2020 Burley Tobacco Research Update

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Chemical Topping for Burley Tobacco

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Topping Burley Tobacco

- Improves burley leaf properties
  - Promotes root growth
  - Improves leaf thickness
  - Increases leaf yield
  - Improves leaf color
- Requires about 5 man-hours per acre?
  - $60 – 75 per acre

Research Question(s)

- Could we eliminate manual topping by spraying sucker control at the right time?
  - What chemical(s) should we use?
  - When should we spray?
  - How will it affect the leaf?
    - Yield
    - Quality
    - Chemistry

Topping effectiveness

Late application for chemical topping

Sucker Control Product and Rate

- Treatments:
  1. Man. topped: No Sucker Control (**UTC**)
  2. Man. topped: 1.5 G/A MH + 0.5 G/A Butralin (**G.S.**)
  3. Chem. topped: 2.0 G/A MH (**Full MH**)
  4. Chem. topped: 1.5 G/A MH (**Red. MH**)
  5. Chem. topped: 2.0 G/A MH + 0.5 G/A Butralin (**Full Mix**)
  6. Chem. topped: 1.5 G/A MH + 0.5 G/A Butralin (**Red. Mix**)

- Treatments applied at:
  - Man. topped treatments applied at 10% bloom
  - Chem. topped treatments applied at prebud (10% button)

Sucker control effectiveness as percent of the control.

	2015[a]		2016		2017	
	Murray	Lexington	Princeton	Lexington	Princeton	Lexington
Treatment	----------%----------					
UTC	0 d	0 d	0 c	0 c	0 d	0 c
G.S.	100 a	100 a	100 a	100 a	100 a	100 a
Full MH	98 a	93 a	83 b	98 a	69 b	100 a
Red. MH	91 ab	91 a	82 b	94 b	50 c	99 b
Full Mix	100 a	94 a	98 a	100 a	100 a	100 a
Red. Mix	100 a	87 a	99 a	100 a	94 a	100 a
p-value	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*

[a] Means within a column followed by the same letter are not significantly different according to Fisher's Protected LSD at P = 0.05.

Sucker control with MH alone was worse at the Princeton location

Sucker control with a mixture was similar for manual or chemical topped

Suckers on MH only treated plants

Total yield by year and location.

	2015[a]		2016		2017	
	Murray	Lexington	Princeton	Lexington	Princeton	Lexington
Treatment	----------lb/A----------					
UTC	1535 b	1670 ab	1681 b	2764	1893 b	1789 b
G.S.	1892 a	1923 ab	2344 a	3008	2431 a	2318 a
Full MH	1932 a	1989 ab	1850 b	2978	2049 b	2479 a
Red. MH	1992 a	1910 ab	1898 b	3031	1884 b	2413 a
Full Mix	2009 a	1924 ab	2362 a	2994	2400 a	2523 a
Red. Mix	1916 a	2002 a	2329 a	2962	2332 a	2298 a
p-value	*0.0026*	*0.0371*	*0.0030*	*0.6447*	*<.0001*	*<.0001*

[a] Means within a column followed by the same letter are not significantly different according to Fisher's Protected LSD at P = 0.05.

Leaf yields were reduced where sucker control was worse

With mixtures yields were similar for manual or chemical topped

Federal quality grade index.

	2015[a]		2016		2017	
	Murray	Lexington	Princeton	Lexington	Princeton	Lexington
Treatment	---------- 0 – 100 ----------					
UTC	42	-	60	77 a	64	62
G.S.	38	-	61	71 b	57	65
Full MH	43	-	61	70 b	67	62
Red. MH	47	-	62	71 b	62	58
Full Mix	39	-	61	73 b	63	66
Red. Mix	48	-	62	73 b	68	70
p-value	*0.3463*	-	*0.1306*	*0.0107*	*0.1884*	*0.6712*

[a] Means within a column followed by the same letter are not significantly different according to Fisher's Protected LSD at P = 0.05.

Grade was not impacted by topping method

Maleic hydrazide residues.

	2015[a]		2016		2017	
	Murray	Lexington	Princeton	Lexington	Princeton	Lexington
Treatment	----------µg/g----------					
G.S.	64	49	15 a	62	41 a	29
Full Mix	34	32	10 b	54	10 b	50
Red. Mix	59	19	11 b	51	36 a	44
p-value	*0.1886*	*0.0837*	*0.0066*	*0.6929*	*0.0231*	*0.1168*

MH residues were not increased by chemical topping

Conclusion

- Chemical topping can be a tool in the tool box for growers
  - Late blooming variety
    - KT 210
    - NC 7
    - HB 4488P
    - KT 215
  - Uniform growth in the field
  - Targeting 10-50% button growth stage
  - Using a tank mix of MH and DNA
    - 1.5 to 2.0 G/A MH (Regular Concentrate)
    - 0.5 G/A Butralin, Flupro, Drexalin

Why Conservation Tillage for tobacco ? To prevent this…..

And this…

2 years sod – 1 year conventional tillage tobacco

(3rd cycle)

And this

9 years continuous conventional tillage tobacco

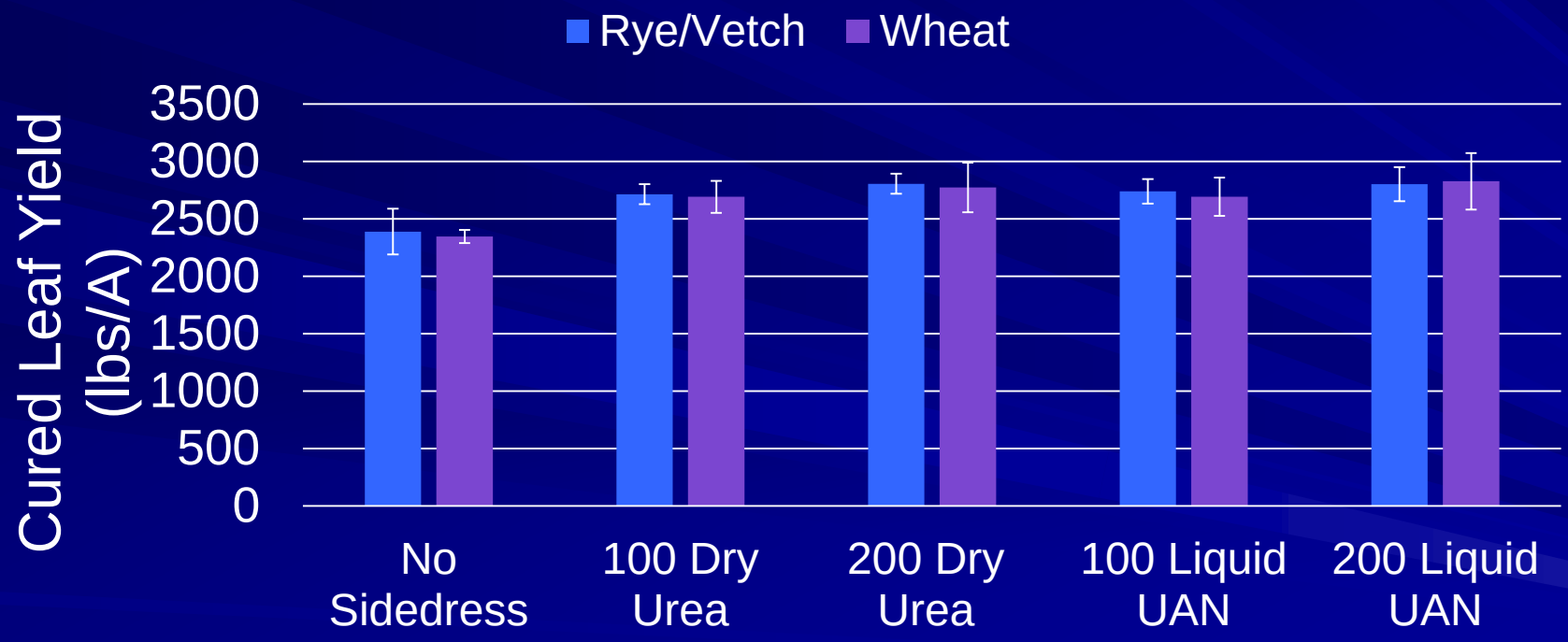
No-till Tobacco

Strip-till

Liquid Fertilizer Applicator for No-till

Pictures by Jon Anderson: Kentucky Department of Fish and Wildlife

No-Till Sidedress Trial 2019
Bob James Farm



All plots received 75 lbs N/Ac Preplant (Urea)

University of Kentucky
College of Agriculture, Food and Environment
Cooperative Extension Service

Agronomic Research Update for Hemp

Bob Pearce and Tom Keene

Plant and Soil Sciences

Winter 2020

Highlights from IFR: State plans must include

- Procedures for tracking land where hemp is grown
  - Grower licensing requirement
  - GPS location of all growing, storage, processing locations
  - Reporting of hemp acreage to FSA
- Procedures for testing Delta-9 THC in hemp crops
  - Sample must be conducted within 15 days prior to harvest
  - Testing must be done by DEA registered labs
  - Must use post-decarboxylation method (report total THC)
  - Test reports must include an “uncertainty range”
- Procedures for disposing of non-compliant plants
- Compliance provisions
- Procedures to share information
- Certification of resources to manage plans

Status of state plans under the 2018 Farm Bill 2/8/20

- Plans approved
  - 6 state plans (Delaware, Louisiana, Nebraska, New Jersey, Ohio, and Texas)
  - 7 tribal plans
- Plans under review
  - 13 state plans
  - 14 tribal plans
- Plans still being formulated but expected to be submitted to USDA
  - 8 state plans
  - 5 tribal plans
- Will continue to operate under 2014 pilot project
  - 13 states

https://www.ams.usda.gov/rules-regulations/hemp/state-and-tribal-plan-review

Know the rules and regulations for the jurisdiction where the crop will be grown!

