

Industrial Hemp: An Emerging Crop in Connecticut

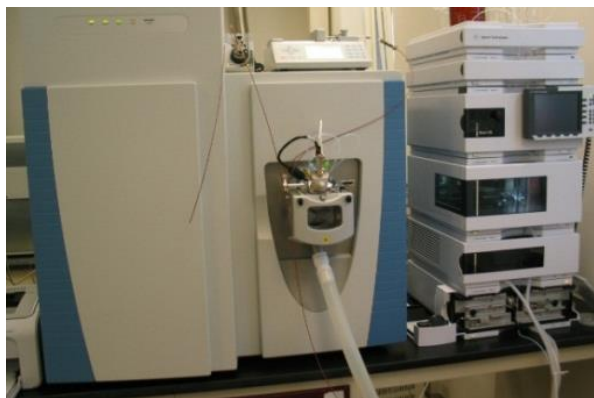
Ms. Terri Arsenault and Dr. Walter Krol

The Department of Analytical Chemistry
The Connecticut Agricultural Experiment Station
New Haven, CT



The Connecticut Agricultural Experiment Station Analytical Chemistry Department

Accredited to ISO 17025 by A2LA since 2016
Pesticide Residues, Aflatoxins and Arsenic in Food

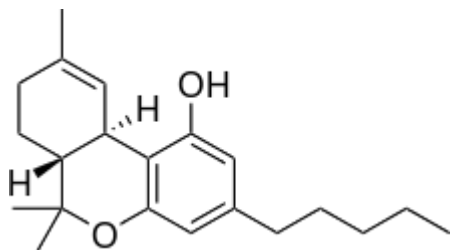


Testing THC and CBD was brought under the scope of accreditation in January of 2021

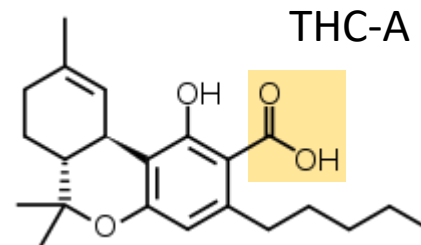
Agricultural Improvement Act 2018 Definitions

1. Sec. 297A Definitions – “HEMP.—The term ‘hemp’ means the plant *Cannabis sativa* L. and ***any part of that plant***, including the seeds thereof and all derivatives, extracts, cannabinoids, isomers, acids, salts, and salts of isomers, whether growing or not, with a ***delta9 tetrahydrocannabinol*** concentration of not more than 0.3 percent on a ***dry weight basis***.”
2. Sec. 297B. State and Tribal Plans requires: “a procedure for testing, using ***postdecarboxylation*** or other similarly reliable methods, delta-9 tetrahydrocannabinol concentration levels of hemp produced in the State or territory of the Indian tribe”
3. Two critical points for testing:
 1. Analysis of THC includes THC-A
 2. Dry weight is not defined
4. Our lab decided to test total delta-9 THC using gas chromatography with flame ionization detection. Testing is quick and easy providing total THC in one step. Testing includes analysis for CBD that includes CBD-A

Method Considerations



THC



THC-A

- Quick turn around
 - Only two weeks from sample to harvest
- Total Delta-9 THC for compliance with farm bill
 - Includes THC-A (new for 2018)
 - CBD testing is not needed for compliance
- Report specifies “pass” if $<0.3\%$, or “fail” if $>0.3\%$
 - Decision includes the measurement uncertainty
 - New USDA guidance states MU *must* be on the report
- Measurement Traceability
 - Is the lab getting the same result regardless of time or analyst?
 - Is the lab getting the same result as other labs?

