2019 RESEARCH REPORT

SAGINAW VALLEY

RESEARCH & EXTENSION CENTER

MICHIGAN STATE UNIVERSITY

AgBioRESEARCH

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SAGINAW VALLEY RESEARCH AND EXTENSION CENTER REPORT

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INTRODUCTION

The Michigan sugar beet grower cooperative, Michigan Sugar Company, and the Michigan dry bean growers and industry represented by the Michigan Bean Commission and Michigan Bean Shippers Association, donated the proceeds of the 120 acre Saginaw Valley Bean and Beet Research Farm, located in Saginaw County for 38 years, to Michigan State University in 2009. Michigan Wheat Program and Michigan Corn Marketing Program also are contributing partners. The Michigan State University Office of Land Management operates a 450 acre farm near Richville Michigan in Denmark Township and is established as an AgBioResearch research center. The Education Center was completed in 2016 and in 2019 has hosted numerous events and expanded the partners associated with the farm. 75 acres of the 150 acre purchase previously rented will begin farming in the 2020 season. An additional 50 acres was purchased in 2019 bringing the total acres to 450. The additional land will be available for research in the 2021 season. The site is located on the southeast corner of Reese and Krueger Roads, address of 3775 South Reese Road, Frankenmuth, Michigan 48734.

Field research was initiated in 2009 and the 2019 season was the eleventh season of research at the site. This research report is primarily a compilation of research conducted at the site in 2019. Most of the work represents one year's results, and even though multi-season results are included, **this work should be considered as a progress report.**

Soil – The soil type on the farm is classified as a Tappan-Londo loam, these are very similar soil types separated by subsoil drainage classifications, the Tappan not being as naturally well drained as the Londo. The site was soil tested in spring 2009 at 2.5 acre increments. The soil pH averages 7.9, soil test phosphorus averages 56 pounds P/acre, soil test Potassium averages 294 pounds K/acre. The soil type on the newly farmed 75 and 50 acres is similar and will be soil tested in 2020 and fertilized or limed as needed.

Weather – The monthly rainfall for 2019 collected with the automated rain gauge is given in Table 1. The monthly totals are given at the bottom of the table. Rainfall was average in January through April, May and June were above average making planting difficult, July and August were dryer, September and October were wet making harvest difficult also. The rainfall total of 34.06" was above average by 7.26". Maximum and minimum daily temperatures along with growing degree days (base 50^0F) are given in Table 2. The 2019 season was moderate with 3 days above 90 degrees and 16 days above 85 degrees. The growing degree days for 2019 was 2371.5, which was below average. . The average yields for crops grown on the farm was: corn at 170 bushels/acre, soybeans at 50 bushels/acre, wheat at 90 bushels/acre, dry beans at 25 cwt/acre, and sugarbeets at 25 tons/acre.

GROWING DEGREE DAYS - SAGINAW VALLEY RESEARCH FARM

Base 50 (max + min / 2 - 50)

	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	TOTAL
1983	16.00	118.50	491.00	716.00	645.00	369.50	97.00	2453.00
1984	67.50	164.50	506.00	558.50	627.00	282.00	114.50	2320.00
1985	183.50	306.00	388.00	603.50	523.00	394.50	100.00	2498.50
1986	124.50	310.00	435.00	664.00	459.50	370.00	96.50	2459.50
1987	84.00	336.50	566.50	725.50	537.50	334.00	19.50	2603.50
1988	35.50	290.50	544.50	739.50	667.50	283.00	48.00	2608.50
1989	21.50	202.00	456.50	648.00	535.00	315.00	167.00	2345.00
1990	165.50	146.00	493.50	587.50	553.50	332.50	100.50	2379.00
1991	144.00	423.50	541.00	641.00	567.50	289.50	114.00	2720.50
1992	56.00	241.50	367.00	446.50	403.50	257.50	41.50	1813.50
1993	23.50	208.00	430.00	642.00	613.50	184.50	25.00	2126.50
1994	95.50	227.50	526.50	613.50	501.50	380.00	115.00	2459.50
1995	3.00	221.00	536.00	698.50	745.00	225.00	125.50	2554.00
1996	41.00	157.00	486.00	572.00	611.00	357.50	91.50	2316.00
1997	27.00	48.00	534.00	596.50	443.00	299.50	134.50	2082.50
1998	46.00	267.00	505.50	623.50	648.00	456.00	114.00	2660.00
1999	49.50	299.00	578.50	684.50	500.00	339.00	67.50	2518.00
2000	17.00	284.00	474.50	509.50	544.50	289.00	157.00	2275.50
2001	78.00	289.50	504.00	649.50	654.00	282.00	114.00	2571.00
2002	123.00	141.50	535.00	710.00	575.00	443.00	99.00	2626.50
2003	66.50	147.50	410.00	606.00	608.00	312.50	82.00	2232.50
2004	89.00	240.50	429.50	561.00	450.50	421.50	69.00	2261.00
2005	58.00	145.00	623.00	647.50	611.50	429.00	130.00	2644.00
2006	79.00	283.50	470.50	661.00	555.50	260.00	38.50	2348.00
2007	53.50	277.00	534.00	564.00	594.00	393.00	231.00	2646.50
2008	110.00	116.50	512.00	620.00	532.50	343.00	56.50	2290.50
*2009	50.50	190.00	432.00	458.50	517.50	345.00	27.00	2020.50
2010	89.00	368.50	528.50	729.00	697.50	311.50	95.00	2819.00
2011	38.00	273.00	515.00	758.50	576.50	308.50	122.50	2592.00
2012	28.00	341.00	555.50	756.00	552.00	295.00	109.50	2637.00
2013	45.50	347.50	483.50	617.00	516.00	288.00	131.50	2429.00
2014	45.50	271.50	536.00	488.00	525.00	285.00	74.00	2225.00
2015	18.00	306.00	444.50	577.00	546.50	342.00	90.50	2324.50
2016	37.50	274.00	509.00	688.50	680.00	430.50	189.50	2809.00
2017	99.50	227.50	546.00	609.50	506.00	411.50	204.50	2604.50
2018	14.50	417.00	509.50	664.00	649.50	422.00	115.00	2791.50
2019	37.00	172.50	438.00	691.00	538.50	415.50	79.00	2371.50
AVERAGE	63.80	245.41	496.64	630.43	567.88	337.74	102.34	2444.23

* Station moved to from Saginaw, MI to Richville, MI

MAXIMUM-MINIMUM AIR TEMPERATURES (F)
SAGINAW VALLEY RESEARCH & EXTENSION CENTER - 2019

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
DAY	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
1	33	19	17	-6	35	7	44	19	64	40	69	53
2	30	20	37	10	29	7	57	36	51	37	67	47
3	32	27	45	35	21	1	50	32	49	38	64	40
4	44	28	51	41	13	-2	45	23	62	40	78	49
5	44	26	41	24	16	5	48	31	71	41	77	52
6	36	27	31	24	18	-1	64	35	65	46	74	51
7	49	27	45	25	22	4	68	45	54	37	80	53
8	45	31	32	11	34	5	68	52	61	32	81	55
9	31	21	20	10	37	13	58	40	74	46	73	58
10	25	17	25	16	42	33	44	33	57	43	67	52
11	25	14	28	21	35	27	40	29	54	33	75	48
12	29	21	31	23	41	23	59	36	53	41	77	56
13	30	14	27	17	45	34	53	33	53	42	61	50
14	31	10	39	16	59	41	36	31	70	35	70	45
15	28	26	38	16	43	31	52	32	72	44	72	57
16	31	11	24	9	34	25	46	36	78	42	67	53
17	29	8	24	13	38	23	56	38	66	49	69	53
18	28	19	22	4	42	26	64	43	71	46	79	56
19	19	5	25	1	47	26	43	37	67	49	73	59
20	8	-5	35	14	46	31	46	36	60	41	64	54
21	13	-9	35	23	40	33	68	33	66	35	75	50
22	28	0	36	16	41	28	76	48	68	47	75	48
23	39	25	37	25	44	22	62	40	73	53	80	52
24	27	20	44	23	54	28	61	31	63	47	79	61
25	21	1	23	13	40	23	67	39	77	55	81	61
26	15	-8	18	12	41	21	63	38	72	55	83	64
27	14	-5	25	-6	53	28	50	32	70	49	87	59
28	18	-5	32	-8	66	39	54	32	58	51	84	66
29	17	-2			52	30	43	32	67	50	85	66
30	1	-12			38	27	46	37	68	55	81	61
31	2	-12			35	22			80	47		

MAXIMUM-MINIMUM AIR TEMPERATURES (F)
SAGINAW VALLEY RESEARCH & EXTENSION CENTER - 2019 cont.

	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
DAY	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
1	88	60	76	48	71	55	78	64	42	32	32	29
2	83	69	81	49	75	55	67	50	44	33	32	28
3	83	67	85	56	79	57	64	50	43	32	34	26
4	87	59	84	60	72	52	54	41	53	40	34	31
5	90	70	85	60	73	45	59	35	42	25	34	29
6	81	66	80	63	69	54	66	53	35	23	37	23
7	78	54	84	59	72	56	67	44	34	23	33	20
8	77	49	80	59	64	50	67	34	34	19	43	30
9	82	52	79	53	65	49	68	42	39	27	48	38
10	89	59	79	51	81	58	70	41	41	30	39	20
11	81	60	81	53	82	61	67	47	30	20	22	11
12	79	58	84	65	66	58	50	39	23	0	36	11
13	89	62	80	59	79	58	54	40	22	0	39	31
14	82	53	78	55	73	55	52	35	29	21	36	28
15	88	59	66	56	75	54	57	31	36	19	32	22
16	85	61	79	53	74	56	54	43	31	11	31	20
17	83	66	83	62	76	51	54	36	39	12	30	20
18	86	63	81	65	80	50	54	31	44	26	25	9
19	93	75	82	62	80	52	60	34	40	24	31	10
20	91	69	86	62	82	55	67	44	43	28	34	24
21	82	66	83	63	87	62	63	40	50	37	46	25
22	75	58	72	54	83	67	58	45	39	24	50	32
23	76	51	73	50	71	55	56	41	39	24	48	26
24	80	51	74	45	75	51	53	39	45	28	37	24
25	83	57	76	46	73	61	48	30	50	34	50	27
26	84	60	77	54	68	47	49	26	47	33	58	29
27	85	66	79	61	72	46	58	41	53	36	53	32
28	88	67	75	55	65	47	65	37	36	30	37	29
29	84	68	81	53	58	44	50	37	34	30	46	34
30	81	63	74	53	76	54	44	36	35	29	46	31
31	74	57	73	43			44	32			32	26

