insecticides????
  - Azadirachtin???????

Most significant potential pest of the crop in Colorado

Corn earworm

Helicoverpa zea

Corn earworm shows wide range in coloring and patterning on hemp (as with most crops)



Corn earworm tunnels into and can extensively damage developing buds of hemp

In 2016, 2018 and 2019 corn earworm caused serious losses to CBD hemp in southeastern Colorado

Adults of the corn earworm

One night's light trap capture, September 8, 2016

A fact sheet on Corn Earworm at the Hemp Insect Website

Corn Earworm

The insect that has shown the most potential to damage hemp in Colorado is the **corn earworm** (*Helicoverpa zea*). This is one of the most widespread and commonly damaging insects in much of the United States, affecting both field crops and vegetable crops. Evidence of its importance is indicated by it having three accepted common names: corn earworm (when in corn), **tomato fruitworm** (when feeding on fruits of peppers, tomatoes, etc.), and **bollworm** (when feeding on cotton bolls).

In hemp the primary damage occurs when they tunnel into buds and developing seeds. Damage to hemp by corn earworm has potential to cause significant damage, particularly to crops grown for production of large buds to extract CBD or other pharmaceutical compounds. Potential damage to fiber or seed producing cultivars is likely to be minimal. Populations of this insect vary greatly from season to season in Colorado and will usually peak in hemp during late August and/or September.

Corn earworm caterpillars in hemp. The bottom photo is by Janna Beckerman, purduehemp.org

Parts of Colorado include areas of the northern range of where corn earworm has historically been able to survive through winter (as a pupa in the soil). However, mild winters will allow this

Melissa Schreiner

Proposed Management Plan for Corn Earworm in Hemp

Background. Corn earworm (*Helicoverpa zea*) is a key pest of hemp grown in Colorado. Damage is caused by the larva (caterpillar) that tunnels through and destroys maturing buds. This insect is present every growing season in Colorado, where it may be found on a wide variety of crops and weed hosts. However, population size, and associated damage, can vary greatly from season to season and by location.

Traps (light, pheromone) can be used to capture the adult stage of this insect, a night flying moth. When used over a period of time these traps can provide information on in changes in abundance of the insect, with high trap captures being associated periods of peak egg laying on plants.

The insecticides that have the most potential to control corn earworm - and are allowable by the Colorado Department of Agriculture for use on cannabis crops – are certain strains of the microbial insecticide *Bacillus thuringiensis* (Bt). These are best applied at times coinciding with periods of peak egg laying by the adult moths and subsequent egg hatch, which occurs a couple of days after eggs are laid.

Use of Traps for Monitoring Corn Earworm

Two types of traps can be used to capture the night flying moths of the corn earworm, light traps or pheromone traps.

Basic design of a **light trap** uses a light, preferably UV, to attract insects that fly at night. The insects then hit a vane and are funneled into a collecting container below. Usually a killing agent (often a dichlorvos Pest-Strip) is placed in the collecting container to minimize damage to the collected insects, particularly damage to the delicate wings of moths, which may be torn by "June bugs" and other other active insects that come to these traps.

Light traps will capture a wide variety of insects, mostly various kinds of moths and beetles. Traps

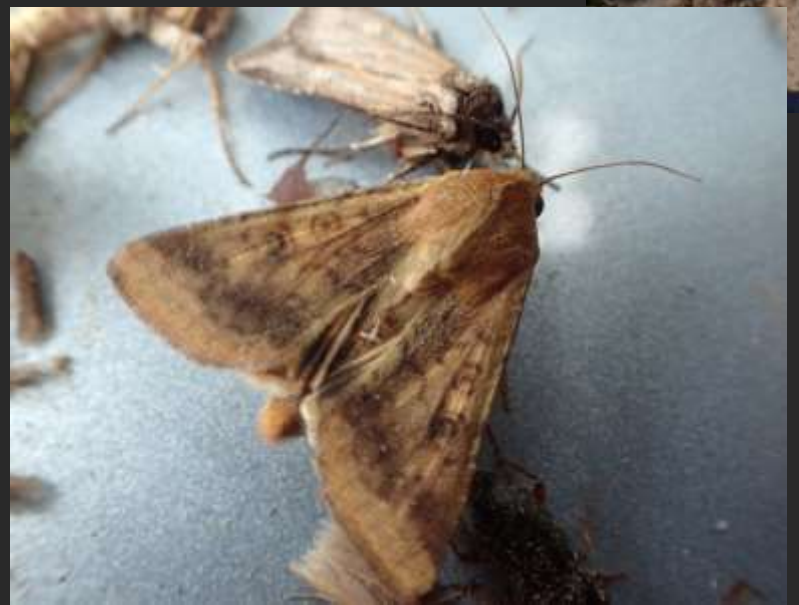
Present proposed IPM program for corn earworm in hemp