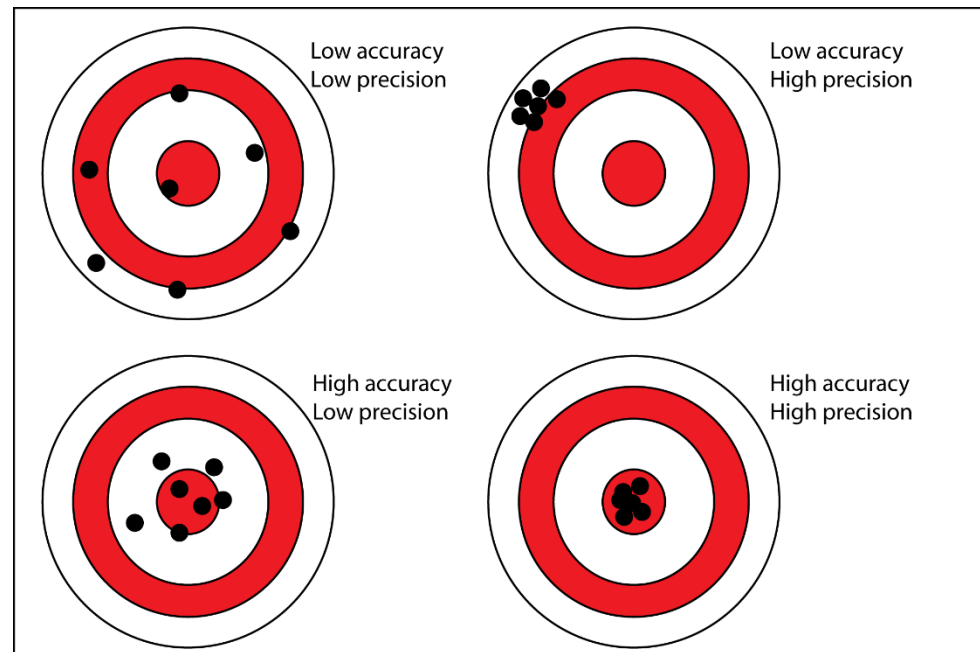


ISO/IEC 17025

Measurement Uncertainty Affected by both Accuracy and Precision

Accuracy: How close a measurement is to the true value

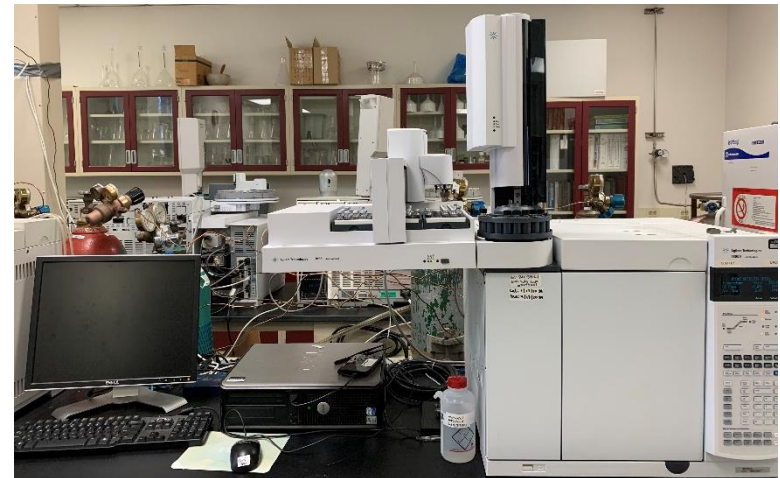
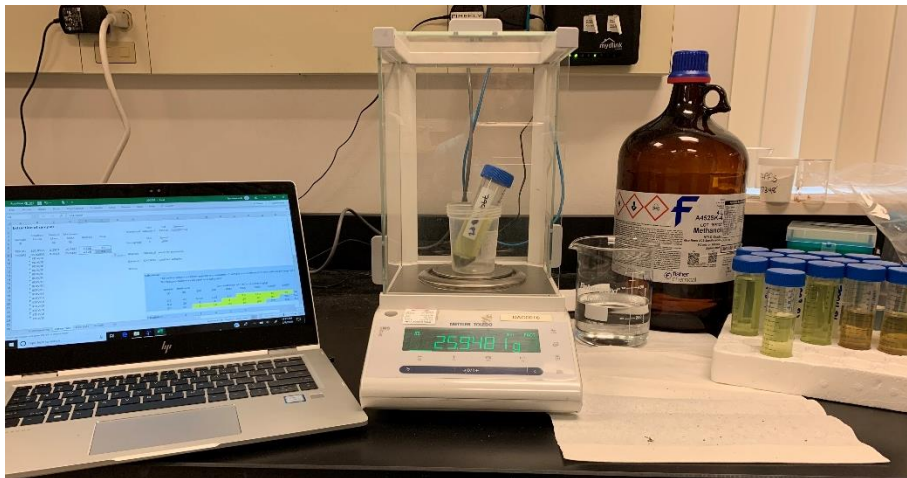
Precision: How close two or more measurements are to each other



