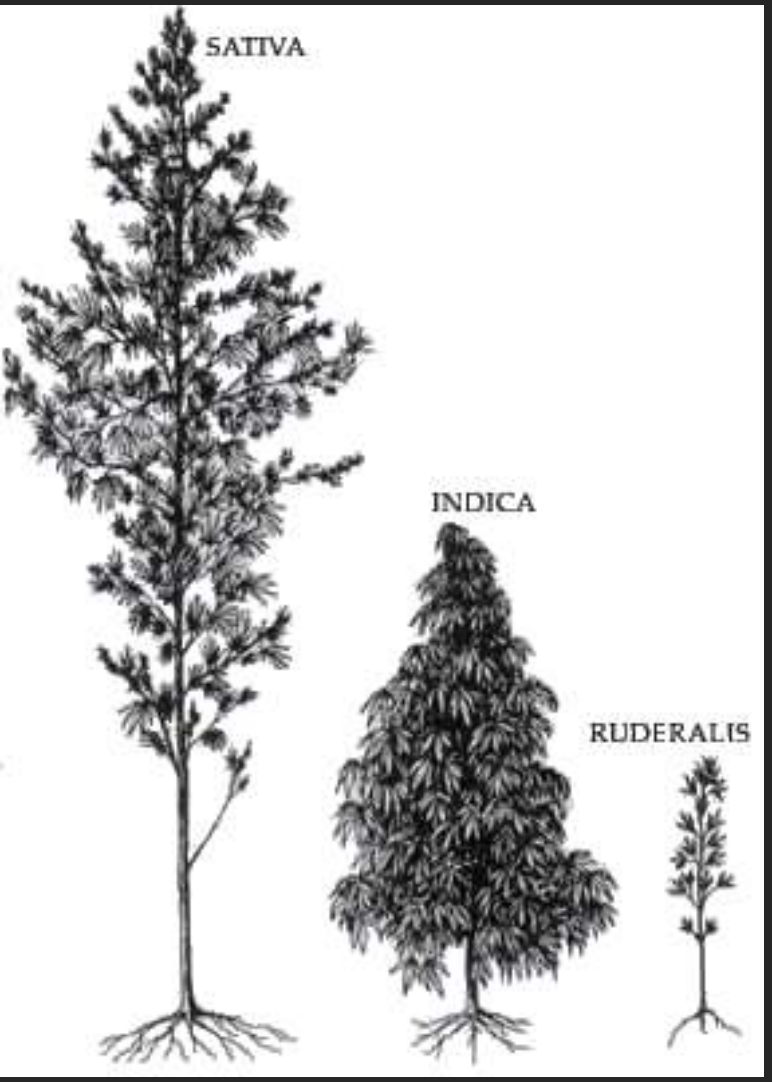
Cannabis Pest Management - A Perspective from Colorado

