Northeastern IPM Center

Industrial Hemp IPM

USDA United States Department of Agriculture National Institute of Food and Agriculture

Webinar Details

- Welcome
- A recording of this webinar will be available within a week at

http://www.neipmc.org/go/ipmtoolbox

We Welcome Your Questions

- Please submit a question **at any time** using the Q&A feature to your right at any time

- If you'd like to ask a question anonymously, please indicate that at the beginning of your query.

Webinar Presenter

Whitney Cranshaw
Colorado State University

Northeastern IPM Center

Some Questions For You

USDA United States Department of Agriculture National Institute of Food and Agriculture

Industrial Hemp IPM

Whitney Cranshaw
Colorado State University

What type of crop is hemp?

Hemp (broad sense)

Cultivars of *Cannabis* with low levels* of psychoactive compounds (THC).

* The magic number is 0.3% by dry weight. Don’t ask why.

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

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

Hemp Grown for Fiber and/or Seed

Produced by seeding

Plant populations are high

Hemp Grown for Fiber and Seed

Crop may be a mixture of separate female and male (dioecious) plants or may include monoecious plants

Pollination (wind) is needed for seed production

Hemp Grown for CBD

Most hemp grown for CBD has involved use of transplanted clones.

This usually involves a greenhouse/indoor production phase.

Some live plants (mother plants, clones) are normally present year-round.

Hemp Grown for CBD

(and other non-psychoactive cannabinoids)

Often all-female plants

- Male flowers, pollen absent
- Plants often sticky near harvest

Wide plant spacing, branching plant growth form

Hemp Grown for CBD (and other non-psychoactive cannabinoids)

Typically grown by transplants, with early season indoor production

In-field plant populations are often low

Duo-use crops may be grown, such as CBD/seed

With stabilized genetics more CBD forms of hemp are being grown from seed

Stages in Developing Insect Pest Management Systems for Industrial Hemp

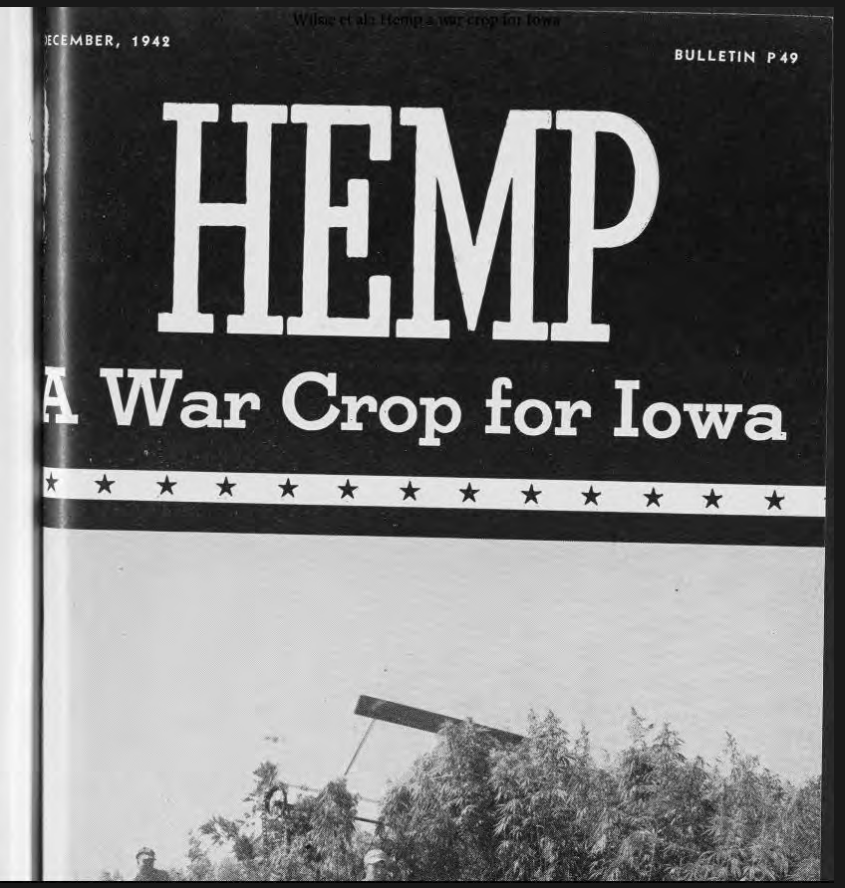
- Descriptive Stage
- Development Stage
- Implementation Stage

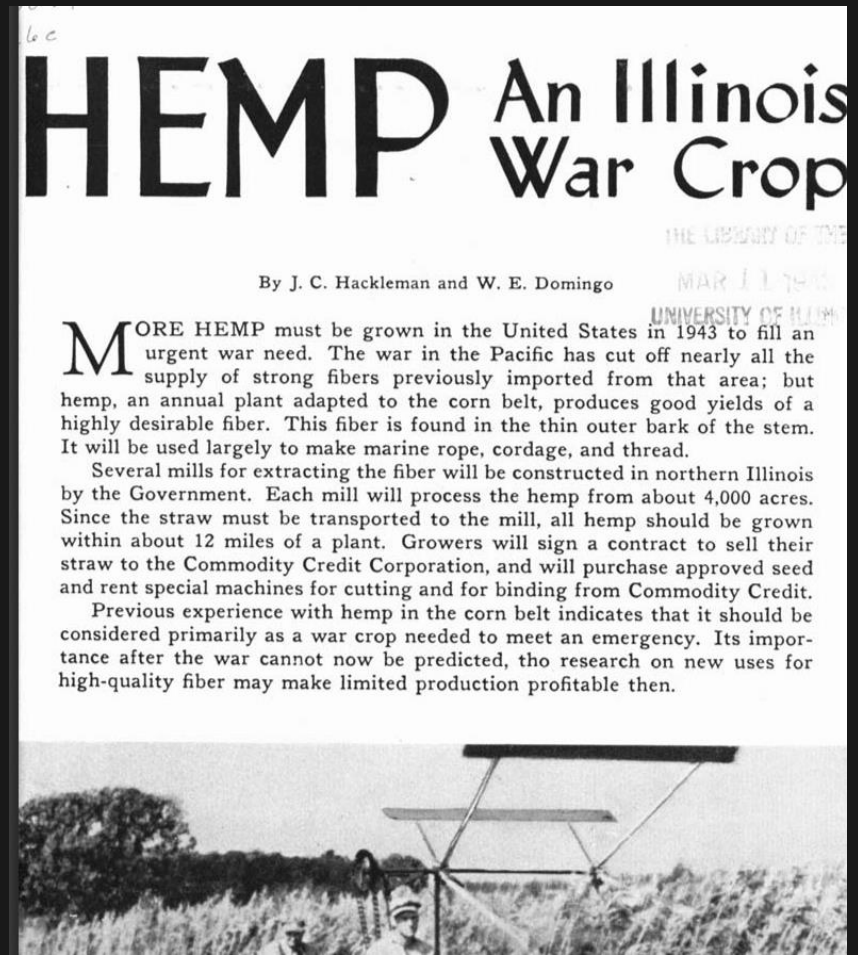
Descriptive Phase

What kinds of arthropods will we find associated with North American hemp 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