Overview of Testing



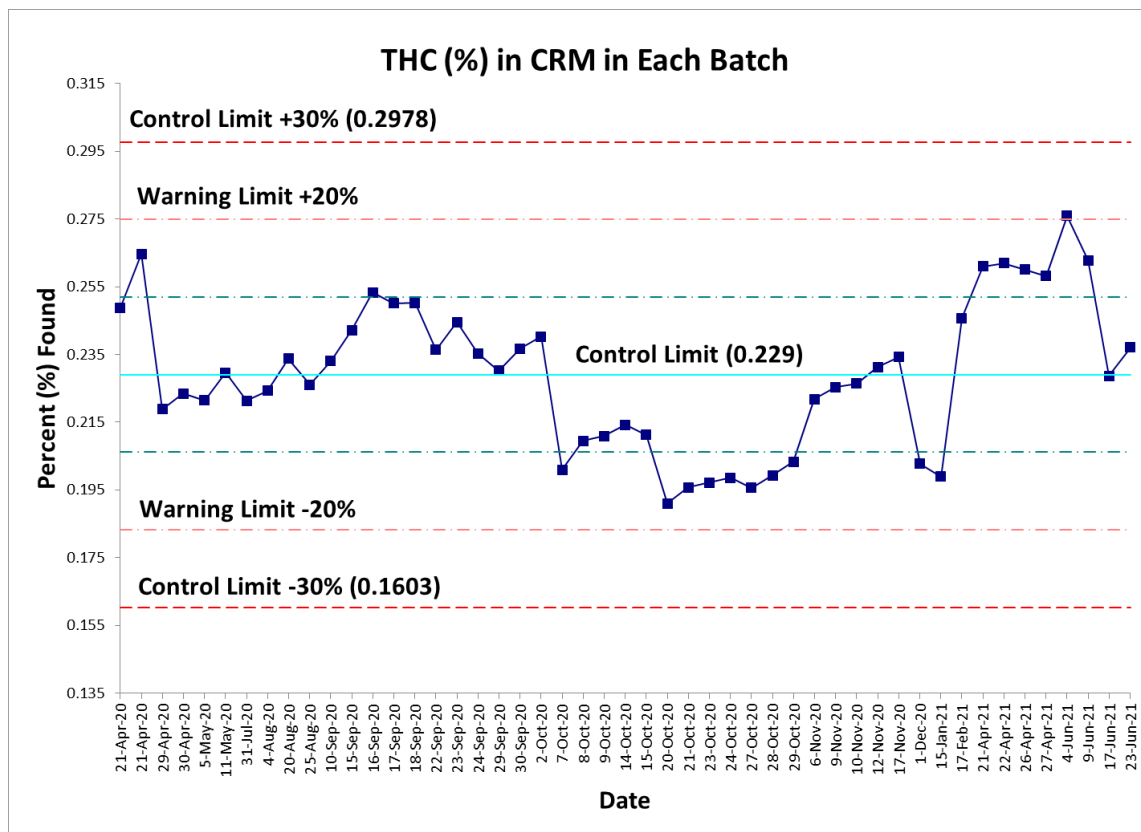
Dry sample overnight in oven at 90 °C - Sieve
Extract 0.2 grams of sample into 25 grams of methanol
Inject Gas Chromatograph-Flame Ionization Detector
Run time is 10 minutes



Quality Control (Every Batch)



THC CRM = 0.193%
lab value = 0.22%
(114% of True)



- Certified Reference Material with each daily run
- Blank (parsley) with each daily run
- Samples run in duplicate
- Successful completion of Proficiency Testing