- Details will likely be a patchwork of regulations
  - May vary from state to state
  - May vary within a state (tribal plans)
  - Some states may still operate under 2014 pilot project plans in 2020
  - When will states be required to comply with IFR
    - November 2020?
    - End of calendar year 2020?

Growth of Hemp Production Under the KDA pilot program

KDA Industrial Hemp Research Pilot Program

Annual Overview

Production Year	# University Projects	Approved Processors	Approved Growers	KY Counties with Hemp	Approved Acres	Planted Acres	Harvested Acres	% Grain or Seeds	% Fiber	% CBD	% Grain & CBD	% Seed & Fiber
2014	7	9	20	14	-	33	-	47%	32%	21%		
2015	8	29	99	41	1,742	922	500	47%	6%	47%		
2016	17	45	137	60	4,600	2,300	2,000	34%	6%	60%		
2017	17	49	204	71	12,800	3,200	2,300	36%	5%	27%	32%	
2018	14	72	210	73	16,100	6,700	6,000	18%	4%	61.5%	14%	2.5%
2019	12	200	978	102	60,000	26,500	24,900	2%	4%	92%	0	2%

National Growth of Hemp Farming

Year	States	Grower Licenses	Acres
2016	14	817	9,649
2017	19	1,456	25,713
2018	23	3,546	78,176
2019	34	16,877	511,442*
2020	47	???	???

* Licensed acres not acres planted

National figures from: Vote Hemp www.VoteHemp.com

Fertility Questions?

- How much N P K
  - Use a soil test for P and K
    - Follow recommendations for small grains (until we get better information)
  - Nitrogen
    - 50 to 200 lbs./A for maximum biomass
      - Less if following sod/pasture/hay
      - More if following row crop
    - Follow the advice of the processor you contract with
  - Soil test will also tell you how much lime
    - Optimum pH 6 to 7
    - Optimize micro-nutrient balance
    - Minimize heavy metal availability
- Impact of fertility on concentration of “essential oils” and THC
  - We don’t know !!!!!
- What do deficiencies look like?
  - Recently published paper from NC-State has identified symptoms

https://www.mdpi.com/2076-3417/9/20/4432

Figure 2. Nutritional disorders of nitrogen (N), phosphorus (P), and calcium (Ca) deficiency in *Cannabis sativa* 'T1' plants. These pictures display the symptomological progression of nutritional disorders from initial, intermediate, through advanced.

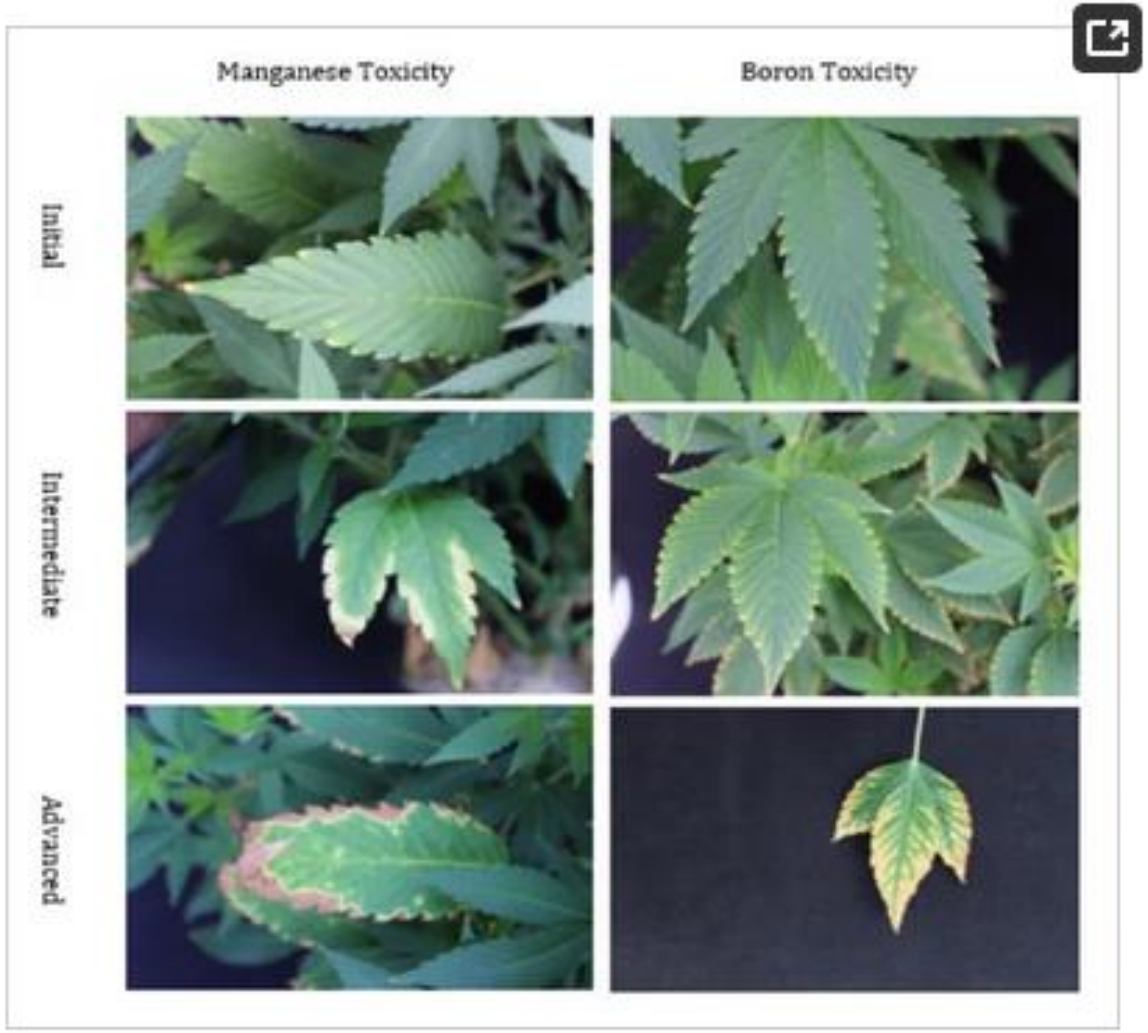
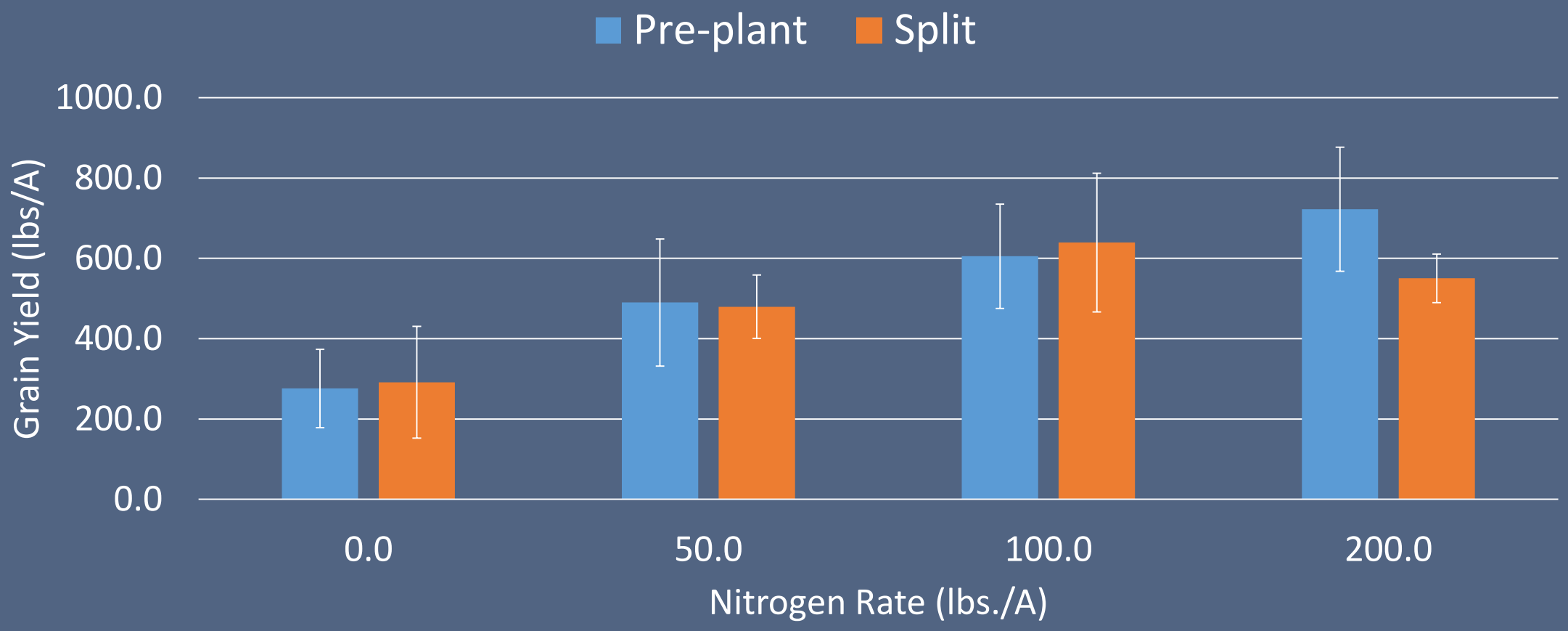
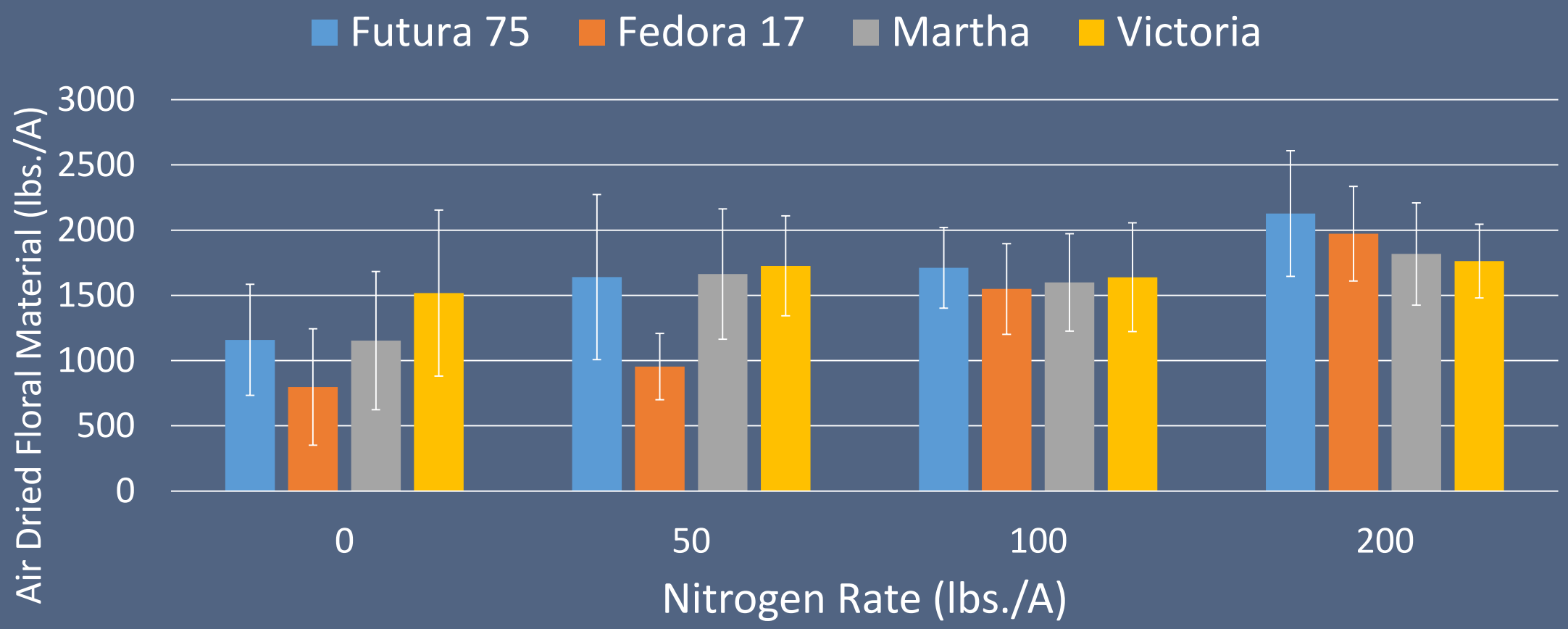