An IPM Implementation Phase effort

Outline of Corn Earworm Management Program in Hemp

- **Establish a program to monitor flights of adult corn earworms using pheromone traps**
  - This should *begin by midsummer* to establish baseline of adult captures
  - Traps should be *checked twice a week* and the number of new moths recorded

Pheromone trap used to monitor corn earworm



Outline of Corn Earworm Management Program in Hemp

- ***If very high numbers of moths are discovered* during flowering, treatment should be considered**
  - –***Bacillus thuringiensis* var. *aizawi***
    - **Agree WG, XenTari Biological Insecticide**
  - –***Helicoverpa NPV***
    - ***HelicoVex***

Colorado allowed insecticides that can be used to control corn earworm in hemp

Agree® WG

BIOLOGICAL INSECTICIDE

For control of lepidopterous insect pests of certain terrestrial fruits, vegetables, ornamentals and flowers, tobacco, corn, cotton, soybeans, and citrus.

FOR ORGANIC PRODUCTION

OMRI LISTED

Active Ingredient: *Bacillus thuringiensis* subspecies *aizawai* strain GC-91
Solids, spores and Lepidopteran active toxins* 50.0%
Other Ingredients: 50.0%
Total: 100.0%

*The percent active ingredient does not indicate product performance and potency measurements are not federally standardized.

KEEP OUT OF REACH OF CHILDREN
CAUTION

Net Contents: 5 or 20 Pounds
EPA Reg. No. 70051-47
EPA Est. N0. 67545-AZ-1*
(Lot Number with "G")
EPA Est. No. 70051-CA-001
Lot No.:

Manufactured by
Certis USA, L.L.C.
9145 Guilford Road
Suite 175

See ad

***Bacillus thuringiensis* (*aizawi* strain)**

Andermatt USA

where Nature leads Innovation

www.andermattusa.com

HELICOVEX®

Insecticidal Virus for Use in Greenhouses and Open Fields for the Control of the Corn earworm, the Tobacco budworm and the African cotton bollworm

FOR ORGANIC PRODUCTION

OMRI LISTED

Active Ingredient:*
Helicoverpa armigera nucleopolyhedrovirus strain BV-0003 0.60%
Other Ingredients: 99.40%
Total: **100.00%**
*Contains a minimum of 7.5×10^{12} viral occlusion bodies per liter.

KEEP OUT OF REACH OF CHILDREN
CAUTION

SEE SIDE/INSIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS AND FIRST AID

Net Contents:
Lot No.:
EPA Reg. No.: 69553-2
EPA Est. No.:

Manufactured by: Andermatt Biocontrol AG
Stahlermatten 6
6146 Grossdietwil
Switzerland

***Helicoverpa* Nuclear Polyhedrosis Virus**

Pollinator use may complicate controls if there are insects that are pests of the crop during flowering

Fortunately, the *Bacillus thuringiensis* (Bt) and HelicoVex products used for corn earworm ***are compatible with pollinators***

Colorado allowed insecticides that can be used to control corn earworm in hemp

Agree® WG

BIOLOGICAL INSECTICIDE

For control of lepidopterous insect pests of certain terrestrial fruits, vegetables, ornamentals and flowers, tobacco, corn, cotton, soybeans, and citrus.

FOR ORGANIC PRODUCTION

OMRI LISTED

Active Ingredient: *Bacillus thuringiensis* subspecies *aizawai* strain GC-91
Solids, spores and Lepidopteran active toxins* 50.0%
Other Ingredients: 50.0%
Total: 100.0%

*The percent active ingredient does not indicate product performance and potency measurements are not federally standardized.

