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.
Cultivation is extremely intensive, expensive, - and produces a crop of very high value per unit area.
In addition to commercial production, small “home grows” exist involving up to six plants/person.
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
Who Regulates Marijuana in Colorado?

• Colorado Department of Revenue
  – All licensing, tracking, tax collection

• Colorado Department of Agriculture
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  – Safety, fire, building code regulations
  – Municipalities have right to allow – or not allow – retail sales and/or commercial cultivation
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)
• 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.
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.
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.

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
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
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*
Hemp russet mite
*Aculops cannabicola*

Photo credit Karl Hillig
Onion Thrips

*Thrips tabaci*
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*
Pythium root rots

*Pythium* spp.

Photograph courtesy of Tamla Blunt
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
“....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
“....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...”
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

- Section 25b minimum risk pesticides (exempt from federal registration)
Criteria for Pesticides Allowed to be Used on Cannabis in Colorado

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

<table>
<thead>
<tr>
<th>Colorado product name</th>
<th>Company</th>
<th>EPA Number</th>
<th>Active Ingredients</th>
<th>Percent</th>
<th>Commercial use</th>
<th>Personal use</th>
<th>Hemp use</th>
<th>Comments</th>
<th>Pesticide Type</th>
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<tbody>
<tr>
<td>#1 Fungus Bully (concentrate)</td>
<td>Sprins LLC</td>
<td>T5046</td>
<td>Sodium Lauryl Sulfate Corn Oil</td>
<td>8.00%</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Fungicide</td>
</tr>
<tr>
<td>#1 Pest Bully</td>
<td>Sprins LLC</td>
<td>T5046</td>
<td>Castor Oil Corn Oil</td>
<td>8.00%</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Insecticide</td>
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<td>T5046</td>
<td>Sodium Lauryl Sulfate Corn Oil</td>
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<td>Yes</td>
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<td>Fungicide, Insecticide</td>
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<td>420 Fungus Bully (concentrate)</td>
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<td>T5046</td>
<td>Castor Oil Corn Oil</td>
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<td>Yes</td>
<td>Yes</td>
<td></td>
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<td>T5046</td>
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<td>Castor Oil Corn Oil</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Insecticide</td>
</tr>
<tr>
<td>420 Pest Bully Ready-to-Use</td>
<td>Sprins LLC</td>
<td>T5046</td>
<td>Castor Oil Corn Oil</td>
<td>8.00%</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Insecticide</td>
</tr>
<tr>
<td>70% Neem Oil (Monterey)</td>
<td>Lawn and Garden Products, Inc</td>
<td>T0001-3-5470S</td>
<td>Clarified Hydrophobic Extract of Neem Oil</td>
<td>70.00%</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td>Fungicide, Insecticide</td>
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<tr>
<td>86 Milk &amp; Mold Ready to Use</td>
<td>NorCal Plant Nutrients LLC</td>
<td>T2568</td>
<td>Rosemary Oil Lemon Grass Oil</td>
<td>0.30%</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
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<td>NorCal Plant Nutrients LLC</td>
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<td>Rosemary Oil Lemon Grass Oil</td>
<td>1.20%</td>
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<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Fungicide, Miticide</td>
</tr>
</tbody>
</table>

Wednesday, June 24, 2014
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.
This poses some obvious registration problems.

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