MONTHLY PRECIPITATION, SAGINAW VALLEY RESEARCH FARM

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1989	1.09	0.34	1.40	2.05	5.03	6.25	1.06	2.92	4.43	1.72	3.24	0.48	30.01
1990	1.23	1.21	1.17	1.54	2.81	2.07	2.53	6.94	3.74	5.87	4.51	1.45	35.12
1991	0.85	0.60	3.68	6.61	3.71	2.66	4.53	2.61	1.50	3.52	2.04	1.24	31.58
1992	1.20	1.65	1.31	4.56	1.10	2.10	4.33	2.92	4.08	2.54	4.50	2.10	32.39
1993	2.72	0.47	0.87	4.08	2.76	3.03	2.46	4.62	4.00	3.70	1.99	0.53	31.23
1994	0.55	0.66	0.91	3.58	2.04	6.99	2.57	4.44	2.19	2.24	4.40	1.03	31.60
1995	1.67	0.35	1.38	2.72	1.44	1.96	1.29	5.00	1.33	2.39	4.05	0.79	24.37
1996	0.83	0.94	0.49	3.18	5.47	5.65	2.32	1.53	3.52	3.31	1.37	2.21	30.82
1997	1.51	4.25	1.32	1.38	3.00	0.69	2.44	3.61	3.46	1.31	1.03	0.36	24.36
1998	2.66	2.05	3.17	2.14	1.87	1.56	1.02	2.01	1.41	3.18	1.79	1.32	24.18
1999	2.75	0.41	0.62	5.01	2.33	3.07	5.02	3.01	2.52	1.12	1.04	1.90	28.80
2000	0.57	1.35	0.89	2.94	5.34	2.65	3.03	3.69	3.27	0.90	2.07	1.57	28.27
2001	0.33	3.16	0.11	2.38	4.42	2.45	0.53	3.52	4.34	4.90	1.76	1.61	29.51
2002	1.02	1.49	2.47	3.49	4.46	3.15	3.00	4.50	0.50	1.87	1.19	0.97	28.11
2003	0.27	0.21	1.66	0.36	4.19	2.04	2.49	1.33	1.99	1.09	5.35	1.20	22.18
2004	1.09	0.55	2.50	1.31	7.34	2.70	2.01	2.32	0.66	2.41	3.44	1.51	27.84
2005	2.90	0.71	0.62	1.32	1.74	4.97	3.20	0.72	0.72	1.30	3.83	1.49	23.52
2006	1.91	1.57	1.59	1.87	4.17	2.03	5.72	2.61	2.53	3.77	3.05	2.81	33.63
2007	1.11	0.35	1.27	3.02	2..20	1.06	2.59	4.80	2.64	2.86	0.89	1.93	22.52
2008	1.76	2.59	1.23	1.99	1.13	3.88	3.94	2.10	5.61	1.70	1.36	1.21	28.50
*2009	0.01	2.12	1.84	4.69	1.23	4.81	2.73	3.48	0.82	3.61	0.47	1.88	27.69
2010	0.14	0.20	0.40	2.15	3.36	2.71	0.89	1.27	3.11	1.94	1.97	0.42	18.56
2011	0.48	0.24	1.82	4.96	3.86	1.51	1.34	2.98	2.28	2.85	2.74	1.42	26.48
2012	1.86	0.76	1.41	1.19	3.92	1.10	3.62	4.03	1.60	4.29	0.38	1.41	25.57
2013	2.77	0.84	0.36	7.38	3.43	1.73	2.03	1.85	0.58	3.26	2.34	0.74	27.31
2014	0.47	0.55	0.92	3.99	3.06	2.74	4.17	3.90	3.03	2.10	2.07	1.49	28.49
2015	0.59	0.08	0.56	1.97	2.86	2.68	2.20	3.94	2.62	1.96	1.26	2.04	22.76
2016	0.94	0.73	4.09	1.30	1.59	1.51	3.47	5.15	2.03	2.11	2.14	0.81	25.87
2017	2.80	1.98	1.90	5.79	1.97	4.83	1.10	2.26	1.54	3.52	2.08	0.33	30.10
2018	0.71	1.96	0.54	2.82	2.14	1.47	1.98	7.90	1.92	2.65	1.27	2.17	27.53
2019	0.61	0.92	1.33	2.27	5.02	6.97	2.37	1.06	3.78	6.29	1.41	2.03	34.06
AVG.	1.25	1.11	1.37	2.96	2.96	2.78	2.57	3.29	2.39	2.58	2.25	1.30	26.80

**Station moved from Saginaw, MI to Richville, MI*

PRECIPITATION - SAGINAW VALLEY RESEARCH & EXTENSION CENTER- 2019

Day:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1		0.04			0.83	0.61	0.01		0.08	1.25	0.04	0.27
2		0.02	0.04	0.01	0.26	0.13	0.25		0.15	1.48	0.02	0.03
3	0.01				0.03					0.29		0.04
4		0.05									0.07	0.02
5				0.11		0.50	0.61			0.01		
6		0.02						0.05	0.33	0.01	0.03	
7	0.2	0.01			0.05						0.09	
8	0.02			0.03				0.2				
9			0.19		0.28	0.52	0.01					0.35
10			0.11			2.01			0.06			
11				0.04					0.67	0.15		
12		0.12		0.21					0.01	0.03	0.03	
13						0.72	0.01		0.07			
14		0.12	0.31	0.51							0.01	
15			0.03	0.08	0.04		0.19	0.26	0.01	0.01		
16				0.33					0.02	0.37		
17						0.05		0.05				
18				0.22				0.21				
19			0.25	0.13	0.27	0.04						
20		0.03	0.01	0.18		1.94	0.85					
21								0.02	0.15	0.24	0.19	
22					0.07		0.01		0.93	0.01		
23	0.37	0.10			0.28		0.02		0.19			
24		0.31				0.32						
25					2.70	0.05			0.01			
26				0.03				0.16		0.97	0.13	
27	0.01	0.04			0.11			0.01	0.28	0.10	0.80	
28		0.06		0.25	0.08	0.08			0.67			
29				0.14	0.01		0.41	0.10	0.15			0.63
30			0.38		0.01					0.38		0.69
31			0.01							0.99		
TOTAL	0.61	0.92	1.33	2.27	5.02	6.97	2.37	1.06	3.78	6.29	1.41	2.03

Rainfall is measured in inches

2019 YEAR END TOTAL - 34.06 INCHES

2019 Seedless Pickling Cucumber Variety Trial

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A pickling cucumber variety trial was planted at the Saginaw Valley Research and Extension Center (43.399097, -83.694497, Frankenmuth, Michigan). Bejo (BJ), Nunhems (NU), and Rijk Zwaan (RZ) seed companies donated parthenocarpic (seedless) varieties.

Materials and Methods

On 19 June, 2019, 20 varieties were planted in a completely randomized block design with four replications. Seeds were pre-counted and distributed into four rows by a cone planter. Rows were 20 ft long, 20 inches on-center, with 10 inch in-row spacing targeting 30,000 seeds per acre. The soil type was a Tappan-Londo loam with a poor-moderate drainage class, typical of the pickling cucumber-growing region of the Saginaw Valley.

On 30 May 175 pounds 46-0-0 was preplant incorporated, resulting in ~80 lb N per acre. On 19 June, immediately following planting, Curbit (ethalfluralin) and Command (clomazone) preemergent herbicide was applied at 2 pints per acre and 1 pint per acre, respectively. Fungicides were not required.

Four reps of all cultivars were harvested and measured between 5-11 Aug (day 47-53). Due to the low population, all plants were destructively harvested from both of the middle rows in the 4-row plots. All fruit were removed from the plants and sent through a sorter that separated and weighed them by the following sizes: 2As (1 1⁄16” – 1 ¼”), 2Bs (1 ¼” – 1 ½”), 3As (1 ½” – 1 ¾”), 3Bs (1 ¾” - 2”), and 4s (> 2” in diameter). L:D ratios and hollow center percentage were measured from ten cucumbers per size class, subsampled from a combination of all reps of a variety. Hollow centers were counted if a hole larger than 1⁄16” could be seen in the center of the seed cavity. Three holes along the outside of the seed cavity were not counted as anything. Fruit per plant, bushels per acre of each size class and combined total bushel per acre yield calculations do not include culls.

Results and Discussion

The top five varieties with the highest combined yields of 2B and 3A fruit were V 5031, RZ 74, RZ 79, Liszt, 53050, (Table 1). Of those, V 5031 had L:D ratios the closest to 3.0 in both 3A and 2B size classes. The top five varieties with the highest combined yields of 3A and 3B were Gershwin, 53050, Liszt, RZ 74, RZ 79. Of these, Gershwin had the L:D ratios the closest to 3.0 in both size classes. Cull rates were between 0.00% and 17.04%. The five varieties with the lowest cull percentages were 53053, Bowie, RZ 79, A4374, and V 5025. The five varieties with the highest cull percentages were Aristan, 53051, V 5031, Amarok, and RZ 74.

Most Bejo, Nunhems, and Rijk Zwaan varieties were harvested by day 48, but Gershwin and A4734 were harvested on day 51, and Ansor was harvested on day 53 (Table 2). The data on Table 1 suggest that Gershwin and A4734 could have been harvested along with most other varieties for a better yield of 3A’s and 2B’s.

On 1 July, the plant stands were calculated. The night following planting, the site received 2 inches of rain, and the ethalfluralin herbicide damaged plots such that populations averaged 14,995 plants per acre (Table 3).

Table 1. Yield data on 20 seedless picking cucumber varieties planted at the Saginaw Valley Research and Extension Center in 2019 arranged in order of highest combined yields of 3A and 2B fruit. Values are averaged across four replicates. Values in bold indicate that the variety performed statistically similar to the variety with the highest value for that column, as determined through a Least Significant Difference test at alpha = 5% and a two-tailed t-statistic ($_{(57,0.05\%)}$). NS indicates that there were no significant differences between varieties. Rows were 20 ft long, 20 inches on-center, with 10 inch in-row spacing targeting 30,000 seeds per acre and a final population of 14,995 plants per acre after ethalfluralin injury.

Variety	Bushels Per Acre						% Cull	Fruit Per Plant
	Total	**4**	**3B**	3A	2B	2A		
V 5031	279.2	11.3	48.5	**118.6**	**82.3**	18.6	**17.0**	1.7
RZ 74	231.6	0.0	31.4	**111.2**	**76.0**	13.0	**11.4**	1.8
RZ 79	**316.0**	0.0	23.3	**174.7**	**99.6**	18.5	9.1	**2.3**
Liszt	**309.3**	11.5	86.8	**114.3**	**83.4**	13.3	7.1	1.8
53050	**331.3**	0.0	52.5	**170.8**	**100.5**	7.4	6.5	**2.3**
V 5025	209.2	32.9	73.2	79.6	11.6	11.9	5.8	1.3
Bowie	279.6	0.0	60.1	**141.5**	65.3	12.7	5.7	1.7
Absolut	**335.8**	8.6	92.2	**142.5**	**80.8**	11.8	5.4	**2.3**
Aristan	189.8	27.3	77.6	55.4	20.8	8.6	5.4	1.1
Amarok	**385.1**	66.0	**198.0**	73.3	27.8	20.0	4.2	1.7
53054	**324.6**	13.1	81.2	**160.9**	57.9	11.4	4.2	1.8
53051	**291.2**	3.8	70.5	**123.9**	**71.4**	21.5	3.9	**2.2**
53053	256.9	59.5	41.9	61.4	69.8	24.3	1.7	**2.1**
RZ 80	206.6	0.0	37.5	105.4	51.5	12.2	1.2	1.3
Ansor	128.0	0.0	31.7	41.5	40.6	14.3	1.1	1.1
Gershwin	248.8	4.1	13.3	106.1	**106.3**	19.0	0.8	**2.2**
RZ 21	**301.2**	**123.5**	100.4	24.9	29.0	23.5	0.5	1.3
53052	**322.4**	3.1	68.6	**144.7**	**90.4**	15.6	0.0	**2.0**
A4737	258.7	0.0	33.6	**123.8**	**85.3**	16.1	0.0	1.4
A4734	234.3	3.3	65.9	104.4	55.0	5.6	0.0	1.6
Mean	272.0	18.4	64.4	108.9	65.3	15.0	4.6	1.7
CV	26.1	113.4	51.8	41.5	38.7	54.4	112.4	16.0
LSD	100.7	29.6	47.3	64.0	35.7	NS	7.2	0.4
p-value	<0.0001	<0.0001	<0.0001	0.00	<0.0001	0.08	0.0009	<0.0001

Table 2. Quality data on 20 seedless picking cucumber varieties planted at the Saginaw Valley Research and Extension Center in 2019 arranged in the same order as Table 1. Values are averaged across four replicates. No statistics were performed on quality data. Rows were 20 ft long, 20 inches on-center, with 10 inch in-row spacing targeting 30,000 seeds per acre and a final population of 14,995 plants per acre after ethalfluralin injury.