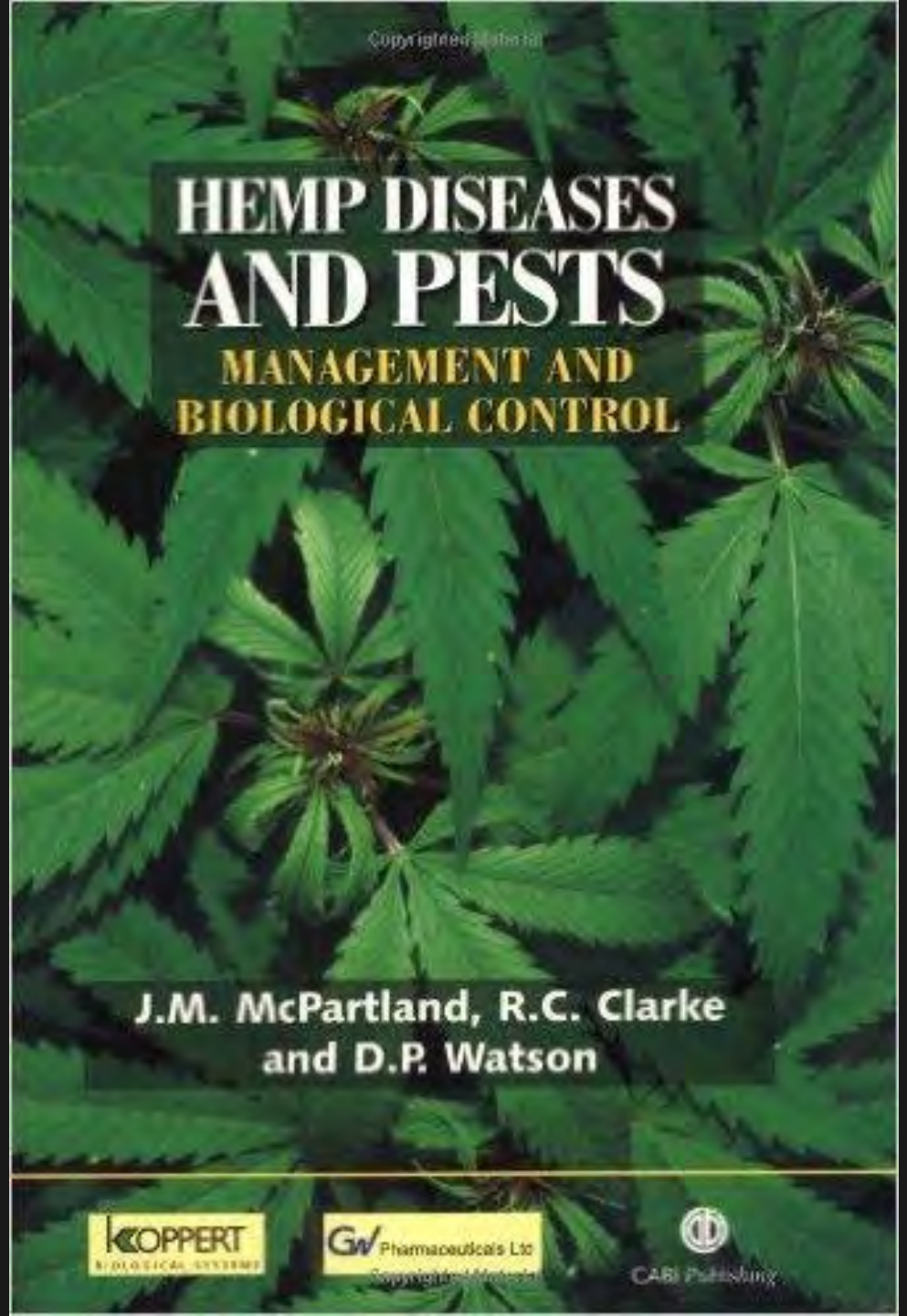
By J. C. Hackleman and W. E. Domingo

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



This book has very well summarized the information known about hemp pests, worldwide, prior to 2000.

There are very few references from North America sources.

What is a Hemp Insect?

What is a hemp insect?

Zygogramma disrupta – a leaf beetle of ragweed

Argus tortoise beetles pupating on hemp

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

Western corn rootworm

Diamondback moth

An Unusual Insect Event in Hemp - 2018

A Lace Bug

Gargaphia sp.

A field of young hemp in southeastern Colorado was massively infested by a lace bug in early June. Adults of a *Gargaphia* sp. were found on essentially every plant.

Large numbers of eggs were laid on the plants

Some plant injury was observed on the lower leaves

What happened?

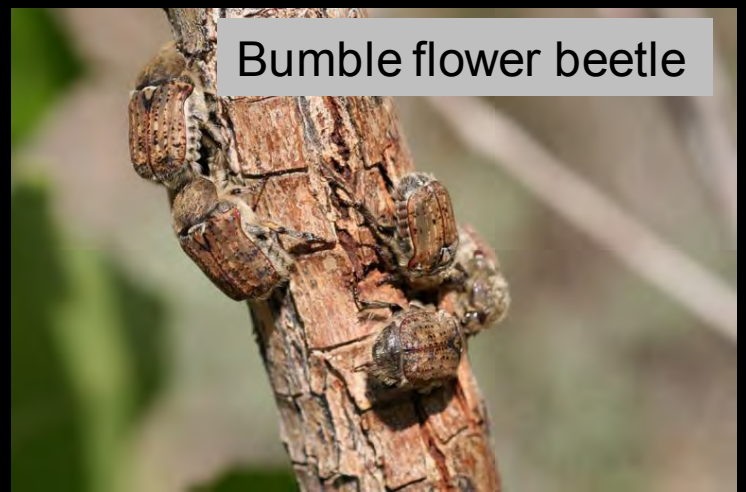
Nothing. Eggs hatched but no nymphs developed.

A few adults were found on the plants for weeks.

The field as it was being readied for first harvest in September

Several insects will be associated with ooze from wounds or infections of stems, stalks

Physiphora demandata



Bumble flower beetle

Green June beetle

Photograph by Leah Black

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

A robust complex of natural enemies can be expected to be found in hemp when it is grown outdoors (particularly on flowering plants?)

The most common lady beetles found in hemp fields

Coleomegilla maculata is a common species in VA and TN

Lady beetles found in CO hemp fields

Ninespotted lady beetle –
State Insect of New York!

Lady Beetle Larvae

Three species of Green Lacewings have been observed in hemp fields.