Figure 5. Nutritional disorders of manganese toxicity (Mn) and boron toxicity (B) in *Cannabis sativa* 'T1' plants. These pictures display the symptomological progression of nutritional orders as they progress from initial, intermediate, and advanced.

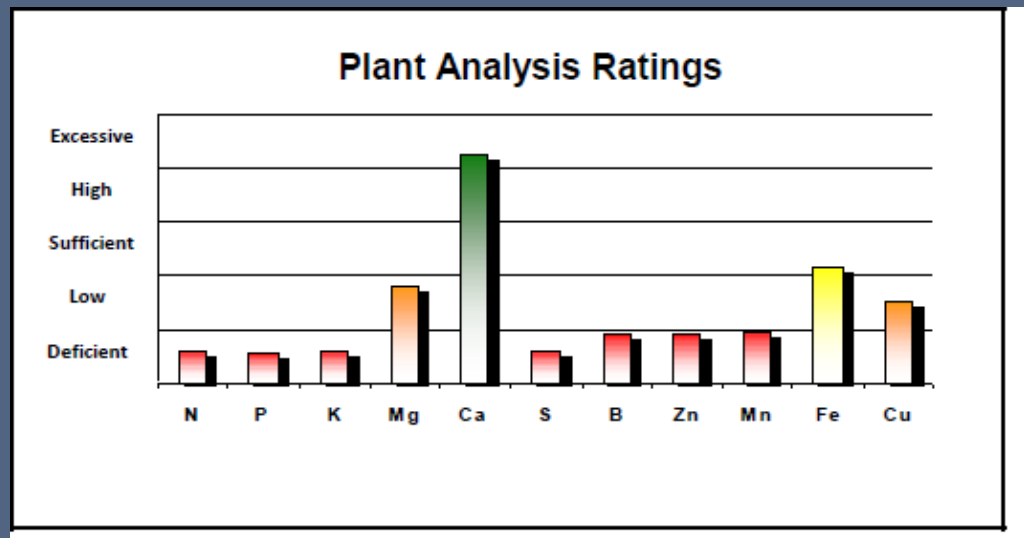
2019 Grain Yield (Air dried)

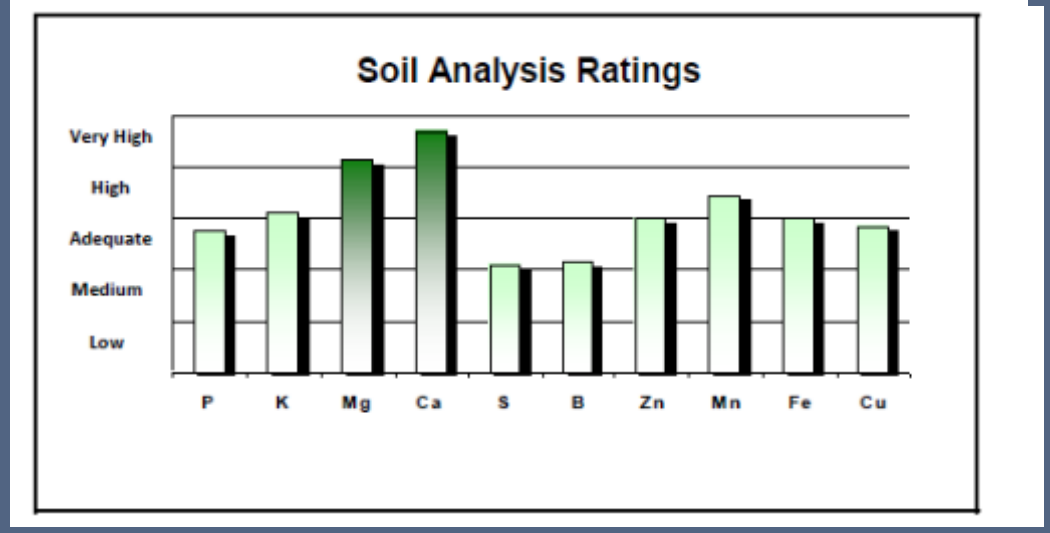


Air dried floral material yield

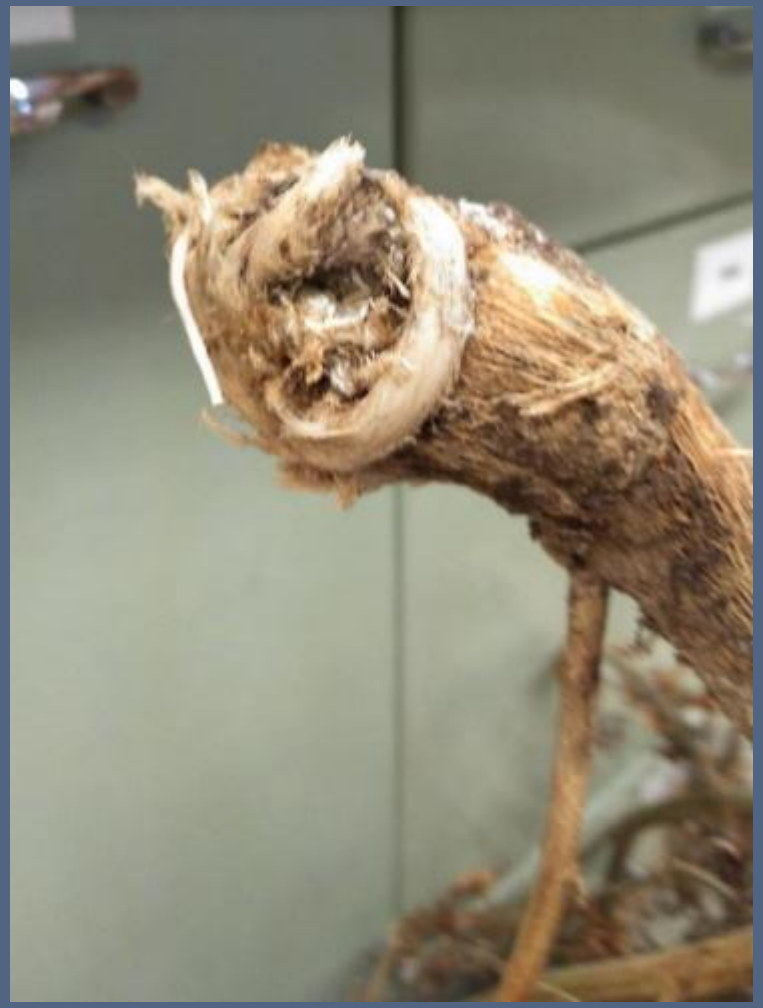


Nutrient Deficiencies Observed in 2019?