Whitney Cranshaw
Colorado State University

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



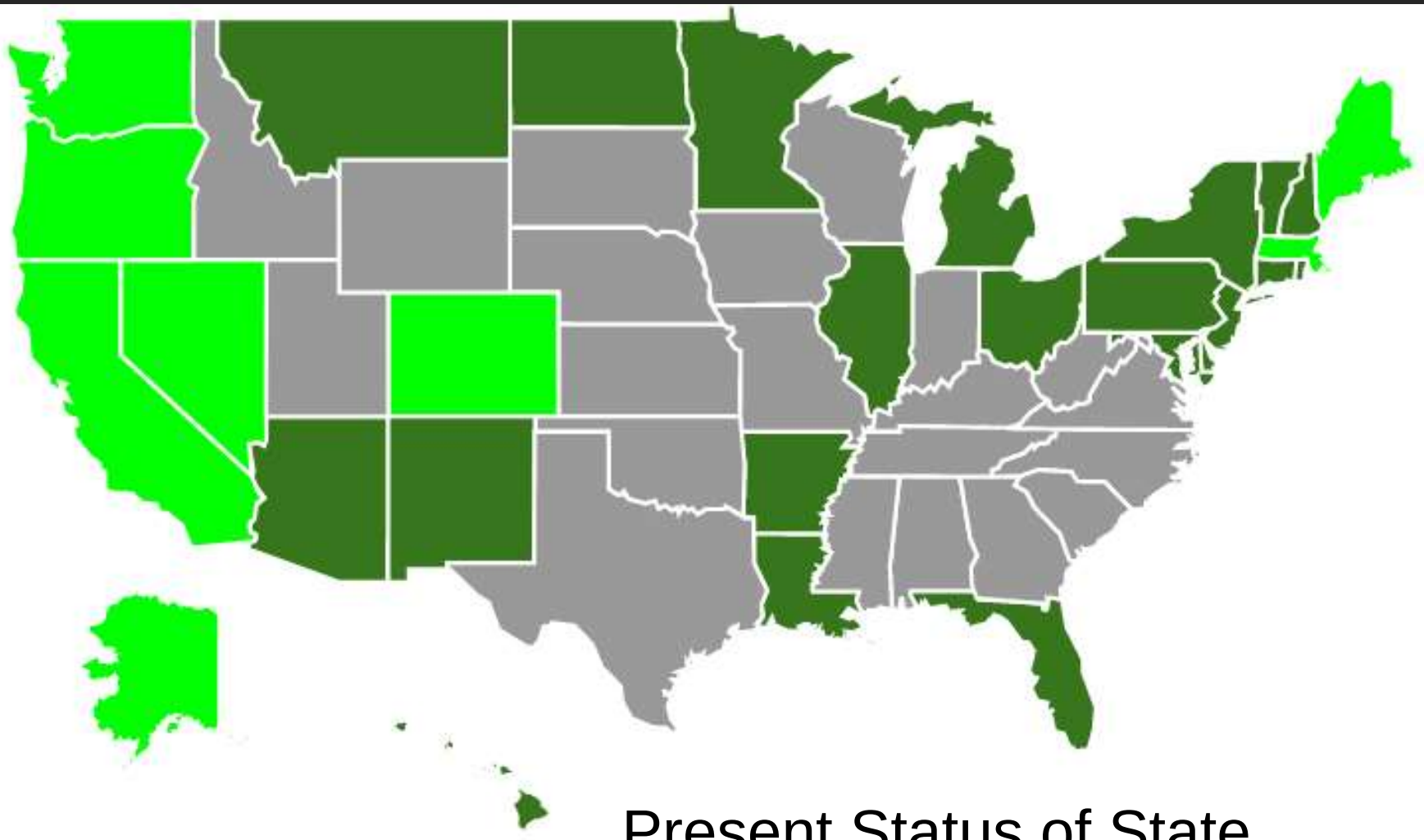
Cannabis indica

Cannabis sativa

What type of crop is cannabis?

Types of Cannabis Crops

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



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

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)

Some Background – Key Date

- **November 2012 – Passage of Amendment 64**
  - **Allows personal use of *Cannabis* for all uses (e.g., recreational use)**
  - **Establishes regulations on production and sale of *Cannabis***
  - **Directed that a system be established to allow hemp production within the state**

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

The crop is clonally propagated – all female plants.

Culture is with drip irrigation into pots or through hydroponic production

Each plant is tagged and tracked through the entire production stage – through end point distribution.

Medical/Recreational Marijuana Production Practices in Colorado

Cultivation is extremely intensive, expensive, - and produces a crop of very high value per unit area

Production Size Varies

In addition to commercial production small “home grows” exist involving up to six plants/person.

Medical/Recreational Cannabis Production Practices in Colorado

State laws specify that production is grown in secured, indoor facilities

Outdoor cultivation may be allowed in some states for personal production

A few, very highly secured, outdoor growing facilities exist in Colorado

Primary crop outcome – Sinsemilla

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

Who Regulates Marijuana in Colorado?

- **Colorado Department of Revenue**
  - **All licensing, tracking, tax collection**
- **Colorado Department of Agriculture**
  - **Worker protection, establishment of pesticide use guidelines**
- **Local jurisdictions**
  - **Safety, fire, building code regulations**
  - **Municipalities have right to allow – or not allow – retail sales and/or commercial cultivation**

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What type of Cannabis is hemp?

Hemp (broad sense)

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

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)

Colorado Revised Statute § 35-61-101 to 35-61-109

- Allows hemp cultivation for commercial and research purposes to be overseen by the Industrial Hemp Committee under the Department of Agriculture.
- Establishes a seed certification program.
- Establishes a grant program for state institutions of higher education to research new hemp seed varieties.

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.

