Hemp Insect Pest Management: Needs and Challenges

Whitney Cranshaw

Colorado State University

Present Challenges Regarding Hemp Insect Management

- Legal challenges
  - Challenges related to the legal status of all *Cannabis* grown in the United States
  - Challenges related to a crazy quilt of state laws and regulations
- Challenges Related to the Crop
  - Hemp is many different crops
  - Markets and crop value in limbo
- Needs and Challenges of Entomological Base
  - Paucity of information on North American hemp insects
  - Future production will be very different and occur over a much broader area than in the past
  - The “Pesticide Conundrum” with hemp

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Some Key Federal Laws on Cannabis

- **1937 Marihuana Tax Act**
  - **All *Cannabis sativa* is marijuana**
- **Marijuana presently classified by DEA as Schedule I drug under 1970 Controlled Substances Act**
  - *Substances in this schedule have no currently accepted medical use in the United States, a lack of accepted safety for use under medical supervision, and a high potential for abuse*
  - **DEA ruled last year that extracted products from *Cannabis sativa* (e.g., cannabidiol/CBD) are also Schedule I drugs**

Hemp and the 2013 Farm Bill*

Section 7606. Legitimacy of Industrial Hemp Research

- Allows production of industrial hemp under some conditions
  - Where state laws allow hemp production
  - Sites where hemp is grown must be under the direction and regulation of state Departments of Agriculture
- Defines hemp as:
  - "means the plant ***Cannabis sativa*** and any part of that plant, whether growing or not, with a **delta-9 tetrahydrocannibol** of not more than 0.3 percent** on a dry weight basis"

* Signed into law February 7, 2014

** Known as **THC**

Key Colorado State Laws Regarding Cannabis

- **November 2000 – Passage of Amendment 20**
  - Allows usage of *Cannabis* for patients with written medical permission (“medical marijuana”)
  - Patients may grow up to 6 plants
  - Patients may acquire *Cannabis* from a caregiver or from non-state affiliated clubs/organizations (dispensaries)

Colorado Amendment 64

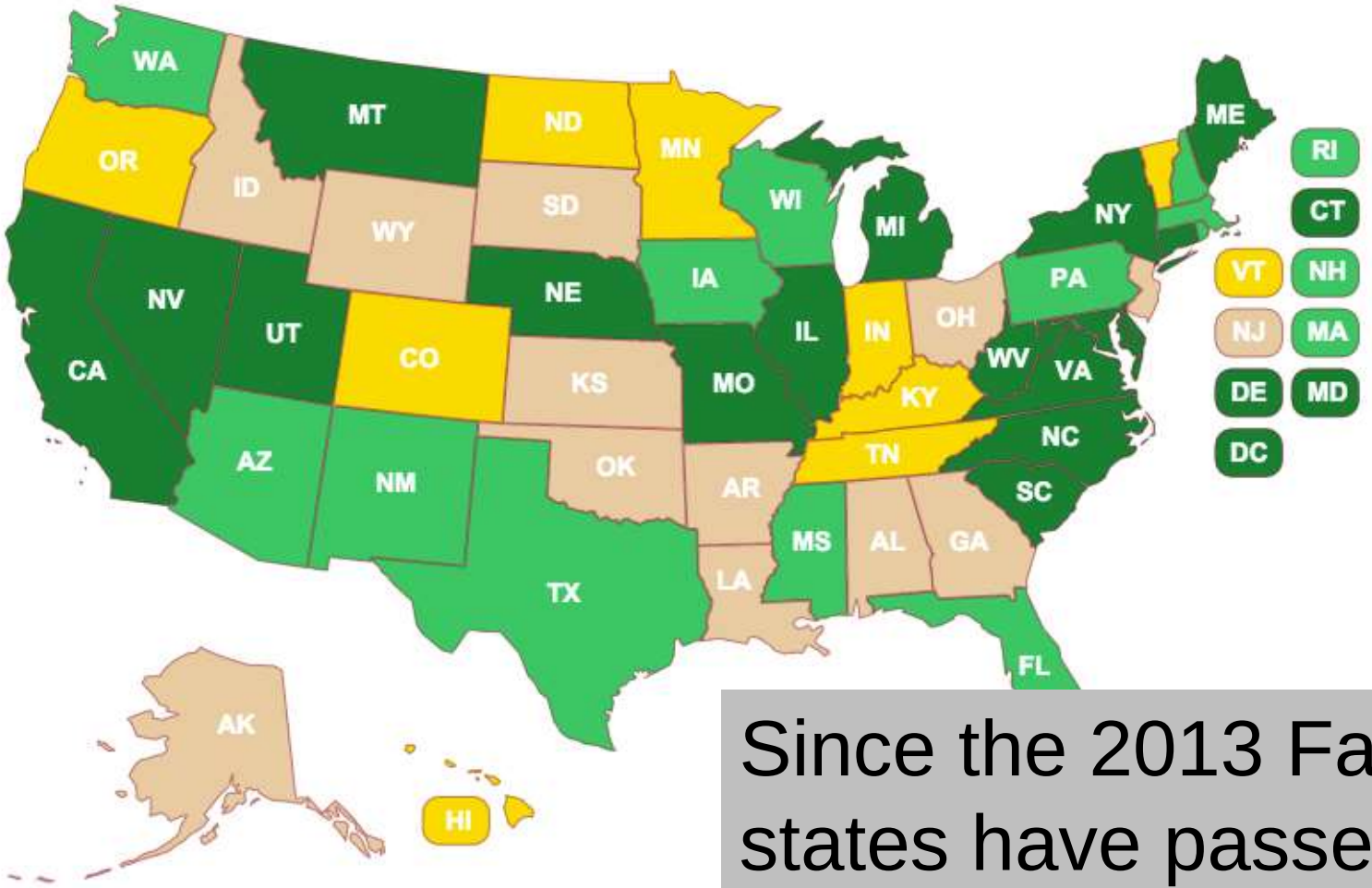
- Passed November 2012
- Allows personal use of *Cannabis* above age 21 (regulated as alcohol)
- Establishes regulations on production and sale of *Cannabis*
  - July 1, 2013 deadline for regulations
- Sets taxes
  - Additional taxes (state, county) subsequently enacted
- Industrial hemp also included in ballot initiative