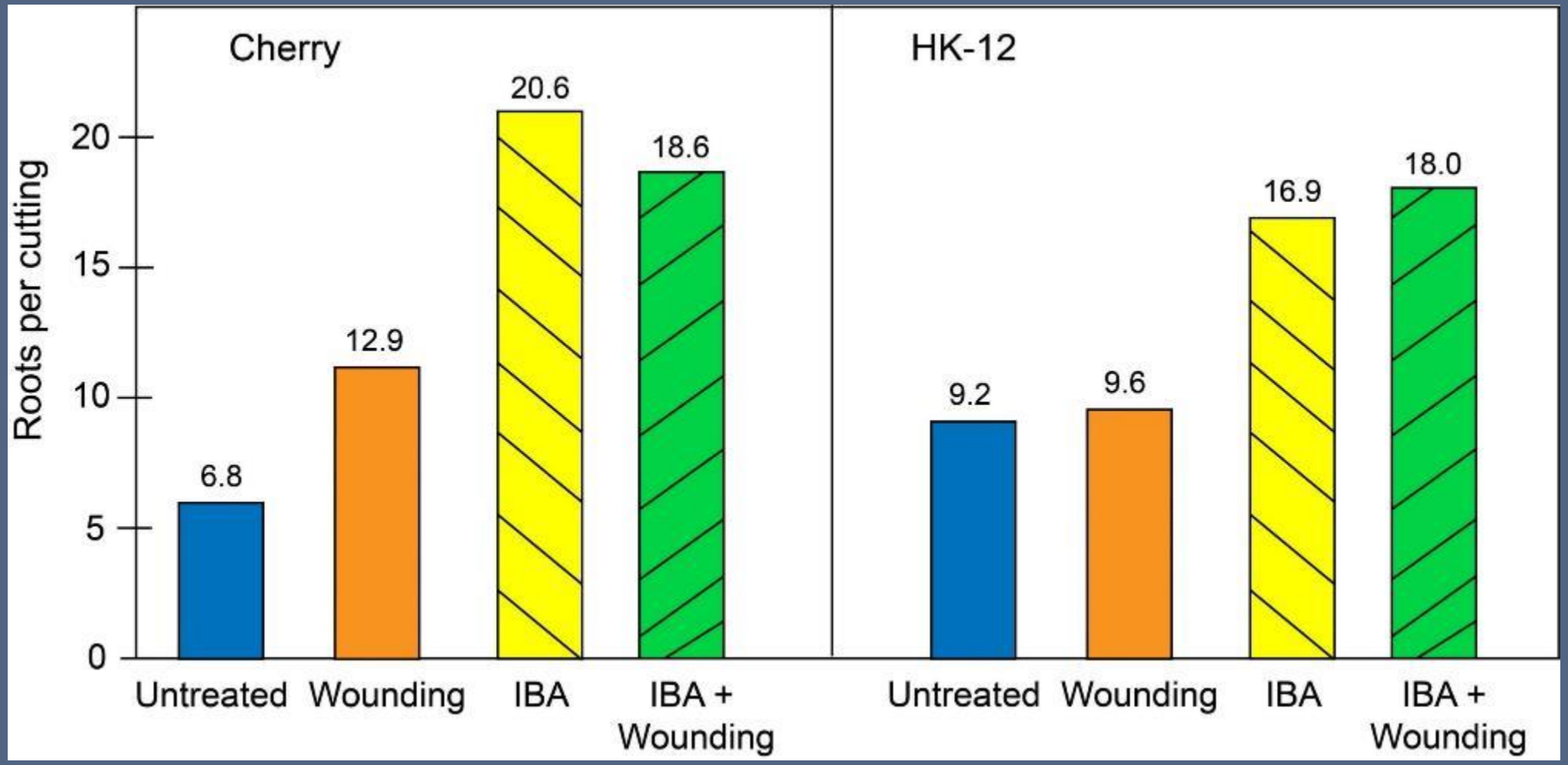
Potential root concerns with cloned plants?



Basics of cutting propagation

Cutting environment – Auxin and wounding

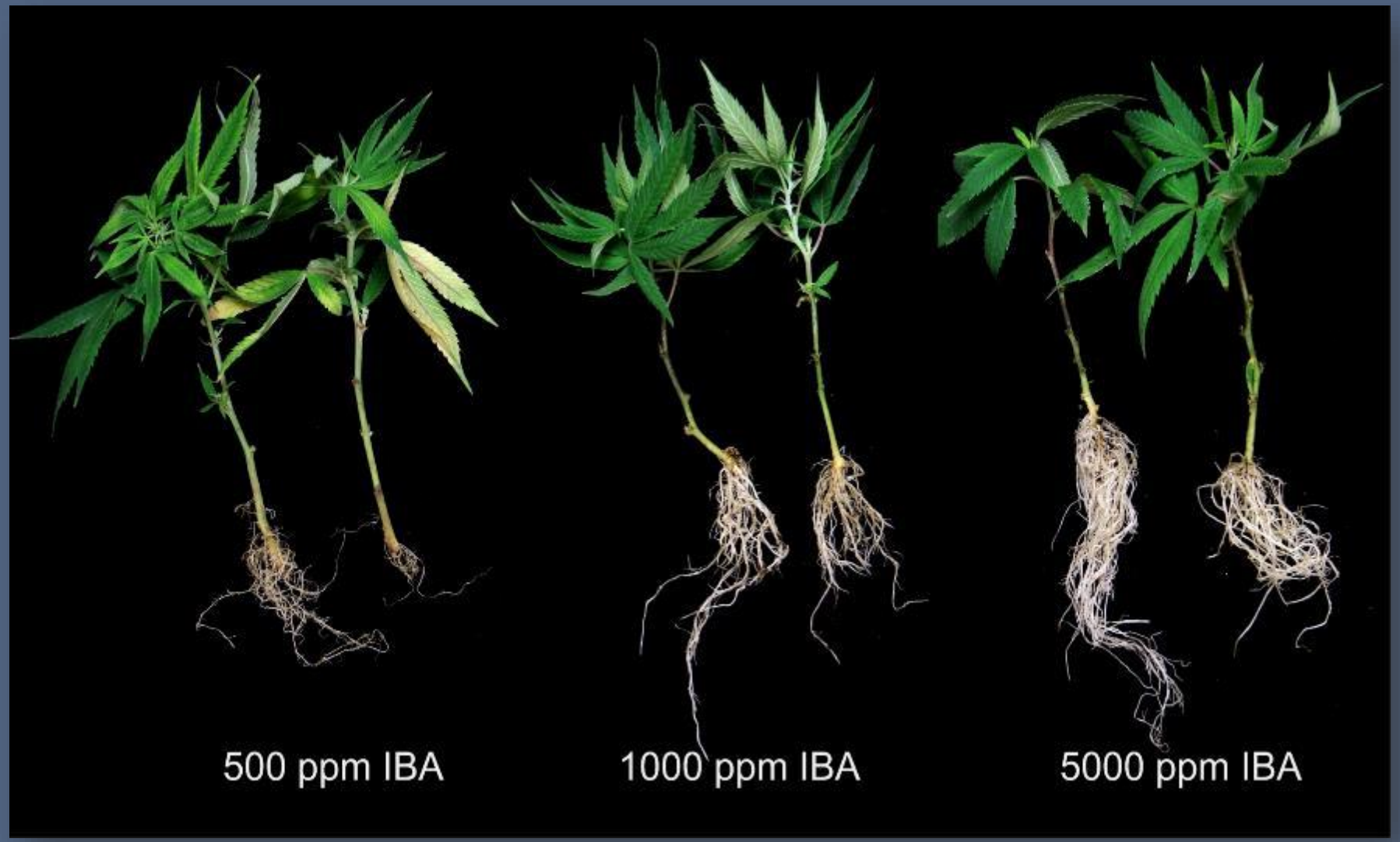
Preliminary example of the effects of auxin and wounding on rooting hemp cuttings.



Basics of cutting propagation

Cutting environment – Auxin treatment

Positive effect of IBA quick dip on rooting in hemp.



Variety Adaptation and Development

- Many varieties have been developed in other countries and/or have unknown history (many have come from cannabis industry).
- Genetics are tightly controlled for named varieties.
  - Rights to most varieties are privately held
    - Variety owners often require "Material Transfer Agreements"
  - Public/University breeding programs barely getting started
    - No established germ plasm banks
    - Some are using naturally occurring populations as genetic variability sources
- It will take time to develop locally adapted varieties.
  - Optimum photoperiod for different latitudes
  - Reduced seed shatter
  - Optimized for fiber, grain, and/or CBD
  - Consistently compliant with THC restrictions

Where can I find Variety Performance Information?

