



**PRODUCTION
CONSIDERATIONS
FOR INDUSTRIAL
HEMP**

Allison Justice, PhD.

The Hemp Mine

What is The Hemp Mine, LLC?

- 40 acre farm
 - *2 locations*
- 2 Sales units
 - *Consumer Products*
 - *Genetics Supplier (Hemp Breeder)*
- Research Plot





- Consumer Products
- 40 acres hemp production
- 2000 retail store locations



Rooting Station - Sales Unit

- Liners and Unrooted cuttings (URCs)
- Production facilitates
 - MI
 - VA
 - NC
 - AL
 - LA
 - TX
- 3 Breeders



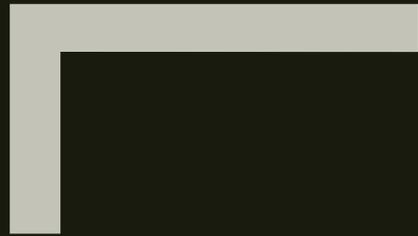
My background

- Grew up on ornamental tree farm
- PhD. Plant Science: Clemson University (Dr. Jim Faust)
- Hope Greenhouses- *Clematis armandii*
- IPM Consulting
- OutCo
- The Hemp Mine & SC Botanicals





OUTCO- SAN DIEGO, CA



OUTCO SAN DIEGO, CA

Vertically Integrated





Today's discussion...

- Learn about hemp
- Learn about extraction & contracting
- Learn about the importance of genetic selection

What is “Industrial” hemp?

- ALL *Cannabis sativa*
- Hemp seed oil, fiber, seed & cannabinoid production (CBD)
- 0.3% or less in THC





PLANT BIOLOGY

Cannabis sativa

- Dioecious- male and female flowers occurring on separate plants. Hemp grown for CBD.
- Monoecious- male and female flowers occurring on the same plant. Hemp grown for seed/fiber.





***Cannabis sativa* (CBD production)**

- *Female flower*
- Photoperiod: Short-day plant
- Can be grown from seed or vegetative cutting



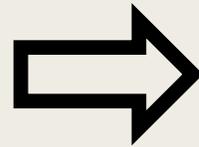
How do we induce flowering?