Present Status of State Laws Regarding Legality of Medical and/or Recreational Marijuana

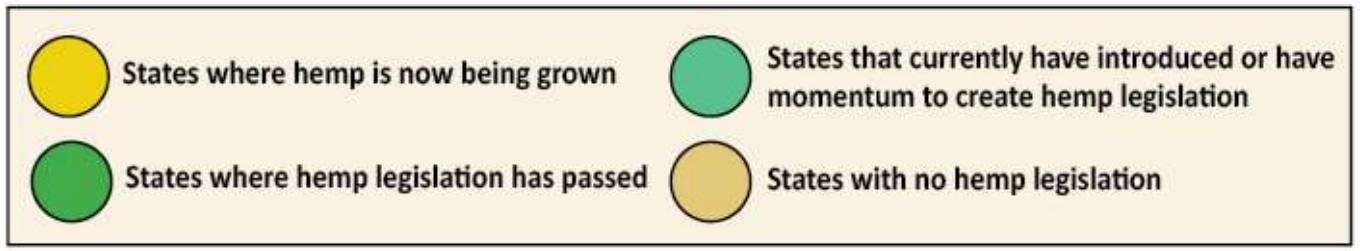
Amendment 64 Language Regarding Hemp*

IN THE INTEREST OF ENACTING RATIONAL POLICIES FOR THE TREATMENT OF **ALL VARIATIONS OF THE CANNABIS PLANT**, THE PEOPLE OF COLORADO *FURTHER FIND AND DECLARE THAT INDUSTRIAL HEMP SHOULD BE REGULATED SEPARATELY FROM STRAINS OF CANNABIS WITH HIGHER DELTA-9 TETRAHYDROCANNABINOL (THC) CONCENTRATIONS*.

* Amendment 64 passed November 6, 2012 (55% yes vote)



Since the 2013 Farm Bill, a majority of states have passed laws that allow hemp production



There are also institutional guidelines for hemp research

Guidelines provided to Colorado State University research and Extension employees

HEMP & MARIJUANA RESEARCH FREQUENTLY ASKED QUESTIONS (FAQs) & GUIDELINES

(Revised March 2016)

Office of the General Counsel (OGC) & the Office of the Vice President for Research (OVPR)

PREAMBLE: Within the Controlled Substances Act (CSA), there is no current legal delineation between marijuana and hemp – it all falls within the CSA definition of *Cannabis sativa*. That said, the Federal Agriculture Act of 2014 (the "Farm Bill") did contain language providing for the cultivation of "industrial hemp" for research purposes by universities in states that allow such cultivation.

The purpose of this document is to provide guidance and direction to CSU administrators, researchers, and employees, as well as communication to the greater (public) community by providing the legal position of the university in this arena, and the legal framework for hemp and marijuana research on campus as indicated below. For any additional questions not answered below, please contact Linda Schutjer, Senior Legal Counsel for the Board of Governors of the Colorado State University System, at Linda.Schutjer@colostate.edu or (970) 491-6270, or Mark Wdowik, AVP for Research & Industry Partnerships, OVPR, at (970) 492-4519, or Mark.Wdowik@colostate.edu .

FAQs:

HEMP RESEARCH:

9. Can CSU researchers and/or extension agents provide advice and/or assistance to non-university hemp growers inside (and external to) the state of Colorado?