- Grain and Fiber
  - University trials
  - https://hemp.ca.uky.edu/
- Cannabinoid
  - Limited trials
    - Cornell
    - NC-State
  - KDA Summary of Varieties List
    - No field performance data
    - Identifies varieties' potential to result in non-compliant THC levels
    - https://www.kyagr.com/marketing/hemp-pilot.html
- Variety owner or processor

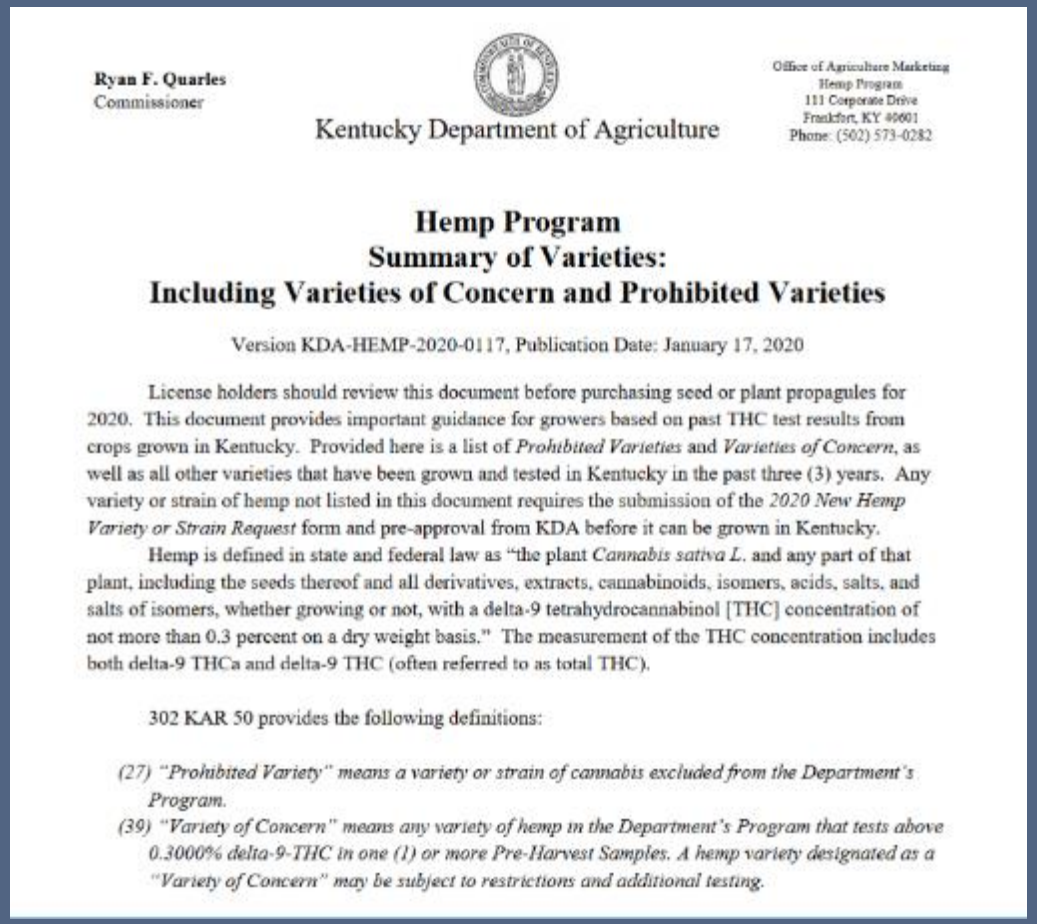
Fiber Variety Selection

Variety	KDA Status 2020	Country of origin	2019 LEX	2018 Q-Sand	2018 VER	2018 PRCTN
			----------Dry Straw Yield (lbs/A)----------			
SS Alpha	Prohibited	China		10,236	4,447	3,358
SS Beta		China		10,574	4,261	3,115
SS Charlie	VOC	China	4,919			
Elletta Campana		Italy	5,355	6,406	3,291	
Fibranova		Italy	5,728	2,630	2,117	1,861
Tygra	VOC	Poland	1,731			

Grain Variety Selection

Variety	KDA Status 2020	Country of origin	2019 KY	2019 NY	2019 ND	2019 KS
			----------Grain Yield (lbs/A)----------			
CFX 1		Canada	1298	1384	1480	83
CRS 1		Canada	1307	1221	1600	1212
Fedora 17		Italy	858	1331	1480	1191
Felina 32		Italy	394	1316	1250	1576
Futura 75		Italy	494	1231	950	1576
Hlesia	New	Ukraine	370	366	1250	798
Hliana	New	Ukraine	384	407	1240	--
Hlukhovskii	New	Ukraine	396	393	930	805
Katani		Canada	1120	1073	1260	--
USO 31		Italy	569	721	1300	1202

https://www.kyagr.com/marketing/documents/HEMP_LH_Summary_of_Varieties_List_2019.pdf



Ryan F. Quarles
Commissioner

Kentucky Department of Agriculture

Office of Agriculture Marketing
Hemp Program
111 Corporate Drive
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Hemp Program
Summary of Varieties:
Including Varieties of Concern and Prohibited Varieties

Version KDA-HEMP-2020-0117, Publication Date: January 17, 2020

License holders should review this document before purchasing seed or plant propagules for 2020. This document provides important guidance for growers based on past THC test results from crops grown in Kentucky. Provided here is a list of *Prohibited Varieties* and *Varieties of Concern*, as well as all other varieties that have been grown and tested in Kentucky in the past three (3) years. Any variety or strain of hemp not listed in this document requires the submission of the *2020 New Hemp Variety or Strain Request* form and pre-approval from KDA before it can be grown in Kentucky.

Hemp is defined in state and federal law as "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 delta-9 tetrahydrocannabinol [THC] concentration of not more than 0.3 percent on a dry weight basis." The measurement of the THC concentration includes both delta-9 THCa and delta-9 THC (often referred to as total THC).

302 KAR 50 provides the following definitions:

(27) "Prohibited Variety" means a variety or strain of cannabis excluded from the Department's Program.

(39) "Variety of Concern" means any variety of hemp in the Department's Program that tests above 0.3000% delta-9-THC in one (1) or more Pre-Harvest Samples. A hemp variety designated as a "Variety of Concern" may be subject to restrictions and additional testing.

- Check this list before ordering seed or plants!!!
- Over 250 cultivars listed
  - 37 have been Prohibited
  - Including several that were allowed in 2019
- 104 designated as Varieties of Concern
  - Varieties of Concern should be utilized with caution as they are at a higher risk of exceeding the THC limit and potentially resulting in the ordered destruction of the crop.

Use caution when selecting varieties for floral/cannabinoid production

6	AC1S1	Variety of Concern	Floral	U.S.A.	2019	1.285	8	0	1
7	AC4	Variety of Concern	Floral	U.S.A.	2019	0.316	2	2	0
8	Apollo	NEW	Floral	U.S.A.	Not Yet Tested in Kentucky - No Results				
9	AR-4	Variety of Concern	Floral	U.S.A.	2019	0.445	0	0	1
10	Auto Pilot 1.0		Floral	U.S.A.	2019	0.193	5	0	0
11	B-100	Variety of Concern	Floral	U.S.A.	2019	2.082	8	2	3
12	BaOx	Variety of Concern	Floral	U.S.A.	2019	0.987	100	25	9
13	Baox x Autoflower	Prohibited Variety	Floral	U.S.A.	2019				
14	BCHF	Variety of Concern	Floral	U.S.A.	2019	0.32	0	1	0
15	B-CHP	NEW	Floral	U.S.A.	Not Yet Tested in Kentucky - No Results				
16	Berry Blossom	Variety of Concern	Floral	U.S.A.	2019	0.509	34	7	5
17	Blue Maze	Variety of Concern	Floral	U.S.A.	2019	0.564	9	1	1
18	Bluegrass Maze		Floral	U.S.A.	2019	0.106	1	0	0
19	Bottom Cherry	NEW	Floral	U.S.A.	Not Yet Tested in Kentucky - No Results				
20	Brilliance	Variety of Concern	Floral	U.S.A.	2019	1.098	3	0	1
21	C4	Variety of Concern	Floral	U.S.A.	2019	0.367	2	4	0
22	C4-Otto	NEW	Floral	U.S.A.	Not Yet Tested in Kentucky - No Results				
23	Canda		Grain	Canada	2017	0.022	2	0	0
24	Carmagnola	Variety of Concern	Fiber	Italy	2019	0.861	4	0	1
25	Carmagnola Selezionata	Variety of Concern	Fiber	Italy	2019	0.742	4	0	2
26	Carolina	Variety of Concern	Floral	U.S.A.	2019	0.345	0	1	0
27	Carolina Dream	Variety of Concern	Floral	U.S.A.	2019	0.357	1	1	0
28	Cat Lady	NEW	Floral	U.S.A.	Not Yet Tested in Kentucky - No Results				
29	CBD Dream	NEW	Floral	U.S.A.	Not Yet Tested in Kentucky - No Results				
30	CBDawgL	Prohibited Variety	Floral	U.S.A.	2019				
31	CBDRx Cherry	Variety of Concern	Floral	U.S.A.	2019	0.803	157	72	51
32	CBG Bliss	NEW	Floral	U.S.A.	Not Yet Tested in Kentucky - No Results				
33	CC	Variety of Concern	Floral	U.S.A.	2019	0.607	83	38	9
34	CFX 1		Grain	Canada	2017	0.019	1	0	0
35	CFX-2		Grain	Canada	2018	0.115	3	0	0
36	Chardonnay		Floral	U.S.A.	2019	0.261	3	0	0
37	Charlottes Wife	NEW	Floral	U.S.A.	Not Yet Tested in Kentucky - No Results				
38	Cherry	Prohibited Variety	Floral	U.S.A.	2019				
39	Cherry 2.0	Variety of Concern	Floral	U.S.A.	2019	0.304	4	1	0
40	Cherry BD		Floral	U.S.A.	2019	0.179	3	0	0
41	Cherry Blossom	Variety of Concern	Floral	U.S.A.	2019	0.641	22	14	4