VEG

Long days: 18+ hours of light



Grown for 3 weeks

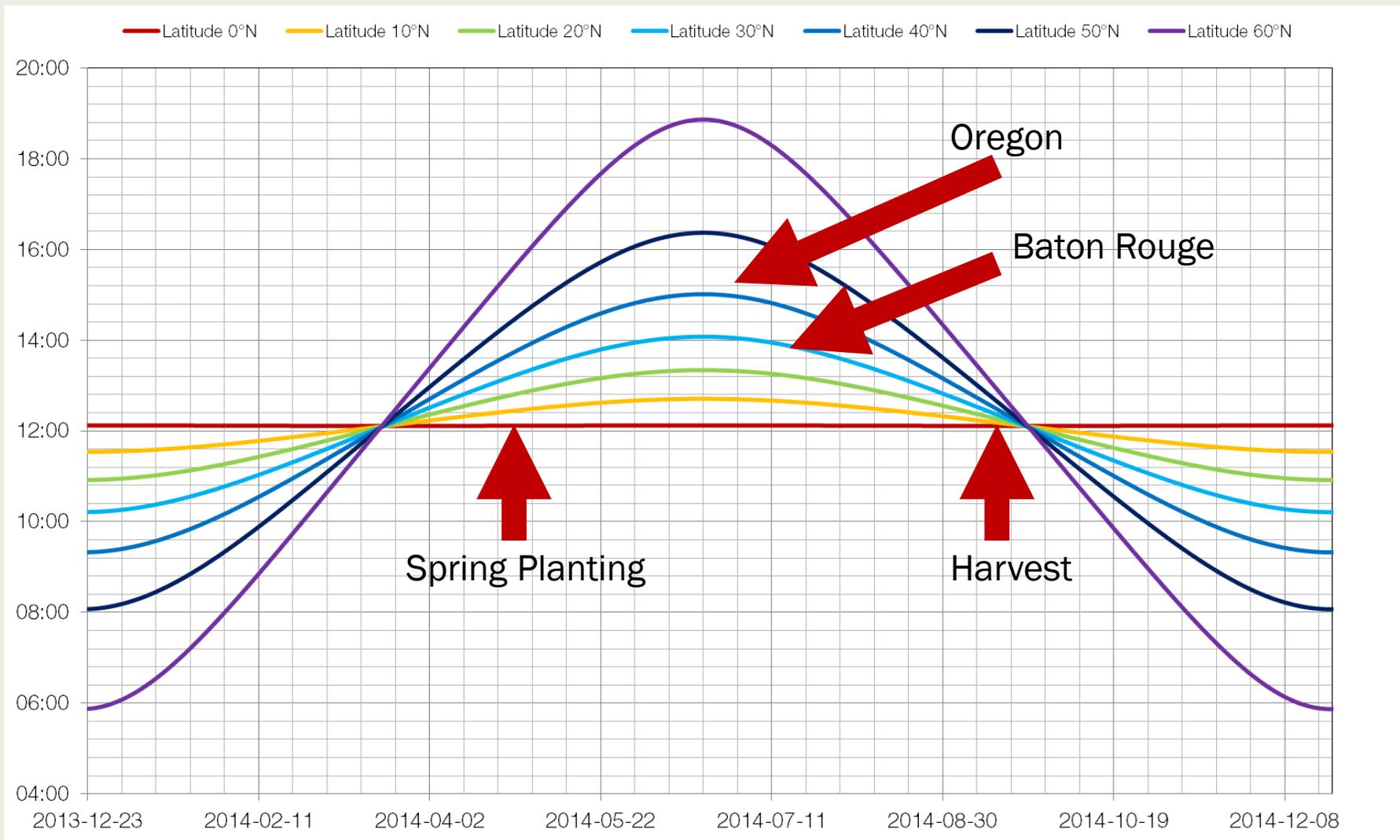


Flower

Short days: Less than 12 hours of light



Grown 8-12 weeks





July 20th



June 13th

PLANTING DATE



“Auto-Flower” “Day-Neutral”