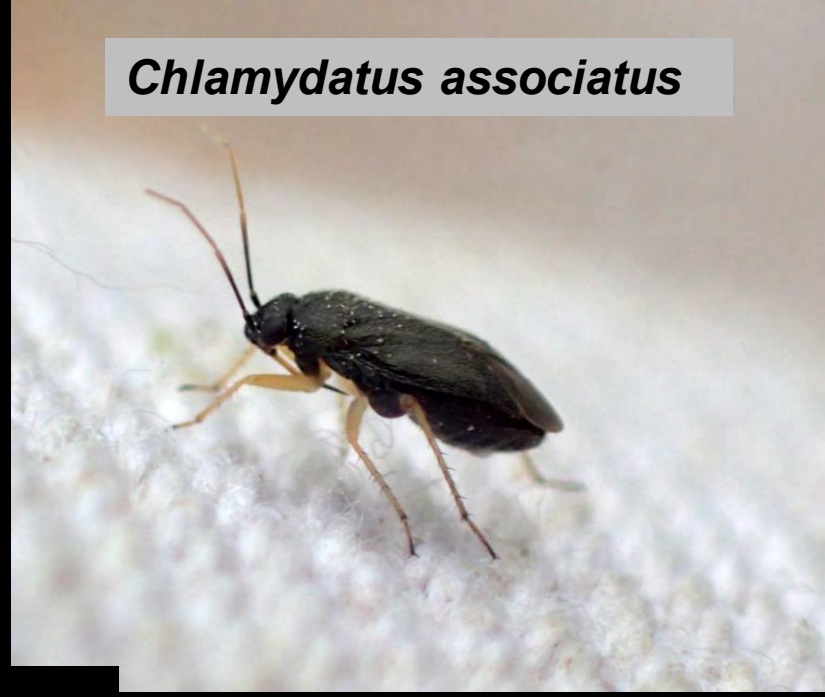
Chrysopa oculata,
Chrysoperla floribunda,
Chrysoperla nigricornis

Flower flies

….and other families of predatory flies

Some generalist hemipteran predators

Damsel bug



Chlamydatus associatus

Spined assassin bug

Minute pirate bug

Damsel Bug

Nabis alternatus

Damsel bug nymph (right) and lady beetle

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

Primary families:

Philodromidae
Salticidae
Thomisidae
Tetragnathidae

Photo by Hunter Konchan

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

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

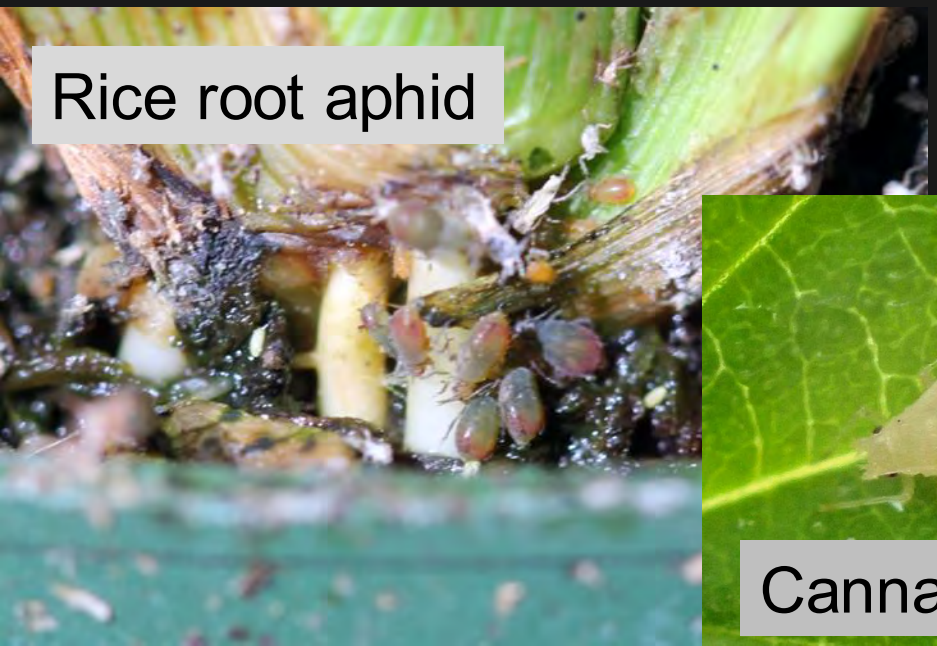
Key Arthropod Pests of Indoor Grown Cannabis