KEEP OUT OF REACH OF CHILDREN
CAUTION

Net Contents: 5 or 20 Pounds
EPA Reg. No. 70051-47
EPA Est. N0. 67545-AZ-1*
(Lot Number with "G")
EPA Est. No. 70051-CA-001
Lot No.:

Manufactured by
Certis USA, L.L.C.
9145 Guilford Road
Suite 175

See ad

***Bacillus thuringiensis* (*aizawi* strain)**

Andermatt USA
where Nature leads Innovation
www.andermattusa.com

HELICOVEX®

Insecticidal Virus for Use in Greenhouses and Open Fields for the Control of the Corn earworm, the Tobacco budworm and the African cotton bollworm

FOR ORGANIC PRODUCTION

OMRI LISTED

Active Ingredient:*
Helicoverpa armigera nucleopolyhedrovirus strain BV-0003 0.60%
Other Ingredients: 99.40%
Total: **100.00%**
*Contains a minimum of 7.5×10^{12} viral occlusion bodies per liter.

KEEP OUT OF REACH OF CHILDREN
CAUTION

SEE SIDE/INSIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS AND FIRST AID

Net Contents:
Lot No.:
EPA Reg. No.: 69553-2
EPA Est. No.:

Manufactured by: Andermatt Biocontrol AG
Stahlermatten 6
6146 Grossdietwil
Switzerland

