

Hemp Regulation and Production in Michigan

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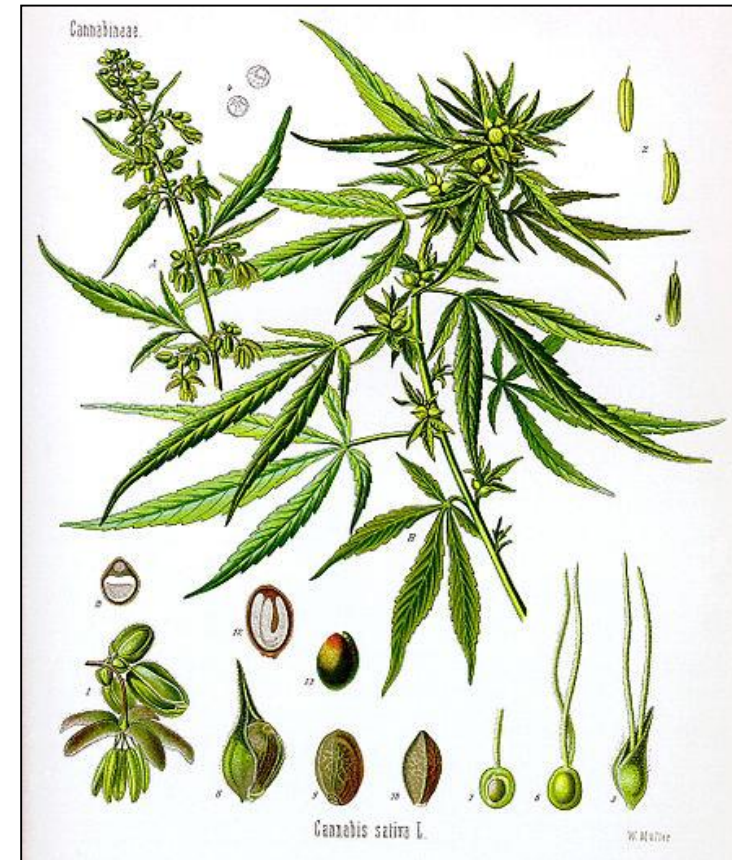
Overview

- Hemp Definition and Uses
- Hemp History
- Hemp Regulation
- Hemp Agronomy and IPM
- Cannabis Cross Pollination
- Hemp Economics
- MSU Grain/Fiber Variety Trial
- MSU Resources



What is Hemp?

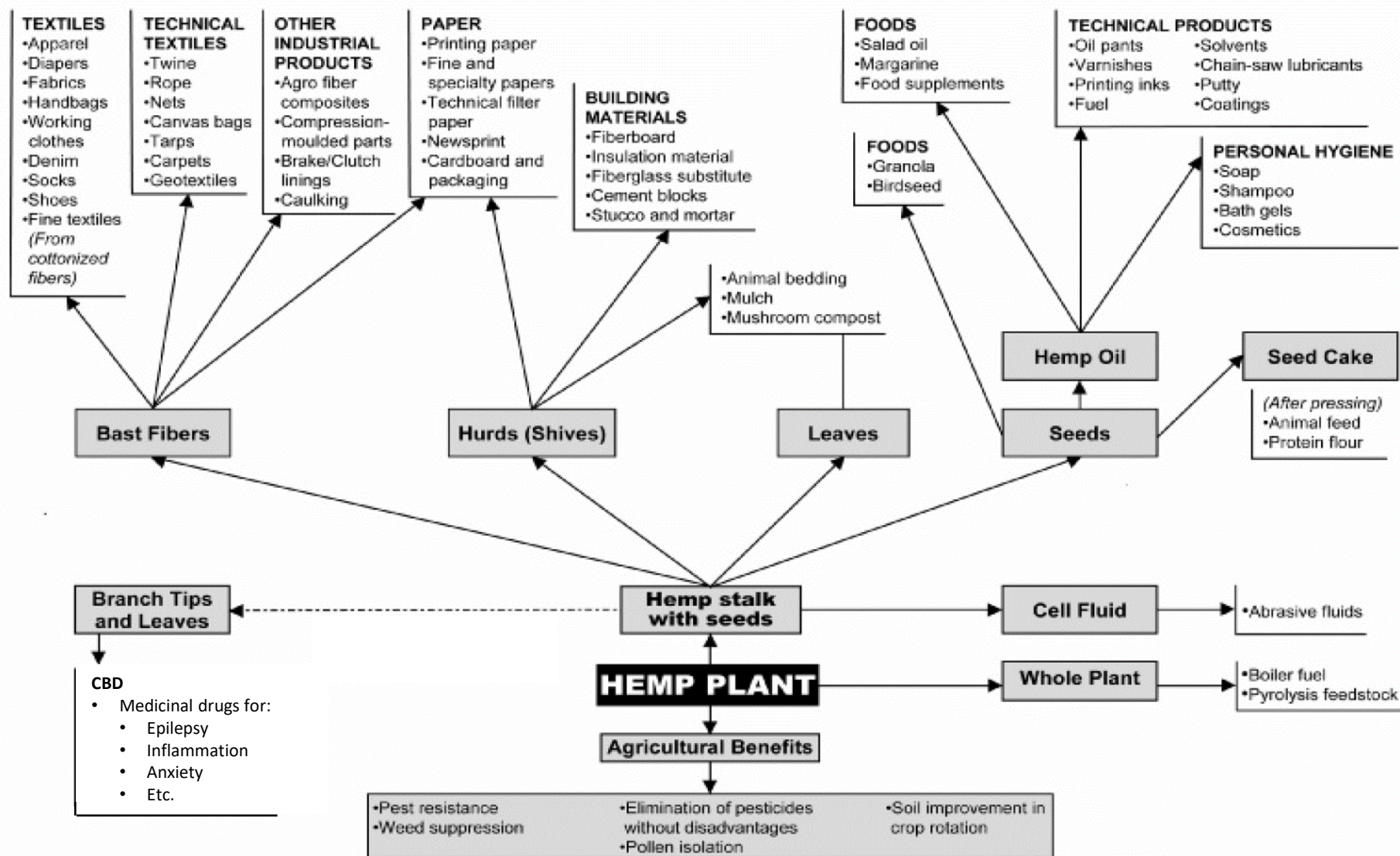
- *Cannabis sativa* L.
- Legally defined as cannabis with $\leq 0.3\%$ Δ -9-tetrahydrocannabinol (THC)
- Annual broadleaf plant
 - Dioecious and monoecious
 - Tall and competitive, 4-13 ft.
 - Tap rooted
 - Photoperiod sensitive
 - Wind pollinated



Hemp Varieties and Uses

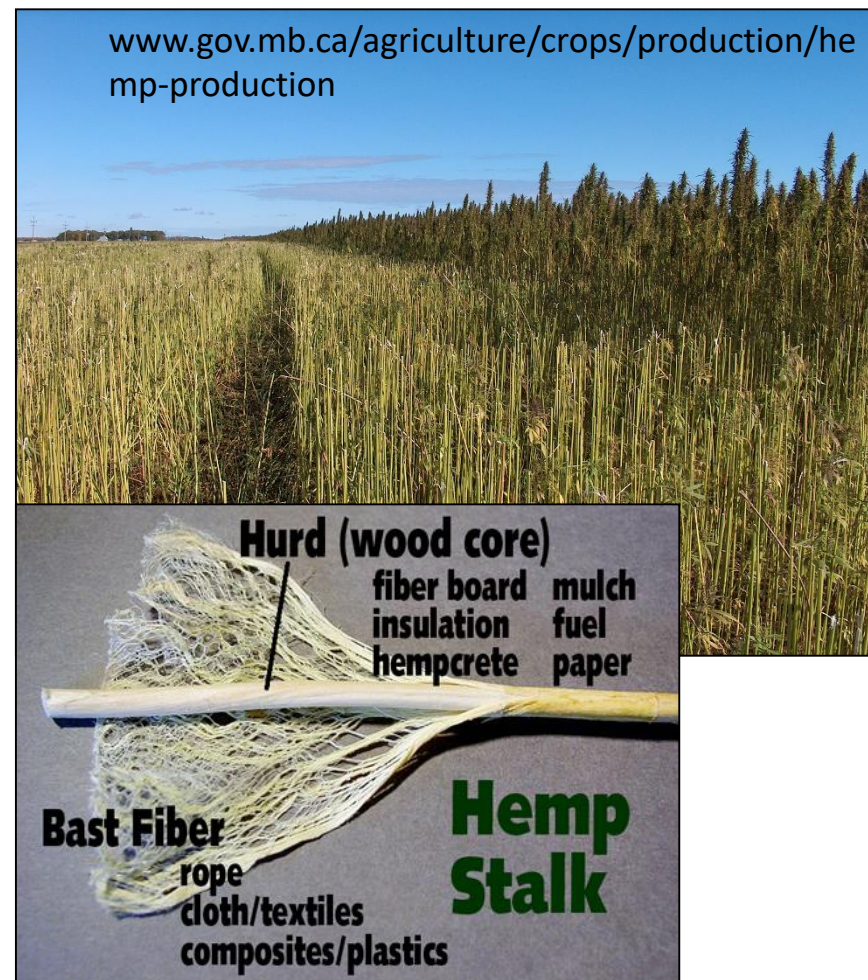
- Varieties selected based on desired end product
 - Fiber
 - Seed/Grain
 - Non-seed oils and extracts (cannabinoids)