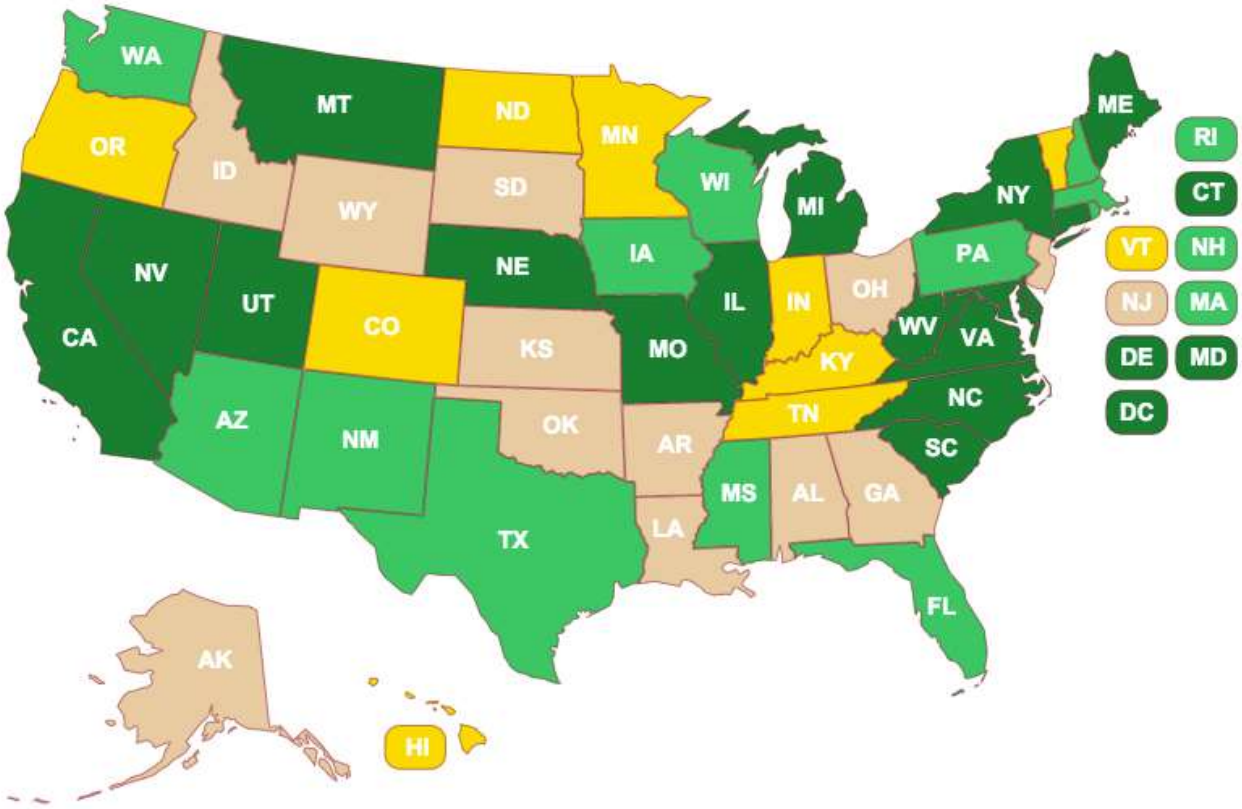
“Industrial hemp" means the plant of the genus *Cannabis* and any part of such plant, whether growing or not, with a delta-9 tetrahydrocannabinol concentration that does not exceed three-tenths percent on a dry weight basis.

Definition of Hemp - Farm Bill of 2013*

The term “industrial hemp” means the plant *Cannabis sativa* L. and any part of such plant, whether growing or not, with a delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis.

* Signed into law February 7, 2014

Status of State Laws Regarding Production of Industrial Hemp as of February 2016



States where hemp is now being grown

States that currently have introduced or have momentum to create hemp legislation

States where hemp legislation has passed

States with no hemp legislation

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 uses transplanted clones of all-female plants.

Mother plants

Rooted cuttings

Genetics involve *C. sativa*, *C indica*, and hybrids

Transplants are widely spaced.
All production in Colorado is irrigated.

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

Typically grown by transplants, with early season indoor production

Male plants, and seed production is often not desirable

Plant is harvested at immature stage

Some CBD crops are being grown from seed

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

Cultivar development includes crops with mixed use (CBD, seed, and/or fiber)

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
  - Inhaled (vaping)
  - Salves, ointments

Hemp Grown for Fiber and Seed

Typically grown by direct seeding to the field

Pollination is central to production

Hemp Grown for Fiber and Seed

Grown by direct seeding

Most, if not all, have *C. sativa* parentage

Crop is usually dioecious

Crops may be heavily foraged for pollen by bees

What type of crop is hemp?

