




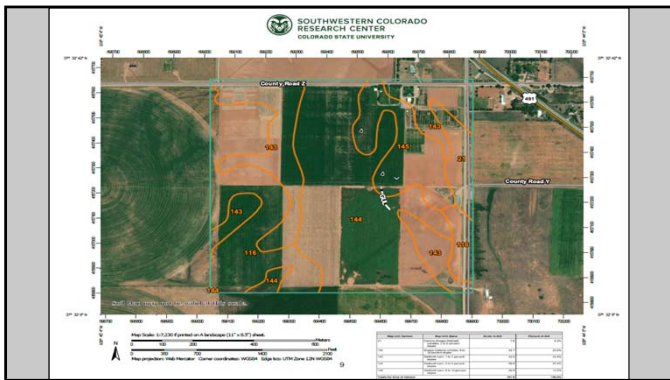
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Location: Yellow Jacket, CO - 158 acres

# Hemp Production Systems





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**Industrial Hemp Taxonomy:**  
Source: CABI, 2019. *Cannabis sativa*. In: Invasive Species Compendium. Wallingford, UK: CAB International. [www.cabi.org/isc](http://www.cabi.org/isc).

Domain: Eukaryota  
Kingdom: Plantae  
Phylum: Spermatophyta  
Subphylum: Angiospermae  
Class: Dicotyledonae  
Order: Urticales  
Family: Cannabaceae  
Genus: Cannabis  
**Species: Cannabis sativa**

## Where to start?

- CDA Website : <https://www.colorado.gov/pacific/agplants/industrial-hemp>

## Where to start?

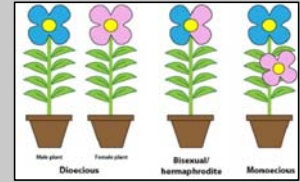
- Find your end market, work on a farm management/business plan.
  - SBDC - <http://www.sbdcfortlewis.org/>
  - End Product:
    - CBD
    - Fiber
    - Grain
  - Labor Constraints?



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## Seed

- Short Day Plant
  - Vegetative – 18H light, 6H dark
  - Reproductive – 12H light, 12H dark
  - Cross pollinated



- Dioecious vs. Monoecious

- What is a hermaphrodite?

• The *sexual dimorphism of Cannabis* is genetically determined by the *XY chromosomal mechanism* although sexual morphology is primarily a result of endogenous *plant growth regulator* levels that fluctuate in response to environmental variables. (Hall et al. 2012)

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## Hermaphrodite

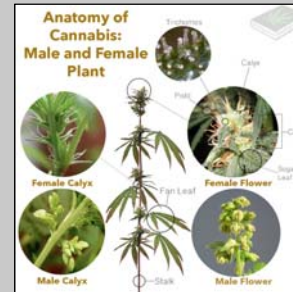
Plants will develop male characteristics at a certain point in an effort to ensure seeds are produced before the stressor can kill the plant. Life Strategy!

- Changes in the photoperiod, specially interruptions of the dark period during flowering
- **Too much heat (>30°C, 86°F approximately)**
- Harvesting too late
- Mechanical stress: broken branches, damaged roots, pruning during flowering....
- **Irrigation issues (lack or excess)**
- **Over-fertilization**
- Insects, mites, diseases...
- Thermal stress (irrigating plants with cold water...)
- **Use of phytotoxic products (pesticides, fungicides...)**

<https://www.livestrong.com/grow/hermaphrodite-cannabis-plants-facts-need-know/>

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## Hemp Flower Anatomy



<https://marjaneasy.com/2017/04/26/anatomy-of-the-cannabis-plant/>

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<https://www.cannaleaf.com/botany-of-cannabis/>

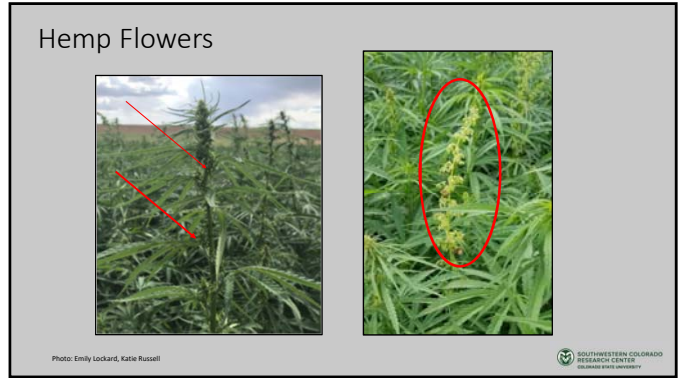
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## Hemp Flowers



Photo: University of Kentucky

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### Feminized Seed

- Mohan Ram and Sett (1982) suggest **Silver Thiosulfate (STS)** can be used to make male flowers with viable pollen on female hemp plants. Male flowers induced on **genetically female plants will produce pollen containing only X gametes**, which when crossed with eggs from female plants result in all-female seed (Mohan Ram and Sett, 1982). Foliar sprays of STS have been effective at **blocking ethylene production** and extending the flowering time for several different species of ornamental plants (Cameron and Reid, 1981, 1983). (Lubell and Brand, 2018)