- Almost any variety that claims to produce high CBD can produce a non-compliant THC test result
- Variety of Concern indicates the variety has had at least one test above 0.3000% THC
- 2019 KY Grower THC test results
  - 40% tested above 0.3% THC
  - 17% tested above 0.4% THC

Cultivars Prohibited in Kentucky for 2020 (examples)

	Avg. THC	Avg. CBD	CBD/THC	Max THC	Max CBD	# tested	%>0.30 THC
CBDawgL	0.36	9.02	25.35	0.52	13.08	30	76.7
Cherry	0.38	8.50	22.48	0.55	12.68	81	84.0
Cobbler #8	0.63	6.22	20.69	2.34	13.09	18	55.6
Elektra	0.39	9.04	23.24	0.56	13.44	20	90.0
HP Stray Kat	0.38	8.90	23.23	0.48	12.00	22	86.4
Merlot D	0.40	8.79	21.95	0.50	10.72	13	76.9
SG 2L	0.31	7.28	24.90	3.20	14.65	162	49.4
Suver Haze	0.35	8.03	23.58	0.60	15.67	87	72.4
Zinfandel-C	0.41	9.80	24.37	0.55	13.19	29	93.1

High Risk Cultivars (examples)

	Avg. THC	Avg. CBD	CBD/THC	Max THC	Max CBD	# tested	%>0.30 THC
CBDRx Cherry	0.29	7.00	25.11	0.80	12.80	278	44.2
CC	0.27	6.44	24.41	0.61	15.01	125	37.6
Cherry Blossom	0.31	7.14	23.91	0.64	15.43	40	42.5
Cherry Wine	0.36	5.13	20.30	2.72	11.48	121	38.0
Lifter	0.32	8.55	27.69	0.52	11.87	25	52.0
Midwest Strain	0.28	6.51	23.08	0.56	12.54	91	36.3
OT	0.24	6.00	25.84	0.91	10.13	82	31.7
T1	0.32	6.11	21.93	2.44	12.95	292	43.2
Wife	0.37	4.60	17.93	1.64	8.65	33	45.5

Moderate Risk Cultivars (examples)

	Avg. THC	Avg. CBD	CBD/THC	Max THC	Max CBD	# tested	%>0.30 THC
BaOx	0.24	5.39	22.45	0.99	16.15	133	25.6
Berry Blossom	0.24	5.14	21.60	0.51	13.18	46	26.1
CC	0.27	6.44	24.41	0.61	15.01	125	37.6
Franklin	0.21	5.08	25.33	1.24	12.99	85	17.6
Late Sue	0.25	6.63	27.05	0.40	10.69	34	14.7
OT	0.24	6.00	25.84	0.91	10.13	82	31.7
Otto II	0.21	5.07	24.48	0.51	12.00	35	17.1
Red Bordeaux	0.29	6.36	21.56	0.47	10.53	31	35.5
Sweetened	0.22	5.08	23.46	1.27	13.73	367	22.9

Low Risk Cultivars (examples)

	Avg. THC	Avg. CBD	CBD/THC	Max THC	Max CBD	# tested	%>0.30 THC
Cherry Citrus	0.19	4.37	23.47	0.34	8.37	42	9.5
Cherry Dwarf	0.15	3.55	23.03	0.29	7.88	8	0.0
Endurance	0.14	3.50	25.84	0.31	7.65	44	2.3
Fibranova	0.06	1.53	26.63	0.10	2.36	21	0.0
Martha	0.08	1.90	25.12	0.19	4.42	50	0.0
Mary	0.14	3.44	25.22	0.27	6.29	46	0.0
Stout	0.17	4.29	25.30	0.55	12.11	84	10.7

NC STATE

2019 North Carolina Hemp Strain Testing Results

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Table 1. Statewide Hemp CBD Strains - Late-May/Early June Planting Date

	Statewide Averages			Henderson County			Johnston County			Rowan County		
Strain	Type†	Floral Yield* (lb/plant)	Whole Plant Dry Weight (lb/plant)	Δ-9 THC (%)	Total THC (%)	Total CBD (%)	Δ-9 THC (%)	Total THC (%)	Total CBD (%)	Δ-9 THC (%)	Total THC (%)	Total CBD (%)
BaOx	Clone	**1.68**	**4.17**	0.11	0.62	12.80	0.15	0.71	16.42	0.23	0.82	16.43
Suver Haze	Clone	**1.56**	3.25	0.19	0.59	13.40	0.25	0.65	14.48	0.22	0.56	13.20
Cherrywine	Clone	1.40	**3.82**	0.09	0.44	9.53	0.30	0.62	14.45	0.20	0.55	12.98
Citrus Cherry	Clone	1.39	**4.09**	0.08	0.44	10.90	0.14	0.50	11.09	0.12	0.34	7.79
Wulf	Seed	1.30	3.32	0.28	0.75	3.56	0.07	0.31	7.06	0.43	1.78	5.94
Spectrum	Clone	1.23	**4.40**	0.09	0.47	10.70	0.11	0.45	10.48	0.11	0.34	8.27
Sweetened	Clone	1.22	3.45	0.07	0.39	9.24	0.21	0.71	16.11	0.06	0.23	5.92
Elektra	Clone	1.19	2.16	0.17	0.50	11.40	0.20	0.61	13.57	0.28	0.68	16.05
Endurance	Clone	1.04	3.44	0.02	0.13	3.48	0.04	0.39	9.47	0.01	0.28	7.62
Cherry Blossom	Clone	1.01	2.72	0.14	0.49	10.80	0.19	0.57	12.22	0.21	0.51	11.08
T1	Clone	0.62	1.17	0.09	0.33	7.22	0.19	0.58	11.95	0.15	0.43	9.59
Mean		1.24	3.27		>0.4%THC	>10%CBD		>0.4%THC	>10%CBD		>0.4%THC	>10%CBD
LSD (p=0.05)		0.26	0.73		0.3-0.39%			0.3-0.39%			0.3-0.39%	
DF		10	10									

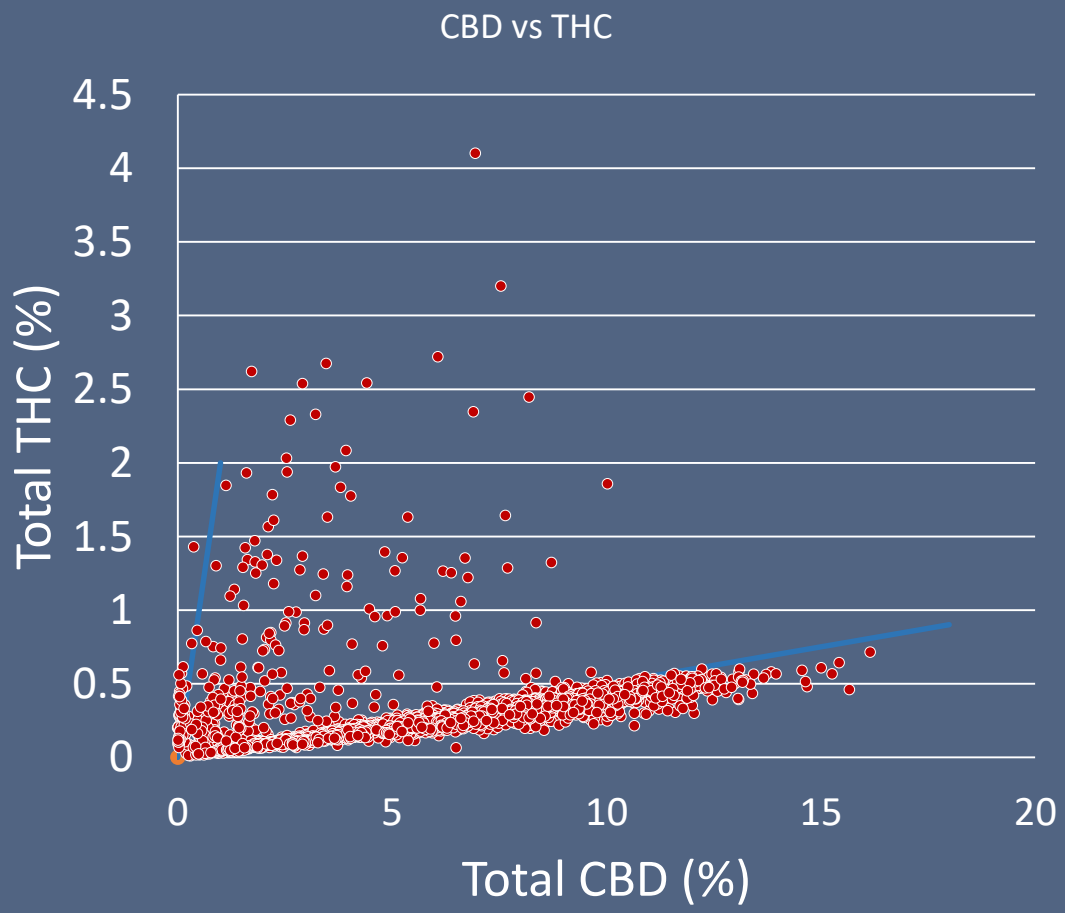
Bolded varieties are not statistically different from the highest yielding variety