PROS

- More harvests/year

CONS

- Expensive seed
- Low CBD potency
- Low availability
- Smaller plants

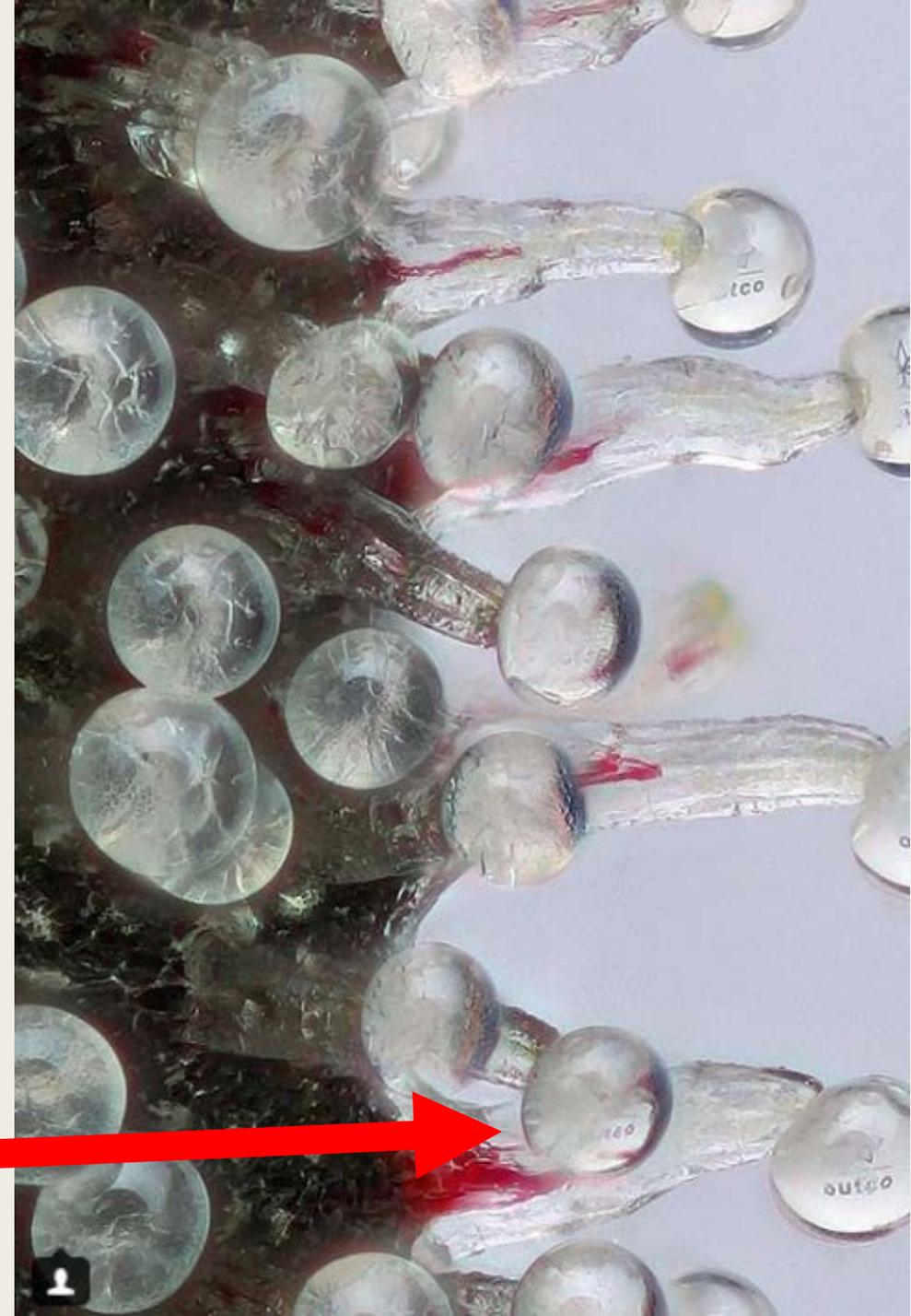


Secondary metabolites

- **Cannabinoids:** Resinous oils produced in trichomes of flowers.
 - *THC and THCA- Tetrahydrocannabinol- psychoactive*
 - *CBD- Cannabidiol*
 - *Over 100 cannabinoids*