Variety	Company	L:D Ratios				% Hollow Centers	Days after planting	Harvest Population
		3B	3A	2B	2A			
V 5031	NU	2.7	2.9	3.1	3.2	0.0	47	14702
RZ 74	RZ	2.6	2.7	2.8	3.0	0.0	47	13558
RZ 79	RZ	2.7	2.8	3.1	3.1	0.0	47	15845
Liszt	RZ	2.6	2.8	2.9	3.1	0.0	47	13231
53050	NU	2.6	2.8	2.8	3.0	0.0	47	16335
V 5025	NU	2.7	3.0	3.2	3.2	0.0	47	13068
Bowie	RZ	2.7	3.0	2.9	3.5	0.0	48	17642
Absolut	BJ	2.6	2.8	3.1	3.1	0.0	47	16008
Aristan	BJ	2.4	2.8	2.9	3.2	0.0	48	16498
Amarok	BJ	2.5	2.7	2.8	2.9	0.0	48	17969
53054	NU	2.7	3.0	3.0	3.2	0.0	47	13068
53051	NU	2.7	2.8	2.9	3.1	0.0	47	13721
53053	NU	2.7	2.9	2.8	3.4	0.0	48	14702
RZ 80	RZ	2.8	2.9	3.0	3.4	0.0	48	15518
Ansor	BJ	2.5	2.9	3.1	3.1	0.0	53	11925
Gershwin	RZ	2.8	2.9	3.2	3.3	0.0	51	16662
RZ 21	RZ	2.7	2.8	2.8	3.2	0.0	48	13231
53052	NU	2.8	3.0	3.0	3.3	0.0	48	12415
A4737	BJ	2.7	2.8	2.9	3.1	2.5	48	15028
A4734	BJ	2.5	2.5	3.0	3.2	0.0	51	18785
Mean	-	2.6	2.8	3.0	3.2	0.1	48.1	14995.5
StDev	-	0.1	0.1	0.1	0.1	0.6	1.7	1955.6
CV	-	3.9	4.0	4.4	4.6	447.2	3.4	13.0

Table 3. Weather data summarized by weeks during the planting at the Saginaw Valley Research and Extension Center in 2019. Temperatures were averaged by week, and precipitation is accumulated inches. No statistics were performed on weather data. Ethalfluralin injury occurred in the first two days of the planting after 2 inches of rain.

Week	Max Air Temp	Min Air Temp	Max Soil Temp	Min Soil Temp	Precipitation (accumulated inches)
1	76.6	56.5	65.3	63.6	2.4
2	84.9	64.6	71.1	69.3	0.3
3	83.9	58.9	73.7	71.7	0.6
4	84.0	60.3	73.5	71.9	0.2
5	83.7	62.3	75.4	73.6	0.9
6	83.0	62.9	74.8	73.3	0.4
7	82.5	57.0	75.8	73.9	0.1
8	80.2	54.4	74.8	73.0	0.2
Mean	82.3	59.6	73.1	71.3	0.6
StDev	2.7	3.6	3.4	3.4	0.7
CV	3.3	6.0	4.7	4.8	117.6

Acknowledgements
Thanks to Kristin Oomen, Ken McCammon, Chris Dyk, Anthony Barbaglia, Robert Grohs, and George Pape at the seed companies; Paul Horny, and Dennis Fleischmann at the farm; Dave Brewer, Aaron, Joel, Tony, Todd, Mike, and others at Hausbeck's Pickle Company.

MSU Wheat Breeding and Genetics
Saginaw Valley Research and Extension Center 2019 Report

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Introduction

The counties of the thumb region have the highest yields in the state and account for up to 35% of all wheat bushels produced in Michigan. To observe high-end yield potential and target the largest production area of the state, MSU Wheat Breeding and Genetics conducts early generation selection and yield testing at the Saginaw Valley Research and Extension Center near Richville, MI.

Four large yield testing and breeding projects were conducted at SVREC in 2019. As part of the variety development program, advanced yield trials (AYT), preliminary yield trials (PYT), and the Uniform Eastern Soft White Winter Wheat Nursery were tested in order to target new high yielding varieties to the thumb region of Michigan.

Late planting was an issue across the state of Michigan in fall, 2018. However, SVREC was the first site planted by the wheat breeding program. A wet and cool spring delayed maturity by two weeks compared to average. Abundant rainfall provided moisture for growth and development. Cool temperatures during grain fill allowed for above average yields, 20 bushels per acre higher than 2018 when high temperature stress limited yields.

Advanced Yield Trials

Plant Materials

A total of 96 new soft red and white winter wheat lines were entered into advanced testing at SVREC in 2019. Soft white winter wheat check varieties were Ambassador and Whitetail. Soft red winter wheat check varieties were Agri-Maxx 413, DF 112R and SY 100.

Trial Design

Entries and checks were tested in two replicates in an alpha lattice design. In addition to SVREC, the advanced yield trial was tested in Gratiot, Ingham, Huron and Sanilac counties.

Results and Discussion

Grain yield was higher in 2018 than previous year due to adequate to cool than average temperatures throughout the growing season. Early season moisture was ideal for establishing good stands and trials were on track for good yield potential. The average

grain yield of the wheat breeding advanced yield trial was 20 bushels higher than 2018 when high temperature stress during grain fill lowered yields.

A total of six soft white winter wheat and nine soft red winter wheat lines have been advanced to further testing in the Michigan State Wheat Performance Trial using data collected from five locations including SVREC (Table 1). The soft white winter line, MI17W0224, was the overall highest yielding experimental breeding line tested. The soft red winter wheat line, MI17R0438, was the highest yielding line at SVREC at 120 bushels per acre.

Preliminary Yield Trials
Plant Materials
Preliminary yield trials were comprised of 200 new soft red and soft white winter wheat entries and the check varieties Ambassador, Pioneer 25R40 (Table 1).

Trial Design
Entries and checks were tested in two replicates in an alpha lattice design. In addition to SVREC, the advanced yield trial was tested in Gratiot, Ingham, Huron and Sanilac counties. Entries were split into two trials of 100 entries and two checks. Planting was in the last week of October, one month later than the advanced yield trial.

Results and Discussion
The one month difference in planting date resulted in a 16 bushel per acre yield reduction in the common check, Ambassador. The average of the two PYT trials were 82.4 and 80.3 bushels per acre. A total of 20 entries from the SVREC trials and 20 entries from preliminary yield trials at Mason, MI have been advanced to further testing in replicated testing across Michigan and the Eastern soft wheat region (Table 1).

Preliminary Yield Trials
Plant Materials
Preliminary yield trials were comprised of 200 new soft red and soft white winter wheat entries and the check varieties Ambassador, Pioneer 25R40 (Table 1).

Trial Design
Entries and checks were tested in two replicates in an alpha lattice design. In addition to SVREC, the advanced yield trial was tested in Gratiot, Ingham, Huron and Sanilac counties. Entries were split into two trials of 100 entries and two checks. Planting was in the last week of October, one month later than the advanced yield trial.

Results and Discussion
The one month difference in planting date resulted in a 16 bushel per acre yield reduction in the common check, Ambassador. The average of the two PYT trials were 82.4 and 80.3 bushels per acre. A total of 20 entries from the SVREC trials and 20 entries from preliminary yield trials at Mason, MI have been advanced to further testing in replicated testing across Michigan and the Eastern soft wheat region.

Uniform Eastern Soft White Winter Wheat Nursery

Plant Materials

The UESWWWN is comprised of soft white winter wheat entries from Michigan State University (MI entries), Cornell University (NY entries) and KWS Cereals. In 2019, the UESWWWN was comprised of 15 entries and five check varieties (Table 2). Lines from the UESWWWN are yield tested at SVREC and evaluated for FHB resistance traits in the misted and inoculated nursery on the MSU campus.

Results and Discussion

SVREC provided critical data for the Uniform White nursery cooperators. The soft white winter wheat from MSU, MI16W0528, was the highest yielding line overall and has been approved for variety release. MI16W0133 was not statistically different from the highest yielding soft white winter wheat line tested in this nursery has been approved for variety release.

Acknowledgements

MSU Wheat Breeding and Genetics is supported by The Michigan Wheat Program, The USDA-National Institute of Food and Agriculture, The US Wheat and Barley Scab Initiative, Michigan Crop Improvement Association, members of the Michigan Millers Association.

Table 1. Yield performance soft red and white winter wheat entries and check varieties in the MSU Wheat Breeding and Genetics advanced yield trial.

Line	Color	Overall Yield bu/ac	*Overall Rank*	SVREC Yield bu/ac	*SVREC Rank*	FHB % Severity
MI17W0224	White	113	*2*	108	*10*	39
MI17W0101	White	108	*7*	110	*8*	77
MI17W0133	White	108	*9*	102	*19*	55
Ambassador	White	108	*10*	111	*6*	87
CN18-20-2	White	107	*13*	104	*17*	87
MI17W0235	White	105	*15*	114	*4*	70
MI17W0100	White	104	*16*	107	*12*	85
Whitetail	White	103	*27*	103	*43*	49
Jupiter	White	102	*35*	99	*80*	62
DF 112 R	Red	115	*1*	115	*3*	44
MI16R0720	Red	112	*3*	106	*15*	76
MI17R0435	Red	110	*4*	106	*16*	53
MI16R0906	Red	109	*5*	107	*14*	69
SY 100	Red	108	*6*	116	*2*	57
MI17R0357	Red	108	*8*	107	*11*	43
MI16R1019	Red	108	*11*	107	*13*	69
MI16R0742	Red	108	*12*	110	*7*	35
MI17R0138	Red	107	*14*	109	*9*	38
MI17R0484	Red	104	*17*	102	*20*	40
MI17R0438	Red	103	*18*	120	*1*	70
AM 413	Red	96	*73*	111	*8*	45
Trial Mean		***99***		***103***		
LSD (0.05)		***2.0***		***3.6***		**-**

Table 2. Yield, agronomics and Fusarium head blight resistance in the Uniform Eastern Soft White Wheat Nursery.