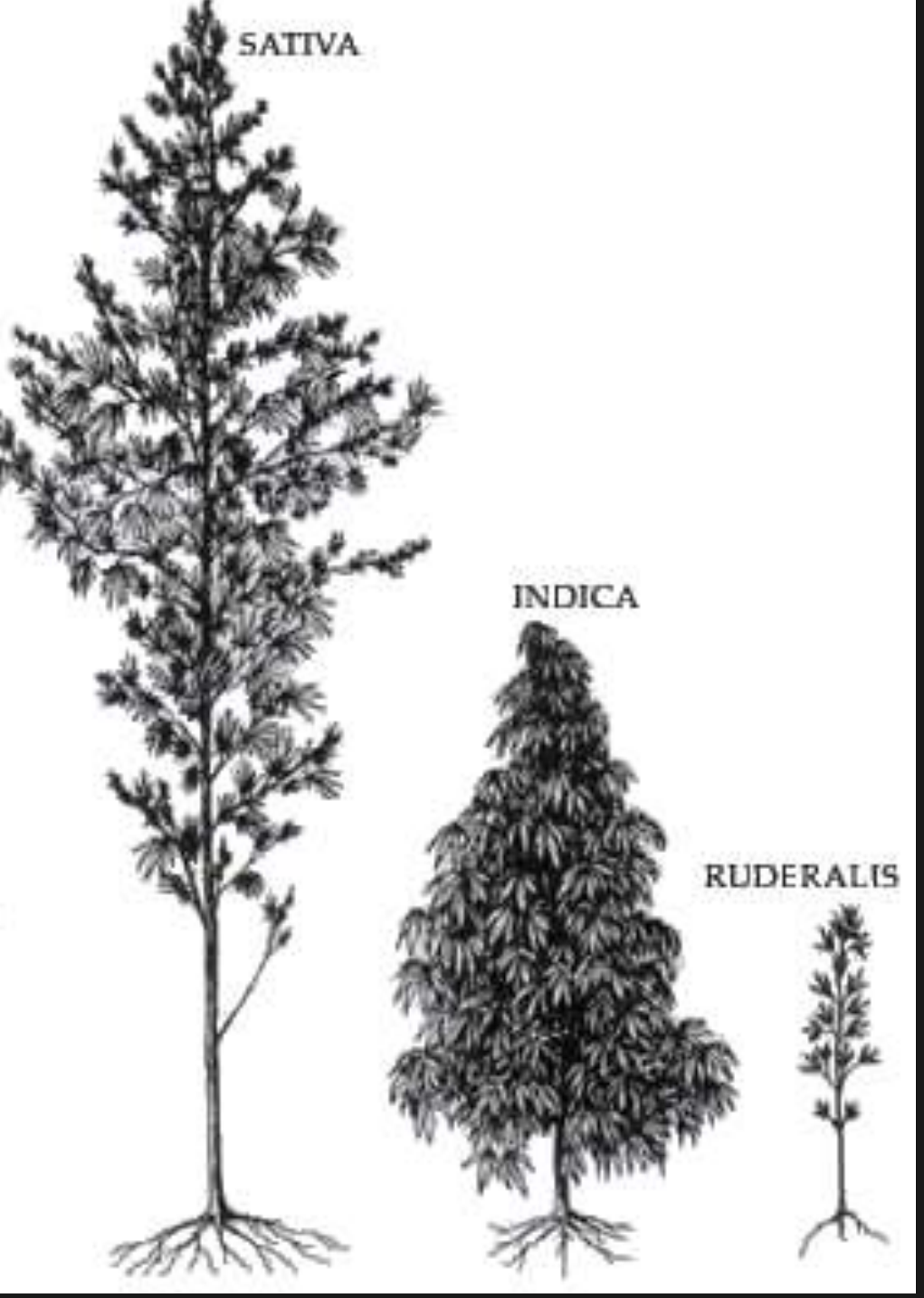
CSU extension agents and faculty may provide advice to Colorado farmers cultivating hemp under the CDA registration program;

CSU extension agents and faculty may NOT assist cultivators of marijuana, or any entity or individual growing hemp outside of the CDA registration program.

9. Can CSU researchers and/or extension agents provide advice and/or assistance to non-university hemp growers inside (and external to) the state of Colorado?

Note that Federal legislation has defunded DEA enforcement actions against hemp growers who are otherwise in compliance with State law. **That said, it is still suggested that CSU employees avoid going to non-CSU hemp facilities/fields.**

What type of crop is hemp?



Cannabis sativa

Cultivated *Cannabis* involves the use of two species (subspecies?) that freely interbreed

Cannabis indica

Types of Cannabis Crops

- Medical/Recreational Use
  - Marijuana
- CBD (cannabidiol) production
  - Non-psychoactive extracts
- Hemp grown for seed, fiber

Marijuana Production

- Involves *C. sativa*, *C. indica* and hybrids
- Primary compound THC
  - Secondary cannabinoids often important
- End uses
  - Whole buds (inhaled)
  - Extracts
    - Edibles
    - Inhalation (vaping)
    - Salves, ointments

10 mg THC is standardized serving size

Primary crop outcome – Sinsemilla

Unfertilized, grossly enlarged, female flowers (aka “bud”)

Cultivation must occur in a secure facility. Production is extremely intensive, expensive, and produces a crop of very high value per unit area

What types of Cannabis crops are 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.

Amendment 64 Language Regarding Hemp

IN THE INTEREST OF ENACTING RATIONAL POLICIES FOR THE TREATMENT OF ALL VARIATIONS OF THE CANNABIS PLANT, THE PEOPLE OF COLORADO FURTHER FIND AND DECLARE THAT INDUSTRIAL HEMP SHOULD BE REGULATED SEPARATELY FROM STRAINS OF CANNABIS WITH HIGHER DELTA-9 TETRAHYDROCANNABINOL (THC) CONCENTRATIONS.

“INDUSTRIAL HEMP" MEANS THE PLANT **OF THE GENUS CANNABIS** AND ANY PART OF SUCH PLANT, WHETHER GROWING OR NOT, WITH A DELTA-9 2 TETRAHYDROCANNABINOL CONCENTRATION THAT DOES NOT EXCEED THREE-TENTHS PERCENT ON A DRY WEIGHT BASIS.

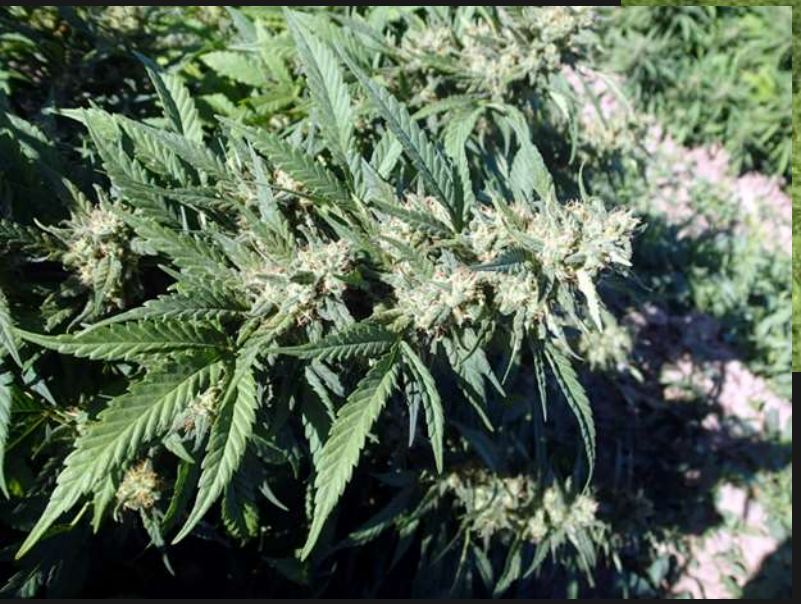
Types of Hemp

- Hemp grown for extraction of **cannabinoids** (“broad sense” hemp)
- Hemp grown primarily for **seed** production (“narrow sense” hemp)
- Hemp grown primarily for **fiber** production (“narrow sense” hemp)

Hemp Grown for CBD

Most hemp being grown for CBD presently uses transplanted clones.