***Helicoverpa* Nuclear Polyhedrosis Virus**

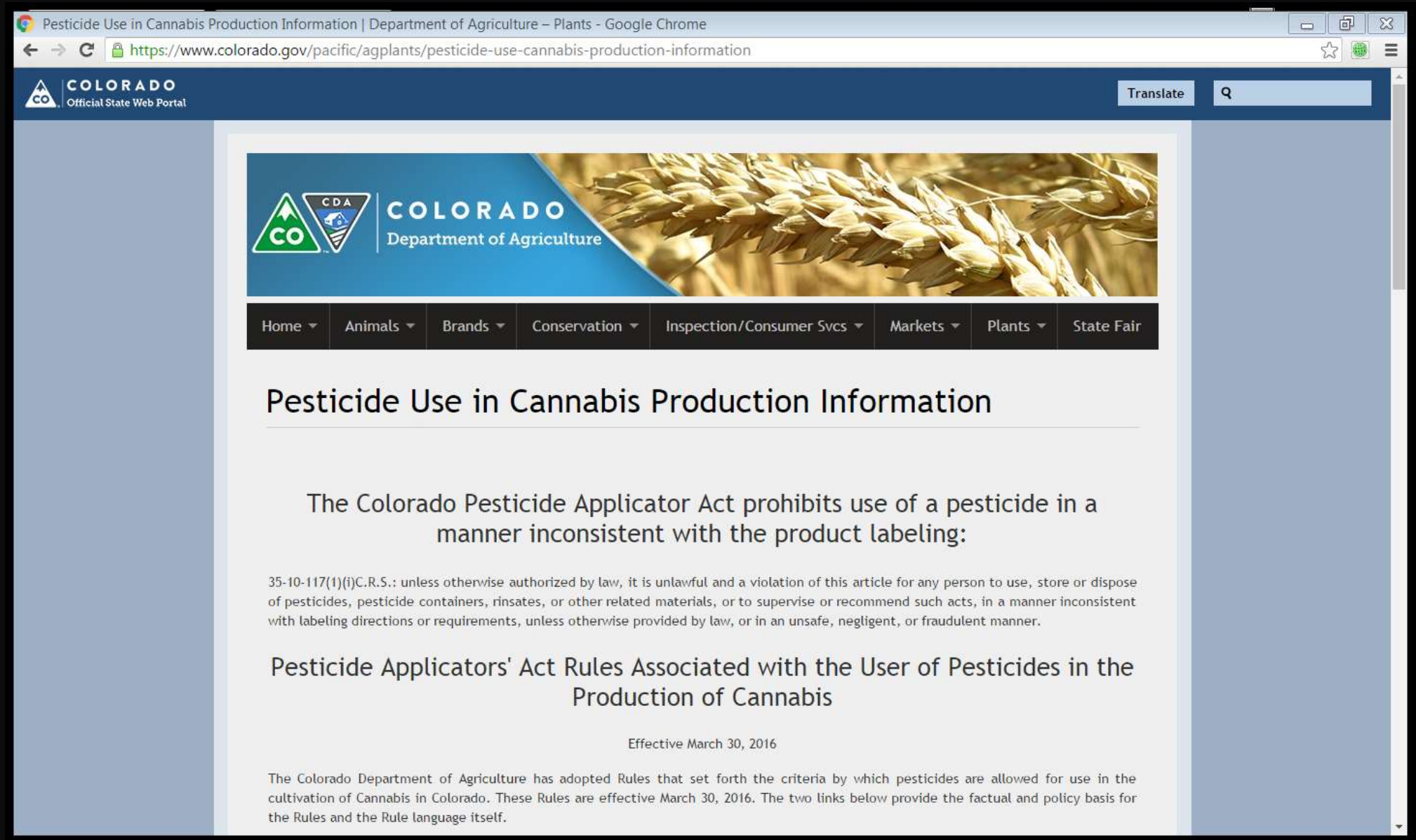
The Pesticide Conundrum with Cannabis

- All registered pesticides can only be legally applied to sites (e.g., crops) on which they are labeled
- Presently the agency overseeing pesticide labeling (EPA) does not recognize cannabis as a crop site

Are there pesticides that can be used on this crop now?

In Colorado, the Colorado Department of Agriculture maintains a website of *pesticides that may be applied to hemp grown within the state*

Not all states that allow hemp production have established guidelines regarding pesticides.



Criteria for Pesticides Allowed to be Used on Cannabis in Colorado

- Pesticides that require federal registration under Section 3 of FIFRA
  - Active ingredient is exempt from the requirements of food crop tolerance, *and*
  - Label has directions for use on unspecified food crops, including unspecified food crops grown as bedding plants
  - EPA and CDA registration is required
  - Pesticide is registered on tobacco
- Section 25b minimum risk pesticides (exempt from most federal registration)

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Example of pesticide label with a very broadly described Crop Site

Labels written in this manner can be interpreted as allowing use on hemp

Such labels are rare

CROPS (including but not limited to)	APPLICATION	COMMENTS
Tomatoes, lettuce, cucumbers, peppers, sweet corn, broccoli, cauliflower, cabbage; peas, beans, beets, celery, onions, garlic, leek, asparagus, okra, eggplant strawberries, grapes, escarole ornamentals and flowers Cotton, alfalfa, soybeans, peanuts, potatoes, corn, wheat, sweet potatoes, tobacco, sunflowers, sugar beets, sorghum, floriculture, and border plants	**Rate:** 1.0 – 2.5 fl. oz. per acre **Method:** Sprayer, Aircraft **Equipment:** Sprayer, Sprinkler Irrigation, Mist Sprayer	Repeat application as above every 6 – 8 sunny days (counting 2 partially sunny days as 1 sunny day) if monitoring indicates that reapplication is necessary. Lower rates (every 6 sunny days) may be used during vegetative stages of the crop or when tank mixed with other insecticides. When flowers, fruits or other harvested structures of the plant are present or when infestation becomes strong, use the higher rates. Sweet corn and corn: For very sunny regions (e.g., California), use 0.5 to 1.25 fl. oz./acre every 3 days; for less sunny regions, use 1 to 2.5 fl. oz./acre every 6 to 8 days. Cover the whole larval hatching period of the treated generation until harvest.