CDA Involvement in Hemp

- CDA solely involved in regulating cultivation of hemp
  - Registration process
  - Mapped areas part of registration
- Random sampling done of fields
  - CDA conducts all aspects of testing/sampling
  - Within 30 days of harvest
  - THC content only tested, in CDA labs
- Processing must be done instate

CSU Guidelines for Extension/Research Involving *Cannabis*

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.

Primary Pest Problems of Indoor Grown Cannabis

- Abiotic disorders
- Pathogens
  - Powdery mildew
  - Pythium root rots
  - Botrytis
- Arthropods
  - Twospotted spider mite
  - Hemp russet mite
  - Rice root aphid, Cannabis aphid
  - Fungus gnats

Twospotted spider mite

Tetranychus urticae

Photo credit Karl Hillig

Hemp russet mite

Aculops cannabicola

Onion Thrips

Thrips tabaci

Cannabis Aphid

Phorodon cannabis

Rice Root Aphid

Rhopalosiphum abdominalis

Once moved outdoors, numerous **natural controls** act to effectively reduce pest problems associated with indoor production

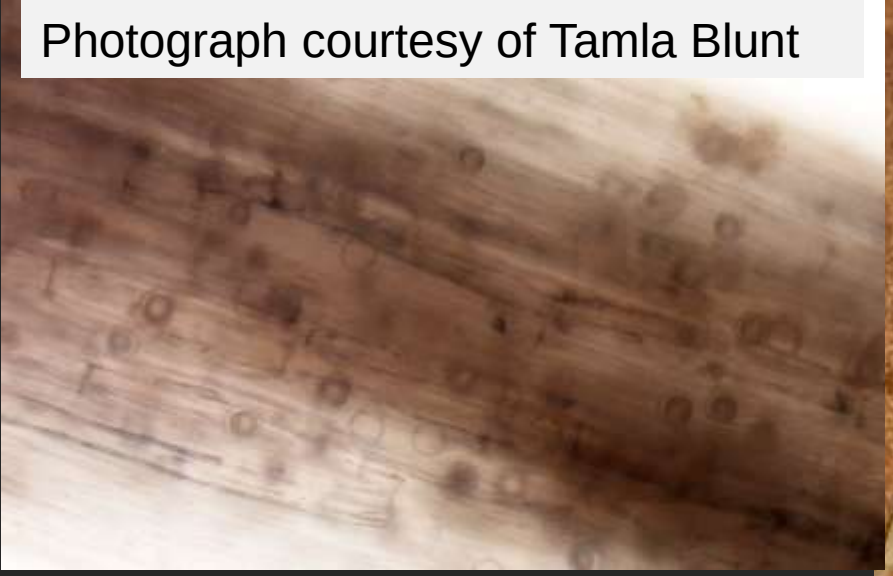
Primary Plant Pathology Problems of Indoor Grown Cannabis

- Abiotic disorders
- Pathogens
  - Powdery mildew
  - Pythium root rots
  - Botrytis
  - Viruses

Powdery mildew of *Cannabis*

Podosphaera macularis

Photograph courtesy of Tamla Blunt



Pythium root rots

Pythium spp.

Personal epiphany

How important can plant pathogens be?

Production of rooted cuttings and hydroponic culture favor spread of Pythium

Viruses?

Anything odd looking is
“tobacco mosaic virus”

Viral Diseases Listed at APS Website
Diseases of Hemp

VIRAL DISEASES

Alfalfa mosaic & Lucerne mosaic
genus *Alfamovirus, Alfalfa mosaic virus* (AMV)
Arabis mosaic
genus *Nepovirus, Arabis mosaic virus* (ArMV)
Cucumber mosaic
genus *Cucumovirus, Cucumber mosaic virus* (CMV)
Hemp mosaic
genus *?, Hemp mosaic virus*
Hemp streak
genus *?, Hemp streak virus*

Primary Pest Problems of Outdoor-Grown Cannabis

- Abiotic disorders
- Pathogens
  - TBD
- Arthropods
  - Grasshoppers
    - Other defoliators, possibly
  - Corn earworm
  - European corn borer?
  - Eurasian hemp borer?

The Pesticide Conundrum with Cannabis

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

Present Status of Pesticide for Use on the Crop: A pesticide *that is a registered pesticide for specific crops* is illegal to use on *Cannabis* under federal law.