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

Male plants, and seed production is often not desirable

Plant is often harvested at immature stage

Some CBD crops are being grown from seed

These crops have lower concentrations of cannabinoids but produce much more biomass

CBD (cannabidiol) Production

- Primarily involves *C. sativa*
  - *C. indica* and hybrids are sometimes grown
- Grown for production of non-psychoactive cannabinoids
  - Extracted from leaves, buds
- End uses (often mixed with oils)
  - Ingested
  - Salves, ointments
  - Inhaled (vaping)

Hemp Grown for Fiber and 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

What type of crop is hemp?

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INVESTIGATION

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CHARGES ▸ 20A

NEST
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Hanging hopes on new economy

COLORADO DIVIDE

Looking to rely less on mining for survival, the rural Paradox Valley turns to hemp crop

Hemp farmer Buck Chavez, working for Paradox Ventures, pulls down locally grown, dried hemp plants to be processed in the gymnasium of the old Nucla schoolhouse. *Andy Cross, The Denver Post*

By Jason Blevins
The Denver Post

NUCLA •

Hardship rides the wind in the West End, a lonely basin where Colorado's Uncompahgre Plateau joins Utah's canyonlands.

It started more than 30 years ago, when the collapse of the uranium market and the failure of the country's nuclear-energy renaissance decimated the town of Uravan and

Detail
COLORADO
Olathe •
Montrose •
MONTROSE COUNTY
Paradox
• Uravan
Bedrock
• Nucla
Naturita
Redvale
UTAH

Feature article in last week's *Sunday Denver Post*

Hemp being viewed as the savior for a rural economy devastated by losses of jobs in mining.

Sound familiar?

What kinds of arthropods will we find associated with hemp in this new era?

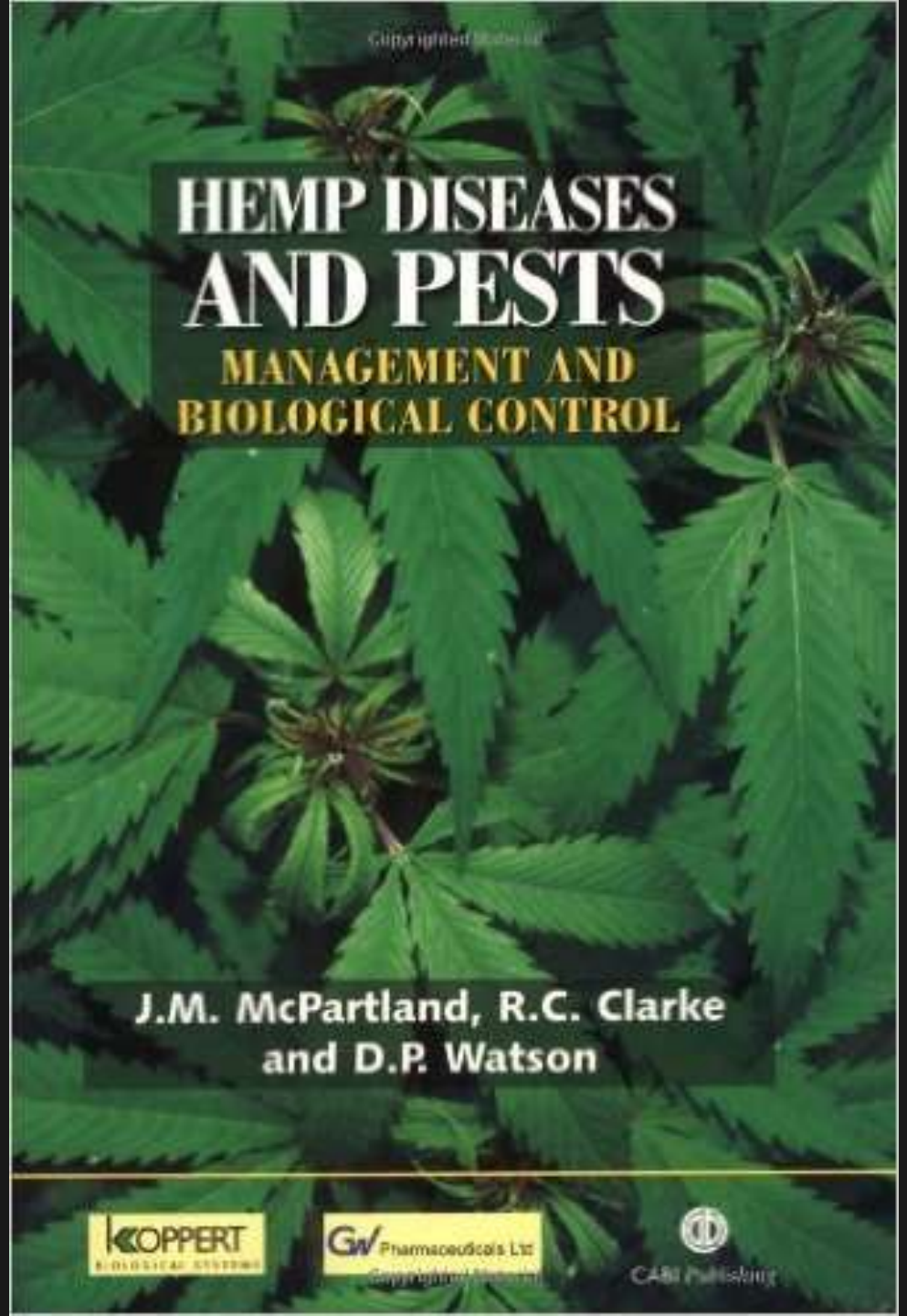
When hemp was last produced in major quantities, during World War II, only one insect was mentioned as significant to production (Willsie et al. 1942)

European corn borer

Ostrinia nubilalis

Photograph from the website of the Canadian Hemp Trade Alliance

Photographs courtesy of Frank Peairs



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

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

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 will happen from increased activities of natural controls combined with dispersal of pest species.