Line	Yield bu/ac	Yield rank	Test Weight	FHB % severity	FHB % Incidence	FHB Index	Flowering JDF
Dyna Gro 9242	106	1	59	17	57	8	162
MI16W0528	**105**	**2**	**59**	**59**	**44**	**27**	**162**
KWS305	105	3	60	48	61	31	163
Ambassador	103	4	57	75	46	38	161
MI16W0133	**103**	**5**	**58**	**57**	**46**	**27**	**162**
KWS304	101	6	60	56	53	29	162
MI16W0129	**101**	**7**	**60**	**77**	**62**	**52**	**162**
KWS258	100	8	60	56	46	22	163
MI16W0522	**98**	**9**	**59**	**61**	**29**	**18**	**162**
KWS307	97	10	60	66	60	33	164
Jupiter	96	11	58	71	51	39	162
NY94052-6090-1074	95	12	59	53	51	28	162
MI16W0149	**95**	**13**	**60**	**35**	**46**	**15**	**162**
KWS306	95	14	60	49	66	35	162
VA12MAS7-519-1-3WS	94	15	60	49	54	28	163
NY11025-07-08-1369	93	16	58	51	56	28	163
NY11014-9-25-1319	93	17	59	31	49	15	162
NY99056-161	93	18	59	35	31	18	166
Caledonia	91	19	58	88	49	44	162
Cayuga	85	20	60	92	38	31	164
Trial Mean	*98*		*59*	*56*	*50*	*28*	*162*
LSD (0.05)	*3*		*1*	*25*	*36*	*26*	*1*

2019 DRY BEAN YIELD TRIALS

J.D. Kelly, E.M. Wright and A. Wiersma
Plant, Soil and Microbial Sciences

The dry bean-breeding program initiated its eleventh season on the 450-acre Saginaw Valley Research & Extension Center (SVREC) research farm near Frankenmuth MI in 2019. The program conducted 17 yield trials in 2019 in ten market classes and participated in the growing and evaluation of the Cooperative Dry Bean, Midwest Regional Performance, National Drought and the National Sclerotinia Nurseries in Michigan and winter nursery in Puerto Rico. The nurseries were planted late (18-19 June) due to an unusually wet spring (May-June; 12"). Bean trials received only 6.75" of rain following planting (June - mid Sept) with only 1.06" in August, so plants were under considerable stress during the critical reproductive phase resulting in overall lower yields. Harvest was challenging due to rainfall totals of over 4" the last week of September. Root rot caused by Rhizoctonia strain AG2-2 caused significant damage throughout the nurseries at SVREC. In contrast with 2018 season, yields were considerably lower in 2019 averaging 20 cwt/acre compared to average yields above 35 cwt/acre in 2018. A total of 2016 single plant selections were made in F_2 and F_4 nurseries and these will be sent to Puerto Rico for seed increase. Two 42-entry black bean trials were conducted side by side at SVREC to measure symbiotic N-fixation of elite black bean lines. One trial received no N while the other received normal fertility of 46 lbs/acre. Data was collected on a range of traits throughout the season using unmanned aerial devices (drones) and plots were sampled at key growth stages to determine N content. Symbiotic N-fixation will be determined using N15 natural abundance method. Yields in the non-fertilized trial ranged from 10.7 to 25.3 cwt/acre, mean 19.3 cwt/acre, compared to range from 16.6 to 24.5 cwt/acre, mean 21.7 cwt/acre in the fertilized trial. The no-nod check was the lowest yielding entry in both trials, but some lines produced consistent high yields in both trials in the absence of applied N.

Five nurseries were conducted at the Montcalm Research Farm (MRF) and all were irrigated. These included three kidney bean trials, a yellow bean trial and the National Sclerotinia white mold trial. Plots were planted June 8, but harvest was delayed due to wet fall conditions. Only the standard kidney trial was pulled and windrowed, whereas the preliminary white and red kidney trials were direct harvested late to salvage seed so yields are corresponding lower. One interesting observation was the lack of root rot infection (typically Fusarium) in these nurseries in 2019. The trial ground had been out of beans for four years which appeared to be a major contributing factor to the lower incidence of root rots. The 30-entry yellow bean trial was abandoned as a new anthracnose race 2 was identified that caused significant damage and any seed saved would be infected with this race. Anthracnose was also detected in Zenith fields in 2019 in Harrisville indicating that race 109 continues to be a problem in Northern Michigan.

A collaborative research project was initiated with Dr. James DeDecker (director of the MSU Upper Peninsula Research and Extension Center) to investigate the climate resilience of Michigan dry bean production and to promote dry bean production in Michigan's upper peninsula. A seed project was funded by PRI-GREEEN to determine how organic dry beans respond to environmental stresses predicted by climate models. This research was conducted in East Lansing and Chatham, MI and utilized rainout shelters to simulate drought stress conditions.

The data for all tests are included in an attached section. Procedures and details on nursery establishment and harvest methods are outlined on the first page. Since the data collected on each test are basically the same, a brief discussion of each variable measured is presented below for clarification purposes.

1. Yield is clean seed weight reported in hundredweight per acre (cwt/acre) standardized to 18% moisture content. Dry beans are commercially marketed in units of 100 pounds (cwt).

2. Seed weight is a measure of seed size, determined by weighing in grams a pre-counted sample of 100 seeds, known as the 100-seed weight. To convert to seeds per 100g (10,000/100 seed wt); for example, 100-seed weight of 50 converts to 200 seeds per 100 g (used in marketing).

3. Days to flower are the number of days from planting to when 50% of plants in a plot have one or more open flowers.

4. Days to maturity are the actual number of days from planting until date when all the plants in a plot have reached harvest maturity.

5. Lodging is scored from 1 to 5 where 1 is erect while 5 is prostrate or 100% lodged.

6. Height is determined at physiological maturity, from soil surface to the top of plant canopy, and is recorded in centimeters (cm).

7. Desirability score is a visual score given the plot at maturity that takes into consideration such plant traits as; moderate height, lodging resistance, good pod load, favorable pod to ground distance, uniformity of maturity, and absence of disease, if present in the nursery. The higher the score (from 1 to 7) the more desirable the variety, hence DS serves as a subjective selection index.

At the bottom of each table, the mean or average of all entries in a test is given to facilitate comparisons between varieties. In order to better interpret data, certain statistical factors are used. The LSD value refers to the Least Significant Difference between entries in a test. The LSD value is the minimum difference by which two entries must differ before they can be considered significantly different. Two entries differing in yield by 1 cwt/acre cannot be considered as performing significantly different if the LSD value is greater than 1 cwt/ acre. Such a statement is actually a statement of "probable" difference. We could be wrong once in 20 times ($p=0.05$) on the average, depending on the level of probability. The other statistic, Coefficient of Variation (CV), indicates how good the test was in terms of controlling error variance due to soil or other differences within a location. Since it is impossible to control all variability, a CV value of 10% or less implies excellent error control and is reflected in lower LSD values. Under the pedigree column, all released or named varieties are **bolded** and always preceded by a comma (,); when preceded by a slash (/), the variety was used only as a parent to produce that particular breeding line.

Expt. 9101: Standard Navy Bean Yield Trial

This 25-entry trial included standard commercial navy bean varieties, and advanced lines from the MSU breeding program, which carry the N-prefix and new lines from Ontario. Yields ranged from 16.5 to 25.0 cwt/acre with a mean of 20.7 cwt/acre. Variability in this trial was moderate (CV= 10.1%) and the LSD needed for significance was 2.5 cwt/acre. However, only two lines significantly out-yielded the test mean and the overall yields were lower compared to those of black beans. Alpena was the top variety in the trial followed by Medalist, which has underperformed in past years at this location. Vigilant and Merlin grouped below the test mean. Two new entries from Ontario were opposites in yield, ACUG-16-6 was second in the trial, while AC Portage yielded at bottom with 16.5 cwt/acre. The yield potential in navy beans needs to be improved, as they are no longer competitive with black beans. Canning tests will be conducted on all new MSU breeding lines before being considered for advance.

Expt. 9102: Standard Black Bean Yield Trial-N

This 42-entry trial included the standard commercial black bean varieties and advanced breeding lines. The trial was planted without any additional N. Yields ranged from 10.7 to 25.3 cwt/acre with a test mean of 19.3 cwt/acre. Variability was moderate in this test, (CV=11.2%) and the LSD was 3.0 cwt/acre. Only three entries significantly outyielded the test mean and they included B16504 for the fourth consecutive year. Black Bear was the top variety at 20.8 cwt/acre, while Zenith, Zorro, and Eclipse yielded at the test mean. Black Tails was the lowest yielding variety at 16.2 cwt/acre. As expected, R99 no-nod line that does not fix N was the lowest yielding entry in the test. Despite the dry conditions during pod fill, a number of lines performed well in the absence of N suggesting they have improved N-fixation capacity. This trait will be evaluated in lab tests using N15 natural abundance method. Given environmental concerns, there exists a need to identify lines that naturally fix higher levels of N that contributes to yield as N application rates of over 50 lbs/acre produce higher plant biomass, which results in greater white mold infections and resulting lower yields. Higher plant biomass does not always translate into higher seed yields, but usually results in the need for chemical desiccation prior to harvest.

Expt. 9103: Standard Black Bean Yield Trial +N

This 42-entry trial included the same standard commercial black bean varieties and advanced breeding lines as test 9102. The trial was planted with normal N treatment of 46 lbs/acre (100 lbs urea broadcast). Yields ranged from 16.6 to 24.5 cwt/acre with a test mean of 21.7 cwt/acre. Variability was lower in this test, (CV=8.2%) and the LSD was 2.5 cwt/acre. Only two entries significantly outyielded the test mean and B18504 ranked third at 24.1 cwt/acre. Black Bear was the top variety at 23.0 cwt/acre, while Zenith ranked above the test mean. Zorro, Black Tails and Eclipse yielded below the test mean. R99 no-nod line that does not fix N was the lowest yielding entry in the test, but yielded 7 cwt better than in test 9102 suggesting that N-fixation was important contributor to yield in the low N test 9102. The N-fixation capacity of all lines in this test will be evaluated in lab tests using N15 natural abundance method and directly compared to their N-fixation in the absence of N fertilizer. Canning tests will be conducted on new breeding lines to ensure only those with canning quality similar to Zenith are advanced.

Expt. 9104: Preliminary Navy Bean Yield Trial

This 84-entry trial included new navy bean lines (N19-prefix) and check varieties. Yields ranged from 16.1 to 26.2 cwt/acre with a mean of 22.0 cwt/acre. Variability was moderate in this 3-rep test (CV=10.5%) and the LSD was 3.1 cwt/acre. Thirteen lines significantly outyielded the test mean. Despite the higher yields compared to the standard test 9101, concerns exists over small seed size (<18g/100 seed) of many of the entries. Two check varieties Vigilant and Merlin performed below the test mean. Many of the lines in this trial carry anthracnose resistance in addition but will need to be screened against race 109. Future advances of any new breeding lines will largely depend on confirmation of disease reactions and canning quality of the entries. One interesting observation following direct harvest, seed loss due to shatter appeared to be higher in this trial than in adjacent black bean nurseries.

Expt. 9105: Preliminary Black Bean Yield Trial

This 56-entry trial included new black bean lines (B19-prefix) and check varieties. Yields ranged from 18.0 to 28.5 cwt/acre with a mean of 23.6 cwt/acre. Variability was controlled in this 3-rep test (CV=9.8%) and the LSD was 3.1 cwt/acre. Only four lines significantly outyielded the test mean including B18504. The test included a number of new varieties from other programs. OAC Vortex and Black Beard were the only two varieties to exceed the test mean. Varieties below test mean were Zenith, Black Spectre, AAC Knight Rider, Zorro and Eclipse. NE14-18-4 and NDF 120287 (Cobra) from NDSU dropped to the bottom of the trial. Future advances of any new breeding lines will largely depend on confirmation of disease reactions and canning quality of the entries.