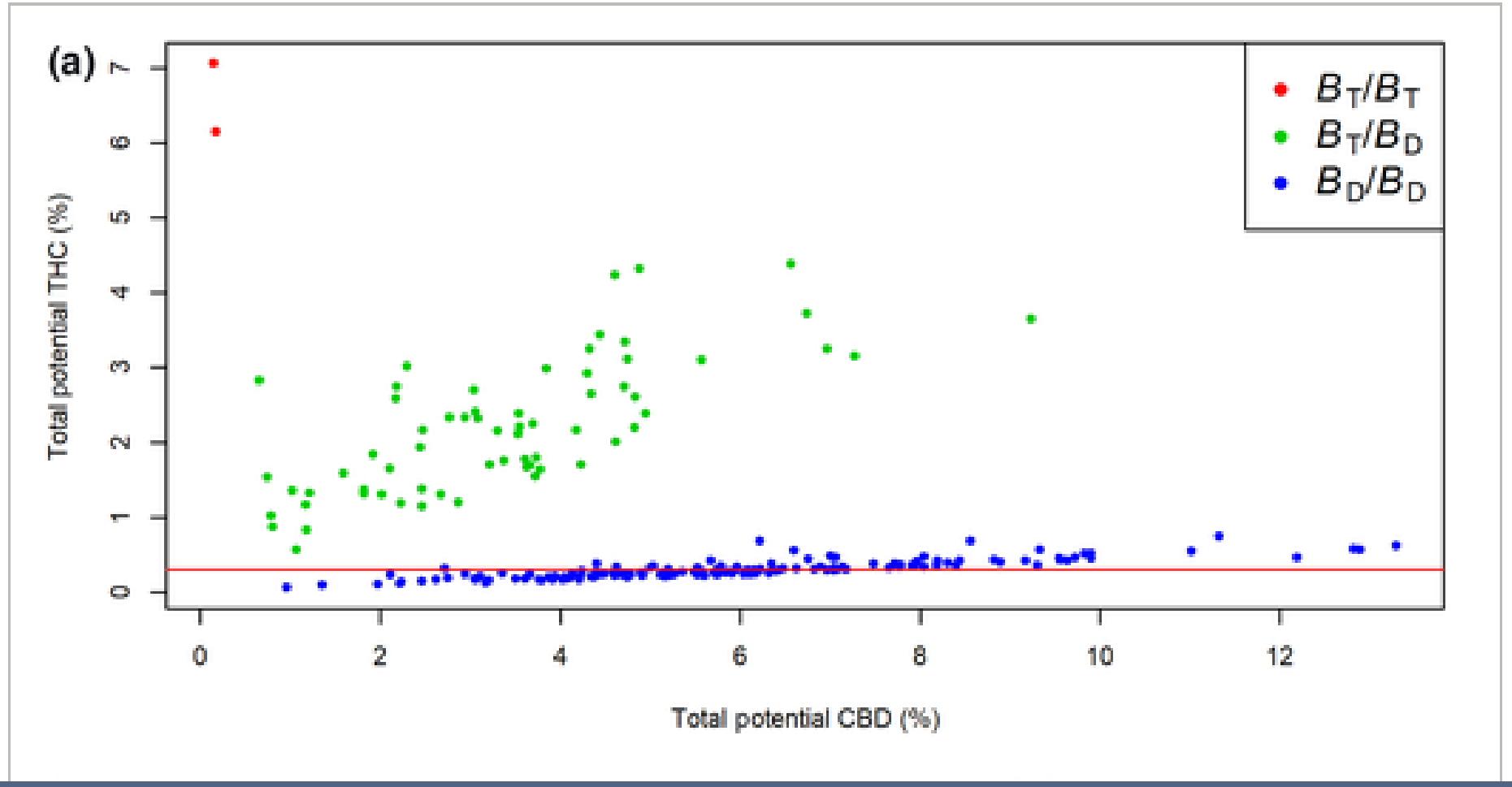
† Clones were vegetative cuttings, seed refers to seed grown transplants.

* Bucked (de-stemmed) dry yield

Factors To Consider for THC Compliance

- Cultivar: has the greatest influence on potential THC
  - Variation within cultivars is high
  - Look for cultivars with high CBD/THC ratio
- Time: both THC and CBD increase with maturity
- Stress: may increase cannabinoid levels (very little is known about these effects)
- Fertility: ?????





Development and validation of genetic markers for sex and cannabinoid chemotype in *Cannabis sativa* L. Jacob A. Toth, George M. Stack, Ali R. Cala, Craig H. Carlson, Rebecca L. Wilk, Jamie L. Crawford, Donald R. Viands, Glenn Philippe, Christine D. Smart, Jocelyn K. C. Rose, Lawrence B. Smart. First published: 10 January 2020. **https://doi.org/10.1111/gcbb.12667**

3 Major Uses/Production Systems for Hemp

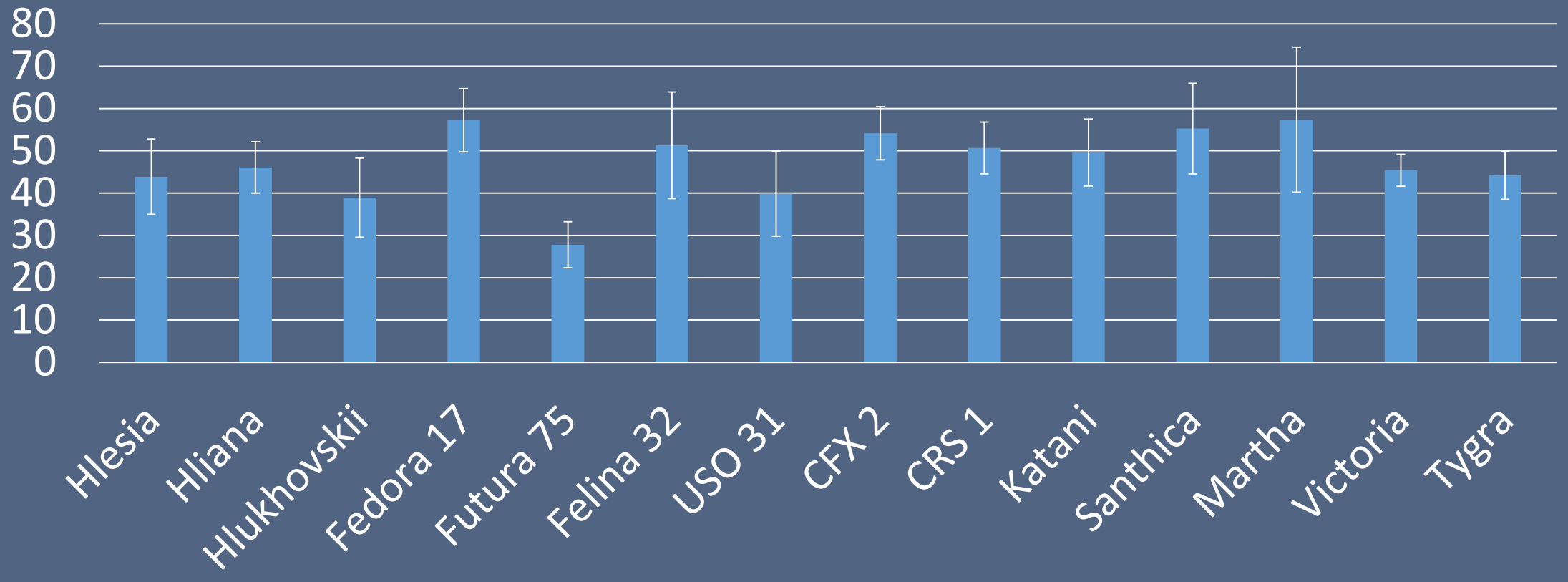
- Floral Components (CBD)
  - High cost inputs
    - $1-2 per seed (feminized)
    - $2 - $8 per plant (clones)
  - May be directed seeded but mostly transplanted for now
    - All female plant population.
    - High labor costs for weed control
  - Typically hand harvested, dried, and hand processed
    - Method determined by processor
  - High return potential?????

Seed Quality

- Germination percentages have been variable.
- Challenge for seed producers
  - Uneven maturity
  - Seed apparently does not store well
- So far results for 2019 seem to be better than in past seasons for some seed lots
- Adjust seeding rates based on germination and seed size

Variety	2019 Germination %	2019 Seeds per pound
Tygra	72	30,228
Eletta Compana	60	22,484
Fibranova	66	21,103
Hlesiia	84	22,723
Hliana	90	22,537
Hlukhivs (HL-51)	85	24,633
Futura 75	69	23,473
USO 31	92	27,282
Fedora 17	96	25,996
Felina 32	93	25,546
Santhica 27	86	25,275

Emergence 2019 Variety Trial
(% of live seed planted)



Planting Depth

- Plant approximately ¼ inch deep
  - Plants emerge in 4 to 5 days under favorable conditions
  - Surface dries quickly
  - Bird predation is a problem
  - Soil crusting is a problem
- Plant ½ inch or deeper
  - Plants slower to emerge
  - Establish slower
  - Less competitive with weeds

Soil conditions also impact stand establishment from seed

- Establishment in a tilled seed bed is most consistent
  - Firm consistent surface to insure even planting depth
- Good soil moisture
- Hemp is susceptible to soil crusting losses
  - Emergence like soybean
  - Heavy rains after seeding can create a crust