Everywhere there will be some suite of hemipterans feeding on foliage

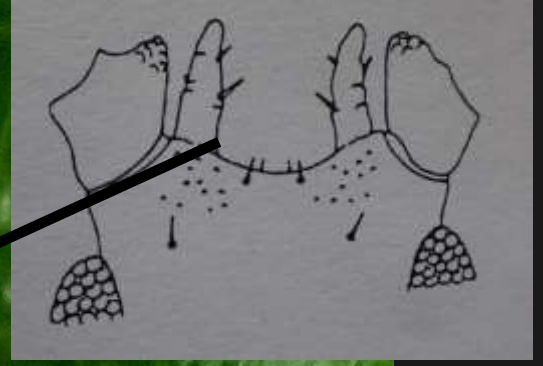
Aphids

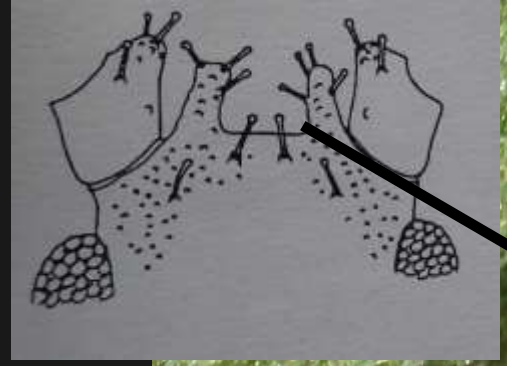
Leafhoppers

Most surprising insect associated with the crop?

Cannabis Aphid

Phorodon cannabis





Hop aphid
Phorodon hamuli

Cannabis aphid
Phorodon cannabis

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

Grasshoppers

Caterpillars

Beetles

Various caterpillars chew leaves of the plant (defoliators)

Yellowstriped caterpillar

Yellow woollybear

Beet webworm

Thistle caterpillar

Beet armyworm

Zebra caterpillar

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

There will be stem boring species that will be important in some areas

Photograph from the website of the Canadian Hemp Trade Alliance

European corn borer

Ostrinia nubilalis

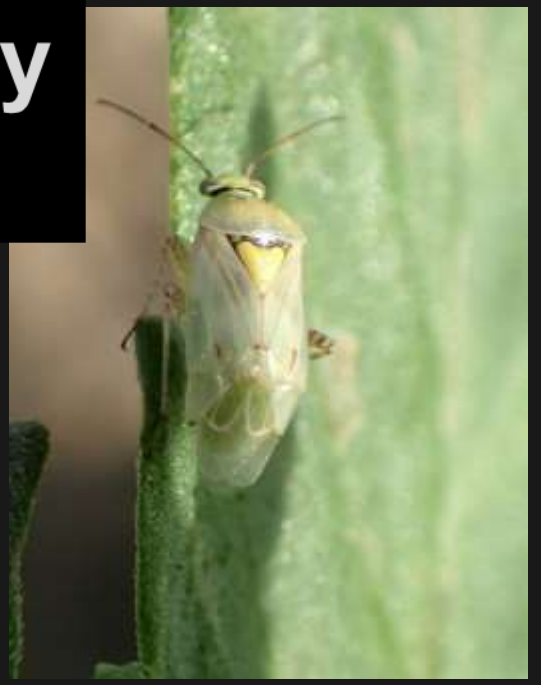
Photographs courtesy of Frank Peairs

An insect that surprised me when found in Colorado

Eurasian hemp borer

Grapholita dilineana

Several hemipterans may primarily feed on developing seeds



Stink bugs (4 species)

Lygus bugs (2-3 species)

Hemipteran seed feeders

False chinch bugs

Hyaline grass bug

Most significant potential pest of the crop in Colorado?

Corn earworm

Helicoverpa zea

A robust complex of natural enemies can be expected to be found in hemp

Syrphid flies

Collops beetles

Green lacewings

Damsel bugs

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

What is the potential value of hemp as a pollen resource in agricultural regions?

Hemp grown for seed or fiber – potentially very useful mid-late summer pollen source

Hemp grown for extractable compounds (e.g. CBD) – not a potential pollen source

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

Result of Federal Resistance to Cannabis Production

- Inability to disseminate information on diagnostics
- Inability to disseminate information on IPM practices
- Increase in unregulated, illegal and often unsafe use of pesticides to manage pests

The Pesticide Conundrum with Cannabis

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

Phases of Pesticide Use Regulation in Cannabis Production

- Phase I - “Wild West” Phase
- Phase II - State Finesse Phase
- Phase III - Normalization Phase
  - *Cannabis* sp. crops are federally recognized as a crop site
  - *Cannabis* sp. crops are regulated as are normal crops

“Wild West Phase”

- All registered pesticides are illegal
- Pesticide regulation and enforcement is ignored by state and federal agencies
- Growers are unaware of pesticide laws or ignore them in the absence of direction
- All pest management information sources devolve to the internet and hearsay