Twospotted spider mite

Hemp russet mite

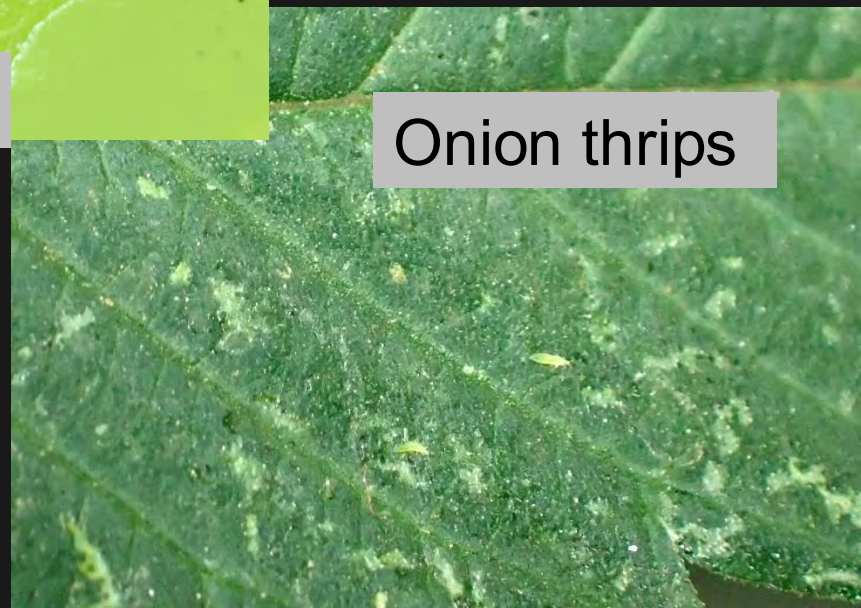
Photograph courtesy of Karl Hillig

Fungus gnats



Rice root aphid

Cannabis aphid



Onion thrips

Twospotted spider mite

Tetranychus urticae

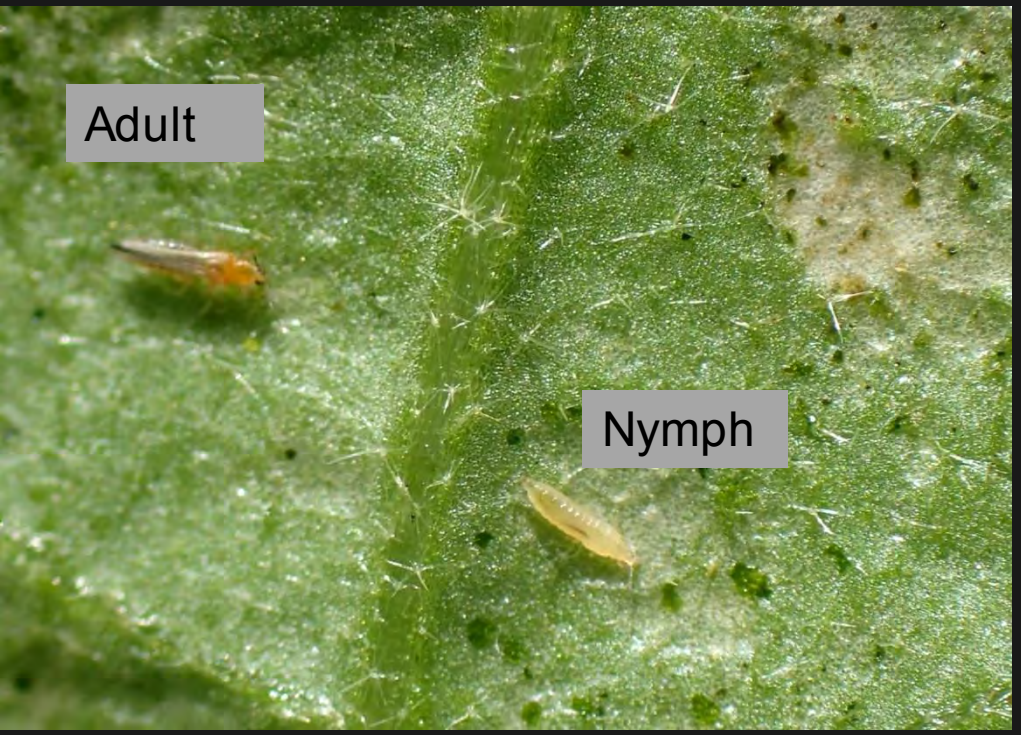
Photograph courtesy of The Ohio State University

Broad mite

Polyphagotarsonemus latus

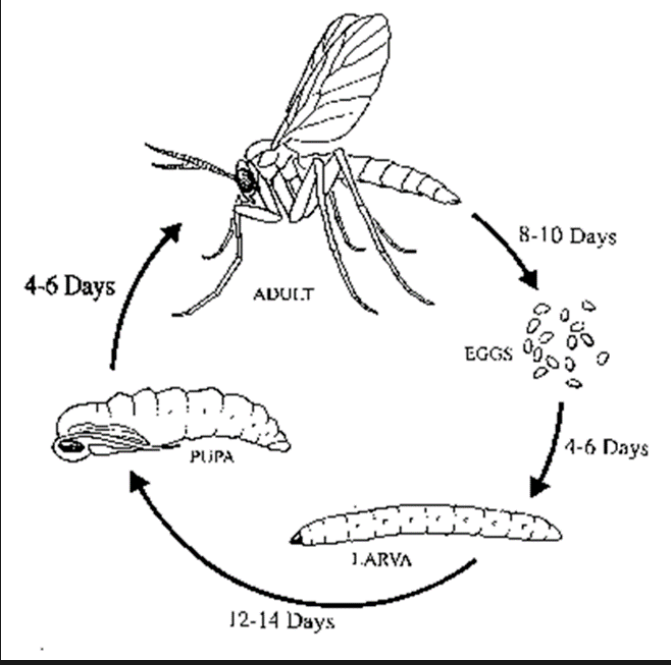
Broad mite injuries to pepper

Photographs courtesy of Janinine Spies, University of Florida



Onion Thrips

Thrips tabaci



Darkwinged fungus gnats

***Bradysia* spp.**

Massed aphids in roots of rice.
Photograph by Emily Luna.

Rice root aphid

Rhopalosiphum rufiabdominalis

Colonizing roots of hydroponically cultured cannabis

Winged forms caught on leaves

Wingless forms at base of plant

Photograph courtesy of Karl Hillig

Hemp russet mite

Aculops cannabicola

Photograph courtesy of Karl Hillig

Cannabis Aphid

Phorodon cannabis

This is what I said in Extension programs last winter:

"Pests problems associated with outdoor grown hemp *will likely have little overlap* with those affecting it when the plant is grown in confined conditions. This is largely due to greater effects of natural controls in outdoor settings."

This is what I had been saying in Extension programs:

"Pests problems associated with outdoor grown hemp *will likely have little overlap* with those affecting it when the plant is grown in confined conditions. This is largely due to greater effects of natural controls in outdoor settings."

Two Hemp Pests that Can Occur in High Population on both Indoor and Outdoor Hemp Production

Photograph courtesy of Karl Hillig

Primary herbivore groups associated with outdoor grown hemp

- Associates of foliage
  - Defoliators
  - Sucking insects, mites
- Stem, stalk borers
- Flower/seed feeders
- Root feeders

Foliage associates

Caterpillars

Grasshoppers

Defoliators

Beetles

Various caterpillars chew leaves (and flowers?) of the plant (defoliators)

Yellowstriped armyworm

Yellow woollybear

Beet webworm

Thistle caterpillar

Variegated cutworm

Zebra caterpillar

Two late season “woollybear” caterpillars are common

Saltmarsh caterpillar

Yellow woollybear

Leaf Feeding Beetles

Palestriped flea beetle

Western black flea beetle

Southern corn rootworm adult and damage

Japanese Beetle

What will be the complex of leaf-feeding beetles in the eastern U.S.?

Photograph by Hunter Konchan

Photograph by Cody Seals, University of Tennessee

Southern Corn Rootworm

Grasshoppers (at least three species)

Stem feeding seems to cause the most injury by grasshoppers

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)?

Foliage Associates

Plant Fluid Feeders

Leafhoppers

Aphids

Various “bugs”

Thrips

Russet Mites

The most common fluid feeding insects that occur on the leaves

Plus some treehoppers, planthoppers, spittlebugs, true bugs, thrips

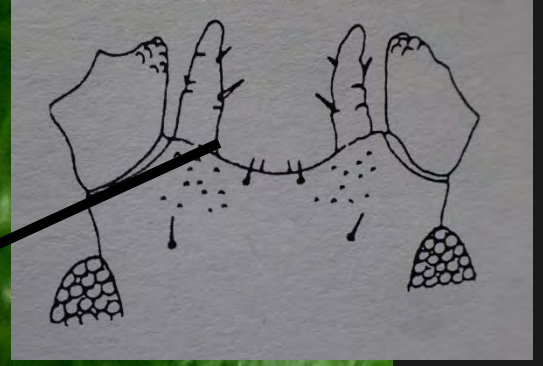
Aphids

Leafhoppers

Most surprising insect associated with the crop?

Cannabis Aphid

Phorodon cannabis



Hop aphid
Phorodon hamuli

Cannabis aphid
Phorodon cannabis

Cannabis aphid is newly describe from North America – *but is very widely distributed in the U.S. and Canada*

Insecta Mundi

Phorodon cannabis Passerini (Hemiptera: Aphididae), a newly recognized pest in North America found on industrial hemp

Whitney S. Cranshaw, Susan E. Halbert, Colin Favret, Kadie E. Britt, Gary L. Miller

Abstract

Phorodon cannabis Passerini (Hemiptera: Aphididae: Macrosiphini) is reported for the first time as a pest of *Cannabis* L. crops in North America. The insect has been confirmed from fields of industrial hemp in Colorado and Virginia and has been found present within greenhouses in at least several American states and one Canadian province. The generic position of the aphid species is discussed and other known members of the genus are ruled out. *Phorodon cannabis* is placed in genus *Phorodon* Passerini and subgenus (*Diphorodon* Börner). *Phorodon persifoliae* Shinji is transferred to *Hyalopterus* Koch as a *nomen dubium*.