Weeds

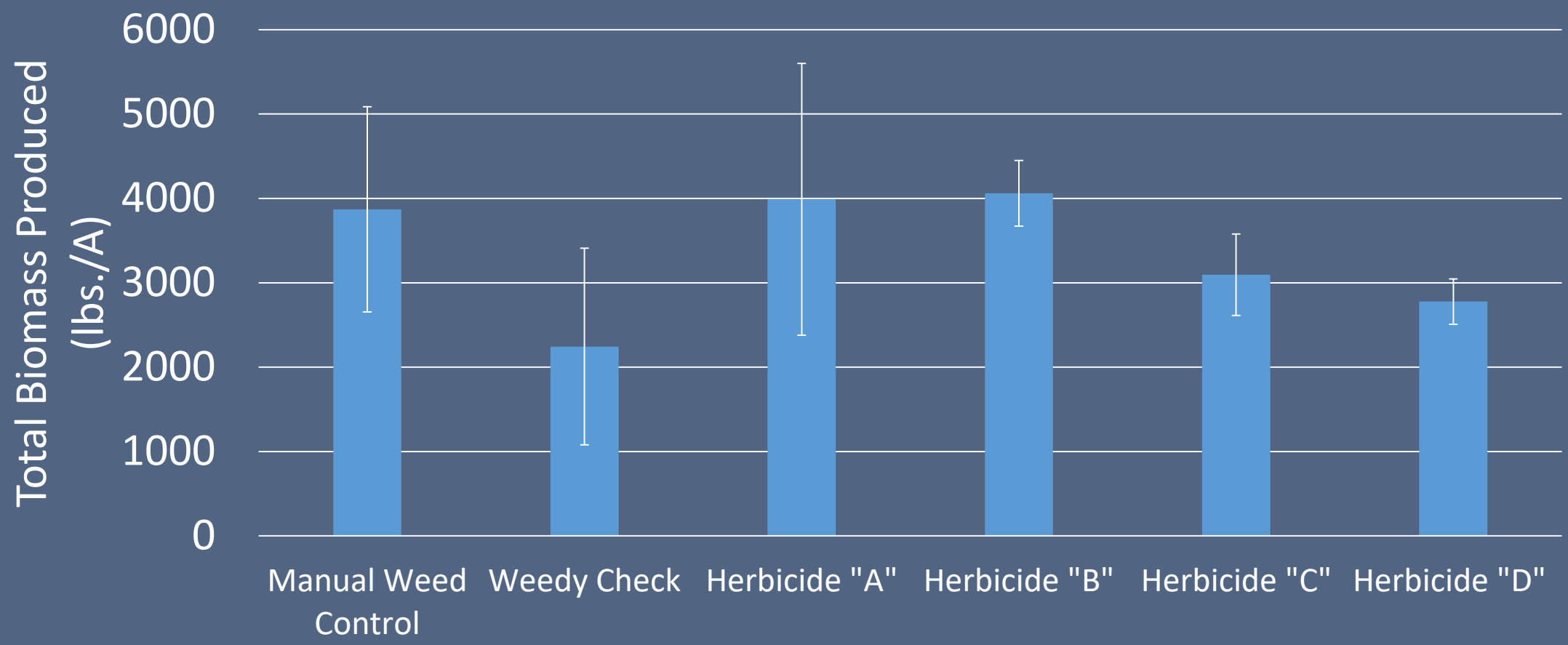
- Competition with crop for:
  - Space
  - Light
  - Nutrients
  - Water
- Harbor Disease
- Physical Damage
  - Morningglories
  - Honeyvine Milkweed

Crop Tolerance to Weed Competition

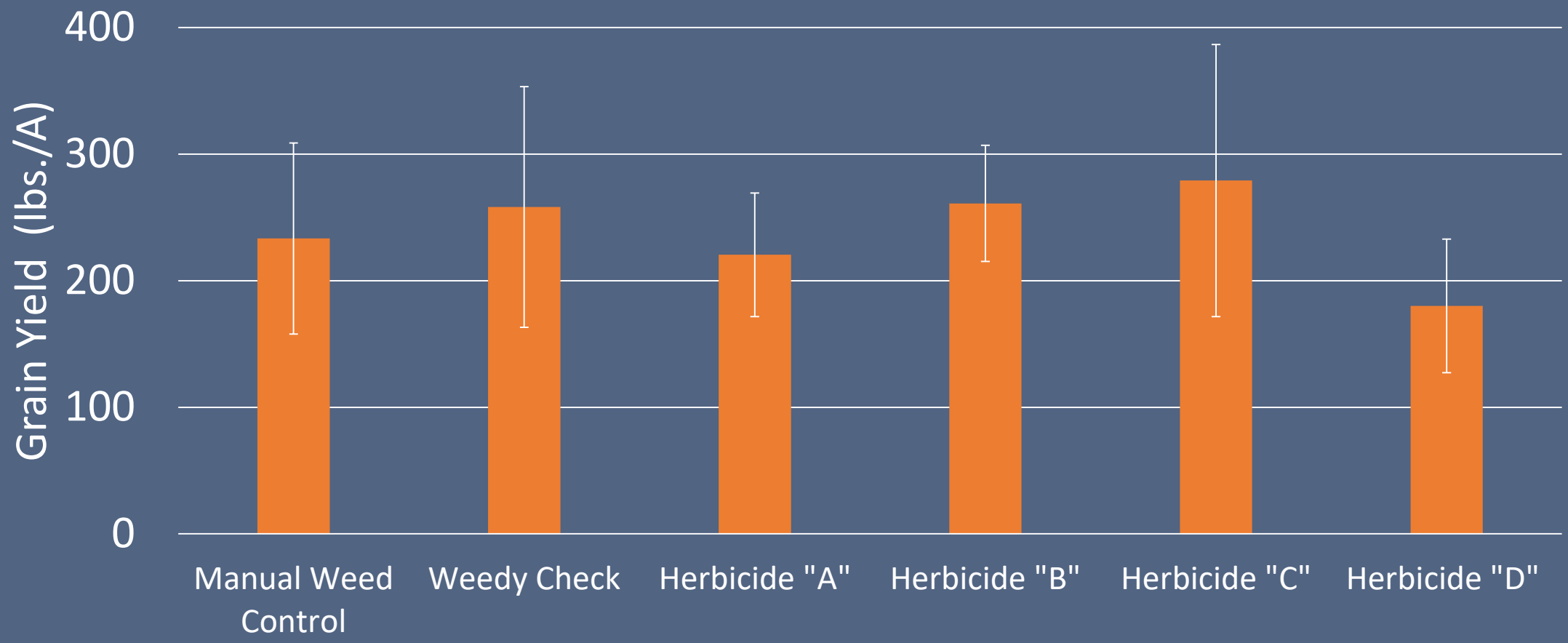
- Weed free for 6 weeks
  - Tobacco canopy tolerates late competition

- Weedy for 2 weeks
  - 5 – 10% yield loss
- Weedy for 4 weeks
  - 10 – 15% yield loss
- Weedy for 6 weeks
  - 40 – 50% loss
- Weedy for season
  - 50 – 90 % loss

Impact of weed control on total biomass produced by transplanted clones (Otto II)

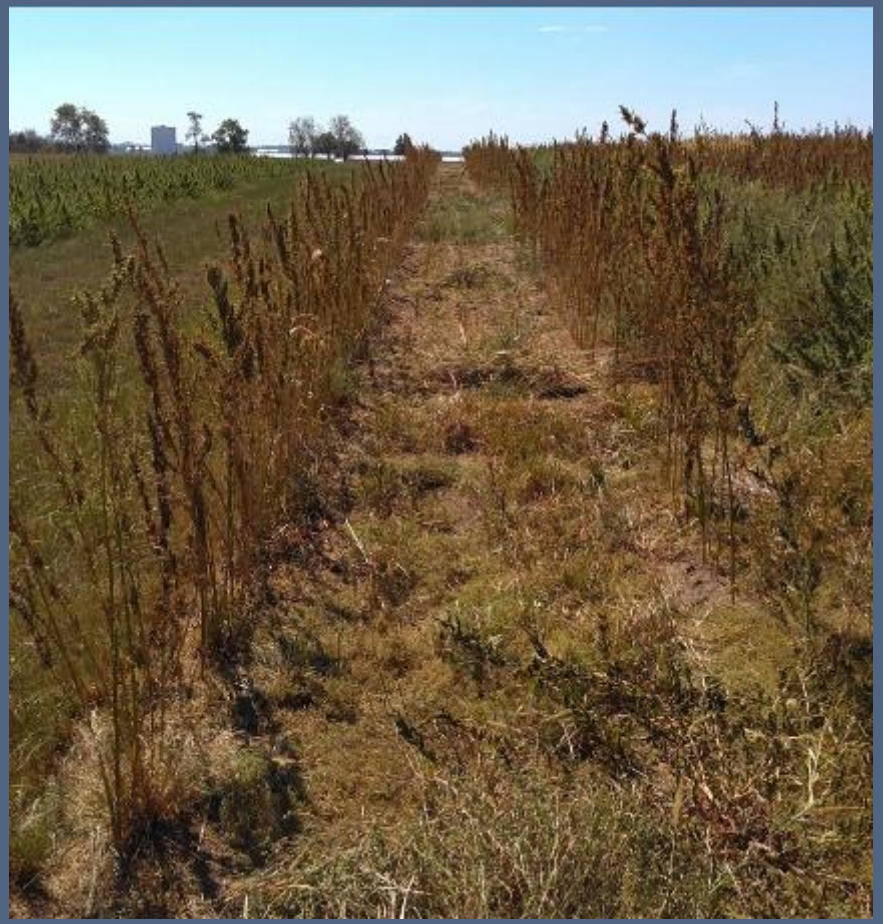


Impact of weed control on grain yield produced directed seeded hemp (USO 31)



Some injury from herbicides observed

Hemp can out compete weeds when planted densely!



Questions

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