Spider Mite Management on the Internet

"….Consider this situation, you spray your chemicals, the mites may not die right away depending on the mode of action, what happens next is the mites panic and start laying eggs like crazy. Before you know it, the mites have become twice as bad as before you hit them……"

Information from Legal Hydro web site

Spider Mite Management on the Internet

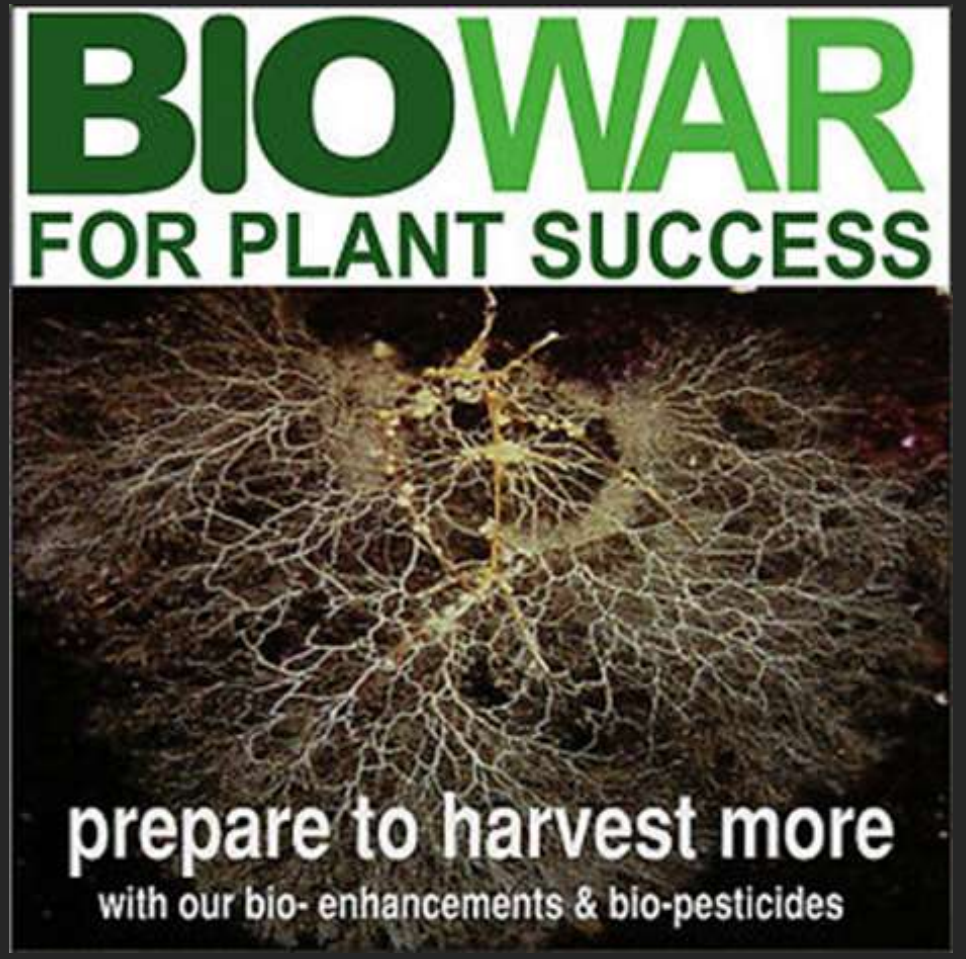
"….The best method to control this pest is to **switch your mode of attack each and every day**. Never spray them with the same stuff twice in a row, if you choose the chemical approach, you want to use a Neem Oil along with as many other forms of Miticides as you can get your hands on…"

Information from Legal Hydro web site

August 14 Letter from a Cannabis Producer
Checklist of treatments July 18-August 12