Mainly determined by cultivar selection

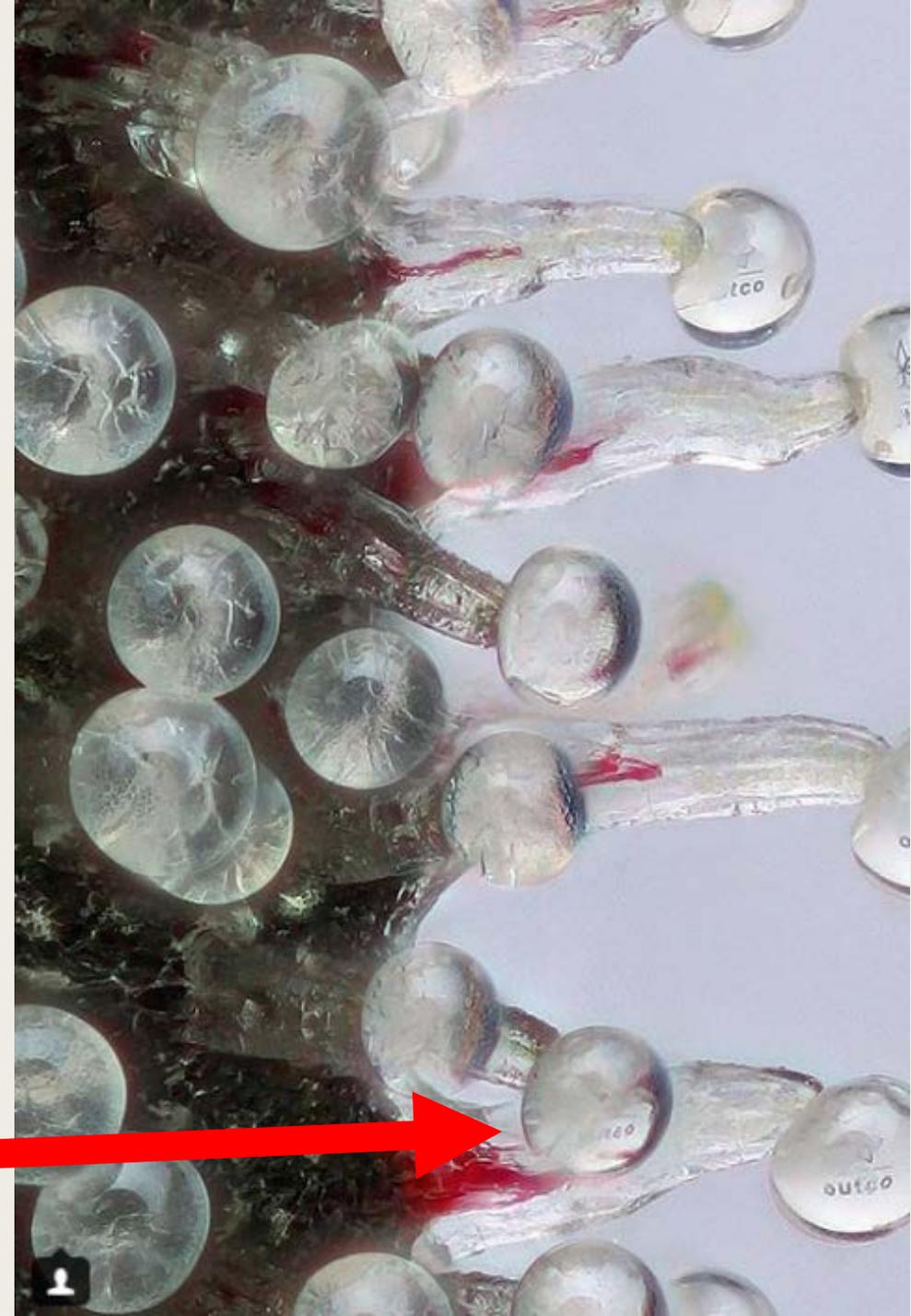
Trichome



Secondary metabolites

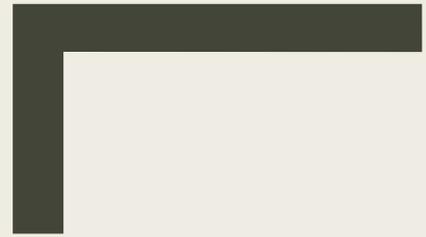