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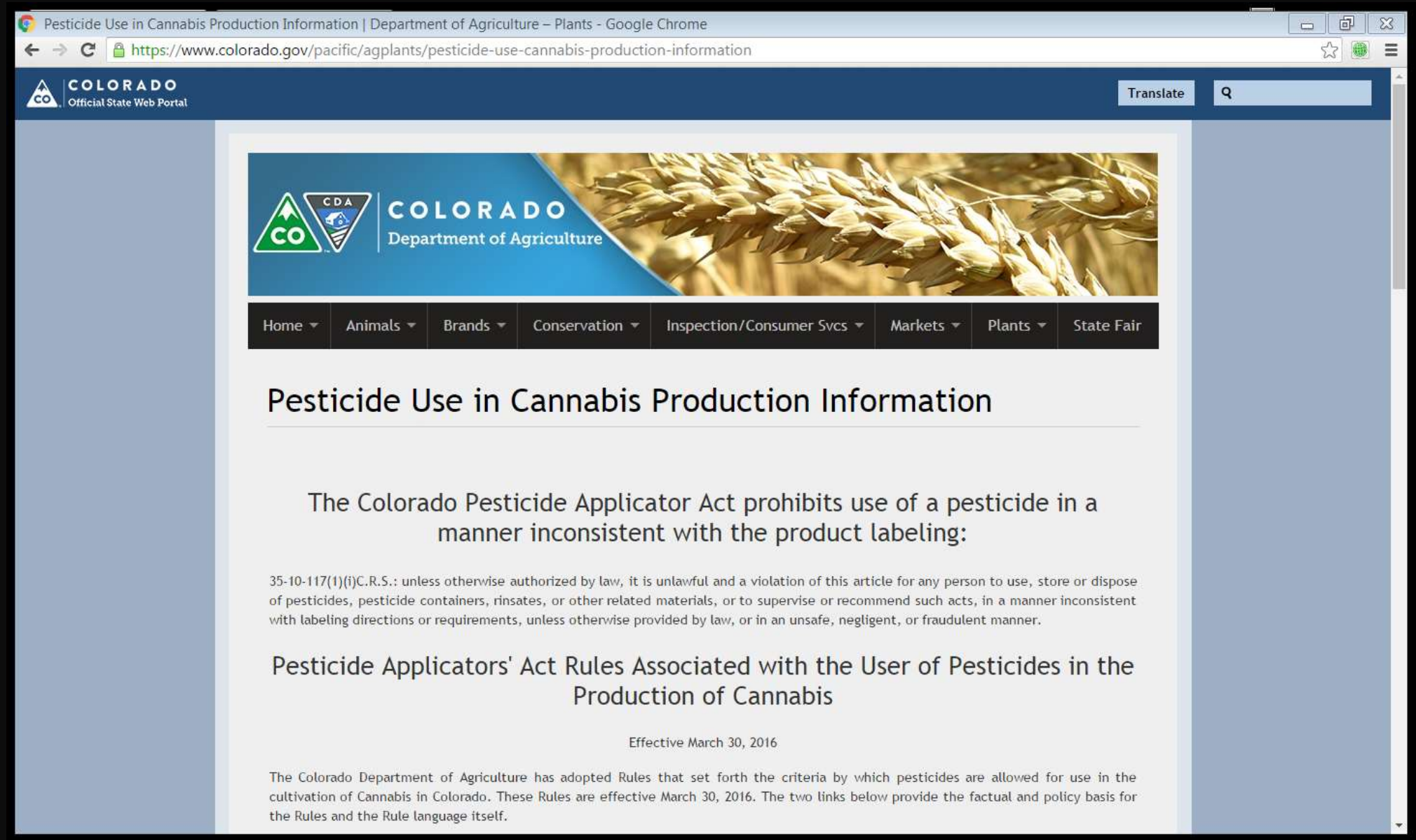

Website page to access what Colorado Department of Agriculture considers to be *not not allowable* (= allowable) for use on Cannabis in Colorado

Pesticides Allowed for Use on Cannabis

Each time we update the Cannabis pesticides list or have industry news we will send out an email blast and you can sign up here to be included. As of March 30, 2016 all past lists will be removed from the CDA website and updates will be made only to the list of approved pesticides that may be used in accordance with Pesticide Applicators' Act Rule - Part 17.

The list developed by CDA is intended to assist Colorado Cannabis growers in identifying which pesticides can be used legally in accordance with the Pesticide Applicators' Act and its Rules in the production of Cannabis (marijuana and industrial hemp), it is not an endorsement or recommendation to use these products in the production of Cannabis in Colorado. These products have not been tested to determine their health effects if used on Cannabis that will be consumed and thus the health risks to consumers is unknown. by including products on this list, therefore, CDA make no assurances of their safety or effectiveness when used on Cannabis and is not responsible or liable for any such use.

To view or download the current list, click the link below:

- Pesticides allowed for use in Cannabis production in accordance with the PAA Rule: Effective June 29th, 2016
  - PDF
  - Excel
- This link provides a list of products that have been removed from the list of pesticides that may be used on Cannabis. These products were either removed from the list prior to the effective date of the rule or were removed as a result of them not meeting the rule criteria as of March 30th, 2016.
  - Excel
- Selected Examples of pesticides that cannot be used in marijuana production January 13 2016
  - PDF

Products added since the last update are now highlighted in red on the PDF version of the file. The Excel version has the date that each product was added and can be sorted or filtered by name, date, active ingredient, etc.