Insects with sucking mouthparts that feed on leaves

Leafhoppers

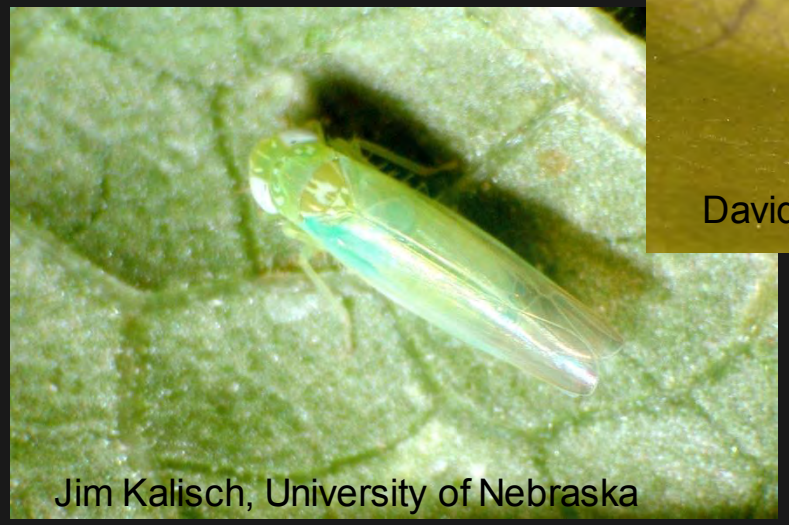
Damage potential of Colorado species to crop:
Negligible, at most

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

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

Could potato leafhopper be a significant pest of hemp?

David Shetlar, Ohio State University



Jim Kalisch, University of Nebraska

Potato leafhopper

Empoasca fabae

Hopperburn injuries to potato (above) and maple (below)

David Shetlar, Ohio State University

Photograph courtesy of Karl Hillig

Hemp russet mite

Aculops cannabicola

This is most important as a pest of developing flower buds on CBD cultivars

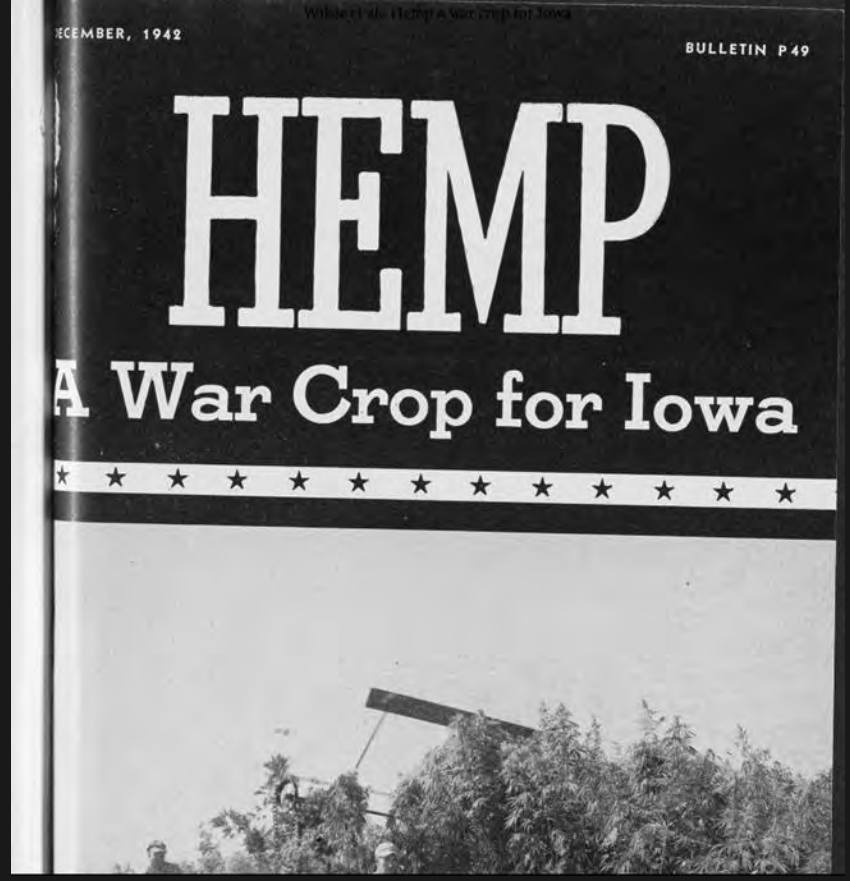
Photograph from the website of the Canadian Hemp Trade Alliance

Stem/Stalk Boring Insects

European corn borer

Ostrinia nubilalis

Photograph from the website of the Canadian Hemp Trade Alliance



European corn borer was pretty much the only insect mentioned in WWII-era publications.

How important is it today?

An insect that surprised me a lot when found in Colorado

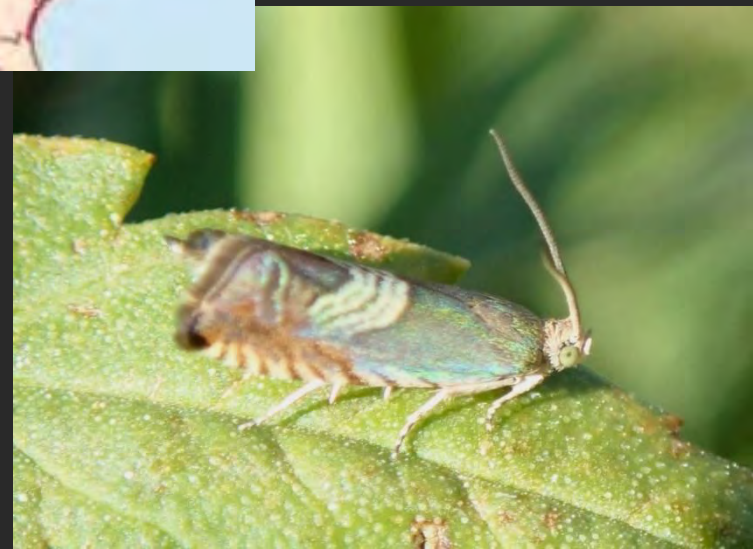
Eurasian hemp borer

Grapholita dilineana

This is most important to flower buds and developing seeds

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

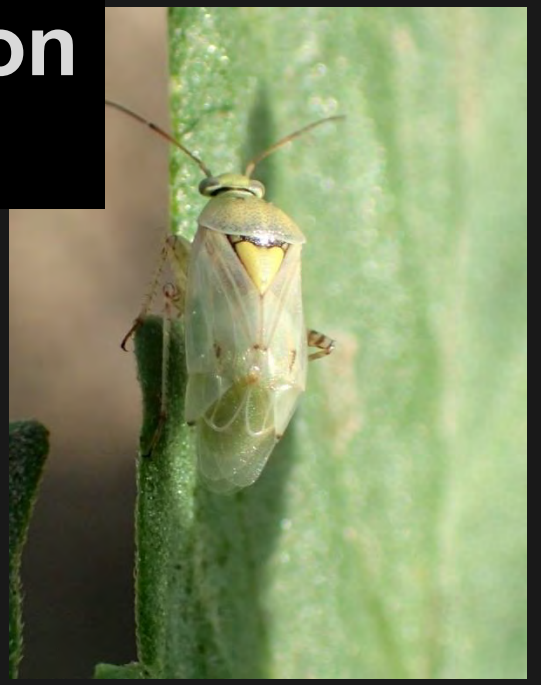


Hemipteran seed/flower feeders

Some of these could be important for hemp crops grown for seed

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

Stink bugs (4 species in Colorado)