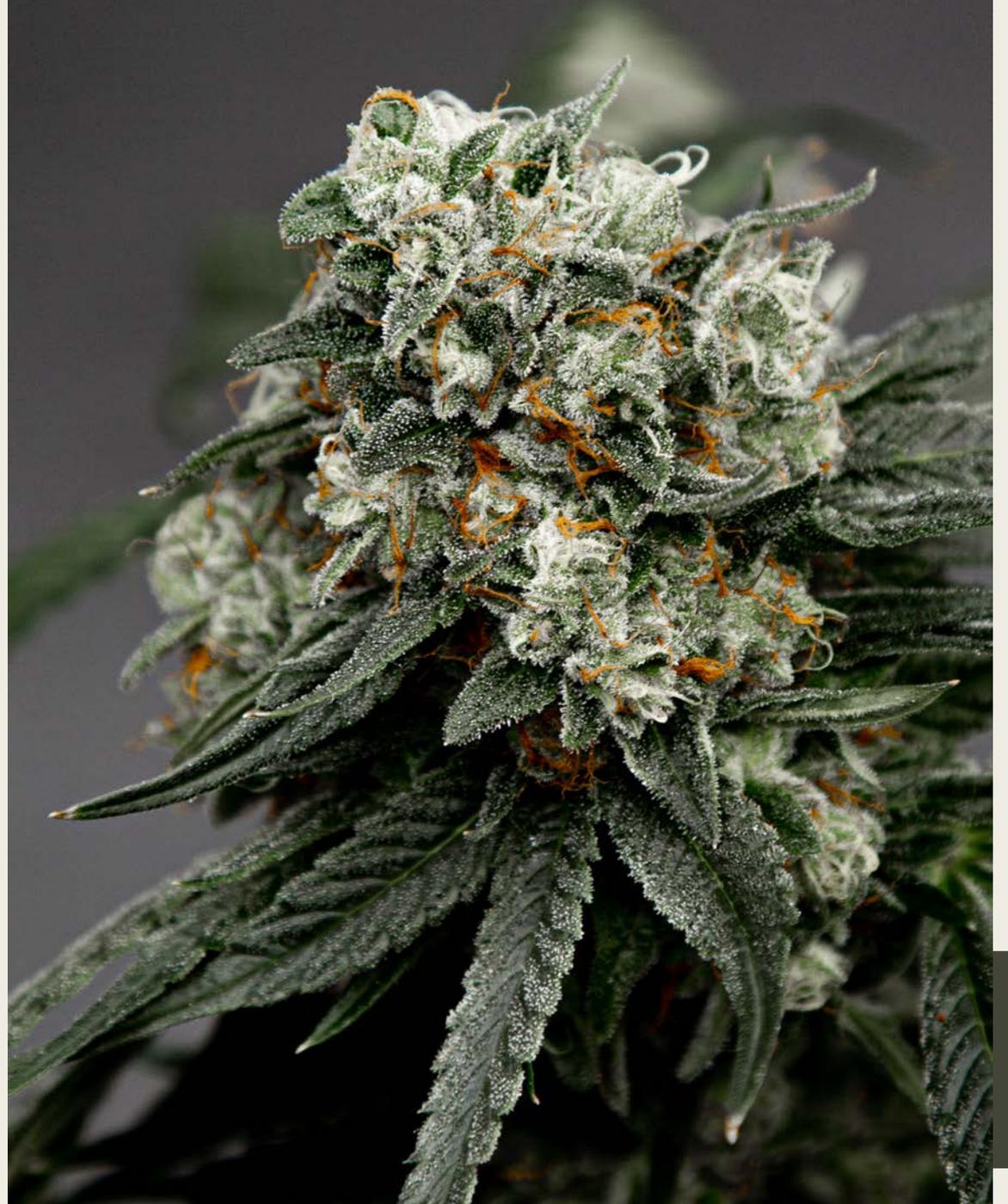
- **Terpenes:** Compounds that attribute to smell
 - *Ex. Limonene, Linalool*
- **Extremely volatile!**
 - *Drying method important*