Lockwood Farm Plot-2020

- Grew eight varieties:
 - *Abacus 2.0, Abacus Early Bird, Abacus Early Bird 2.0, Cherry Abacus, Cherry Abacus 2.0 and Spec 7*
 - *Non-feminized seed - Youngsim10 lot “2018WFS1” and Youngsim10 lot “2018WFS17A”*
- Started from seed in greenhouse, planted in field on June 25, 2020
- 8 Rows spaced 5 feet apart, plants spaced 4 feet apart
- Used black plastic to control weeds within the rows and hose irrigation under the plastic

June 25, 2020



July 24, 2020



August 26, 2020



September 9, 2020



September 16, 2020



September 30, 2020



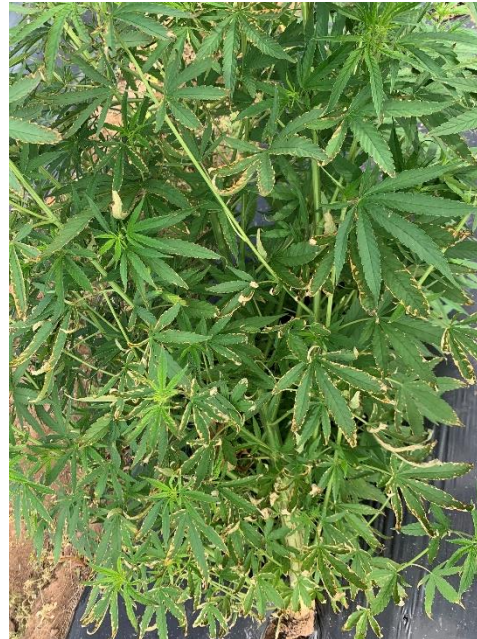
Storm Isaias Damage August 6, 2019

July 24, 2020

Abacus Early Bird



Youngsim 10



Insect Damage



Explosion of
Corn Ear Worm
(Sept. 9, 2020)



Some Damage from
Corn Borer

Summary of Growing Experience

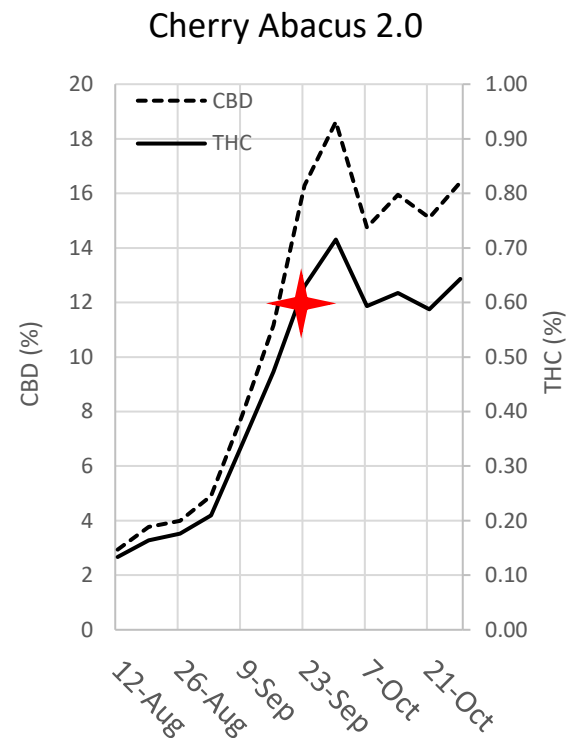
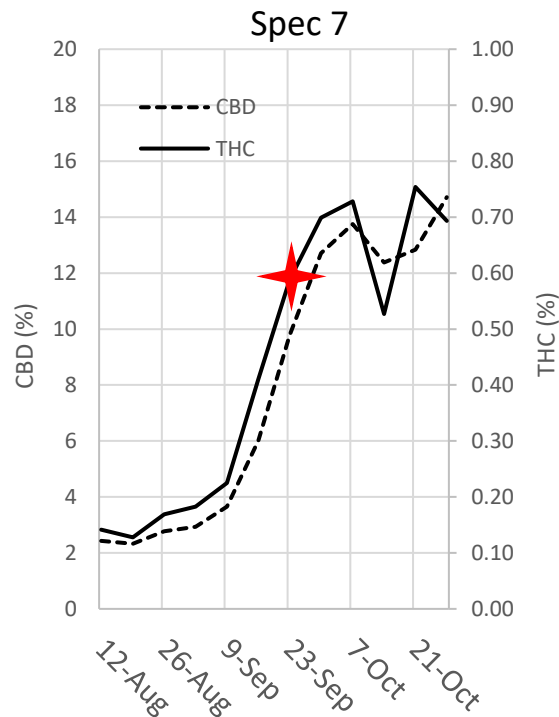
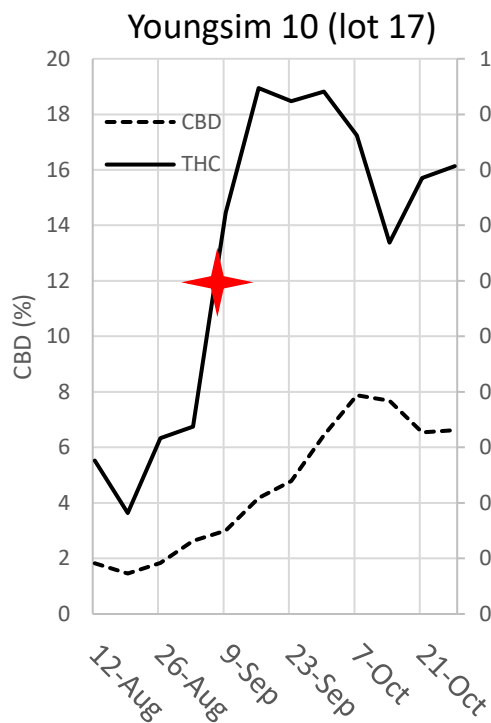
- Removing male plants is a LOT of work and requires checking every few days from mid July until about mid to late August. Highly recommend feminized seed.
- All varieties were variable in the way they looked and the timing of bloom and full maturity
- There was damage from corn borer, corn ear worm, wind, root rot (stunted plants), and possibly some viral damage (curled leaves)
- The buds are very sticky and have a *strong odor*