Lygus bugs (2-3 species)

Add hemp to the long list of plants used by brown marmorated stink bug

Photograph courtesy of Kadie Britt, Virginia Tech

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

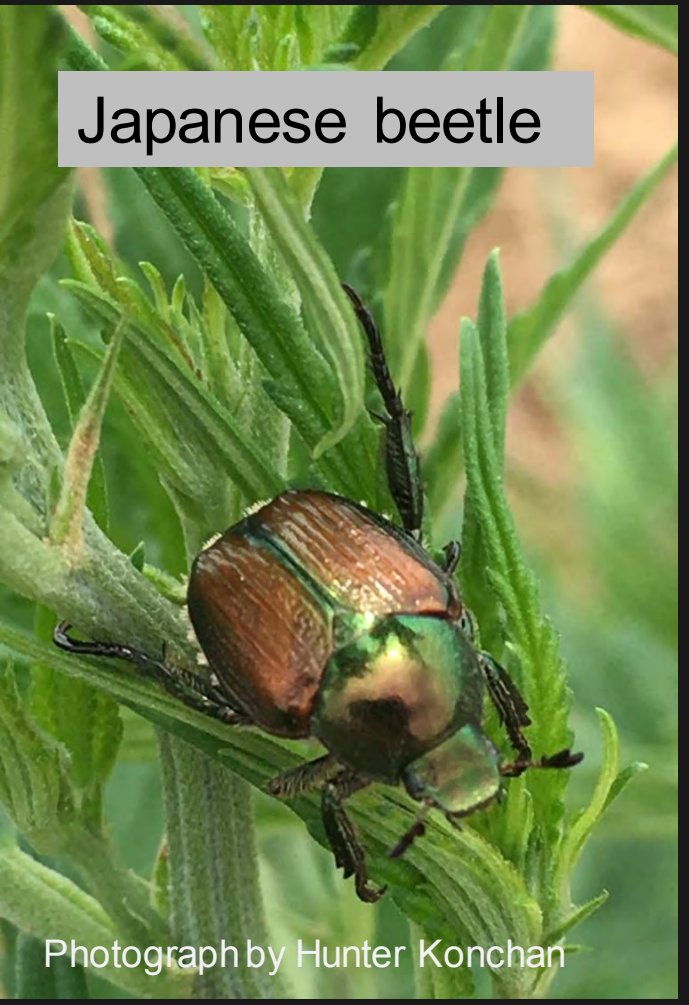
- Feeding concentrated on flowers and developing seed
- Potential damage
  - Aborted seed, damaged seed
- Significant damage??

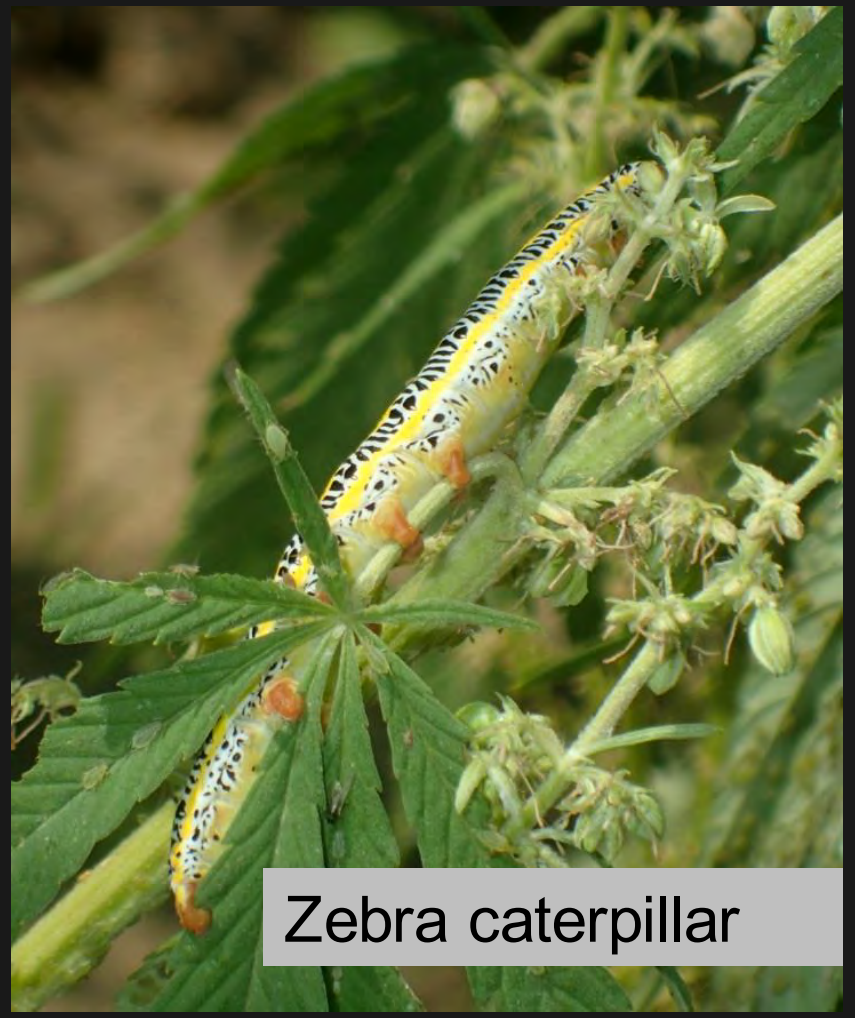
Potential Pest Management Problem:

If we do have significant seed feeding insect pests on hemp…..

….how can they be managed without harming pollinators?