Uses for Hemp Fiber

- Stems processed into two types of fibers:
 - Basts – longer, higher quality for making textile, rope, etc.
 - Hurds, or shivs – shorter, woody, lower quality for animal bedding, compost, other products



Uses for Hemp Seed

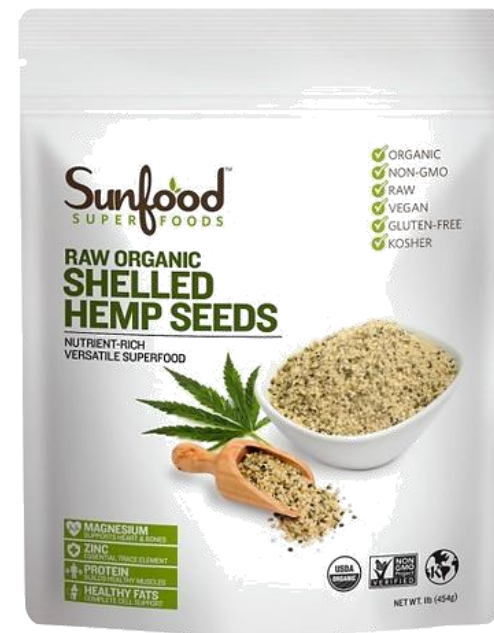
- Seed can be sold into several markets
 - Resold for crop planting
 - Quality likely low outside of qualified breeding program
 - Hulled for food
 - Crushed for oil and cake byproducts



www.amazon.com



www.petco.com



Target.com

Uses for Hemp CBD

- Cannabidiol (CBD) is concentrated in the glandular trichomes (specialized hairs) of flowers and leaves
- Products including tinctures, skin cream and oils with numerous claims of relief from anxiety, pain, sleeplessness, and other ailments



Jonathan Page, Anandia Labs



Uses for Hemp CBD

- Epidiolex was FDA approved in June 2018 for treatment of two specific types of epilepsy (Dravet syndrome and Lennox-Gasaut syndrome)
- In September 2018, Epidiolex was reclassified from schedule I to schedule V
- Derived from marijuana plants, but is made from CBD-isolate
- Stated price of \$32,500/yr



Uses for Hemp CBD

- Smokable flower as a niche market for those wanting smell/feel of smoking marijuana without the psychoactive effect
- Potent method for getting CBD into the body
- \$300-\$400 per pound of flower



<https://greathemp.net>



<https://www.bnbtabacco.com>

Michigan Hemp History

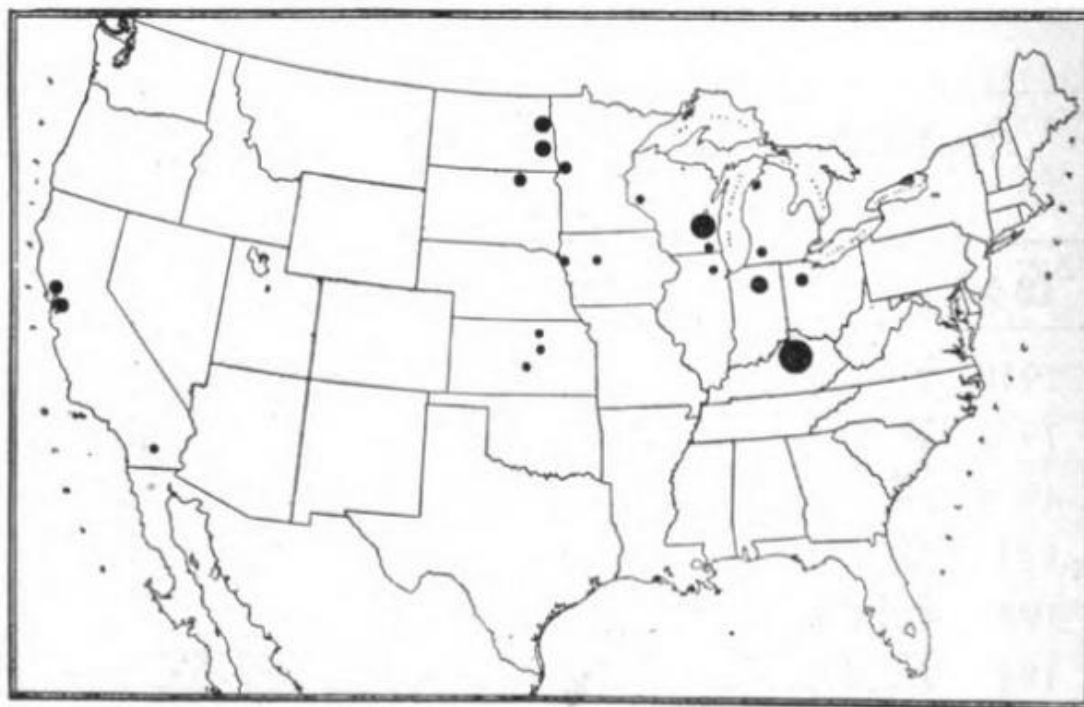


FIG. 4.—WHERE HEMP IS GROWN IN THE UNITED STATES

Wisconsin ranks next to Kentucky in the production of hemp.

Relevant Regulations for Michigan

- [2014 Farm Bill, S. 7606](#) Authorizing hemp research
- [MI HB 5439](#) (2014) Authorizing hemp research
- [MI HB 5440](#) (2014) Defining industrial hemp as cannabis with less than 0.3% THC
- [MI Prop 1](#) (2018) Legalizing recreational marijuana and industrial hemp cultivation
- [MI HBs 6330, 6331 & 6380](#) (2018) Clarifying regulation of industrial hemp research
- [2018 Farm Bill, S.10111](#) Legalizing commercial hemp
- [USDA Interim Final Rule](#) Detailing hemp regulations



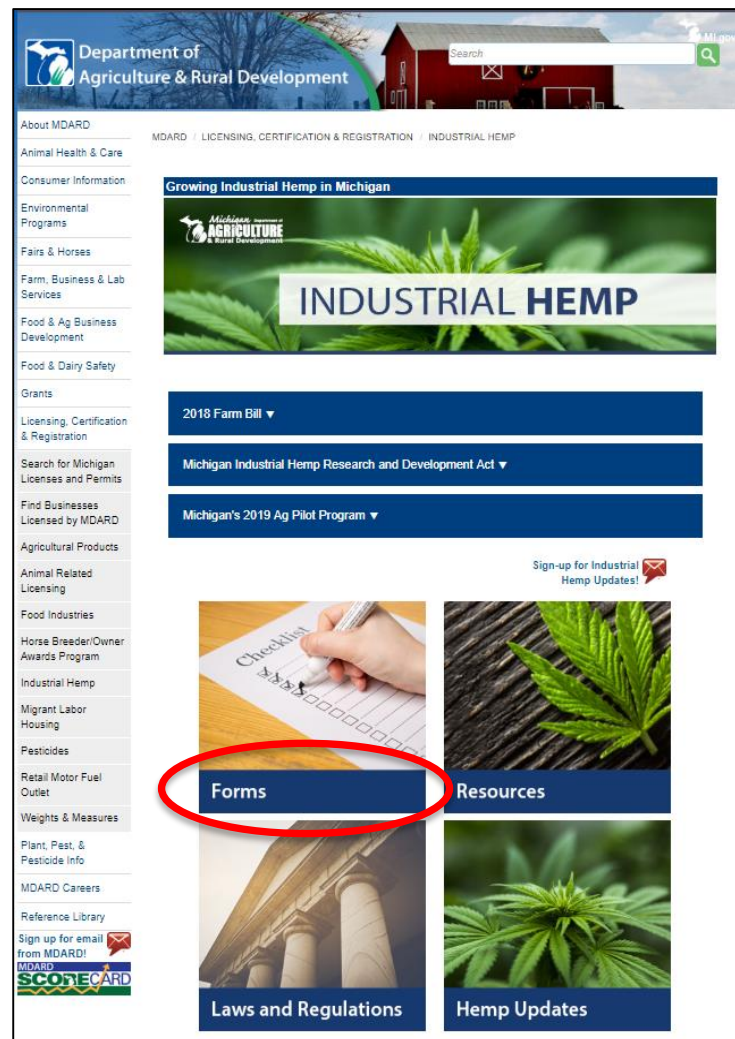
State Regulatory Responsibility

- USDA Interim Final Rule published Oct 30
- MDARD will submit a regulatory plan to USDA:
 - Procedures for recording where hemp is produced
 - Procedures to ensure hemp produced meets the legal definition of not more than 0.3% THC
 - Procedures for disposal of materials with a THC concentration exceeding 0.3%
 - Procedures for handling violations of the 2018 Farm Bill and the proposed state plan
 - Corrective action plan with deadlines & monitoring



MDARD Registration Process

- Required under 2014 Farm Bill language for pilot research programs
- No online process available for 2020, mail only
- 2019 registrations had renewal deadline of Nov. 31, no deadline for new app.