Crop category not present on label directions.

Federal Laws and Pesticides

- **Most all products from Cannabis are classified by the DEA as Schedule I Controlled Substances**
  - As a result no federal agency will recognize Cannabis crops for any purpose – other than drug law enforcement
- **EPA will not establish a crop category for cannabis under pesticide laws**
  - EPA regulates the use of pesticides under provisions of law defined by FIFRA
  - ***No pesticides can be used legally on a crop if the use is not allowed for that crop category***

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

“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

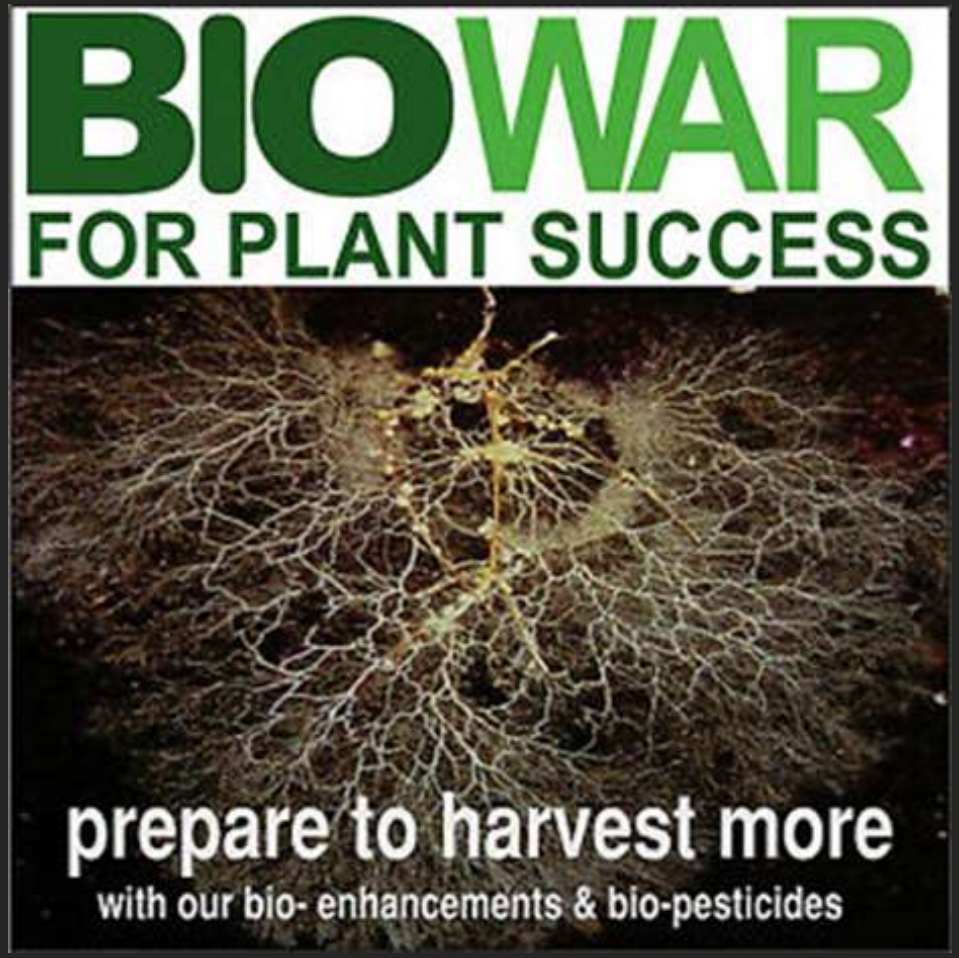
"....The best method to control this pest is to **switch your mode of attack each and every day**. Never spray them with the same stuff twice in a row, if you choose the chemical approach, you want to use a Neem Oil along with as many other forms of Miticides as you can get your hands on..."