Trichome



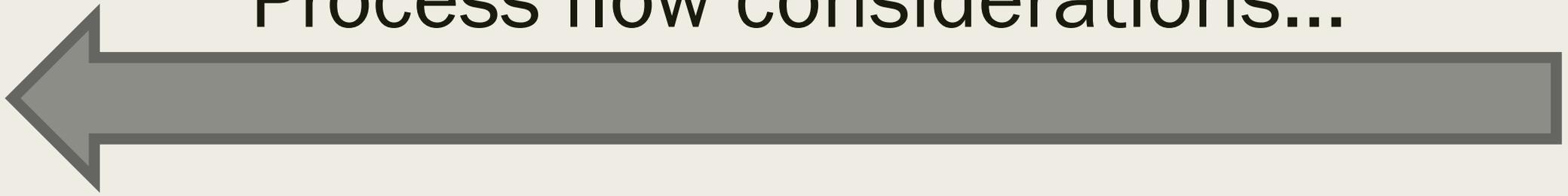


HOW WILL YOU GROW?



CULTIVAR SELECTION

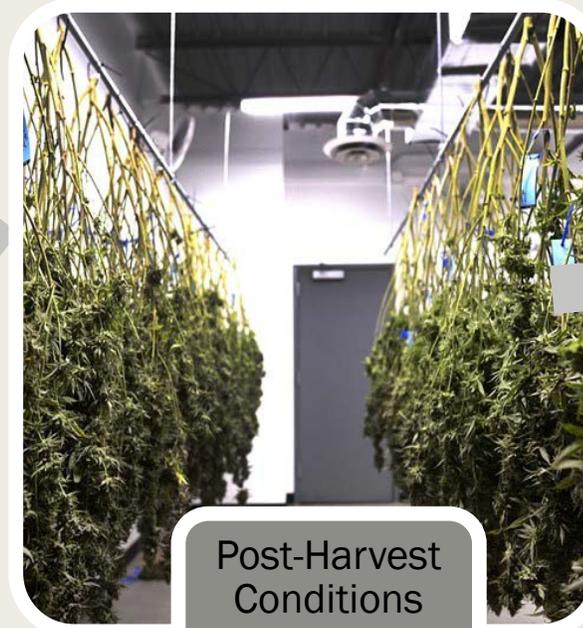
Process flow considerations...



- Finished Product**
- Flower
 - Concentrate



- Extraction Type**
- Solvent
 - Solvent-less
 - None



- Post-Harvest Conditions**
- Slow/low
 - Fast/high
 - None



- Cultivation Practices**
- location
 - cultivar selection



Farmer...

I only want to sell biomass.

More \$ for higher %.

How will you dry?

I want my oil.

More \$ for higher %.

How will you dry?

How will you extract?

HOW DO THEY DETERMINE HOW MUCH YOU GET /Lb.???

OMRI



SAFE

Pesticides

Issues with Genetics

- Confidence in your young plant producer
- Disease resistance/ Pests
- Type of starting genetic
- Regional selection
- Potency/ROI







Diagnosis and Recommendations

Host/Habitat | Hemp (*Cannabis sativa*); Cultivar: Industrial Hemp

Host of *Diagnosis/ID(s)*

Leaf spot (Unidentified Fungus)

Stem girdling (Abiotic disorder)

Final Report

No other diagnosticians from southern states have seen this pathogen, but neither they nor any who responded to my query knew its identity. One person suggested it might actually be *Cercospora* which has similar spores. Others agreed with me that it didn't look like the *Cercospora* species I'm familiar with. Two faculty at other universities are studying this fungus so hopefully I will learn more from one of them. When I find out, I will let you know.