MDARD Registration Process

Industrial Hemp Ag-Pilot Program for 2020

- Step 1: Complete the appropriate application(s)
 - Hemp Grower – growing only (\$100 application fee)
 - Hemp Processor-Handler – if you want to sell (\$1,350 fee)
 - Required for those who process, handle, broker or market
- Step 2: Complete online background check
- Step 3: Complete the Ag-Pilot Program application
- Step 4: Create map(s) of all locations where you will grow, handle, store, process, broker or market hemp including GPS coordinates



Hemp Sample Submission

- Licensees are required to submit tissue samples to MDARD for analysis to ensure THC levels are $\leq 0.3\%$
- Visit www.michigan.gov/IndustrialHemp for full details

GRETCHEN WHITMER
GOVERNORSTATE OF MICHIGAN
DEPARTMENT OF AGRICULTURE
AND RURAL DEVELOPMENTGARY MCDOWELL
DIRECTOR

Industrial Hemp Sample Submission Form

Licensed Grower:	First Name	Last Name	
Licensed Grower Business Name (if applicable):	Business Name		
License Number:	License Number		
Email:	Email.		Phone:
			Phone.
Total acres or Sq ft. to be sampled:	Total Acres or Sq Ft. Sampled		Declared Harvest Date:
			Declared Harvest Date
Harvest Crop Coordinates:	Longitude:	Longitude Coordinates.	Latitude:
		Latitude Coordinates	
From approx. center the harvest field or door of greenhouse, and in decimal format (eg: 45.123456, -123.456789)			
Grow Area Type:	Choose an item.	Field (Outdoor)	Greenhouse (Indoor)
Strain ID		Sample Type*	Analysis*
		Plant/Flower	THC
			CBD
Cost of Testing Services:		\$125.00 per sample, to be billed to the client	

**If you have other products or tests you would like performed or if you have sampling questions, please call 517-284-0500.*

Emergency Rules for Testing Standard

- Released August 15, 2019
- MDARD's Geagley Lab only lab approved to satisfy regulatory requirement, \$125/sample
- Separate sample per variety, per non-contiguous field
- Sample top 2" of flower
- # of plants to sample dependent on # of plants grown, up to 25

Total Number of Plants	Number of Plants to Sample
1-10	3
11-20	4
21-30	5
31-40	6
41-50	10
51-100	20
101 or greater	25

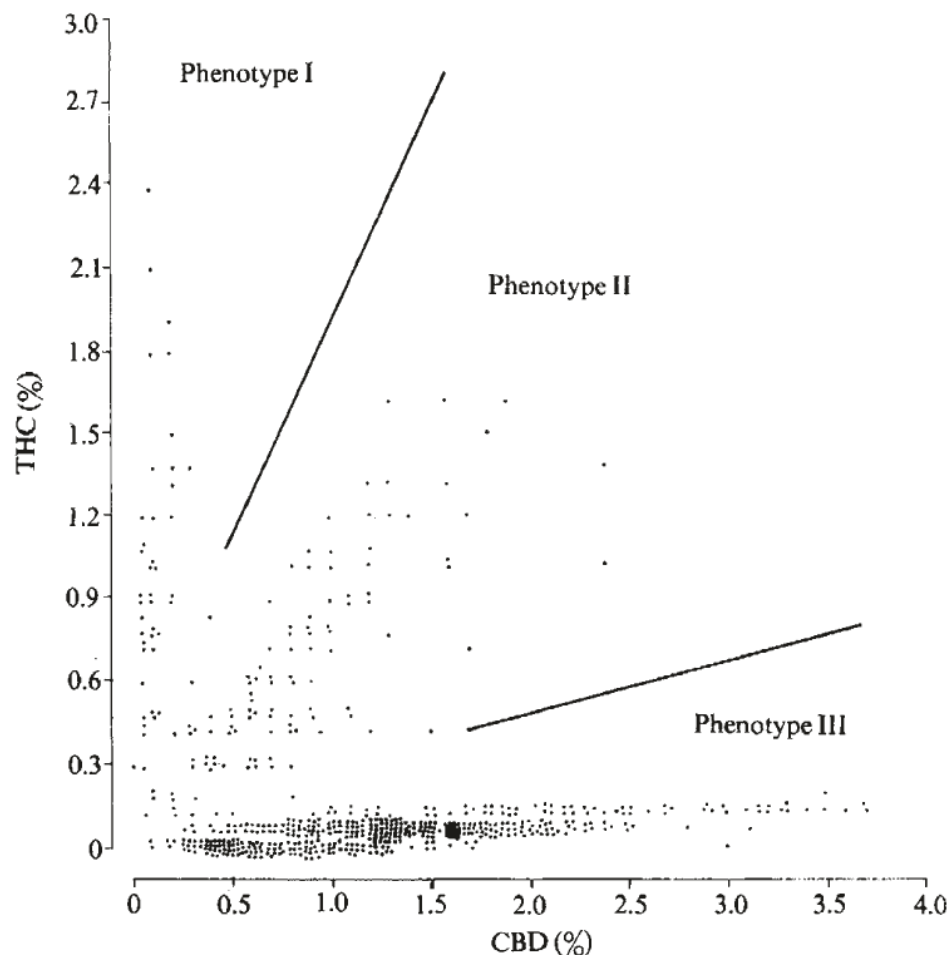
Emergency Rules for Testing Standard

- Sample not more than 15 days before intended harvest date
- Testing performed post-decarboxylation of THC (i.e. total THC)
- Compliant crops must be harvested within 15 days of receiving results
- Non-compliant plots may be resampled twice, or must be destroyed



Hemp Cannabinoids

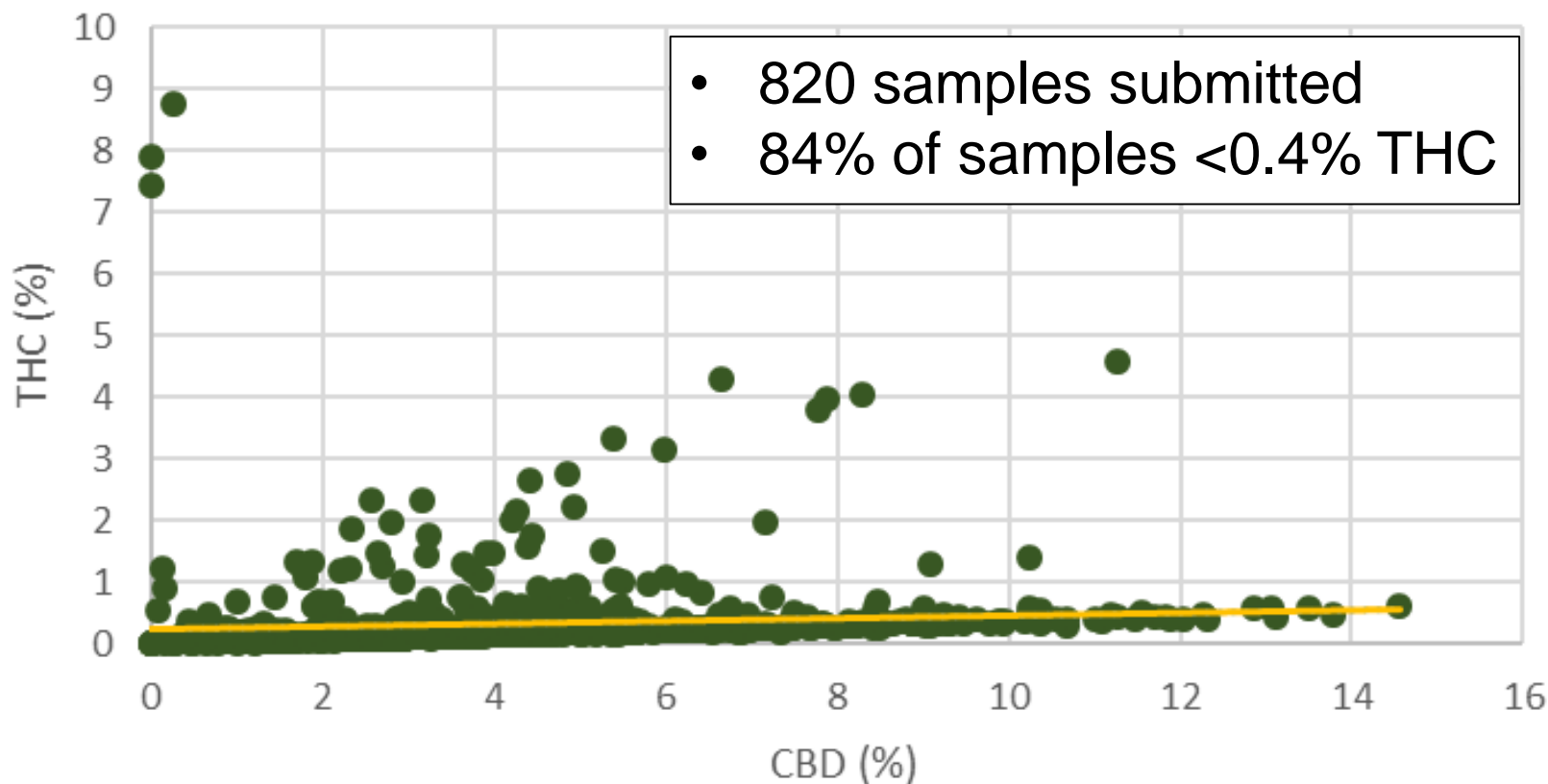
- Cannabis is characterized into three distinct phenotypes based on the ratio of THC:CBD
- Low-THC strains all tested below 0.3% THC in what they called phenotype III



Small and Beckstead. 1973. Cannabinoid Phenotypes in *Cannabis sativa*. Nature 245:147-148.