A page listing the current products **that are allowed** for use on all Cannabis (including hemp) grown in Colorado

Most all of the CDA allowable pesticides are also allowed in production of **Certified Organic** crops

Colorado product name	Company	EPA Number	Active Ingredients	Percent	Commercial	Personal use	Hemp	Comments	Pesticide Type
#1 Fungus Bully (concentrate)	Stills LLC	25(b)	Sodium Lauryl Sulfate Corn Oil Citric Acid	8.000% 3.680% 1.120%	Yes	Yes	Yes		Fungicide
#1 Pest Bully	Stills LLC	25(b)	Castor Oil Garlic Oil Corn Oil	8.000% 4.000% 4.000%	Yes	Yes	Yes		Insecticide
420 Drench Bully	Stills LLC	25(b)	Sodium Lauryl Sulfate Castor Oil Corn Oil	16.000% 8.000% 4.000%	Yes	Yes	Yes		Fungicide, Insecticide
420 Fungus Bully (concentrate)	Stills LLC	25(b)	Sodium Lauryl Sulfate Corn Oil Citric Acid	8.000% 3.680% 1.120%	Yes	Yes	Yes		Fungicide
420 Pest Bully Concentrate	Stills LLC	25(b)	Castor Oil Garlic Oil Corn Oil	8.000% 4.000% 4.000%	Yes	Yes	Yes		Insecticide
420 Pest Bully Powder	Stills LLC	25(b)	Garlic White Pepper Citric Acid	0.250% 0.120% 0.080%	Yes	Yes	Yes		Insecticide
420 Pest Bully Ready-to-Use	Stills LLC	25(b)	Castor Oil Garlic Oil Corn Oil	0.500% 0.250% 0.250%	Yes	Yes	Yes		Insecticide
70% Neem Oil (Monterey)	Lawn and Garden Products, Inc	70051-2-64705	Clarified Hydrophobic Extract of Neem Oil	70.000%	No	Yes	No		Fungicide, Insecticide
86 Mites & Mold Ready to Use	NorCal Plant Nutrients LLC	25(b)	Rosemary Oil Lemon Grass Oil Cinnamon Oil Cottonseed Oil	0.300% 0.100% 0.100% 0.100%	Yes	Yes	Yes		Fungicide, Miticide
86 Mites + Mold Concentrate	NorCal Plant Nutrients LLC	25(b)	Rosemary Oil Lemon Grass Oil Cinnamon Oil Cottonseed Oil	1.200% 0.600% 0.500% 0.300%	Yes	Yes	Yes		Fungicide, Miticide

Wednesday, June 29, 2016

Page 1 of 22

Colorado product name	Company	EPA Number	Active Ingredients	Percent	Commercial	Personal use	Hemp	Comments	Pesticide Type
Agri-Fos Systemic Fungicide	Lawn and Garden Products, Inc	71962-1-64705	Phosphorous Acid, Mono- and Di-Potassium Salts of	45.800%	Yes	Yes	Yes	Use allowed prior to final transplant.	Fungicide
Agri-Fos Systemic Fungicide	Liquid Fertilizer Pty. Ltd.	71962-1	Phosphorous Acid, Mono- and Di-Potassium Salts of	45.800%	Yes	Yes	Yes	Use only allowed prior to final transplant, unless grown in recirculating hydroponics systems.	Fungicide
Agri-Fos Systemic Fungicide Plus	Liquid Fertilizer Pty. Ltd.	71962-2	Phosphorous Acid, Mono- and Di-Potassium Salts of	60.560%	Yes	No	Yes	Use allowed prior to final transplant.	Fungicide
AllPer-Plus Concentrate	AllPer-Plus	25(b)	Geranium Oil Rosemary Oil Clove Oil	0.200% 0.330% 0.330%	Yes	Yes	Yes		Insecticide
AllPer-Plus Ready to Use	AllPer-Plus	25(b)	Geranium Oil Rosemary Oil Clove Oil	0.190% 0.130% 0.190%	Yes	Yes	Yes		Insecticide
Aliude Systemic Fungicide	Cleary Chemical Corporation	71962-1-1001	Phosphorous Acid, Mono- and Di-Potassium Salts of	45.800%	Yes	Yes	Yes	Use allowed prior to final transplant.	Fungicide

Whether or not a pesticide is allowed to be used in Certified Organic production ***does not mean it is legal to be used in hemp!!***