- BioWar (unspecified “beneficial soil microbes)
- Sulfur/pyrethrins

His question was what to do for “cyclamen mites” – he said he saw the eggs

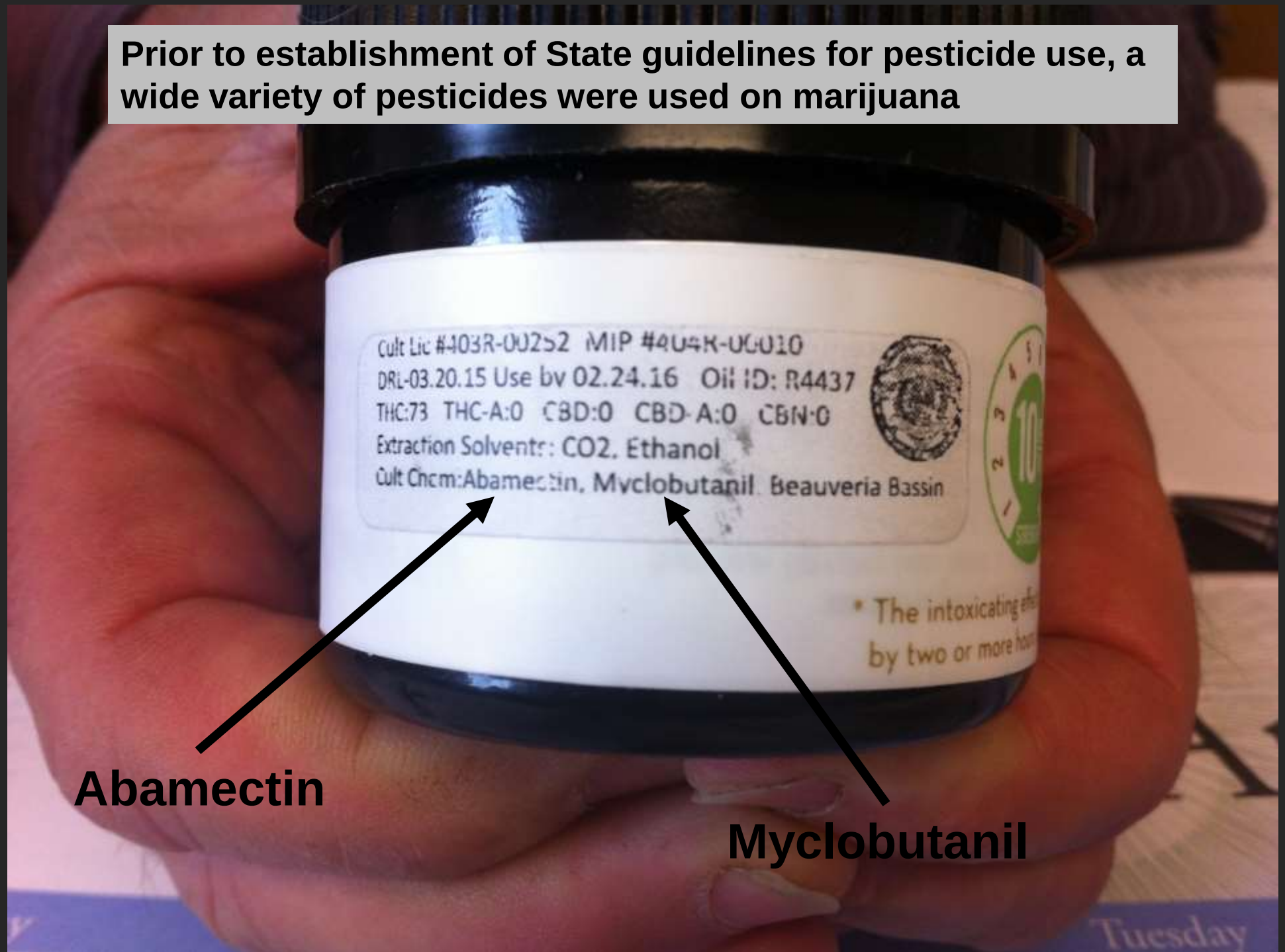


August 14 Letter 2013 from a Cannabis Producer
Checklist of treatments July 18-August 12

- BioWar (unspecified “beneficial soil microbes)
- Sulfur/pyrethrins
- Abamectin (Avid)
- Chlorfenapyr (Pylon)
- Abamectin/bifenazate (Scirocco)
- Fenpyroximate (Akari)
- Abamectin
- Fenazaquin (Magister)

Note: **An examination of the sample indicated that the purported cyclamen mite eggs were glandular hairs.**

Prior to establishment of State guidelines for pesticide use, a wide variety of pesticides were used on marijuana



“State Finesse Phase”

- Some pesticides are identified by State agencies as allowable in *Cannabis* production
- Uneasy alliance with Federal agencies as *Cannabis* remains unrecognized as crop category
- Pest management information sources are provided minimal support by state and local agencies

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)**

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 federal registration)

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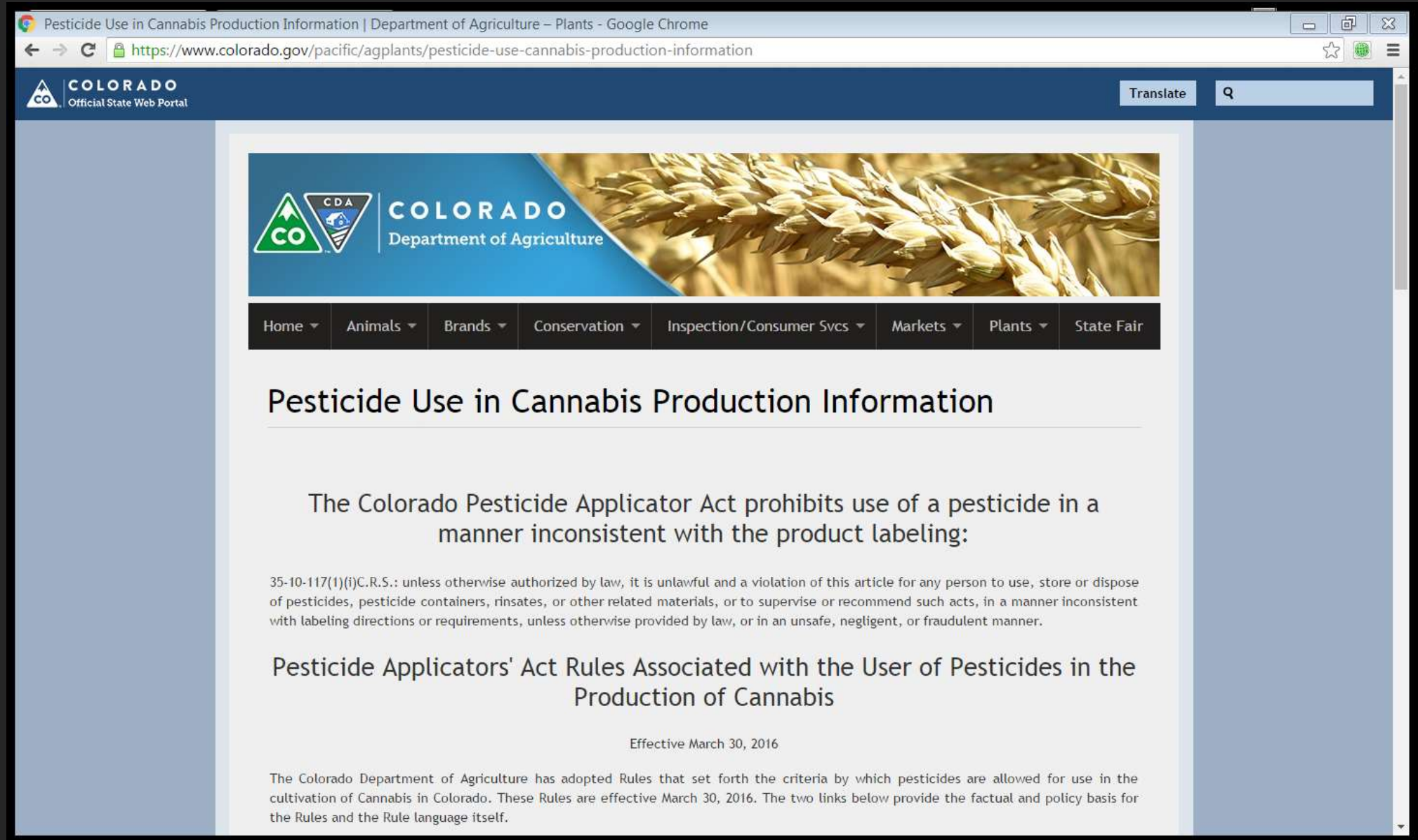
  - **Pesticide is registered on tobacco**
- Section 25b minimum risk pesticides (exempt from federal registration)