Expt. 9106: Standard Great Northern Yield Trial

This 48-entry trial included MSU great northern breeding lines (G-prefix) and standard commercial check varieties. The test ranged in yield from 11.7 to 29.1 cwt/acre with a mean yield of 21.4 cwt/acre. Variability was moderate (CV= 13.4%) resulting in a LSD value of 3.5 cwt/acre needed for significance. Only three entries significantly outperformed the test mean. G16351 line consistent performer over the last 3-years dropped to 7th place in the trial. The checks included Powderhorn and Taurus from Nebraska. Taurus lodges more and is very susceptible to white mold. The high variability in the trial was due to physiological disorder referred to as 'green spot' where plants do not set normal pods but tiny sterile pods which abort so the plant continues to grow vegetatively and remain green into maturity, hence the name. This phenomenon appears to be due to a mycoplasma type organism but this has not been confirmed. As a result infected plants are sterile and all genotypes appear to be equally susceptible to this disorder.

Expt. 9107: Standard Pinto Bean Yield Trial

This 36-entry trial included MSU pinto lines (P-prefix) and standard commercial check varieties. The test ranged in yield from 12.9 to 22.9 cwt/acre with a mean yield of 18.6 cwt/acre. Variability was moderate (CV= 14.3%) resulting in a LSD value of 3.1 cwt/acre needed for significance. Five entries significantly outperformed the test mean and included P16901 the top entry in 2017 and 2018. Checks included standards Eldorado, La Paz and the slow dark pintos Palomino, and

Staybright. The new ND Falcon from NDSU significantly underperformed the test mean at 14.7 cwt/acre. Breeding efforts to incorporate the slow dark trait into pinto beans appears to be bringing along negative traits that are negatively impacting yield due to genetic linkage drag. To overcome linkage drag, F_3 lines expressing the slow dark trait were topcrossed with elite germplasm in the 2018 crossing block. The future of traditional pinto bean seed types in the marketplace is uncertain complicating future breeding efforts in this seed class. Breeding line P16901 is under consideration for release as a standard pinto seed type. The high variability in this test was also due to the green spot phenomenon as described in the adjacent great northern test 9106.

Expt. 9108: Standard Small Red and Pink Bean Yield Trial

This 42-entry trial included small red and pink breeding lines from MSU (R-small red; S-pink prefix), in addition to standard commercial check varieties. The test ranged in yield from 18.1 to 28.3 cwt/acre with a mean yield of 21.6 cwt/acre. Variability was moderate (CV=13.3%) resulting in a LSD value of 3.4 cwt/acre for significance. Only three lines significantly outyielded the test mean. These included a family of new pink S18-lines that tended to be later maturing and less erect, similar to results in 2018. In 2019, small red R17604 showed superiority over other two sibs (R17603, R17605). This family showed outstanding architecture, and performance in 2017, but fell below test mean in 2018. Cayenne and Viper small red varieties yielded above mean (~22 cwt/acre) well ahead of Merlot, lowest yielding entry at 18.6 cwt/acre. As in past years, seed size of Viper (28g) is significantly smaller than that of Merlot (38g) and Cayenne (34g). Progress in pink and small red breeding programs has been limited by a lack of useful variability and inability to combine performance with upright architecture and suitable canning quality in new lines. All new lines will be evaluated for canning quality and BCMV reaction prior to advancing to 2020 trials. The high variability in this test was due to heavy infection of Rhizoctonia strain AG2-2. Some plots were completely damaged while others showed moderate plant stand losses. This was the worst Rhizoc infection observed on SVREC in the past 11 years. The land south of M46 adjacent to the town of Richville is more variable in soil type and has unacceptable disease inoculum levels that compromises any research conducted on these fields.

Expt. 9109: Combined Midwest Regional Performance Nursery (MRPN) & Cooperative Dry Bean Nursery (CDBN) Yield Trial

The MRPN is conducted annually in cooperation with North Dakota (ND-prefix), Nebraska (NE-prefix) and Colorado (CO-prefix) in order to test new pinto, great northern and small red lines from all four programs and assess their potential in the different regions. The CDBN is a national trial and includes all classes but only medium-sized entries were included in this trial. The 36-entry trial ranged in yield from 15.1 to 27.2 cwt/acre with a mean of 23.0 cwt/acre. Variability was moderate (CV=11.5%) resulting in a LSD value (3.6 cwt/acre) for significance. As a result, only three lines were significantly higher in yield than the test mean including a new GN variety Pegasus from NDSU. The small red line R17604 ranked 4th and pinto line P16901 ranked 5th followed by Cayenne. Powderhorn yielded 24.7 cwt/acre in this test compared to 11.7 cwt/acre in test 9106, resulting from the green spot problem. This trial was also damaged by Rhizoc but not to the same degree as adjacent test 9108. This cooperative trial continues to be valuable as it allows an evaluation of potential new lines prior to release in other states. Canning quality will also be evaluated for all entries.

Expt. 9110: National Dry Bean Drought Nursery

This 32-entry trial was conducted at the SVREC to evaluate a series of breeding lines identified through shuttle breeding between University Nebraska and USDA-TARS station in Puerto Rico as possessing improved levels of drought stress. The trial was replicated by colleagues at various locations across the US. Yields ranged from 15.1 to 26.2 cwt/acre with a mean of 21.5 cwt/acre. Variability was moderate (CV=10.5%) and the LSD needed for significance was 3.1 cwt/acre. Six lines significantly out-yielded the test mean, including Cayenne, pinto P16901, PK pink, PT pinto, SR small red from USDA-WA and NE4-18-23 slow dark pinto from NE. G16351 and B18504 from MSU ranked 7th and 8th. As in 2018, Marquis GN was the lower yielding variety. Since drought was a major limiting factor in 2019, it was gratifying to see that new MSU varieties were performing in the top group. This suggests that continued selection for high performance under local precipitation patterns has resulted in materials that exhibit improved performance under stressful conditions.

Expt. 9211: Standard Kidney Bean Yield Trial

This 42-entry trial was conducted on original trial ground at MRF, following a four year rotation, to compare the performance of standard and new light red kidney (LRK), dark red kidney (DRK), white kidney (WK), varieties from MSU and CDBN under supplemental irrigation (12x total 7.25"). A prominent feature of this trial was lack of root rot disease pressure and lack of deer feeding due to the erection of a deer fence. Yields ranged from 17.5 to 39.7 cwt/acre with a mean of 30.8 cwt/acre. Variability was moderate (CV=10.8%) resulting in a LSD value of 3.9 cwt/acre needed for significance. Eleven entries significantly out-yielded the test mean, included mostly new breeding lines and two varieties, Snowdon and OAC Racer. Racer is a large seeded (71 g/100seeds) cranberry bean from Ontario and its performance is worth noting as two other cranberry varieties AAC Scotty and OAC Candycane yielded under 20 cwt/acre due in large part to extreme susceptibility to white mold. Two LRK sib lines K17703, K17704 continue to outperform all other LRK lines. Check varieties Red Cedar, Coho, and Montcalm grouped above test mean at 33 cwt/acre, while Rosie, Beluga, Big Red, Chaparral, and CELRK, fell below the mean. All check varieties had CBB scores of 3 or greater indicating susceptibility to common bacterial blight while many new lines had lower scores of 1 to 2. These results provide a comparison of the performance, seed size, maturity and disease reaction of all current red and white kidney bean varieties.

Expt. 9212: Standard Yellow Bean Yield Trial

This 30-entry trial was abandoned due a severe outbreak of anthracnose that was sourced to the two check varieties Patron and SVS-0863 that spread throughout the trial from seed saved in 2018. Any seed saved in 2019 would carry the disease, so none was harvested. The race was characterized as race 2 to which all entries appeared to be susceptible. This was a major setback in this program as the present emphasis had been on developing virus resistant lines with good yellow color development at harvest. A reemphasis on incorporating anthracnose resistance will be initiated in this class.

Expt. 9213: Preliminary White Kidney Bean Yield Trial

This 40-entry trial was conducted to compare the performance of new white kidney bean lines from MSU grown under supplemental irrigation (12x total 7.25"). The trial was direct harvested (salvaged) as harvest had been delayed by weeks of wet weather. Yields were lower and ranged from 17.6 to 35.0 cwt/acre with a mean of 26.0 cwt/acre. Variability was moderate (CV=9.8%) in this 3-rep experiment resulting in a LSD value of 3.5 cwt/acre needed for significance. Check varieties Beluga, Snowdon and the new ND Whitetail fell below the trial mean. Eleven lines significantly outyielded the test mean and these included all new K19-lines that varied considerably in maturity. Even though these lines showed good levels of CBB resistance (scores ~1-2), large seed size and (bullet) shape will be important selection criteria in future trials. Since canning quality is critical in white kidney beans, only those lines equivalent in canning quality to Beluga will be advanced in 2020.

Expt. 9214: Preliminary LRK and DRK Bean Yield Trial

This 56-entry trial was conducted to compare the performance of new red kidney bean lines from MSU grown under supplemental irrigation (12x total 7.25"). The trial was direct harvested (salvaged) as harvest had been delayed by weeks of wet weather. Yields were lower and ranged from 5.4 to 36.0 cwt/acre with a mean of 21.7 cwt/acre. Variability was moderate (CV=10.7%) in this 3-rep experiment resulting in a LSD value of 3.1 cwt/acre needed for significance. Twenty-one lines significantly outyielded the test mean and these included Red Cedar, Coho and Montcalm varieties and two DRK lines K16131 and K16136 continue to show promise. Combining acceptable seed size (~60 g/100seeds) with low CBB scores (1-2) will be emphasized in selection in future years in the K19-lines. Later maturity seems to be a factor that also needs to be addressed in the LRK class as the early season varieties Clouseau and CELRK underperformed. Since canning quality is vital in red kidney beans, only those lines equivalent in canning quality to check varieties will be advanced in 2020.

Expt. 9215: National White Mold Yield Trial

This 32-entry trial was conducted to evaluate a range of diverse dry bean varieties and breeding lines for reaction to white mold under natural field conditions. Genotypes included commercial navy and black bean cultivars, elite MSU lines, and new sources of white mold resistance entered as part of the National *Sclerotinia* Initiative (NSI) Nursery. Lines in the National trial were developed at MSU, USDA-WA, and NDSU. Entries were planted in two row plots with two rows of susceptible spreader variety Samurai between plots and were direct harvested. Plots were fertilized with 100 lbs N/ acre to promote vegetative growth and supplemental overhead irrigation was applied 19 times for a total of 11.8" to maintain adequate levels of moisture for favorable disease development at the critical flowering period. The trial was planted on original bean land previously infected with white mold. Natural white mold infection occurred, and was very severe on both spreader rows and check varieties. White mold was rated on a per plot basis on a scale of 1 to 9 based on disease incidence and severity where 9 had 90+% incidence and high severity index. White mold ranged from 22.2 to 96.3% with a mean value of 51%. The susceptible check Beryl had the highest white mold rating. The test ranged in yield from 11.1 to 44.7 cwt/acre with a mean yield of 30.0 cwt/acre. Variability was moderate (CV=15.9%), thus a high LSD value (6.5 cwt/acre) was needed for significance. Seven lines significantly out-yielded the test mean and

included Cayenne, and its parental line SR9-5 from USDA-WA. It is interesting that at this location with high-input management all the medium seeded pinto, GN and small red lines significantly outperform the small seeded black and navy bean lines. Two new R17-red lines and two new P16-pinto lines fell in the top group similar to results in 2018. G16351 and P16901 ranked 8th and 10th exceeded 36 cwt/acre despite high white mold infection levels, supporting the importance of stand ability and lodging resistance in white mold avoidance. The higher N rates coupled with excessive irrigation contributes to lodging and the higher white mold scores. Similar observations were made with the two black lines. Stand ability was a key trait in avoiding white mold in this trial and new line B18504 tended to lean due to heavy pod load and contracted higher white mold levels as a result. The trade off in erectness versus yield (pod load) is a major factor in avoidance of white mold. Interestingly the two checks, G122 resistant check yielded the same as the susceptible check Beryl (12.4 cwt/acre) yet differed in white mold infection from 22% to 96%. This trial will continue to be part of the breeding effort to improve tolerance to white mold in future varieties in 2020.