OMRI

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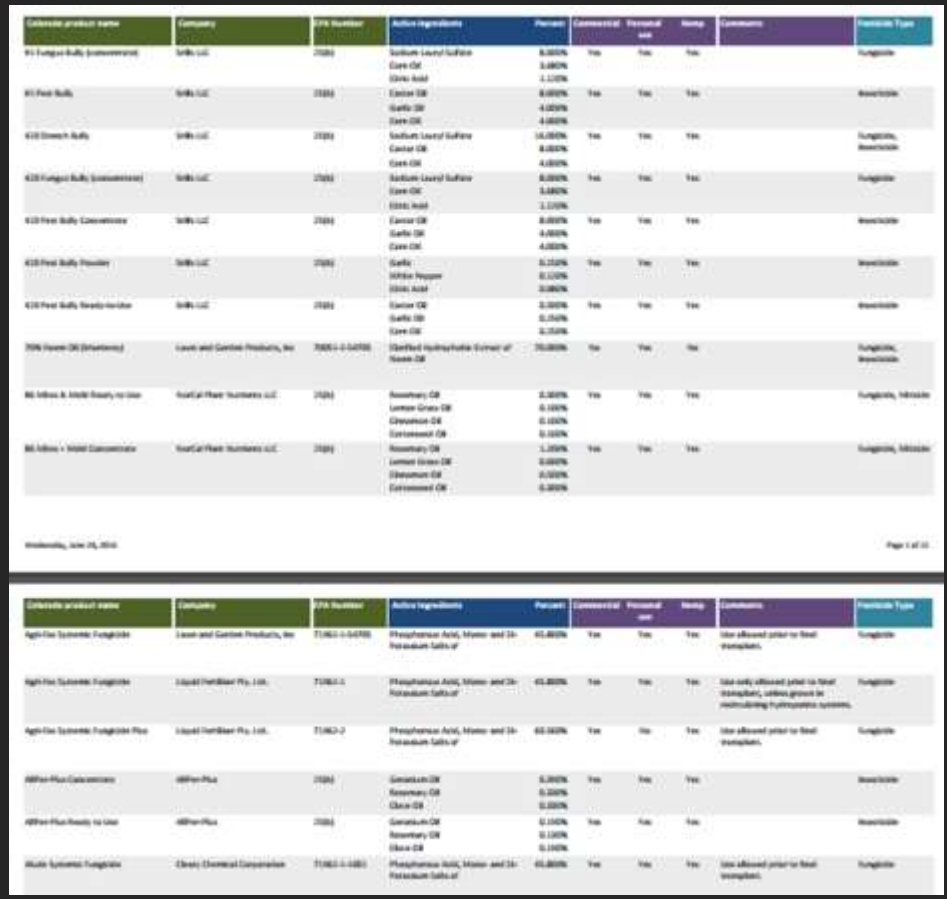


When hemp "grows up" as a crop, addressed by federal laws and regulations as are all other crops - *how will the pesticides issues work out?*