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



Web site 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 Cannabis in Colorado

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	0.280% 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
Allude 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

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?*

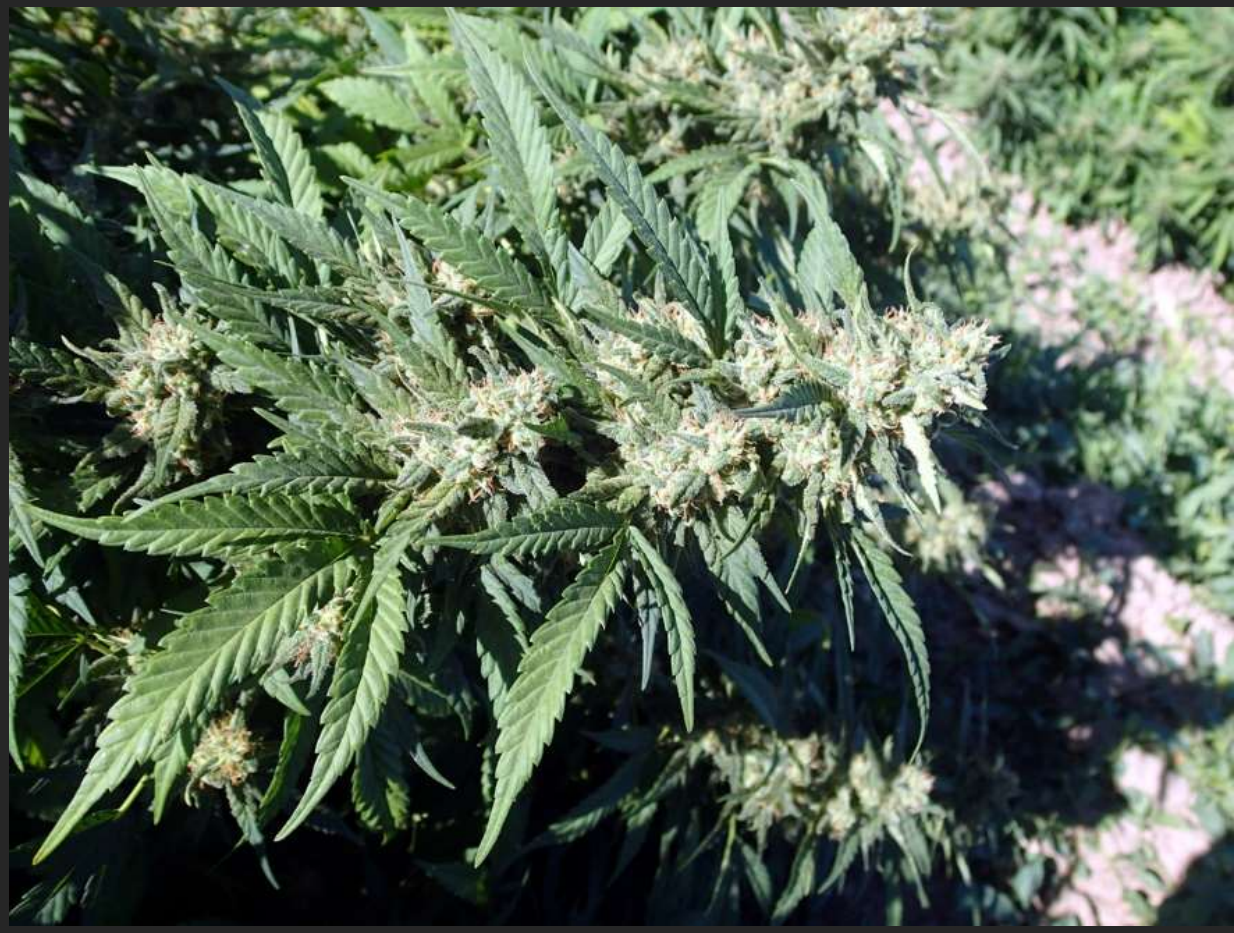
It will very likely vary by the type of hemp crop, and end use

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

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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.

Hemp Insect Management Needs and Challenges

- **The biggest present challenges to hemp pest management are based in legal uncertainties affecting the crop**
- Hemp is many different kinds of crops and the pest management issues will vary by production method and end use
- In the next few years we will be learning a lot about hemp entomology in North America. It will be an interesting time.

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This presentation will be posted at the Colorado State University Hemp Insect Website

hempinsects.agsci.colostate.edu

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Hemp Insects

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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.

In this start-up form (2017), the Hemp Insect Website is giving particular attention to insects and mites that are