Expt. 9416: Rainout Shelter Trial

This trial was a sister trial to a similar one being conducted at the Chatham research farm in the Upper Peninsula as part of a climate resilience research effort on dry beans. The purpose was to use rainout shelters to identify bean lines with tolerance to drought and adapted to conditions in the central UP of MI. A second objective was to determine N-fixation capacity of lines grown under water stress. The site in the UP was on dedicated organic land whereas no N was applied to plot on the Soils Farm at East Lansing where test 9416 was conducted. Funding came from Project GREEEN/PRI initiative. Four lines were compared under normal and rainout conditions. These included Rosetta pink, Cayenne small red, B18504 black and no nod line R99 used in tests 9102 and 9103. The yields at EL ranged from 7.9 to 20.3 cwt/acre with a mean of 16.7 cwt/acre. The variability was very high (CV=22.9%) and the LSD needed for significance was 4.6. Only a slight reduction in yield was observed between plots under the rainout shelters (mean: 16.2 cwt/acre) compared to plots without rainout shelters (mean: 17.2 cwt/acre), and the difference was not statistically significant. Surprisingly, the varieties Rosetta and Cayenne both performed slightly better under rainout shelters than they did without rainout shelters. This could be due to the fact that red and pink beans tend to be more drought hardy compared to other bean market classes.

Expt. 9417: Phaseolus Improvement Cooperative (PIC) Observation Trial

As part of the continued focus of the Plant Resilience Institute (PRI) we retested 24 PIC lines (20 lines and 4 local checks) from Dr. Timothy Porch USDA-ARS, Mayaguez PR. These entries were among the best adapted in MI in 2018. The PIC lines are mainly large seeded kidney, cranberry and yellow lines that have been bred for tolerance to heat stress. We wanted to confirm their adaptation to MI conditions as most originate from crosses with tropical germplasm from South America and East Africa. The lines were planted late (June 28) in 2-row plots, with a common border on the Soils Farm in East Lansing. Growing conditions were sub optimum all season starting with excessive wet conditions, dry during the reproductive stage and wet during harvest. Data was collected on maturity, height, lodging, seed size and yield (3-rep). Due to wet conditions the plots were direct harvested, which reflects the lower yields. Yields ranged from 1.2 to 18.4 cwt/acre with a mean of 6.1 cwt/acre and variability was very high (CV=21.5%). Five lines significantly out-yielded the test mean and included check variety Coho (10.6 cwt),

followed by K17703 LRK (8.1 cwt). Two top entries were rated as equivalent to the best checks and were selected as parents for crossing to broaden the genetic base of local kidney, and cranberry bean classes.

Early Generation Breeding Material grown in Michigan in 2019

F3 through F5 lines
Navy and Black - 416 lines
Pinto - 26 lines
GN - 69 lines
Pinks and Reds – 67 lines
Kidneys (DR, LR, White) - 86 lines
Yellow – 9 lines

F2 populations
Navy and Black -105 populations
Pinto - 44 populations
GN & Tebo - 25 populations
Pinks and Reds - 33 populations
Kidneys (DR, LR, White) - 103 populations
Yellow – 29 populations

F1 populations: 392 different crosses among ten contrasting seed types.

2019 DRY BEAN YIELD TRIALS

Experiment	Title	Planting Date	Location	Entries	Design	Reps	Harvest Method
9101	STANDARD NAVY BEAN YIELD TRIAL	6/18/2019	SVREC	30	REC. LATTICE	4	DIRECT
9102	STANDARD BLACK BEAN YIELD TRIAL -N	6/18/2019	SVREC	42	REC. LATTICE	4	DIRECT
9103	STANDARD BLACK BEAN YIELD TRIAL +N	6/18/2019	SVREC	42	REC. LATTICE	4	DIRECT
9104	PRELIMINARY NAVY BEAN YIELD TRIAL	6/18/2019	SVREC	84	ALPHA LATTICE	3	DIRECT
9105	PRELIMINARY BLACK BEAN YIELD TRIAL	6/18/2019	SVREC	56	REC. LATTICE	3	DIRECT
9106	STANDARD GREAT NORTHERN BEAN YIELD TRIAL	6/19/2019	SVREC	48	ALPHA LATTICE	4	DIRECT
9107	STANDARD PINTO BEAN YIELD TRIAL	6/19/2019	SVREC	36	SQ. LATTICE	4	DIRECT
9108	STANDARD RED AND PINK BEAN YIELD TRIAL	6/19/2019	SVREC	42	REC. LATTICE	4	DIRECT
9109	MIDWEST AND CO-OP REGIONAL TRIAL	6/19/2019	SVREC	36	SQ. LATTICE	3	DIRECT
9110	NATIONAL DRYBEAN DROUGHT YIELD TRIAL	6/19/2019	SVREC	32	ALPHA LATTICE	3	DIRECT
9211	STANDARD KIDNEY BEAN YIELD TRIAL	6/8/2019	MRF	42	REC. LATTICE	4	ROD PULLED
9212	STANDARD YELLOW BEAN YIELD TRIAL	6/8/2019	MRF	24	ALPHA LATTICE	4	ABANDONED
9213	PRELIMINARY WHITE KIDNEY BEAN YIELD TRIAL	6/8/2019	MRF	40	ALPHA LATTICE	3	DIRECT
9214	PRELIMINARY LIGHT AND DARK RED KIDNEY YIELD TRIAL	6/8/2019	MRF	56	REC. LATTICE	3	DIRECT
9215	NATIONAL WHITE MOLD YIELD TRIAL	6/8/2019	MRF	32	ALPHA LATTICE	3	DIRECT
9416	RAINOUT SHELTER YIELD TRIAL	6/28/2019	EL	8	RCBD	4	HAND PULLED
9417	ADVANCED PIC YIELD TRIAL	6/28/2019	EL	24	ALPHA LATTICE	3	DIRECT

PROCEDURE: PLANTED IN 4 ROW PLOTS, 20 FEET LONG, 20 INCH ROW WIDTH, 4 SEEDS/FOOT, 15 FOOT SECTION OF CENTER 2 ROWS WAS HARVESTED AT MATURITY.

SVREC-FRANKENMUTH: FERTILIZER BROADCAST: 350# OF 8-27-19 + S, ZN,MN PRIOR TO PLANTING.
HERBICIDES APPLIED: 1.0 PT DUAL + 1.25 QT EPTAM APPLIED PPI.
INSECTICIDE: 9.6 OZ. ASANA ON JULY 10.

MRF-ENTRICAN: FERTILIZER BROADCAST: 200# OF 19-10-19 PRIOR TO PLANTING. 100# 46-0-0 SIDE DRESSED ON JULY 11.
HERBICIDES APPLIED: 1.0 QT DUAL + 1.25 QT EPTAM + 1.0 QT SONOLAN APPLIED PPI. 4 OZ. RAPTOR + 13 OZ. REFLEX + 1 PT. BASAGRAN + 8 OZ. SELECT ON JULY 1.
INSECTICIDE: 4 OZ MUSTANG MAX ON JULY 19.

EL-EAST LANSING: FERTILIZER BROADCAST:100# OF 46-0-0 PRIOR TO PLANTING ON TRIAL 9417.
HERBICIDES APPLIED: 1.0 QT DUAL + 1.25 QT EPTAM + 1.0 QT SONOLAN APPLIED PPI. 4 OZ. RAPTOR + 13 OZ. REFLEX + 1 PT. BASAGRAN + 8 OZ. SELECT ON JULY 31.
INSECTICIDE: 4 OZ. MUSTANG MAX ON JULY 31.

EXPERIMENT 9101 STANDARD NAVY BEAN YIELD TRIAL								PLANTED: 6/18/19	
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**
N18103	N13120/PR00806-81	18	25.0	20.5	42.0	92.0	1.0	51.0	6.0
I19713	ACUG-16-6	24	23.3	17.5	41.0	95.0	2.0	47.7	3.0
N11283	MEDALIST/N08003, **ALPENA**	4	22.7	18.3	45.0	92.0	1.0	51.0	4.7
I08958	Mayflower/Avanti, **MEDALIST**	22	22.6	18.7	41.0	94.0	1.0	49.7	4.3
N17505	N14230/N12447	10	22.4	19.4	47.0	91.0	1.0	51.0	5.3
N18128	N15341/N14238	13	22.3	20.5	46.0	91.0	1.0	48.7	4.3
N19285	G14505/X16708	25	22.3	24.1	46.0	93.0	1.0	48.3	4.0
N18130	N15341/N14238	17	22.1	19.1	48.0	91.0	1.0	53.0	5.3
N18104	N13131/N14201	8	22.0	20.3	44.0	91.0	1.0	50.3	4.3
N18127	N14201/N13131	6	21.9	16.2	47.0	91.0	1.0	48.0	4.0
N18109	N13131/B14302	9	21.5	19.8	44.0	91.0	1.0	49.7	4.3
N18122	N15334/N15335	12	21.4	22.0	43.0	92.0	1.0	52.7	5.0
N18105	N13131/N14201	14	21.1	20.7	45.0	91.0	1.0	49.3	4.3
N18119	N14218/N15341	7	21.1	17.4	44.0	91.0	1.0	50.3	4.7
N17506	N14230/N12447	5	20.6	17.9	50.0	92.0	1.0	50.3	5.0
N15306	N11230/N11298	11	20.3	16.9	47.0	93.0	1.0	53.0	5.7
N18102	N13120/PR0806-81	3	20.2	19.5	43.0	91.0	1.0	49.0	5.3
N19284	G14505/X16708	21	19.9	24.7	50.0	96.0	1.0	52.3	4.3
N19289	N14243/N14218	29	19.9	18.4	49.0	92.0	1.0	49.0	5.0
N18117	N14201/N15334	2	19.7	17.0	49.0	94.0	1.0	52.7	5.0
I10101	COOP 02084, **VIGILANT**	15	19.6	19.0	41.0	91.0	1.0	51.7	4.3
N19283	N14243/N14218	20	19.6	18.0	50.0	92.0	1.3	52.7	5.7
N19286	G14505/X16708	26	19.6	17.9	47.0	93.0	1.3	50.0	3.7
N18116	N14201/N15334	1	19.1	17.8	47.0	92.0	1.0	53.0	5.3
N19290	N13142/B14302	30	19.1	18.3	49.0	93.0	1.3	51.0	5.7
N19288	G14505/X16705	28	18.9	21.9	45.0	91.0	1.0	47.7	4.3
I11264	COOP 03019, **MERLIN**	16	18.9	18.9	40.0	94.0	1.3	51.3	4.7
N19287	G14505/X16705	27	17.5	23.5	41.0	90.0	1.0	44.7	3.3
I19712	W2363X-67629BL/OAC Rex, **AC PORTAGE**	23	16.5	19.5	38.0	90.0	1.0	46.0	3.3
MEAN(30)			20.7	19.5	44.8	92.1	1.1	50.2	4.6
LSD(.05)			2.5	0.7	3.3	1.4	0.3	2.0	0.6
CV%			10.1	3.2	4.3	1.1	19.7	2.9	9.4