Testing for THC and CBD

- Weekly testing of all eight varieties from August 12 until October 26
- Tested for Total THC and Total CBD using Gas Chromatography with flame ionization detection
- Tested individual plants (two pairs) of different levels of maturity as noted on August 12
- Tested all plants of three varieties on the same day

Weekly Testing of Each Variety

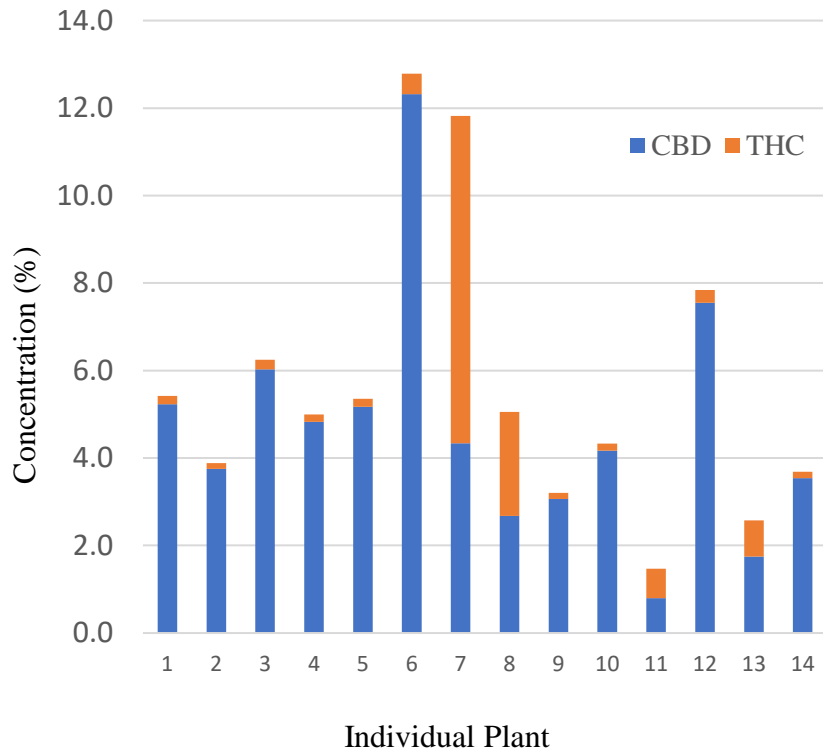
August 12 until October 28, 2020



- The increase in THC and CBD is rapid (one to two weeks)
-  THC exceeded the legal limit when fully mature (50% MU)
- Growers may need harvest early to prevent embargo/loss of crop