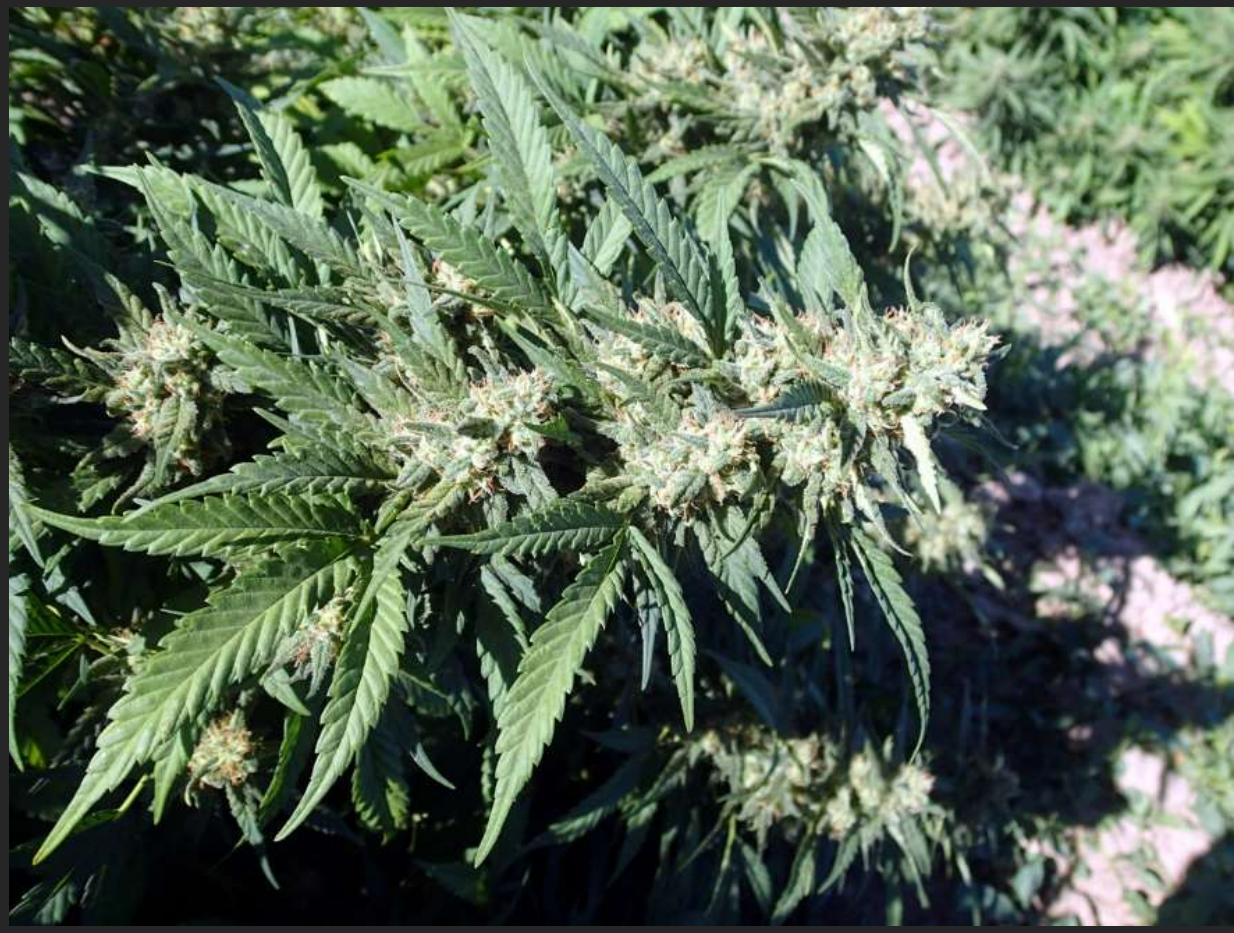
It will very likely vary by the type of hemp crop, and end use

Hemp Grown for Fiber and Seed

For seeds, perhaps this would be considered under Crop Group 20 (Oilseeds, such as sunflower, cotton seed and canola/rape seed)

For a strictly fiber grown crop?

Hemp Grown for CBD



This poses some more serious registration problems

Hemp Grown for CBD

This poses some obvious registration problems.

This produces an extracted product that is consumed by humans, and in different manners (e.g., ingested, inhaled)

Hemp Grown for CBD

This poses some obvious registration problems.

This produces a product that is applied to humans, and in different manners.

Extraction methods used will affect potential for residues, and these must be studied.

You may wish to check out the **Colorado Hemp Insect Website** for periodic updates on this subject

COLORADO STATE UNIVERSITY | COLLEGE OF AGRICULTURAL SCIENCES

Hemp Insects

Home | Hemp Insect Factsheets | Hemp Insect Images | Regulations and Pesticide Use | Got Bugs? | Recommendations | Future Students | Commencement | Dire

Insect Management Considerations in Hemp Production

The Hemp Insect Website is designed to provide hemp producers a way to recognize and to better understand the insects, mites, and other "bugs" that are present when this crop is grown in North America.

The goals of the Hemp Insect Website are to:

(1) Provide description of all insects and mites observed in production of hemp;

(2) Provide information on the habits of all insects that are associated with hemp production.

At present the Hemp Insect Website does give particular attention to insects and mites that are present within the High Plains/Rocky Mountain area of the western United States. This is because, to date, the most extensive surveys of hemp insects have occurred in this region, mostly in Colorado from 2015 to the present. However, the goal of this website is to provide progressively more comprehensive treatment of insects associated with hemp production throughout North America. Submission of photos and inquiries about insects observed on hemp is encouraged from anywhere and the website should expand as the field of hemp insect pest management develops in the United States and Canada.

Note: This website is limited to insect issues involving hemp, defined as *Cannabis* grown for seed, fiber, or non-THC pharmaceutical products. *This is not a forum for marijuana.* Industrial

Insects/Mites found in Hemp: Pest Management Needs

Questions????

This presentation will be posted at the Colorado State Insect Information Website

- Housed at Department of Agricultural Biology
- Within "Entomology"
- "Insect Information"
  - Extension presentations are posted at the bottom of the page, most recent at end

Top of the Colorado State Insect Information Website

Bottom of the Website page