EXPERIMENT 9102 STANDARD BLACK BEAN YIELD TRIAL -N								PLANTED: 6/18/19	
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE
B16504	Zenith//Alpena*/B09197	2	25.3	18.7	46.0	92.0	1.0	49.5	5.0
B17207	B10244/B12724	6	22.8	17.8	46.0	92.0	1.0	49.0	5.0
B17897	B14302/B10244	23	22.4	17.8	46.0	94.0	1.0	51.5	6.0
B17472	B14311/B10244	21	21.4	17.6	46.0	94.0	1.0	50.5	5.5
B16501	Zenith/B10215	7	20.9	19.7	46.0	93.0	1.0	46.5	4.5
B18232	B15430/B10244	34	20.9	20.0	45.0	92.0	1.0	49.5	5.0
I17501	BL12576, **BLACK BEAR**	39	20.8	18.3	46.0	95.0	1.0	51.0	5.0
B17269	B10244/B12724	9	20.6	19.6	46.0	91.0	1.0	46.5	4.0
B18231	B15430/B10244	32	20.6	20.0	47.0	92.0	1.0	48.5	5.0
B17220	B10244/B12724	27	20.4	18.8	44.0	93.0	1.0	48.0	4.0
B17922	B14302/B10244	16	20.3	18.7	46.0	91.0	1.0	48.5	4.5
B17832	B14302/B10244	19	20.3	17.5	47.0	94.0	1.0	46.5	3.5
B18504	Zenith//Alpena*/B09197	1	20.0	18.8	45.0	93.0	1.0	50.5	5.5
B17426	B14311/B10244	24	19.8	17.8	46.0	94.0	1.0	50.5	5.0
B17259	B10244/B12724	10	19.8	17.9	47.0	92.0	1.0	48.5	4.5
B17887	B14302/B10244	14	19.8	18.5	47.0	93.0	1.0	51.5	6.0
B10244	B04644/ZORRO, **ZENITH**	5	19.8	19.1	47.0	93.0	1.0	51.0	5.5
I03390	ND9902621-2, **ECLIPSE**	41	19.8	19.6	45.0	90.0	1.0	47.0	4.0
B04554	B00103*/X00822, **ZORRO**	38	19.7	17.8	47.0	95.0	1.0	51.5	5.0
B17315	B10244/B12724	4	19.6	17.4	48.0	94.0	1.0	52.5	5.5
B18204	B10244/B15430	30	19.6	19.7	44.0	92.0	1.0	46.0	4.0
B17431	B14311/B10244	26	19.5	17.2	47.0	92.0	1.0	47.0	4.5
B17262	B10244/B12724	13	19.3	17.8	47.0	94.0	1.0	50.5	4.5
B18230	B15428/B15418	35	19.3	20.3	49.0	93.0	1.0	46.0	4.0
B17536	B14311/B10244	18	19.3	17.4	46.0	94.0	1.0	49.0	5.0
B18236	B14303/B12724	29	19.1	17.9	46.0	92.0	1.0	47.5	5.0
B15447	B11363/Zenith	3	19.1	19.8	47.0	92.0	1.0	49.0	4.5
B18224	B15418/B10244	36	19.0	22.2	46.0	92.0	1.0	48.0	4.5
B18201	B10244/B13218	28	19.0	18.8	45.0	92.0	1.0	47.5	4.5
B18202	B10244/B13218	33	18.9	18.5	48.0	91.0	1.0	45.5	3.5
B17429	B14311/B10244	25	18.8	20.3	46.0	94.0	1.0	51.5	5.0
B17844	B14302/B10244	20	18.4	19.7	47.0	92.0	1.0	46.5	4.5
B16505	B11363//Alpena*/B09197	11	18.3	18.1	45.0	91.0	1.0	47.5	4.5
B17023	B14303/B10244	15	18.3	18.4	46.0	93.0	1.0	47.5	4.5
B17449	B14311/B10244	17	18.1	18.0	47.0	94.0	1.0	50.0	4.5

EXPERIMENT 9102 STANDARD BLACK BEAN YIELD TRIAL -N								PLANTED: 6/18/19	
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**
B17298	B10244/B12724	8	17.8	17.6	46.0	91.0	1.0	45.5	3.5
B17522	B14311/B10244	22	17.4	17.2	46.0	91.0	1.0	46.0	4.0
B16503	Zenith/B12720	12	17.4	20.9	47.0	92.0	1.0	47.0	4.0
B18238	B14303/B12724	37	17.2	17.7	45.0	94.0	1.0	50.0	4.5
I18625	**BLACK TAILS**	40	16.2	18.9	45.0	91.0	1.0	49.0	3.5
B18237	B14303/B12724	31	14.3	19.4	47.0	94.0	1.0	49.0	5.0
I07112	R99 NO NOD	42	10.7	17.0	46.0	98.0	2.0	47.5	3.5
MEAN(42)			19.3	18.7	45.9	92.5	1.0	48.6	4.6
LSD(.05)			3.0	0.8	1.6	1.9	0.0	3.0	1.4
CV%			11.2	3.6	2.1	1.2	1.1	3.6	18.4

EXPERIMENT 9103 STANDARD BLACK BEAN YIELD TRIAL +N								PLANTED: 6/18/19	
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE
B16501	Zenith/B10215	7	24.5	20.1	47.0	93.0	1.0	50.5	5.0
B17220	B10244/B12724	27	24.3	19.4	45.0	92.0	1.0	49.0	4.5
B18504	Zenith//Alpena*/B09197	1	24.1	19.7	46.0	93.0	1.0	50.5	5.5
B18236	B14303/B12724	29	23.9	19.9	46.0	92.0	1.0	49.0	5.0
B17897	B14302/B10244	23	23.7	18.4	46.0	92.0	1.0	48.5	4.5
B16505	B11363//Alpena*/B09197	11	23.4	19.6	46.0	92.0	1.0	48.0	5.0
B18204	B10244/B15430	30	23.4	21.0	45.0	93.0	1.0	49.5	5.5
B18224	B15418/B10244	36	23.3	23.8	46.0	93.0	1.0	50.5	5.5
B18232	B15430/B10244	34	23.2	21.0	46.0	92.0	1.0	50.5	5.0
B16504	Zenith//Alpena*/B09197	2	23.1	19.4	45.0	93.0	1.0	52.0	6.0
I17501	BL12576, **BLACK BEAR**	39	23.0	18.8	46.0	95.0	1.0	50.5	5.0
B17922	B14302/B10244	16	23.0	18.8	46.0	92.0	1.0	49.5	5.0
B18231	B15430/B10244	32	22.9	21.0	47.0	93.0	1.0	49.5	5.5
B17207	B10244/B12724	6	22.8	18.2	46.0	92.0	1.0	48.0	4.5
B17431	B14311/B10244	26	22.7	18.7	46.0	92.0	1.0	49.0	5.0
B17259	B10244/B12724	10	22.6	19.5	47.0	93.0	1.0	50.0	5.0
B17536	B14311/B10244	18	22.6	19.2	47.0	93.0	1.0	49.0	4.5
B18230	B15428/B15418	35	22.5	22.7	45.0	92.0	1.0	47.5	4.5
B17023	B14303/B10244	15	22.2	19.6	45.0	93.0	1.0	49.0	4.5
B17844	B14302/B10244	20	22.1	19.2	47.0	93.0	1.0	48.0	5.0
B18237	B14303/B12724	31	22.1	21.6	45.0	94.0	1.0	50.5	5.5
B17298	B10244/B12724	8	22.0	18.9	46.0	91.0	1.0	47.0	4.0
B17269	B10244/B12724	9	21.9	19.8	47.0	92.0	1.0	48.0	4.0
B17429	B14311/B10244	25	21.8	21.7	47.0	94.0	1.0	53.5	5.5
B10244	B04644/ZORRO, **ZENITH**	5	21.6	19.9	47.0	93.0	1.0	50.5	5.5
B18201	B10244/B13218	28	21.6	19.1	46.0	92.0	1.0	48.0	4.5
B18238	B14303/B12724	37	21.5	19.3	45.0	91.0	1.0	47.5	4.5
B17262	B10244/B12724	13	21.3	18.3	47.0	94.0	1.0	51.5	5.5
B18202	B10244/B13218	33	21.3	19.8	46.0	93.0	1.0	50.5	5.0
I18625	**BLACK TAILS**	40	20.9	20.3	45.0	92.0	1.0	49.0	4.0
B17522	B14311/B10244	22	20.7	18.8	46.0	92.0	1.0	48.5	4.5
B17315	B10244/B12724	4	20.5	17.7	47.0	95.0	1.0	50.0	4.5
B17832	B14302/B10244	19	20.4	18.5	47.0	93.0	1.0	50.0	5.0
B15447	B11363/Zenith	3	20.4	19.7	45.0	91.0	1.0	49.0	4.5
B17887	B14302/B10244	14	20.2	20.1	49.0	94.0	1.0	51.5	5.0

EXPERIMENT 9103 STANDARD BLACK BEAN YIELD TRIAL +N								PLANTED: 6/18/19	
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**
B17472	B14311/B10244	21	19.9	18.6	46.0	93.0	1.0	47.5	4.0
B17426	B14311/B10244	24	19.3	19.2	47.0	94.0	1.0	51.0	5.5
B04554	B00103*/X00822, **ZORRO**	38	19.1	18.7	48.0	95.0	1.0	52.0	5.0
B16503	Zenith/B12720	12	18.9	22.6	47.0	91.0	1.0	48.5	4.0
B17449	B14311/B10244	17	18.2	18.9	47.0	93.0	1.0	50.0	4.0
I03390	ND9902621-2, **ECLIPSE**	41	18.0	18.4	45.0	91.0	1.0	49.0	4.0
I07112	R99 NO NOD	42	16.6	18.8	45.0	98.0	2.0	48.5	3.5
MEAN(42)			21.7	19.7	46.0	92.6	1.0	49.5	4.8
LSD(.05)			2.5	0.9	1.6	1.6	0.0	2.6	1.1
CV%			8.2	4.1	2.1	1.0	1.1	3.1	13.2