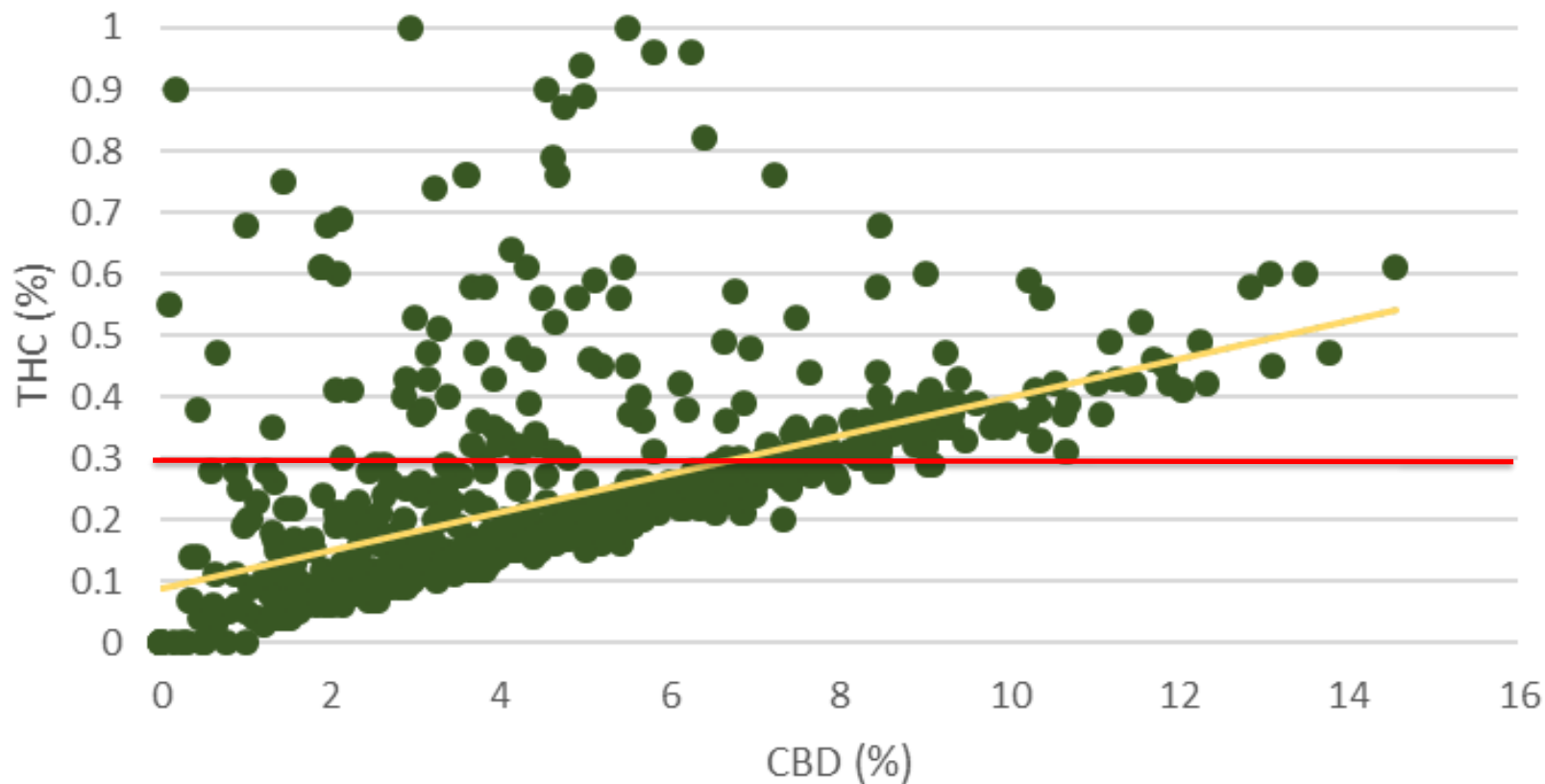
MDARD 2019 Lab Test Results

THC by CBD



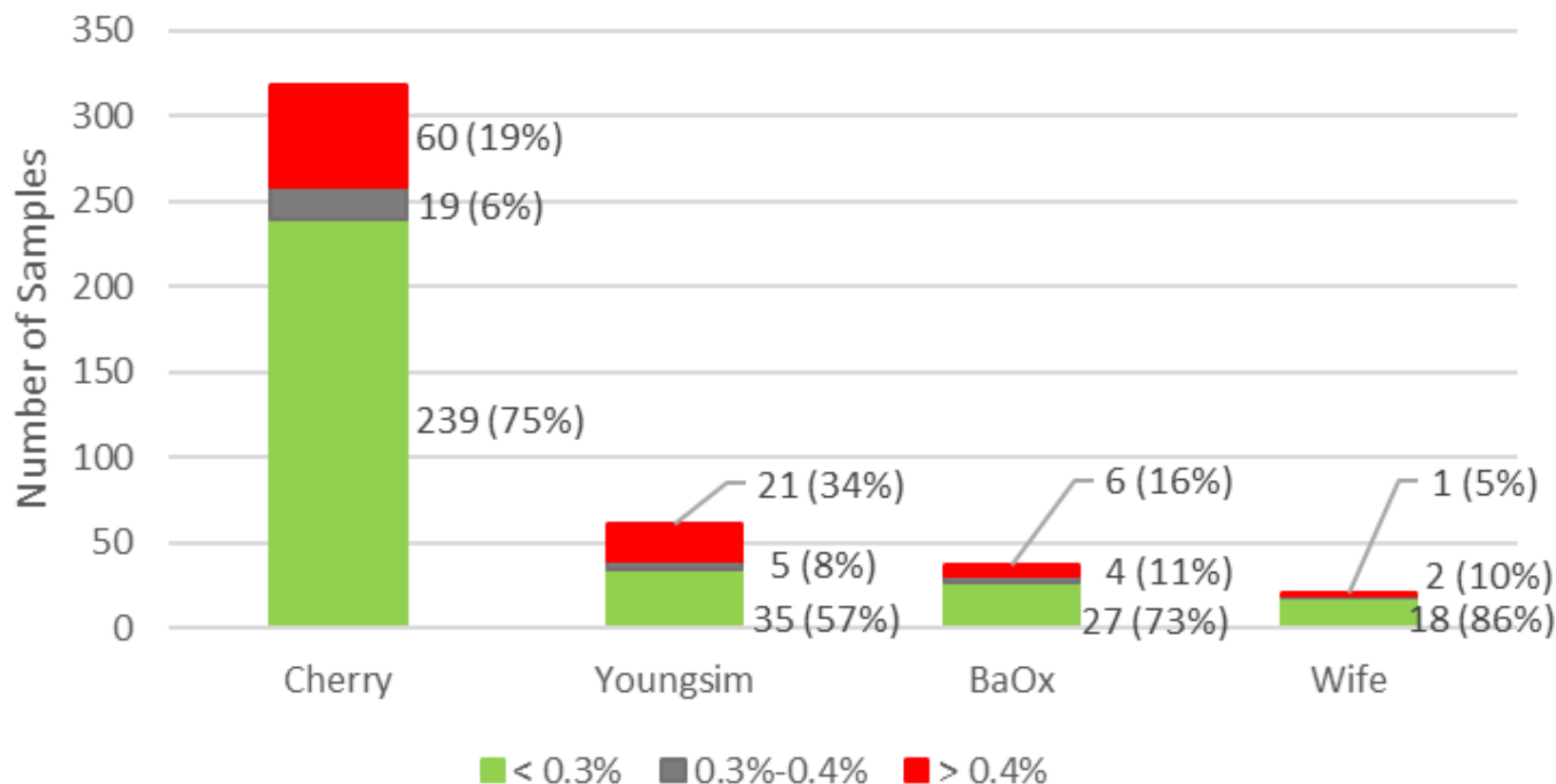
MDARD 2019 Lab Test Results

THC by CBD



MDARD 2019 Lab Test Results

THC in Most Popular Varieties





Law Enforcement Considerations

- Difficulty of distinguishing hemp from marijuana has led several states to temporarily halt misdemeanor marijuana prosecutions until quick and affordable tests can be developed



<https://www.nbcnews.com/news/us-news/i-feel-lucky-real-how-legalizing-hemp-accidentally-helped-marijuana-n1043371>



Law Enforcement Considerations

- Scent dogs trained to detect marijuana may not be able to discern between hemp and marijuana
 - MSU police canine “hit multiple times on a stem of our hemp stuck in or around vehicles” (August 20, 2019)
 - Caution required when transporting or mailing especially out of





Hemp Agronomy: Climate and Soils

- Temperature and rainfall found in Michigan conducive to hemp production
- Almost any soil type is adequate, as long as it's well drained
- Neutral pH (6.0–7.5)
- Planting at typical corn timing in Michigan - May or early June





Hemp Agronomy: Soil Fertility

- Hemp benefits from fertile soil and fertilizer
 - ~110 lbs N/ac for seed, 50 lb N/ac for fiber
 - P and K according to soil tests for winter wheat
 - Additional P and K for fiber vs. seed
 - Sulfur and other micro-nutrients as needed

Hemp Nutrient Removal and Uptake (lbs / acre)			
Nutrient	Total Plant	Grain	Daily Uptake
N	178	36	6
P	42	17	2
K	188	9	5
S	14	3	



Hemp Agronomy: Site Preparation

- Plant in April or May after soil temps warm to greater than 46 °F
 - Do not plant after early June due to photoperiod
- Tillage generally recommended, but no-till can work with even moisture, good seed to soil contact and weed control
- CBD systems often utilize plastic mulch, irrigation and cuttings or transplants