J. Williamson

CERCOSPORA?

Pythium & Fusarium

Diagnosis and Recommendations

Host/Habitat	Hemp (<i>Cannabis sativa</i>); Cultivar: Industrial Hemp
List of Diagnosis/ID(s)	
	Fusarium wilt; Fusarium wilt complex (<i>Fusarium</i> sp./spp.)
	Stem rot (Unidentified Agent)

Final Report

A *Pythium* species was also isolated from discolored streaks within vascular tissue in the stem, but it was at a lower frequency than the *Fusarium* species so it may have been a secondary invader.

Only secondary fungi were detected when outer stem tissue was incubated so it appears that a combination of stem girdling roots and *Fusarium* wilt have caused the decline.

M. Williamson



Common hemp





SOUTHERN BLIGHT



Issues with seed...

- Hermaphrodites
- Variance in phenotypes
 - *Visually*
 - *Harvest time*
 - *Chemotypically*
- Males



IS THIS THE SAME VARIETY?



C



S

REGULAR SEED

	Count/acre	\$/genetic	Total/acre	Male Removal	Plants left/acre	1 lb/plant	Potency	\$1.20%/lb	\$/acre
Seed	2800	\$1.00	\$2,800.00	1400	1400	1400	12%	\$ 14.40	\$ 20,160.00
Liner (Clone)	1800	\$4.00	\$7,200.00	0	1800	1800	12%		\$ 25,920.00
			DIFF						DIFF
			\$4,400.00						\$5,760.00

- Labor in germination?
- Labor in pulling males?
- Lost potency from missed males?
- Lost potency in variance/maturity of phenotypes?

So what are we really permitted with all this math/science from the USDA??



“Dried”

- Average is 8-10% water content
- They do not give a range
- 20%???

This would turn a 0.6% flower into 0.3%.

Water = dilution.

NEW USDA RULING

– *Total THC versus Delta-9 THC*

■ For example:

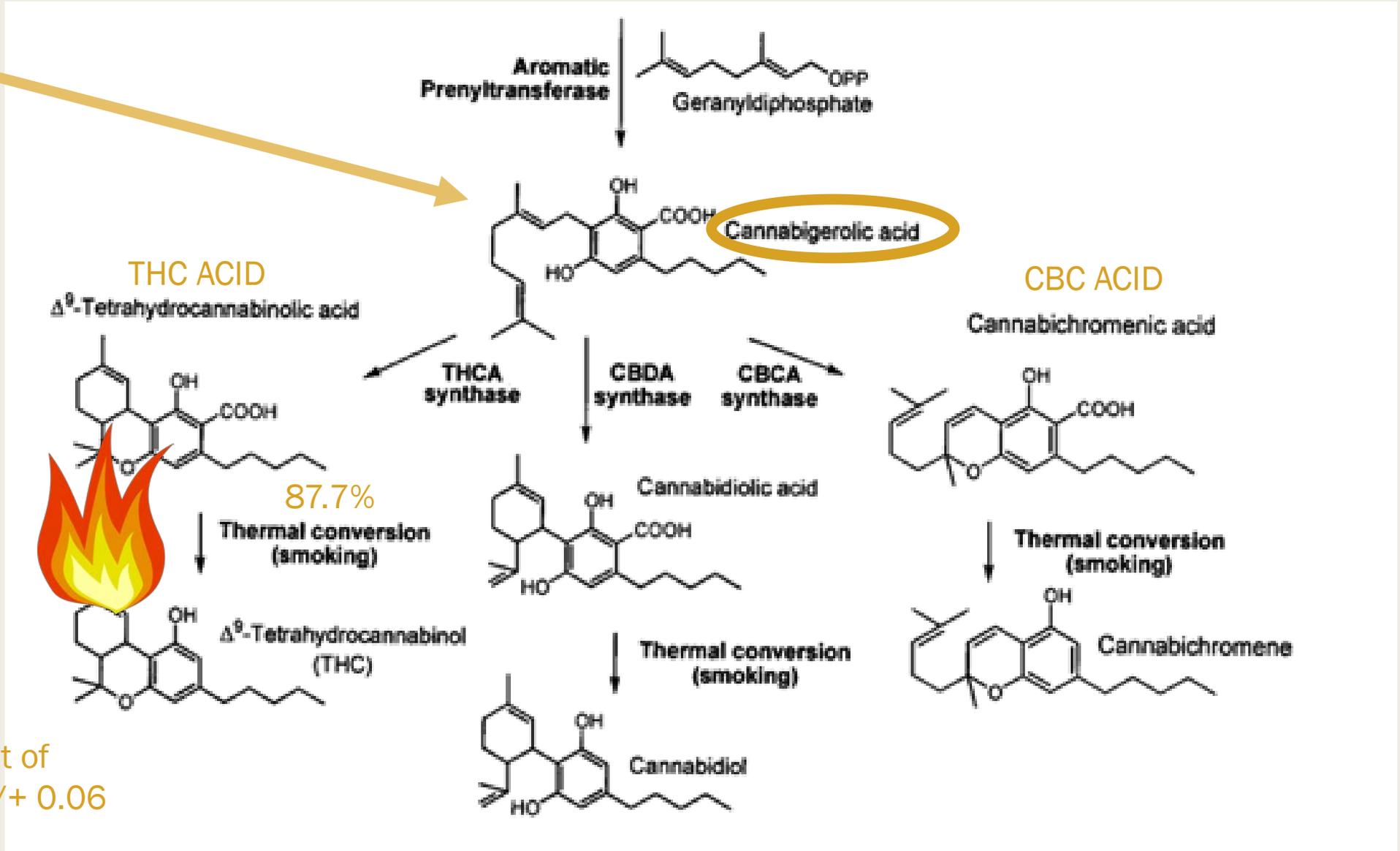
DECARBOXYLATION or “other similar methods”