Some chewing insects seem to favor feeding on flowers and/or seeds





Chewing Insects that Damage Buds

Corn earworm

Eurasian hemp borer

Key Pests Emerging in Colorado Hemp Production


Corn earworm


Eurasian hemp borer


Cannabis aphid


Hemp russet mite

Cannabis Aphid

Phorodon cannabis

Cannabis Aphid

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

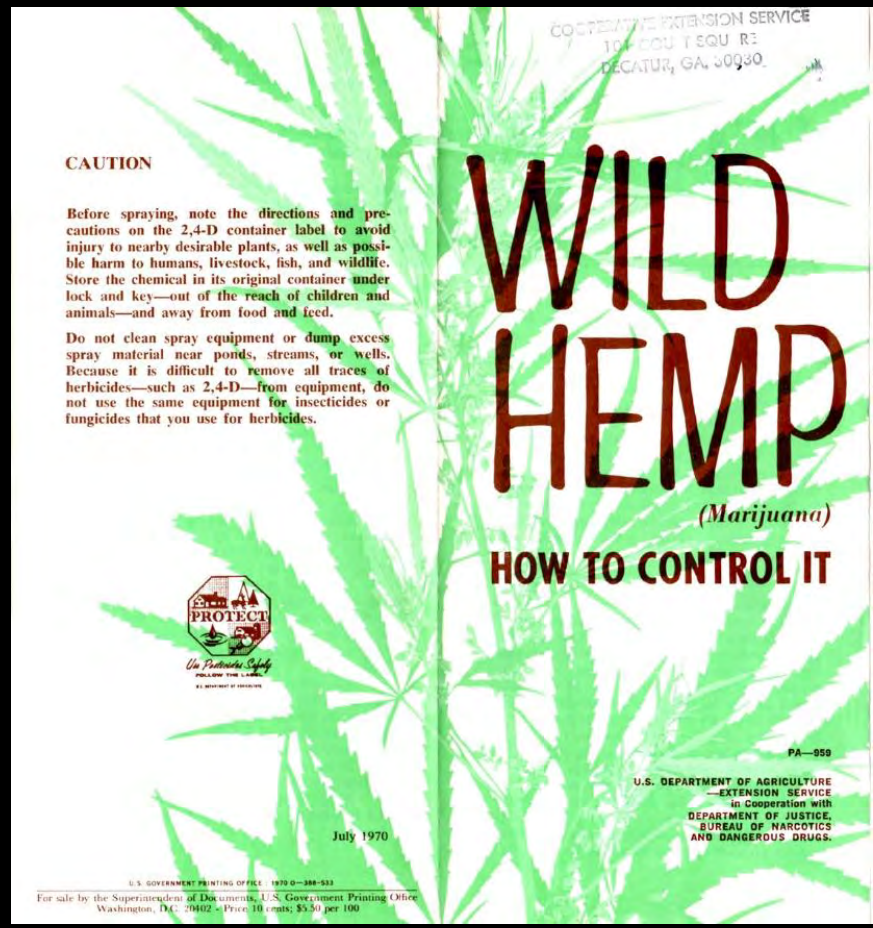
Sexual forms appear in late summer and eggs are laid on plants

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

… mostly on indoor crops?

Feral hemp - and volunteers - could sustain significant numbers of cannabis aphid

Photograph courtesy of University of Missouri



CAUTION

Before spraying, note the directions and precautions on the 2,4-D container label to avoid injury to nearby desirable plants, as well as possible harm to humans, livestock, fish, and wildlife. Store the chemical in its original container under lock and key—out of the reach of children and animals—and away from food and feed.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides—such as 2,4-D—from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

PROTECT

July 1970

WILD HEMP

(Marijuana)

HOW TO CONTROL IT

PA—959

U.S. DEPARTMENT OF AGRICULTURE
—EXTENSION SERVICE
In Cooperation with
DEPARTMENT OF JUSTICE,
BUREAU OF NARCOTICS
AND DANGEROUS DRUGS.

Volunteer hemp

Cannabis aphids were collected from volunteer hemp sampled in midMay

Are there alternative crops for cannabis aphid? Is hops aphid a potential pest of cannabis?

Hop aphid
Phorodon hamuli

Cannabis aphid
Phorodon cannabis

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.

Symptoms of hemp russet mite infestation on developing buds of hemp

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?

OF MITES / LEAF

500
450
400
350
300
250
200
150
100
50
0

6/7/2018
6/14/2018
6/21/2018
6/28/2018
7/5/2018
7/12/2018
7/19/2018
7/26/2018
8/2/2018
8/9/2018
8/16/2018
8/23/2018
8/30/2018
9/6/2018
9/13/2018
9/20/2018

SAMPLE DATES

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.

But do they eat russet mites?

How does hemp russet mite survive outdoors through winter?

Mites were observed on a volunteer plant on June 18. The plant was next to the building used to dry the plants of the 2017 crop.

Is there some non-Cannabis living bridge host that allows survival between growing seasons????

Key Questions in Managing Hemp Russet Mite

- How does hemp russet mite survive outdoors between growing seasons?
- What natural controls help regulate populations of hemp russet mite in fields?
- How damaging is hemp russet mite to hemp (economic injury levels studies)?
- What products can be used to help manage hemp russet mite as economic thresholds are approached?

Eurasian Hemp Borer

Grapholita delineana

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

Exterior symptom of stalk tunneling – leaf flagging

Late in the season larvae will often move into and destroy flower buds.
Developing seed is also reported to be damaged..

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

Serious damage to buds was observed in one field located in northeastern Colorado

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

Pheromone lure to monitor Eurasian hemp borer?

Traps containing available lures used to monitor three other *Grapholita* species oriental fruitworm, cherry fruitworm, lesser appleworm) *failed to capture Eurasian hemp moth*

Adults were found everywhere – in areas with no previous history of hemp….

There *must be* significant non-*Cannabis* host plants that can sustain this insect

Some knotweed (*Polygonum*)? Hops?????

Most significant insect pest observed on hemp

Corn earworm

Helicoverpa zea

Found on all types of hemp. Greatest damage potential to CBD forms of hemp.

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

At what plant growth stage is hemp attractive (and not attractive) to corn earworm?

Risk factor of corn earworm damage to hemp?

Maturing corn next to flowering hemp

Adults of the corn earworm

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

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.

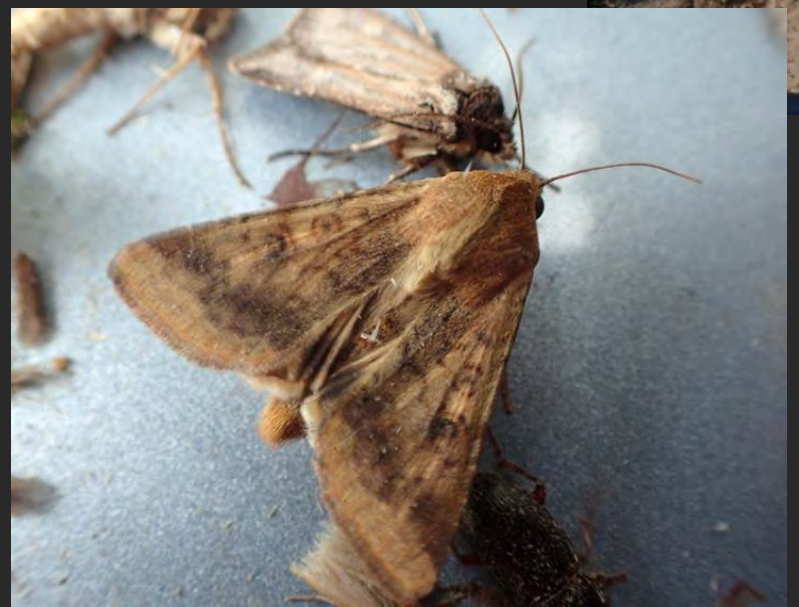
Basic design of a **light trap** uses a light, preferably UV, to attract insects that fly at night. The insects then hit a vane and are funneled into a collecting container below. Usually a killing agent (often a dichlorvos Pest-Strip) is placed in the collecting container to minimize damage to the collected 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

Pheromone trap used to monitor corn earworm



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

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[c]
(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***

2018 Corn Earworm Monitoring Program

- Traps were provided to 7 growers (8 counties)
- In two sites (SE Colorado) high trap captures were noted in September
- At least 3 growers treated for corn earworm in 2018

The Pesticide Conundrum with Cannabis

- All registered pesticides ***can only be legally applied*** to sites (e.g., crops) consistent with label directions
- 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?