Hemp Agronomy: Planting

- Fiber and grain crops planted from seed with planter, grain drill or broadcast and cultipacking
 - $\frac{1}{4}$ – $\frac{1}{2}$ inch deep
- Dense stand ideal for yield, and to out-compete weeds
 - Fiber: ~50 lbs per acre, 8" or less row spacing
 - Grain: ~35 lbs per acre, 8-16" row spacing





Hemp Agronomy: Planting

- Cannabinoid production different than fiber or grain
 - 1,500 – 3,000 plants per acre
 - Female plants only, often grown from cuttings, transplants or feminized seed
 - Rogue out male plants
 - Isolation from other cannabis to avoid pollination, **3–15 miles**
 - Very wide spacing to encourage branching and flowering



Photo: GenCanna



Pest Management: Insects

- Due to lack of previous cultivation, significant insect pests are not expected immediately
- However, many insects can and will feed on hemp, and we expect pest buildup over time as the crop becomes more abundant
 - Defoliators (grasshoppers, corn earworm)
 - Borers (corn borer, hemp borer)
 - Sucking pests (aphids, mites)
- Bud and flower protection most important
- **Two insecticides currently labelled for hemp**



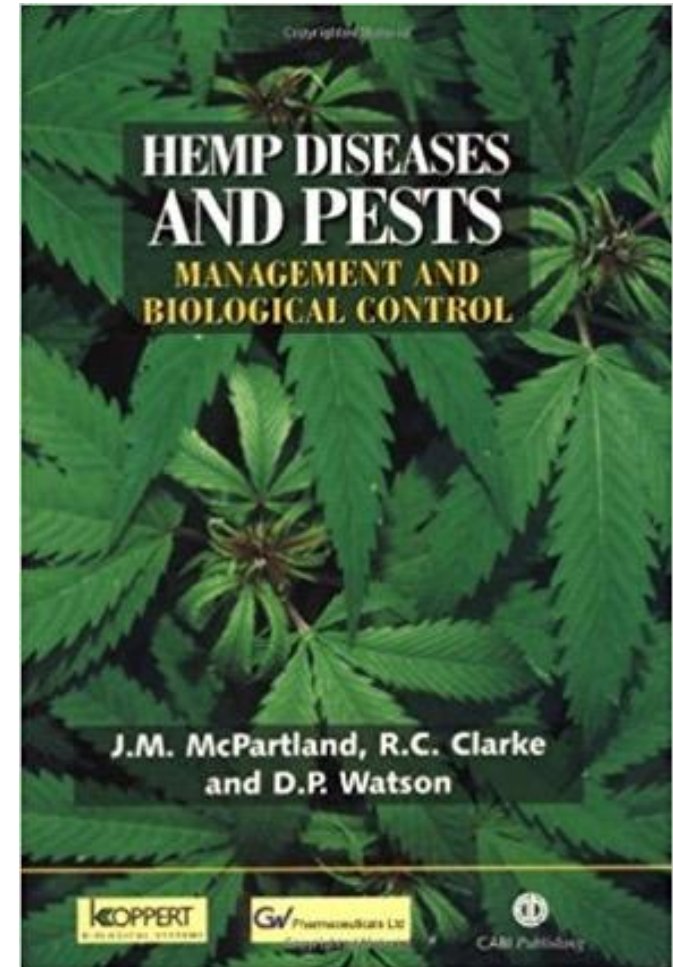
Canadian Hemp Trade Alliance





Pest Management: Diseases

- Hemp is susceptible to many different pathogens
 - **Soil and roots:** Pythium, Phytophthora, Fusarium
 - **Foliar:** Hemp leaf spot, Cercospora, Septoria, Powdery mildew, rust
 - **Stems:** White mold
 - **Flowers:** Botrytis bud rot
- **Only four bio fungicides currently registered for use on hemp nationally, one in Michigan**



Pest Management: Weeds

- **No herbicides are currently labeled for hemp!**
- Design a weed suppressive crop rotation, and follow a competitive crop
- Start clean, selecting fields with low weed pressure and use tillage and/or stale seedbed
- Ensure proper plant population and rapid establishment
- Know your weeds and strategies for control
- Have the right tools at your disposal for prevention, mulch, cultivation, etc.
- Make a weed control calendar to anticipate management
- Don't underestimate the labor required





Hemp Harvest: Fiber

- Fiber hemp is windrowed between early bloom and seed set and left in the field for a ~5 week “dew retting” process
 - When fibers are $\leq 15\%$ baled
 - Drying to 15% may be for Michigan climate
 - Can be left until spring





Hemp Harvest: Grain

- Grain hemp is harvested when shattering begins
 - Grain is between 22–30% moisture
 - Plants are still green at time of harvesting
 - Conventional combine can be used, but some minor required
 - Immediate drying and critical





Hemp Harvest: CBD

- CBD hemp is harvested at peak flowering
 - CBD:THC testing or trichome color can be used to target harvest date
 - Hand harvesting of whole plants is standard
 - Immediate drying at moderate temps with good ventilation





Hemp Economics: Fiber and Seed

<u>2017</u>	<u>Grain</u>	<u>Fiber</u>	<u>Floral</u>
Growers	20	14	112
Acres Planted	1,227	159	1,883
Acres Harvested	826	120	1,371
Avg. Yield lb/acre**	518	2,556	1,024
Avg. Price per lb	\$1.70	\$0.34	\$7.20

**Preliminary; analysis of 2017 production report data is not complete.*

***Average Yield was calculated only from plots with reported yields above zero. (Does not include dual purpose Grain & Floral)*

1 lb/plant
10% CBD
\$1.00/% CBD/lb.
\$10/plant
\$20,000/ac (2000 plants/ac)

Slide courtesy of Dr. David Williams, University of Kentucky, as presented at UW Extension
"Industrial Hemp Educational Meeting", Feb. 25, 2019



Loans and Crop Insurance

- Many lending institutions are hesitant to lend to hemp growers until federal regulations are finalized
 - GreenStone Farm Credit Services will offer loans
- Companies offering hail insurance for hemp
- USDA's Risk Management Agency announced coverage for hemp under Whole-Farm Revenue Protection program for crop year 2020
 - Must have a contract for the purchase of industrial hemp
 - Hemp having THC above the compliance level will not constitute an insurable cause of loss



Cannabis Pollination Basics

- Cannabis is primarily dioecious (separate male/female plants)
- Flowering is induced by short days < 14 hrs (long nights)
 - 4/30 & 8/11 in Lansing
- Male plants flower for 2-4 wks
- A male flower can produce 350,000 pollen grains
- Pollen is carried on the wind to female plants
 - Other vectors are a minor source



Why Pollination Matters

- Pollination is required for seed/grain production, inherent in fiber production
- Prolonged virginity increases the number, size and cannabinoid concentration of female flowers
- Pollination thus decreases the yield, cannabinoid concentration and value of female plants
- Cross pollination **does not** increase cannabinoids in the current generation!

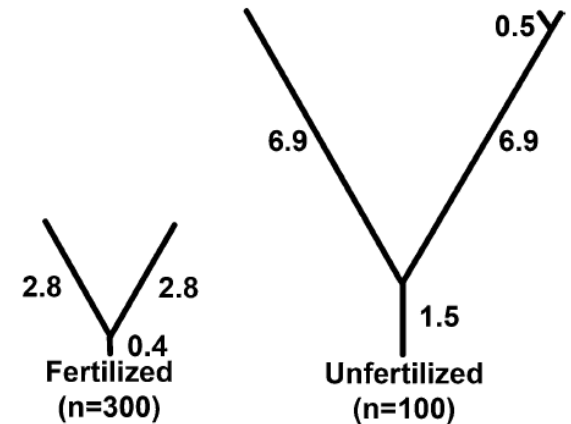


Fig. 5 Mean dimensions (in mm) of stigmas of fertilized plants (*left figure* based on ten stigmas of each of 30 herbarium collections) and of unfertilized plants (*right figure* based on ten stigmas of each of 10 medicinal marijuana samples)



Possible Solutions

- Geographic isolation
- Physical isolation
- Irrigation
- Temporal isolation
- Current best practice