■ $0.3\% \text{ THC-A} * 87.7\% = 0.2631\%$

Measurement of Uncertainty or + or – 0.06%

■ $0.2631\% + \text{ or } - 0.06\% = 0.3231 \text{ or } 0.2031 \%$

CBG



0.41% THCA



X 87.7%



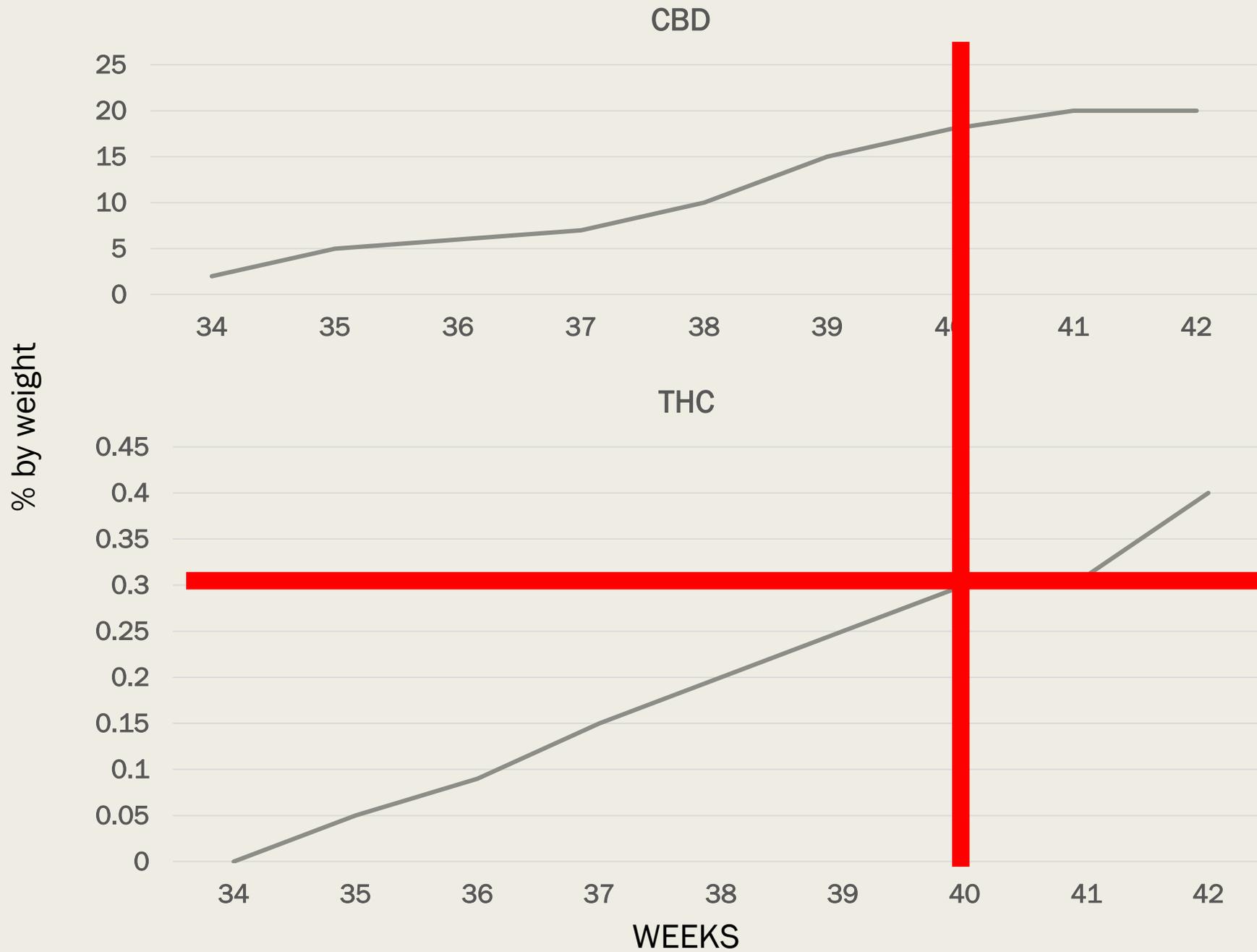
0.3567 % THC

Measurement of
Uncertainty ± 0.06

0.2967 to 0.4167% THC



0.3% THC!!!!!!



Janet's G



Sample: 1909CWBO166.0538

Strain: M.T.0025

Batch#: ; Batch Size: g

Sample Received: 09/20/2019; Report Created: 09/20/2019

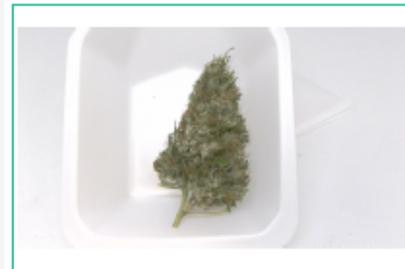
Sampling: ; Environment:

M.T. 0025

Notes:

Plant, Flower - Cured, Other

Harvest Process Lot: ; METRC Batch: ; METRC Sample:



0.15%

$\Delta 9$ THC

0.04%

Total CBD

NT

Moisture

0.28%

Total THC

11.56%

Total
Cannabinoids

Cannabinoids

Complete

Analyte	LOQ	Mass	Mass
	%	%	mg/g
THCa	0.01	0.15	1.5
$\Delta 9$ -THC	0.01	0.15	1.5
$\Delta 8$ -THC	0.01	ND	ND
THCV	0.01	ND	ND
CBDa	0.01	0.04	0.4
CBD	0.01	ND	ND
CBDVa	0.01	ND	ND
CBDV	0.01	0.06	0.6
CBN	0.01	ND	ND
CBGa	0.01	10.96	109.6
CBG	0.01	0.17	1.7
CBC	0.01	0.02	0.2
Total		11.56	115.6

Total THC = THCa * 0.877 + $\Delta 9$ -THC; Total CBD = CBDa * 0.877 + CBD; Total Cannabinoids = Sum of quantifiable cannabinoids
LOQ = Limit of Quantitation; ND = Not Detected; The reported result is based on a sample weight with the applicable moisture content for that sample; Unless otherwise stated all quality control samples performed within specifications established by the Laboratory.

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Cost/ROI

Assumptions	
g/lb	453
Plants/acre	1800
\$/%point of biomass	\$3.50
Flower Potency: CBD%	7 -21%
lb. flower/acres	1800
# of acres	5
Cost/acre	Total Costs
\$10,000.00	\$50,000.00

Assumptions	
g/lb	453
Plants/acre	1800
\$/%point of biomass	\$3.50
Flower Potency: CBD%	16%
lb. flower/acres	1800
# of acres	5
Gross Revenue/acre	Total Gross Revnue/5 acre
\$100,800.00	\$504,000.00
Gross Profit	\$418,000.00

Genetic Selection					
Plant Parental Material	Price Per	Cost/acre	Potency/CBD%	Gross Revnue	Gross Profit
Seed	\$1.00	\$1,800.00	8	\$50,400.00	\$38,600.00
Liner (Clone)	\$4.00	\$7,200.00	16	\$100,800.00	\$83,600.00
	Difference	\$5,400.00	8	\$50,400.00	\$45,000.00

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QUESTIONS??



Picture references upon request