Testing Every Plant

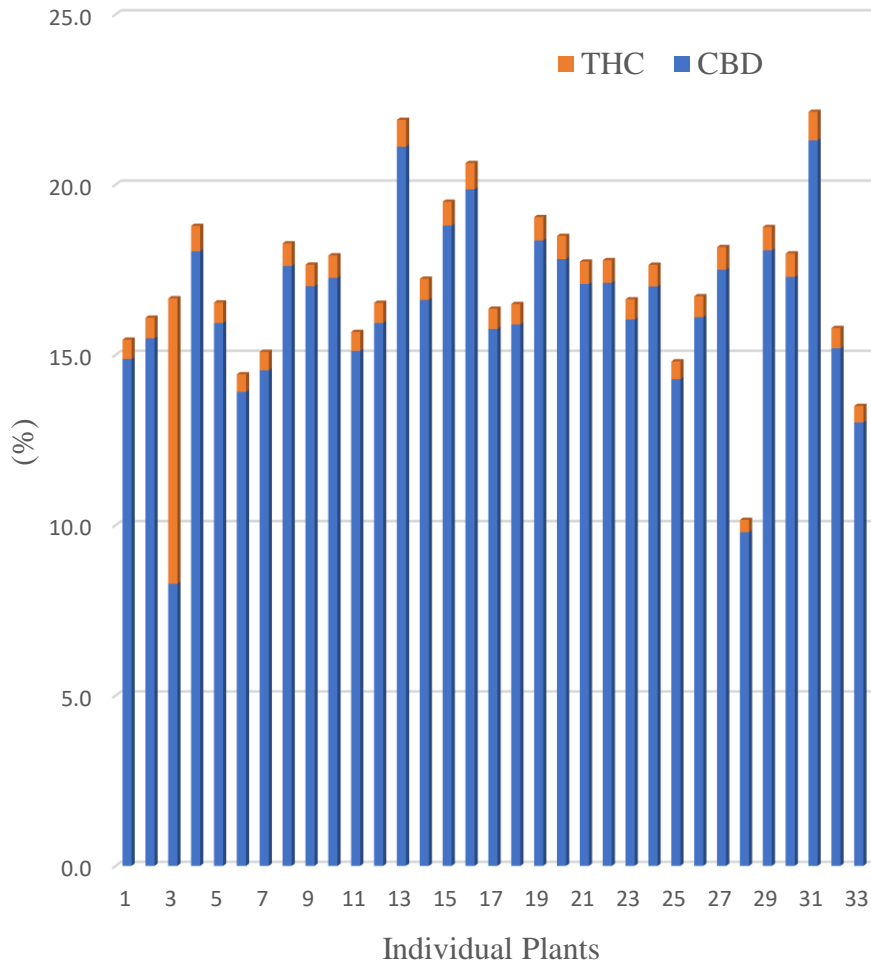
Youngsim 10 (lot 17) collected September 23, 2020



- A LOT of variability between plants of the same variety
- Range CBD: 0.79% to 12.3%
- Range THC: 0.14% to 7.48%
- Range THC/CBD: 1.48% to 12.8%