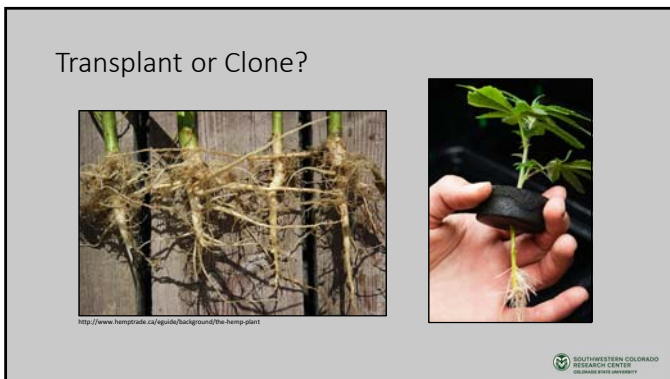
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### Methods for Seed Feminization:

- Gibberellic Acid
- Colloidal Silver
- Silver Nitrate
- Silver Thiosulfate

- All block ethylene production, create male flowers with only X gametes. Cross-pollination still possible!

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### The Basics

- Planting Date:** Target June 1 – Dependent on seed vs. transplant/clone
- Planting Depth:** Shallow 0.5-1"
- Soil pH:** 7.0-7.5 - SW CO: 6.9-8.0
- Seeding/Planting Rate:**
  - CBD – 1500-2000 plants per acre.
    - Decide on 3, 4, 5 ft. centers.
  - Fiber- 40-80 lb/a - 30-35 plants/ft<sup>2</sup>
  - Grain – 25-40 lb/a - 10-15 plants/ft<sup>2</sup>

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## The Basics

- Irrigation:** 12-28 inches, Drought tolerant in later growth stages



SW CO: 15-24 in.

No significant yield increase from 15 in. to 19 in.

(Berrada 2018, unpublished)



## The Basics

**Table 1.** General agronomic recommendations for the main harvestable components of industrial hemp

	Fiber	Grain/Dual Purpose	Cannabinoids*
Seeding rate (PLS)	40-60#/A	30-40#/A	30-40#/A
Row spacing	8 inches	8-16 inches	8-16 inches
Soil pH	6.2-6.5	6.2-6.5	6.2-6.5
Applied nitrogen	50 lb/A	100 lb/A	50-100 lb/A
Available phosphorus	60 lb/A	60 lb/A	60 lb/A
Available potassium	300 lb/A	300 lb/A	300 lb/A
Harvest timing	<=20% male flowering	~70% grain maturity	~75% trichome maturity

\*Optimum agronomic protocols for cannabinoid production in field-scale systems have not been defined by replicated research methods. Much of what is practiced today is extrapolated from Cannabis production systems in U.S. states where it is legal and/or from other countries. Many production practices from these systems (e.g., fertility) pertain mostly to indoor and not field-scale production. Very important questions remain regarding field-scale systems to produce cannabinoids. These include understanding the effects of variety, establishment methods (e.g., direct seeding versus transplanting), and general crop management decisions including nitrogen fertility and harvesting/processing/storage issues. Research is under way to address these questions.

## Pest Management

- Crop Rotation:**
  - Compatible: Wheat, Bean, Alfalfa
  - Not Recommended: Canola, Edible Beans, Sunflowers



- Tillage
- Be a good neighbor.

- Pesticide labeling:**
  - The Colorado Pesticide Applicator Act prohibits use of a pesticide in a manner inconsistent with the product labeling.
  - Any pesticide used in the cultivation of Cannabis must be registered with the Colorado Department of Agriculture.



## Pest Management:

### 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 [visit our page](http://www.cda.state.co.us) 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. Therefore, CDA makes no assurances of their safety or effectiveness when used on Cannabis and is not responsible or liable for any such use.

- <https://drive.google.com/file/d/1upPu4MArISWcdy0eOgP7fkgFDtTSmQo0/view>



## Harvest Timing:

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## Hemp Harvest Methods




September 26, 2018

November 1, 2018



## Storage and Drying:



## Hemp Research Trials

- 3 Varieties x Planting Date
  - Helena May 15
  - Fedora x June 1
  - Felina June 15






## Hemp Trial

- 3 Varieties x Planting Date

Variety	Yield (Wet) (lb/a)	Standard Error
Helena	16,199.48	1564.44
Fedora	17,162.64	1155.5
Felina	15,749.36	1510.16
LSD (p<0.05)	3478.8	

Planting Date	Yield (Wet) (lb/a)	Standard Error
May 15	17,220.72	1764.92
June 1	16,475.36	1270.08
June 15	15,415.40	1155.41
LSD (p<0.05)	2995.3	

## Questions?