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



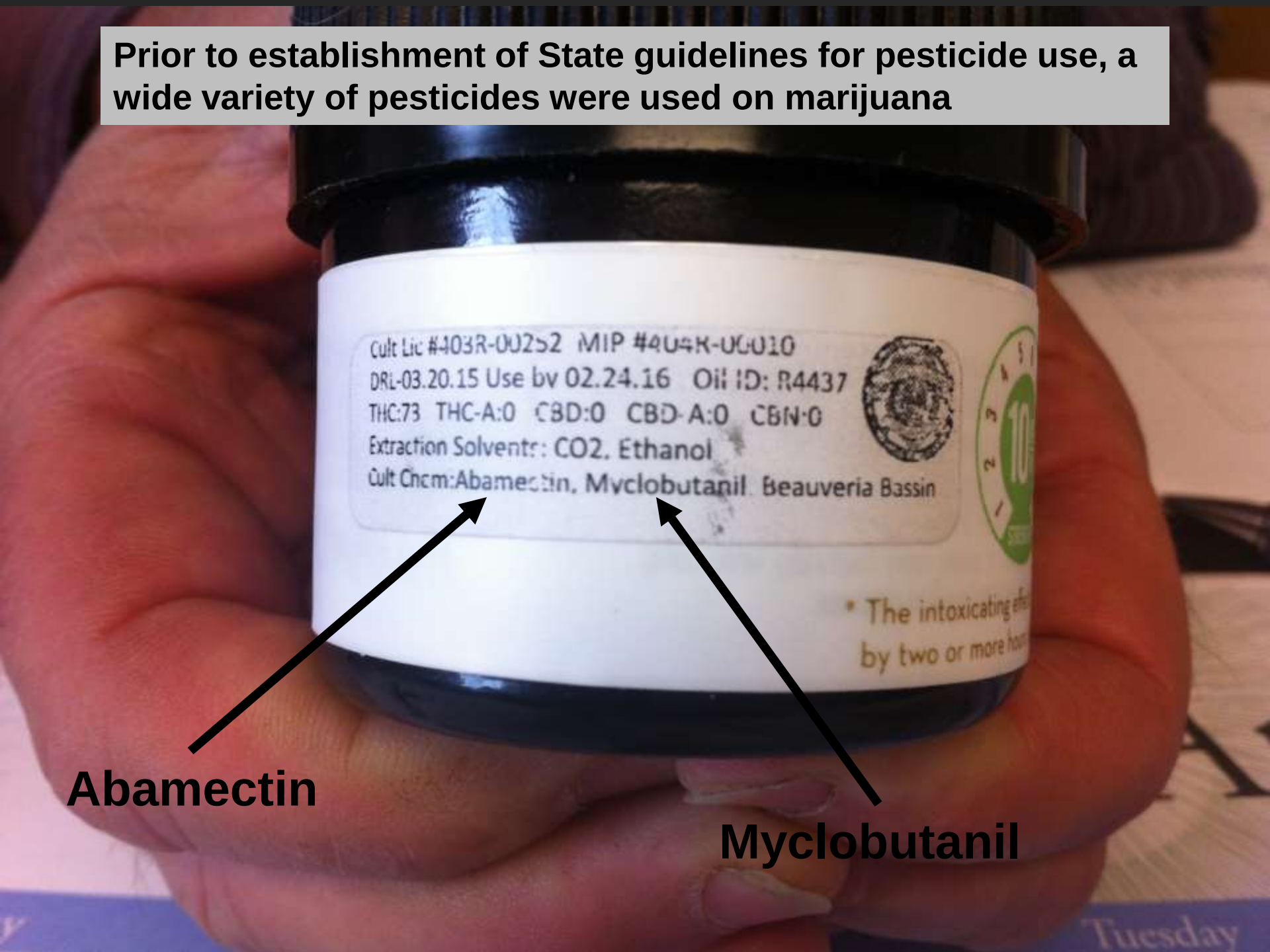
August 14 Letter 2013 from a Cannabis Producer

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



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)

“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

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
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  - **EPA and CDA registration is required**
  - **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 grown hemp 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 (*not not* 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% 0.130% 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	70051-3-64705	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

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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
Alude 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

Pesticides Allowed to be Used for Plant Disease Management in Colorado

- Hydrogen peroxide
- Citric acid
- Phosphorous acid
- Neem oil
- Several essential oils (e.g., clove, rosemary)
- Sulfur (two products)
- Copper octanoate (two products)
- *Bacillus pumilus* Strain GHA 180
- *Bacillus amyloliquefaciens* Strain D747
- *Bacillus subtilis* QST713 Strain
- *Trichoderma asperellum* Strain ICC 012

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 obvious 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.

This presentation will be posted at the Hemp Insect Website

hempinsects.agsci.colostate.edu

COLLEGE OF AGRICULTURAL SCIENCES

Hemp Insects

PROSPECTIVE STUDENTS GIVE N

Home | Hemp Insects | Regulations and Pesticide Use | Got Bugs? | Miscellaneous

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