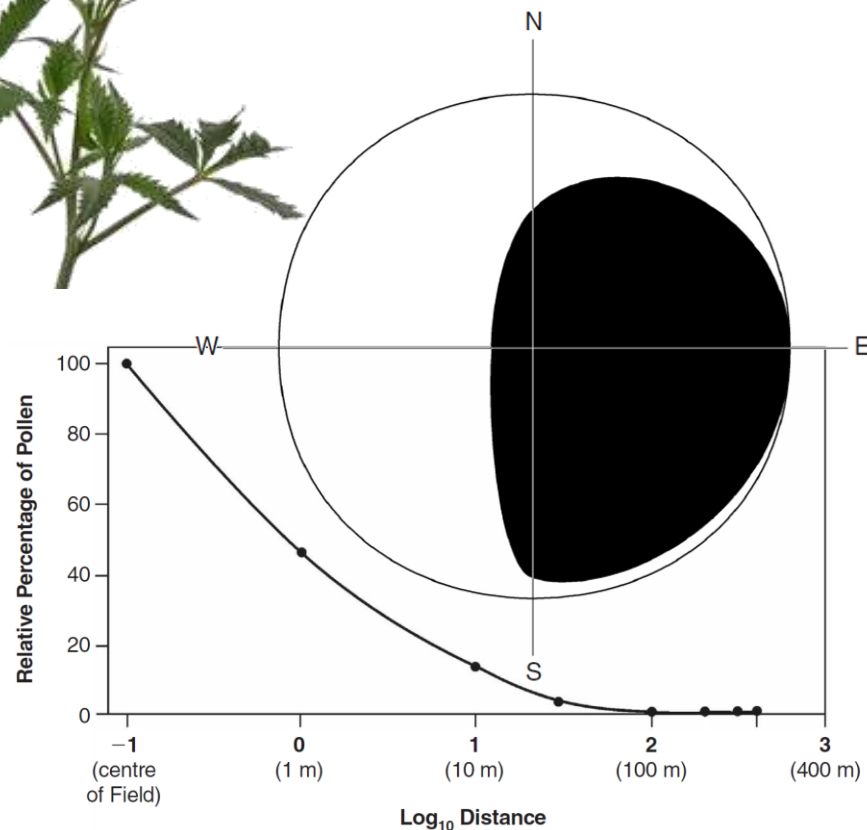
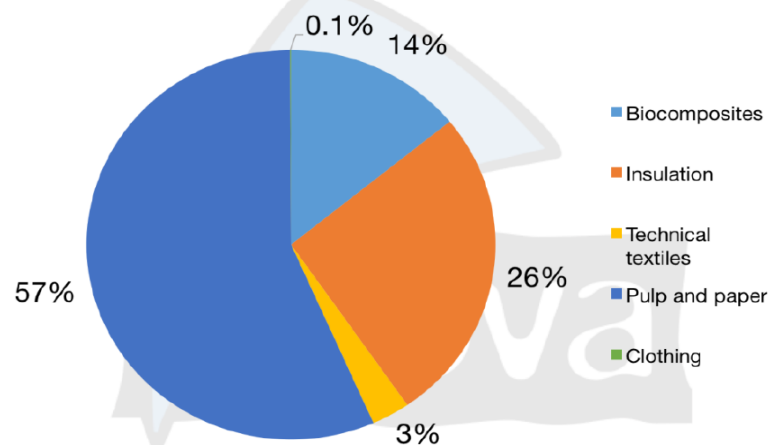


TABLE 2. Mean density of pollen grains/cm²/day over the 3 week main pollen period with respect to field position

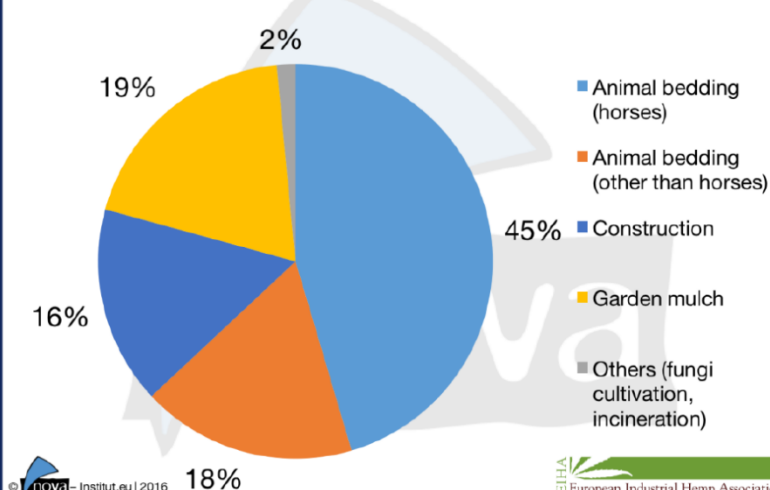
Hemp fibres 2013, total: 25,000 tonnes



© nova-Institut.eu | 2016

EHHA European Industrial Hemp Association

Hemp shivs 2013, total: 43,000 tonnes

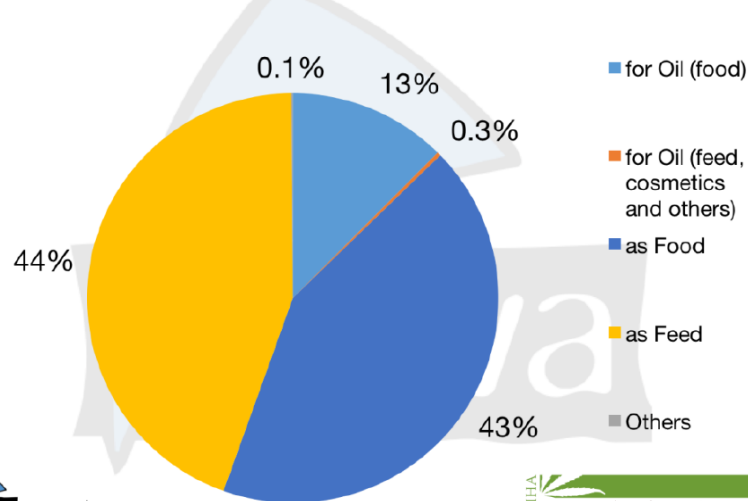


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EHHA European Industrial Hemp Association

Hemp Uses in Europe: 2013

Hemp seeds 2013, total: 11,500 tonnes



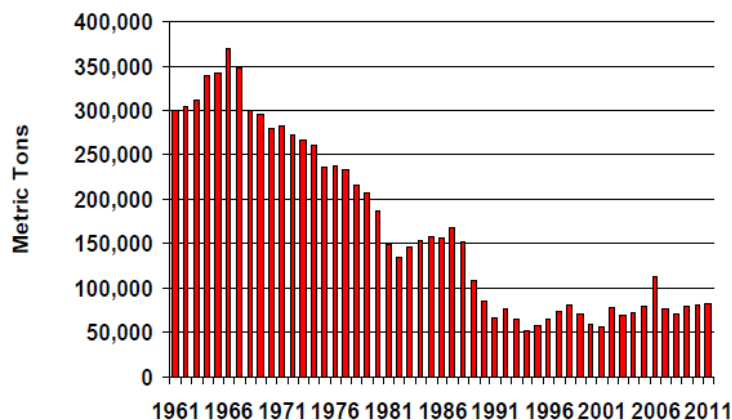
© nova-Institut.eu | 2016

EHHA European Industrial Hemp Association

Carus, M. 2017. The European Hemp Industry: Cultivation, processing and applications for fibres, shivs, seeds and flowers. European Industrial Hemp Association.

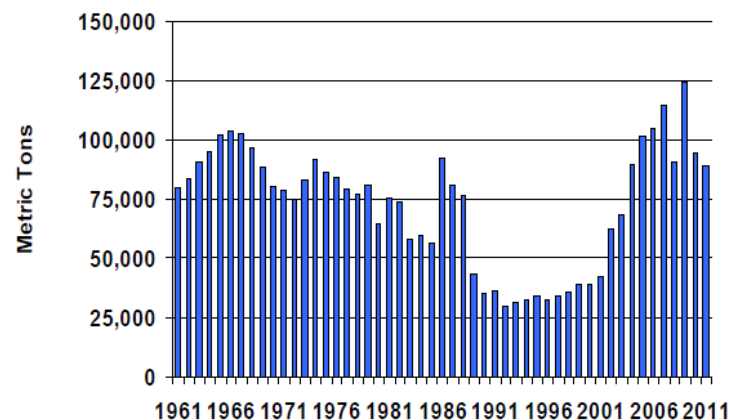
Hemp Economics: Global Production

Figure 2: World Hemp Fiber Production



Source: FAOSTAT

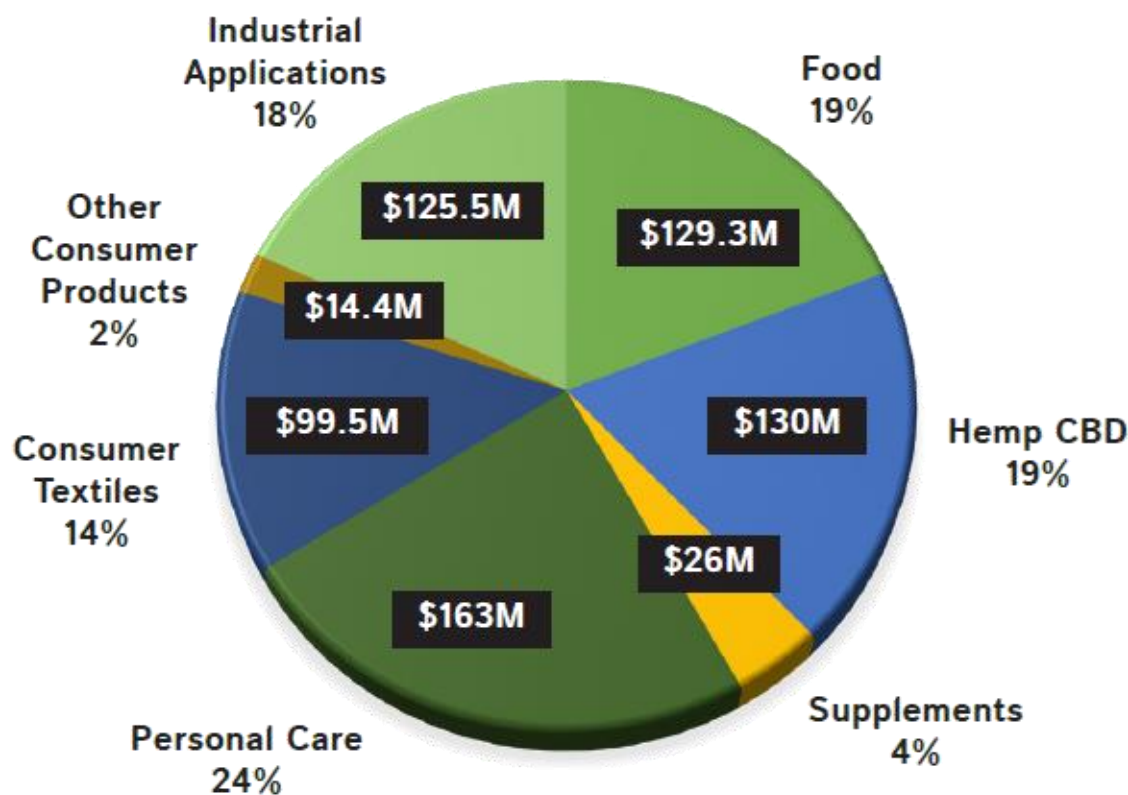
Figure 3: World Hemp Seed Production



Source: FAOSTAT

Hemp Economics: Global Market

Figure 2. 2016 Industrial Hemp Sales by Market Channel¹⁴



Hemp Business Journal and Vote Hemp (consumer sales)