State Responses to the Issue of Pesticide Use on Hemp (and other Cannabis spp. crops)

- Ignore the issue/Provide no guidance
- Allow no registered pesticides
- Provide vague guidelines of some kinds of registered pesticide products that might be allowable
- Provide a list of specific allowable products (“State Finesse”)

2013 Washington State Finesse on the Subject of Pesticide Use on Cannabis

- 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 WSDA registration is required
- Section 25b minimum risk pesticides (exempt from federal registration)

This system provides a state-generated list of specific products that are allowed for use in production of Cannabis spp. crops in the state

Section 3 Federally Registered Pesticides - 3/21/2019

Brand name	Active Ingredient	Percent	EPA Registration Numb	WSDA File I	Company	WPS Y/N	HG Only Y/N
20% VINEGAR HERBICIDE FOR CONTROL OF WEEDS	ACETIC ACID	20.000%	85208-1-90394	1	NATURE'S WISDOM (DH DAWE AND ASSOCIATES)	Yes	No
70% NEEM OIL	CLARIFIED HYDROPHOBIC EXTRACT OF NEEM OIL	70.000%	70051-2-54705	33	LAWN & GARDEN PRODUCTS INC.	No	Yes
ACTINO-IRON BIOLOGICAL FUNGICIDE	STREPTOMYCES LYDICUS WYEC 108	1.300%	73314-2	7	NOVOZYMES BIOAG INC	Yes	No
ACTINOVATE AG BIOLOGICAL FUNGICIDE	STREPTOMYCES LYDICUS WYEC 108	0.037%	73314-1	1	NOVOZYMES BIOAG INC	Yes	No
ACTINOVATE LAWN AND GARDEN	STREPTOMYCES LYDICUS WYEC 108	0.037%	73314-1	9	NOVOZYMES BIOAG INC	No	No
ACTINOVATE SP BIOLOGICAL FUNGICIDE	STREPTOMYCES LYDICUS WYEC 108	0.037%	73314-1	2	NOVOZYMES BIOAG INC	Yes	No
AG DE-CIDE DIATOMACEOUS EARTH INSECTICIDE	DIATOMACEOUS EARTH	85.000%	7655-1-71074	1	CALTEC AG INC	Yes	No
AGM 13027	COMPLEX POLYMERIC POLYHYDROXY ACIDS	0.180%	1381-256	197	WINFIELD SOLUTIONS LLC	Yes	No
AGRI-FOS SYSTEMIC FUNGICIDE PLUS	PHOSPHOROUS ACID, MONO- AND DI-POTASSIUM SALTS (POTASSIUM PHOSPHITE)	60.560%	71962-2	4	LIQUID FERTILISER PTY LTD (TRADING AS AGRICHEM): SCIREG INC	Yes	No
ALUDE FUNGICIDE	PHOSPHOROUS ACID, MONO- AND DI-POTASSIUM SALTS (POTASSIUM PHOSPHITE)	53.600%	55146-83	43	NUFARM AMERICAS INC: AGT DIVISION	Yes	No
ALUDE SYSTEMIC FUNGICIDE	PHOSPHOROUS ACID, MONO- AND DI-POTASSIUM SALTS (POTASSIUM PHOSPHITE)	45.800%	71962-1-1001	16	NUFARN AMERICAS: CLEARY CHEMICAL CORPORATION DIVISION	Yes	No
AMICOS	BACILLUS SUBTILIS STRAIN IAB/BS03	0.080%	91473-1	3	SEIPASA S.A.	Yes	No
ANCORA	ISARIA FUMOSOROSEA APOPKA STRAIN 97	20.000%	70051-19-59807	65	OHP INC.	Yes	No
AVENGER AG OPTIMA	D-LIMONENE	55.000%	92967-4	3	AVENGER PRODUCTS LLC	Yes	No
AVIV	BACILLUS SUBTILIS STRAIN IAB/BS03	0.080%	91473-1-86182	2	STOCKTON (ISRAEL) LTD (WALTER G TALAREK PC)	Yes	No
AXIOM PLANT GROWTH STIMULATOR	HARPIN PROTEIN	1.000%	71771-3-89112	1	RX GREEN SOLUTIONS LLC	No	No
AZA-DIRECT BIOLOGICAL INSECTICIDE	AZADIRACHTIN	1.200%	71908-1-10163	44	GOWAN CO.	Yes	No
AZAGUARD	AZADIRACHTIN	3.000%	70299-17	18	BIOSAFE SYSTEMS	Yes	No

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)

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)**

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)**

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.

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)**

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)**

Criteria for Pesticides Allowed to be Used on Cannabis in Colorado

- Pesticides that require federal registration under Section 3 of FIFRA
- **Section 25b minimum risk pesticides with food crop uses** (exempt from most federal registration)
  - **Must be registered with the state**

Mostly sodium lauryl sulfate and soybean oil

Rosemary oil

Mostly geraniol

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

Similar lists are produced by Washington, Oregon, and Nevada

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 21

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	71963-1-64705	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.	71963-1	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.	71963-2	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	0.300% 0.300% 0.300%	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
Aluda Systemic Fungicide	Cleary Chemical Corporation	71963-1-1001	Phosphorous Acid, Mono- and Di-Potassium Salts of	45.800%	Yes	Yes	Yes	Use allowed prior to final transplant.	Fungicide

Phases of Pesticide Use Regulation in Cannabis Production

- Phase I - “Wild West” Phase
- Phase II - State Finesse Phase
- Phase III - Normalization Phase
  - Cannabis is federally recognized as a crop
  - Cannabis is regulated as a normal crop

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

Northeastern IPM Center

Western IPM Center

Questions

USDA United States Department of Agriculture National Institute of Food and Agriculture

Some Questions for You

Find a Colleague

- To post a profile about yourself and your work:
  http://neipmc.org/go/APra

- “Find a Colleague” site
  http://neipmc.org/go/colleagues

Archive of Today's Webinar

- Today's Webinar will be available to view **on demand** in a few business days.

http://www.neipmc.org/go/ipmtoolbox

- You can watch as often as you like.

Northeastern IPM Center

Western IPM Center

Acknowledgements

This presentation was funded in part by the Northeastern IPM Center through Grant #2014-70006-22484 from the National Institute of Food and Agriculture, Crop Protection and Pest Management, Regional Coordination Program.

USDA United States Department of Agriculture National Institute of Food and Agriculture

The presenter wishes to acknowledge funding assistance from the Western IPM Center and the Colorado Agricultural Experiment Station.

AGRICULTURAL EXPERIMENT STATION
COLORADO STATE UNIVERSITY