Testing Every Plant

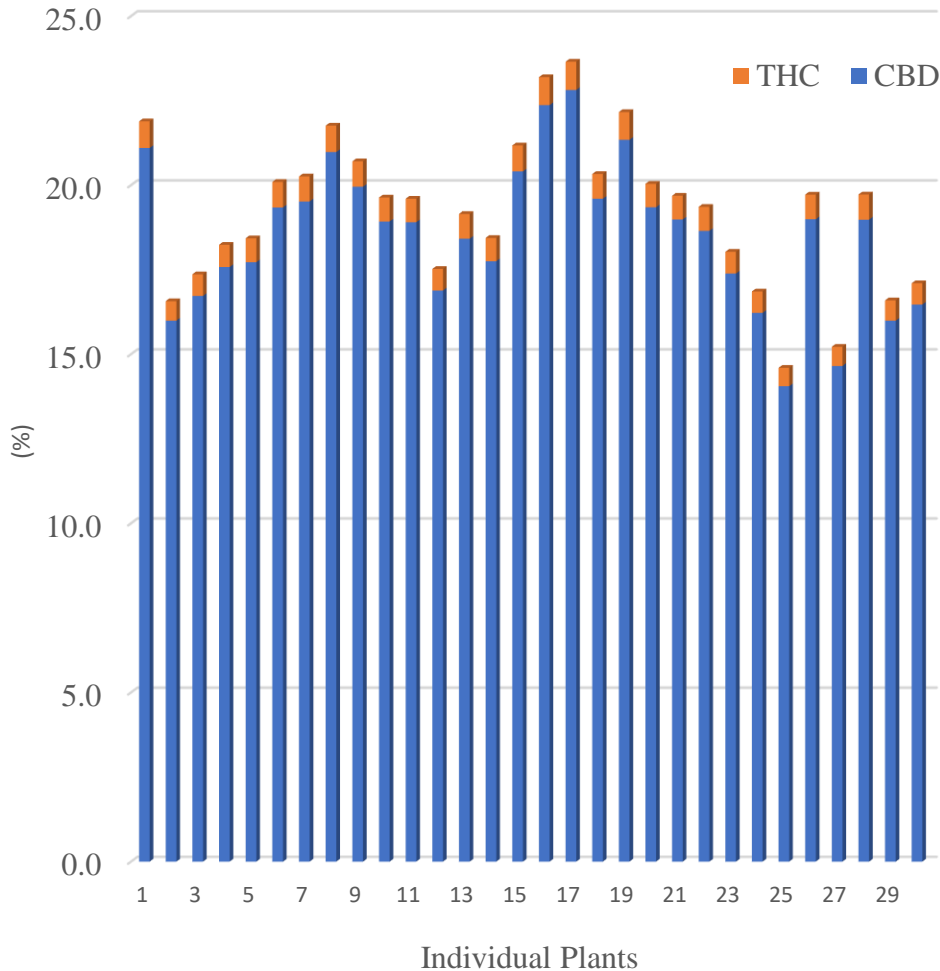
Spec 7 collected October 14, 2020



- Range CBD: 8.28% to 21.3%
- Range THC: 0.36% to 8.38%
- Range THC/CBD: 10.2% to 22.1%

Testing Every Plant

Cherry Abacus 2.0 collected October 22, 2020



- Range CBD: 14.1% to 22.8%
- Range THC: 0.54% to 0.84%
- Range THC/CBD: 16.8% to 23.2%