Hemp Economics: Profitability

Net Hemp Returns/Acre (does not include land cost)
\$75/ton Fiber and \$.70/lb Seed

Production System	Low Productivity	Medium-Low Productivity	Medium-High Productivity	High Productivity
Fiber Only	-\$167	-\$149	-\$130	-\$112
Dual System (fiber plus seed)	\$42	\$125	\$208	\$290
Seed Only	\$119	\$217	\$315	\$412

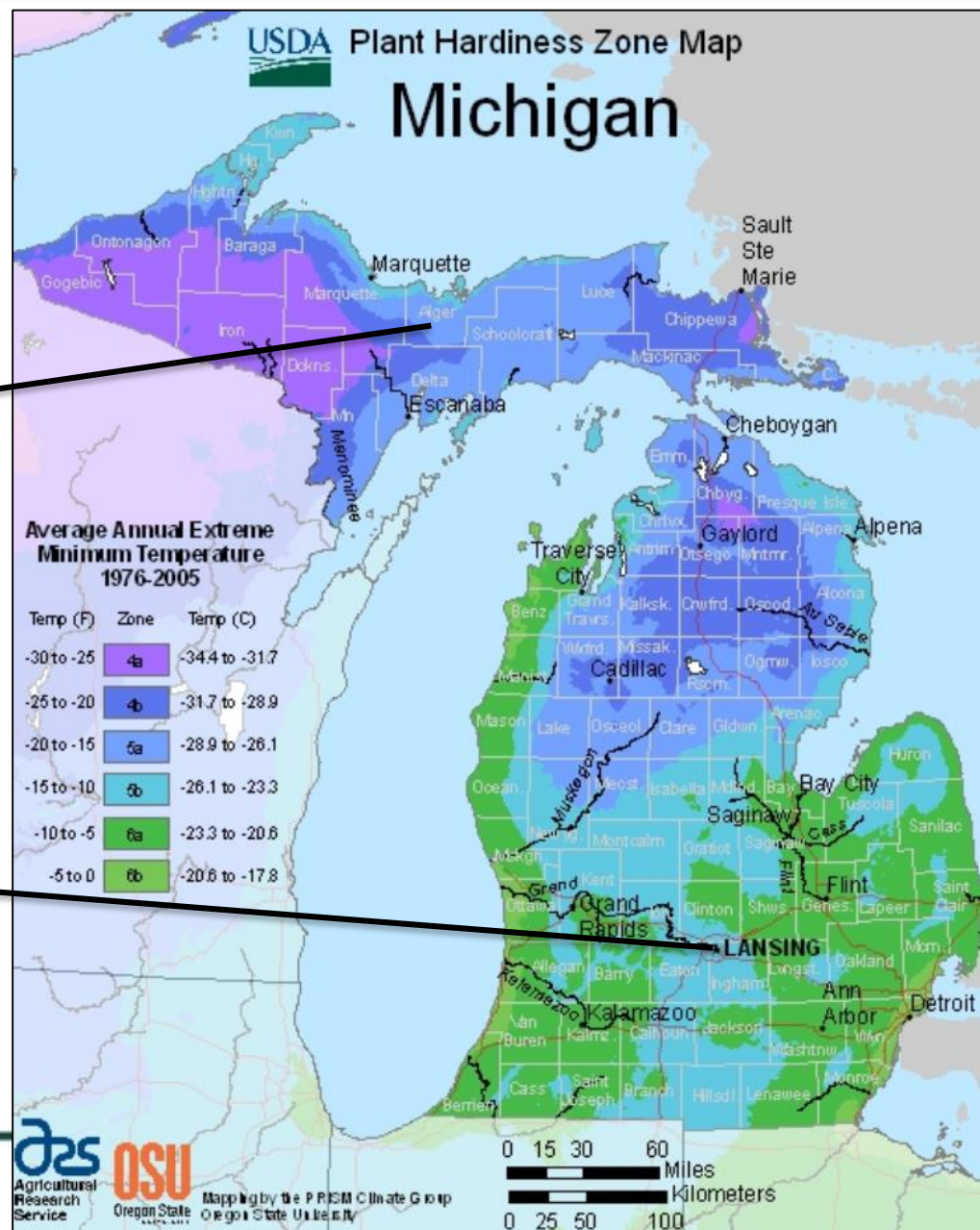
Notes: Costs include labor and depreciation/overhead but not land costs. \$3.50/gal fuel; N, P, and K at \$.50/unit; 50 miles one-way trucking to market.

CBD producers should budget using a price of \$1 / %CBD / pound


Trial Locations

MSU UPREC
Chatham, MI
46.35 N, -86.93 W

MSU Campus
East Lansing, MI
42.73 N, -84.48 W



Materials & Methods

- Nine Canadian grain/fiber varieties from three companies, 103-125 days to maturity
 - 1,500 lbs/acre of 10-0-4 poultry litter & 321 lbs/acre of 0-0-22 Kmag applied pre-plant based on soil test
 - Planted June 14th at 45 lbs/acre on certified organic site
 - RCBD with 4 reps, plots 4' X 16' and 7 in. row spacing
 - Hoed once July 1st for weed control
 - Male flowers clipped, followed by pulling of male plants from dioicous variety plots
 - Harvested Sept. 5th (dioicous) & Sept. 12th (monoicous)
- 

Varieties & Early Observations

Variety	Use	Habit	Maturity	Stand Est.	Stand Density (plants/m ²)	Flowering Date	Height at Flowering (cm)
CFX-2	Grain	Dioicous	103 days	10.28%	47.48	7/12/19	81.48
CFX-1	Grain	Dioicous	105 days	8.64%	39.53	7/12/19	81.92
Grandi	Grain	Dioicous	110 days	13.95%	64.59	7/12/19	81.74
Katani	Grain	Dioicous	110 days	13.68%	62.24	7/11/19	81.99
Piccolo	Grain	Dioicous	110 days	7.65%	35.32	7/11/19	71.32
X-59	Grain & Fiber	Dioicous	110 days	2.79%	12.83	7/14/19	93.27
Anka	Grain & Fiber	Monoicous	110 days	11.71%	53.24	7/20/19	139.90
USO 31	Grain	Monoicous	125 days	10.81%	49.83	7/23/19	137.92
Fermion	Grain	Monoicous	125 days	8.68%	39.95	7/30/19	164.34