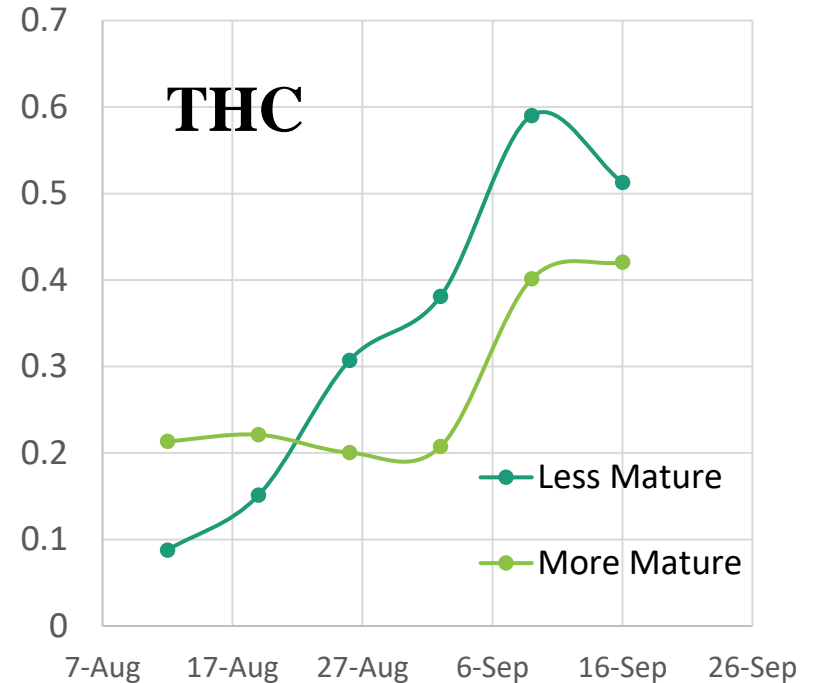
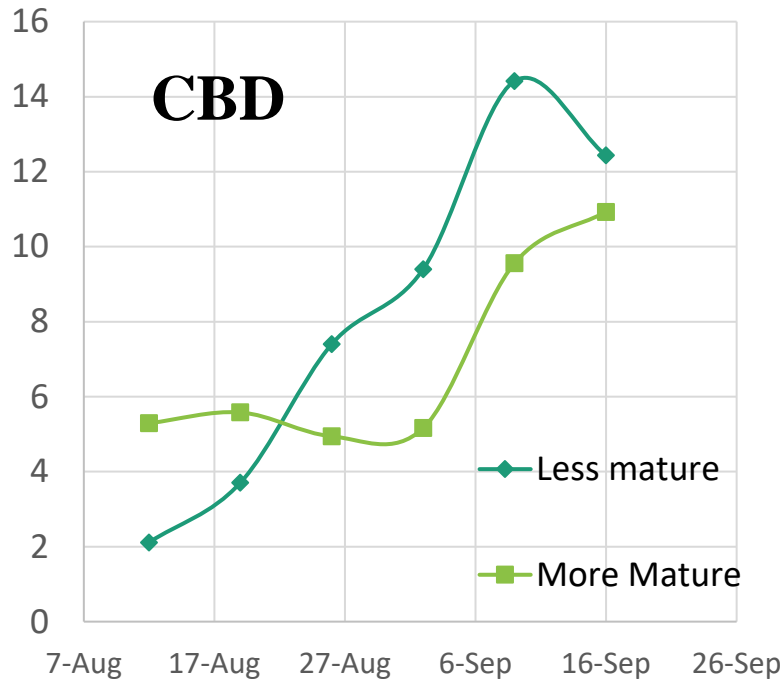
August 12, 2020

Difference in Level of Maturity-Abacus 2.0
(THC/CBD from terminus of three branches)



	THC	CBD
No Buds	0.09%	2.1%
Buds	0.21%	5.3%

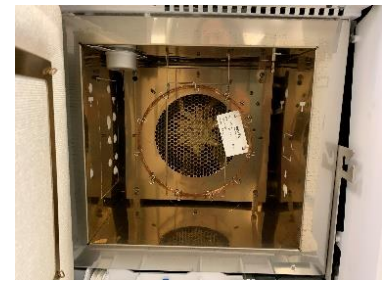
Abacus 2.0 - THC and CBD Levels



- Flower buds appear at different times for the same variety
- Early maturity does not equal more CBD production



Conclusions



- Gas Chromatography with flame ionization detection is a robust method for analysis of total Delta-9 THC
 - Quick sample run time, robust and reliable
 - Virtually no maintenance on the instrument, no down time
- CBD and THC began to spike around the beginning of September
 - Individual plants mature at different times
 - At full maturity, high likelihood of exceeding the 0.3% THC limit
- Hemp varieties appear to have higher variability and poorer predictability than other plant varieties
 - Plants look different
 - THC and CBD levels highly variable within varieties



Acknowledgements

Staff of the Experiment Station

- Dr. Jason C. White
- Dr. Christian Dimkpa
- Rich Cecarelli
- Mike Ammirata
- Kitty Prapayotin-Riveros
- Staff of Analytical Chemistry



Thank You!!

Questions?

Dr. Walter Krol

Walter.krol@ct.gov

203-974-8456

and

Ms. Terri Arsenault

Terri.Arsenault@ct.gov

203-974-8570