Growth & Development



Pests & Disease



Pests & Disease



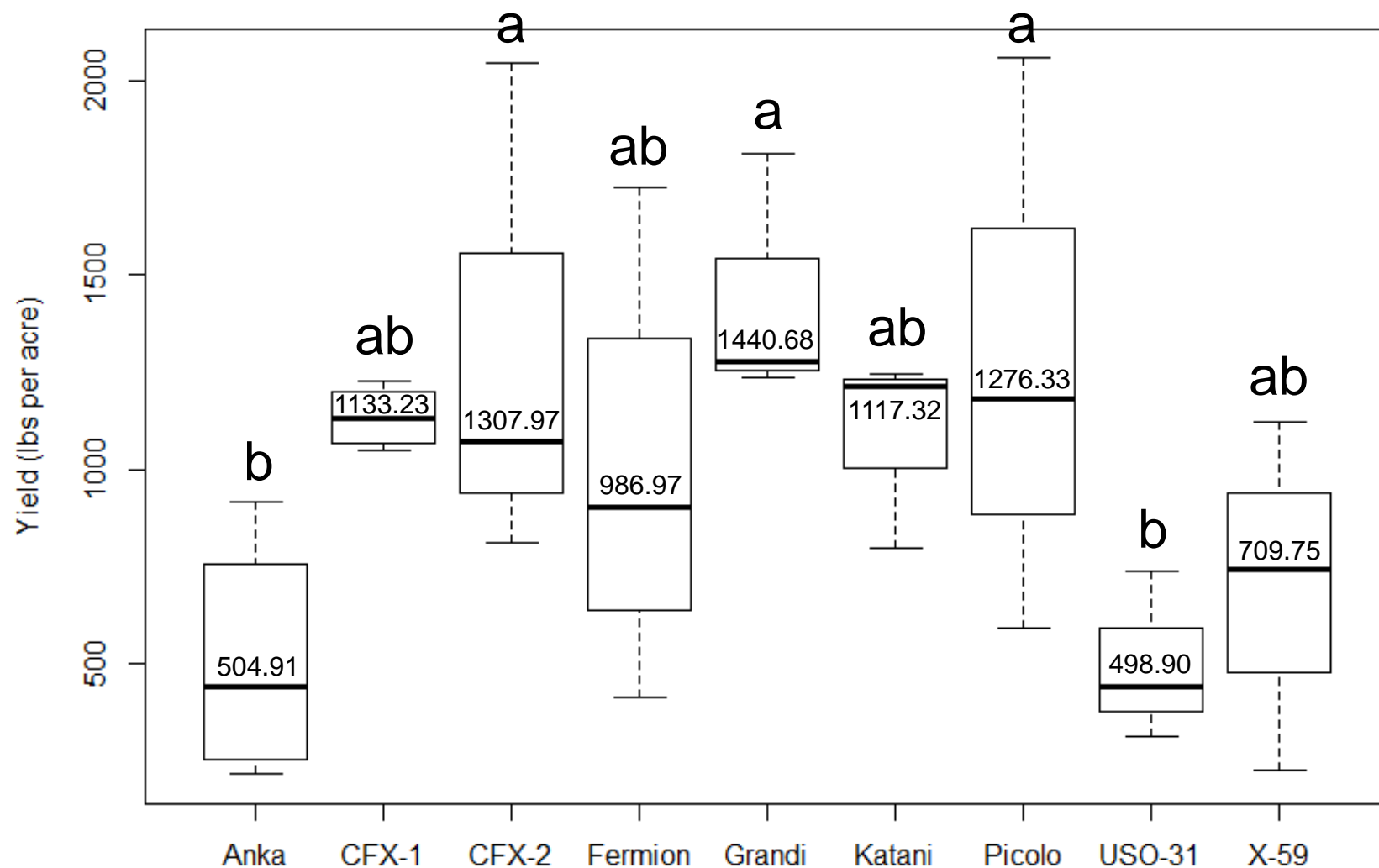
THC Analysis Results

Variety	Total THC	CBD	Variety	Total THC	CBD
CFX-2	0.10%	1.30%	X-59	0.04%	0.90%
CFX-1	0.10%	1.50%	Anka	0.10%	1.20%
Grandi	0.10%	1.50%	USO 31	n.d.	0.40%
Katani	0.20%	0.50%	Fermion	0.09%	2.00%
Piccolo	0.10%	1.70%			

Yield Sampling & Results

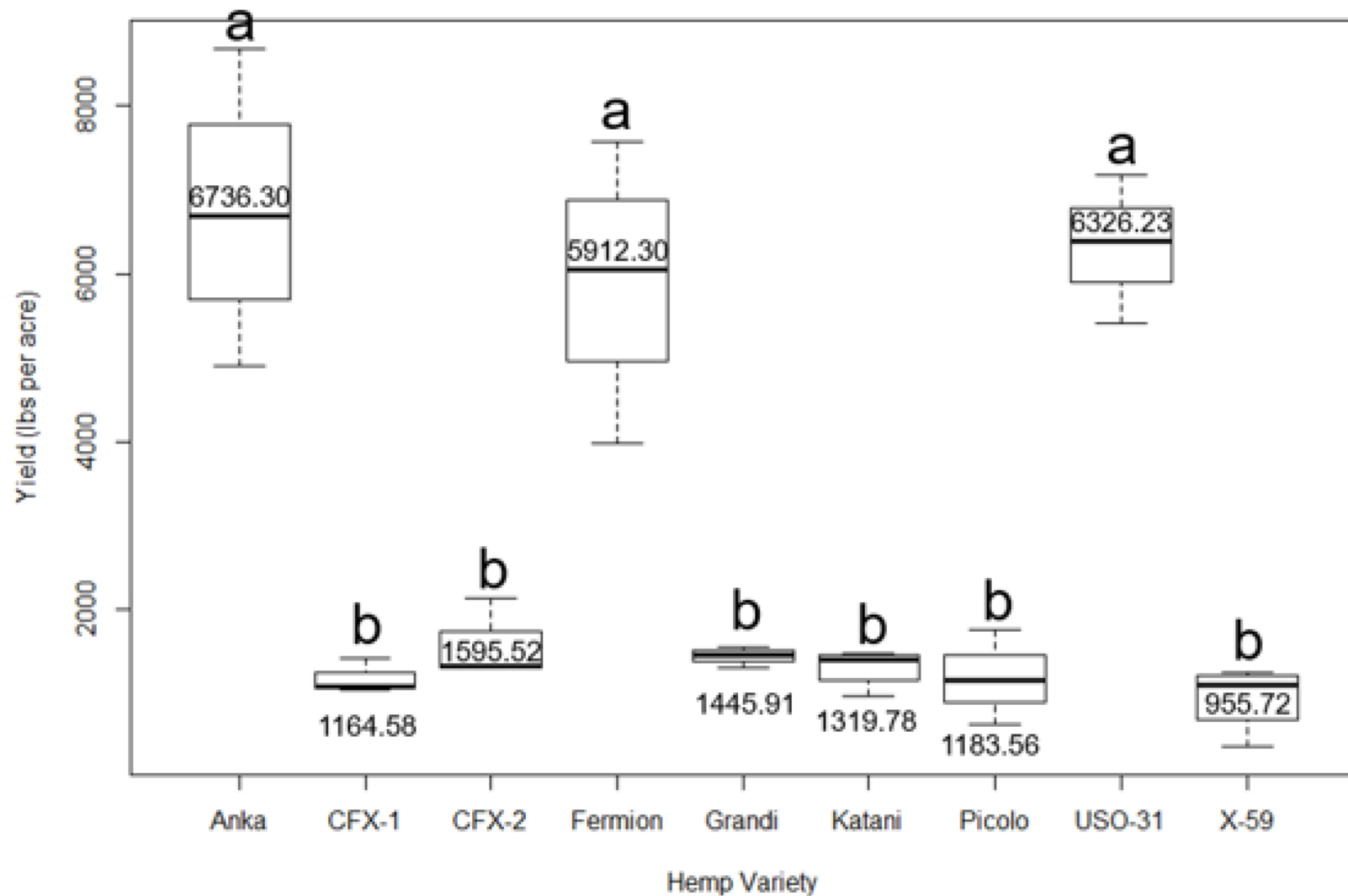


Hemp Grain Yield by Variety



$$R^2 = 0.51, F_{11,20} = 3.89, P = 0.004$$

Hemp Fiber Yield by Variety



$R^2 = 0.93$, $F_{11,20} = 37.8$, $P < 0.001$

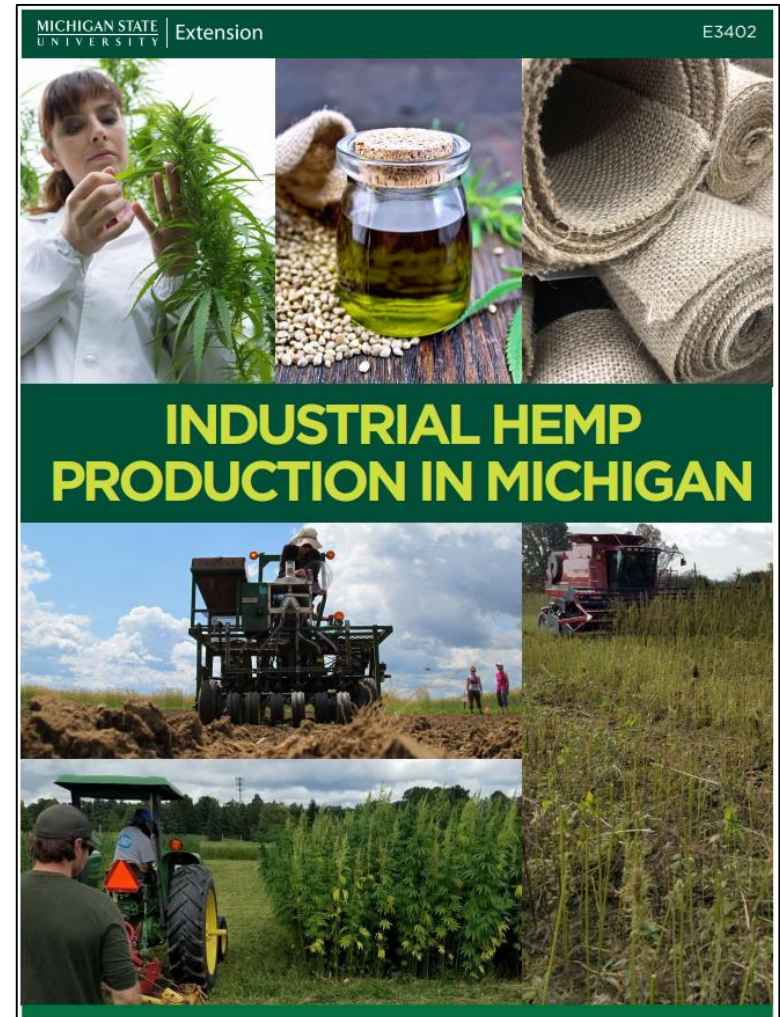
Discussion

- Difficulty of establishment
- Flowering 3-5 weeks after emergence
- Menagerie of minor pests and disease
- Surprising ability to compete with weeds
- Highest yields from early dioecious HGI varieties
- Cross pollination concerns
 - Communication with other cannabis growers
- Limited knowledge among law enforcement



MSU Hemp Resources

- Many MSU hemp resources available at www.canr.msu.edu/hemp
 - Bulletins
 - Articles
 - Recorded webinars
 - Events



Points of Contact within MSU Extension

Field-based for field crops:



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Thank You!



Questions?