EXPERIMENT 9104 PRELIMINARY NAVY BEAN YIELD TRIAL								PLANTED: 6/18/19	
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE
N19241	N15331/N16404	41	26.2	19.5	42.0	92.0	1.0	48.5	4.5
N19277	N14229/N14218	77	26.1	16.0	46.0	92.0	1.0	49.5	5.0
N19239	N15331/N16404	39	25.8	18.9	43.0	92.0	1.0	48.0	4.5
N19279	N14229/N14218	79	25.7	15.1	44.0	93.0	1.0	50.5	5.0
N19252	N15335/N14243	52	25.6	20.0	42.0	92.0	1.0	50.0	5.0
N19244	N15331/N16405	44	25.5	20.0	43.0	92.0	1.0	48.5	4.5
N19248	N15331/N16405	48	25.4	17.8	43.0	92.0	1.0	49.5	5.0
N19246	N15331/N16405	46	25.3	19.9	44.0	91.0	1.0	49.0	5.0
N19253	N15335/N14243	53	25.2	18.3	46.0	92.0	1.0	51.0	6.0
N19278	N14229/N14218	78	25.2	14.9	45.0	91.0	1.0	49.0	4.5
N19240	N15331/N16404	40	25.2	18.9	44.0	92.0	1.0	48.5	5.0
N19242	N15331/N16404	42	25.1	18.4	42.0	91.0	1.0	49.0	5.0
N19223	N14230/N16405	23	25.1	17.1	49.0	93.0	1.0	52.0	5.5
N19262	N16405/B16504	62	25.0	17.7	45.0	91.0	1.0	47.0	4.5
N19269	B15453/N14243	69	24.6	20.1	47.0	92.0	1.0	49.5	4.0
I10101	COOP 02084, **VIGILANT**	83	24.5	19.2	40.0	91.0	1.0	52.5	4.5
N19209	N13120/N15331	9	24.5	15.9	45.0	91.0	1.0	47.5	4.5
N19243	N15331/N16405	43	24.2	20.4	44.0	91.0	1.0	48.5	4.5
N19259	N16405/B16504	59	24.2	13.7	48.0	92.0	1.0	48.5	4.5
N19216	N14201/N15331	16	24.0	19.0	45.0	93.0	1.0	52.0	6.0
N19254	N15335/N16405	54	23.8	19.8	44.0	92.0	1.0	49.0	4.5
N19281	N14243/N14218	81	23.8	19.1	45.0	93.0	1.0	51.0	5.0
N19220	N14229/N15326	20	23.7	16.4	41.0	92.0	1.0	50.5	5.5
N19221	N14229/N15326	21	23.7	16.0	42.0	92.0	1.0	47.0	4.5
N19280	N14229/N14218	80	23.6	15.0	48.0	93.0	1.5	53.0	5.5
N19226	N14243/N15326	26	23.5	17.0	46.0	92.0	1.0	49.0	5.0
N19276	N14229/N14218	76	23.4	14.8	44.0	92.0	1.0	50.5	4.5
N19217	N14229/N13120	17	23.1	14.3	45.0	93.0	1.5	51.5	4.5
N19218	N14229/N14218	18	23.1	16.0	43.0	92.0	1.0	46.5	4.0
N19229	N15326/N14229	29	22.9	17.0	41.0	92.0	1.0	49.0	5.0

EXPERIMENT 9104 PRELIMINARY NAVY BEAN YIELD TRIAL								PLANTED: 6/18/19	
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE
N19237	N15331/N14243	37	22.8	16.6	47.0	92.0	1.0	50.0	5.0
N19245	N15331/N16405	45	22.7	18.1	45.0	91.0	1.0	49.5	4.5
N19257	N16405/B16504	57	22.6	14.3	43.0	91.0	1.0	49.5	5.0
N19207	I15616/N15331	7	22.6	18.5	43.0	92.0	1.0	49.5	5.0
N19261	N16405/B16504	61	22.5	15.9	42.0	92.0	1.0	50.0	5.0
N19204	N14229/I15616	4	22.4	18.0	47.0	92.0	1.0	48.5	4.5
N19272	G14505//N13120/PR0806-81A	72	22.4	22.1	41.0	91.0	1.0	49.0	5.0
N19202	N13120/I15616	2	22.3	20.2	41.0	92.0	1.0	48.0	4.0
N19256	N15335/N16405	56	22.2	18.3	43.0	92.0	1.0	47.5	4.5
N19258	N16405/B16504	58	22.2	15.7	43.0	92.0	1.0	48.5	4.5
N19230	N15326/N14229	30	22.2	17.7	42.0	90.0	1.0	48.0	3.5
N19213	N14201/N14230	13	22.1	15.8	47.0	92.0	1.0	50.0	5.0
N19236	N15331/N14243	36	21.8	15.5	47.0	92.0	1.0	49.5	4.0
N19214	N14201/N15326	14	21.8	17.2	44.0	94.0	1.0	51.5	5.0
N19275	N14229/N14218	75	21.8	16.5	49.0	94.0	1.0	51.0	4.5
N19228	N14243/N15326	28	21.5	17.5	47.0	93.0	1.0	49.5	5.5
N19282	N14243/N14218	82	21.4	17.8	47.0	92.0	1.0	48.0	3.5
N19210	N14201/N14229	10	21.4	16.4	42.0	93.0	1.0	50.0	5.0
N19250	N15335/N13120	50	21.3	18.6	45.0	92.0	1.0	48.0	4.5
N19271	G14505//N13120/PR0806-81A	71	21.3	23.8	39.0	92.0	1.0	51.5	5.5
N19267	N15326/N16404	67	21.1	15.7	41.0	92.0	1.0	46.0	4.0
N19263	N15326/N16404	63	21.1	14.9	43.0	92.0	1.0	46.5	4.0
N19274	G14505//N15341/N15331	74	21.0	22.6	40.0	90.0	1.0	45.0	3.0
N19238	N15331/N14243	38	21.0	15.6	46.0	92.0	1.0	51.5	5.5
N19251	N15335/N13120	51	20.9	17.8	44.0	92.0	1.0	49.0	5.0
N19231	N15326/N15331	31	20.9	16.9	43.0	92.0	1.0	47.0	4.0
N19224	N14230/N16405	24	20.8	15.8	49.0	92.0	1.0	50.0	4.5
N19247	N15331/N16405	47	20.8	19.7	46.0	93.0	1.0	49.5	4.5
N19249	N15335/N13120	49	20.6	18.9	44.0	92.0	1.0	49.0	4.5
N19219	N14229/N15326	19	20.5	16.1	42.0	92.0	1.0	48.0	4.5

EXPERIMENT 9104 PRELIMINARY NAVY BEAN YIELD TRIAL								PLANTED: 6/18/19	
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE
N19212	N14201/N14229	12	20.4	15.8	42.0	92.0	1.0	47.0	4.0
N19203	N13120/I15616	3	20.4	22.2	40.0	91.0	1.0	49.0	4.0
I11264	COOP 03019, **MERLIN**	84	20.3	19.3	40.0	94.0	1.5	51.0	4.5
N19205	N14229/I15616	5	20.3	18.1	44.0	93.0	1.0	53.0	5.0
N19211	N14201/N14229	11	20.3	16.4	41.0	92.0	1.0	50.0	5.0
N19232	N15326/N15331	32	20.2	17.9	43.0	91.0	1.0	47.5	4.5
N19206	I15616/N15331	6	20.2	18.4	47.0	92.0	1.0	48.0	4.0
N19215	N14201/N15326	15	20.2	15.3	42.0	92.0	1.0	52.5	5.0
N19201	N13120/I15616	1	20.2	19.8	40.0	92.0	1.0	48.5	4.0
N19273	G14505//N13120/PR0806-81A	73	20.0	23.4	39.0	92.0	1.0	53.0	5.5
N19255	N15335/N16405	55	19.8	16.4	44.0	92.0	1.0	51.0	5.0
N19260	N16405/B16504	60	19.7	15.4	43.0	91.0	1.0	51.5	4.0
N19270	B15453/N14243	70	19.6	19.5	50.0	94.0	1.0	53.0	6.0
N19234	N15326/N15331	34	19.6	17.2	42.0	92.0	1.0	48.5	4.5
N19225	N14243/N14230	25	19.0	15.4	50.0	92.0	1.0	47.0	4.0
N19208	I15616/N15331	8	19.0	17.1	45.0	93.0	1.0	53.0	5.0
N19235	N15331/N14201	35	18.9	15.8	43.0	91.0	1.0	49.5	5.0
N19266	N15326/N16404	66	18.9	16.3	44.0	91.0	1.0	46.0	4.0
N19233	N15326/N15331	33	18.7	16.9	42.0	91.0	1.0	46.5	4.0
N19268	N15326/N16404	68	18.7	15.9	46.0	93.0	1.0	46.0	4.0
N19222	N14229/N15331	22	18.1	14.2	43.0	92.0	1.0	47.5	4.0
N19264	N15326/N16404	64	17.3	15.4	45.0	92.0	1.0	47.5	4.0
N19265	N15326/N16404	65	17.0	15.5	41.0	92.0	1.0	48.5	4.5
N19227	N14243/N15326	27	16.1	16.2	44.0	90.0	1.0	48.0	3.5
MEAN(84)			22.0	17.5	43.6	91.8	1.0	49.3	4.6
LSD(.05)			3.1	1.0	3.2	1.6	0.2	2.7	0.9
CV%			10.5	4.4	4.4	1.1	13.2	3.3	11.7

EXPERIMENT 9105 PRELIMINARY BLACK BEAN YIELD TRIAL								PLANTED: 6/18/19	
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE
B19330	B16501/B15414	30	28.5	22.2	43.0	93.0	1.0	53.5	5.5
B19311	B15414/B16504	11	28.0	21.8	42.0	93.0	1.0	47.5	4.5
B19312	B15417/B15442	12	27.1	21.3	41.0	93.0	1.0	51.5	5.0
B18504	Zenith//Alpena*/B09197	49	26.7	18.7	42.0	93.0	1.0	50.0	5.0
B19346	B15414/B16504	46	26.6	21.6	42.0	92.0	1.0	49.0	5.0
B19332	B16501/B15464	32	26.5	20.2	44.0	94.0	1.0	51.5	5.0
B19316	B15417/B16511	16	26.2	18.8	43.0	94.0	1.0	51.5	5.5
B19309	B15414/B16504	9	26.1	18.8	44.0	92.0	1.0	52.5	5.5
B19344	B16506/B16507	44	26.0	18.5	42.0	93.0	1.0	50.5	4.0
B19313	B15417/B15442	13	25.7	20.7	41.0	92.0	1.0	50.5	5.0
B19341	B16507/B16501	41	25.7	20.3	42.0	91.0	1.0	50.0	4.5
B19308	B15414/B16504	8	25.3	19.2	44.0	92.0	1.0	50.5	5.0
B19345	B16506/B16507	45	25.3	19.1	43.0	91.0	1.0	48.0	4.0
B19301	N15335/B15464	1	25.2	19.7	45.0	95.0	1.0	49.0	4.0
B19314	B15417/B16511	14	25.1	20.5	43.0	92.0	1.0	48.0	4.0
B19322	B15453/B16504	22	24.7	20.9	45.0	92.0	1.0	50.0	5.5
I17517	ACUG 15-B4, **OAC VORTEX**	54	24.7	21.1	43.0	94.0	2.0	50.5	4.0
B19328	B15464/B15417	28	24.6	21.0	42.0	92.0	1.0	49.5	5.0
B19336	B16504/B10244	36	24.4	19.4	41.0	92.0	1.0	47.0	4.0
B19302	N16405/B16504	2	24.4	18.4	44.0	92.0	1.0	51.5	6.0
B19335	B16504/B10244	35	24.3	20.6	44.0	92.0	1.0	48.0	4.0
B19305	B10244/B16504	5	24.3	19.7	44.0	93.0	1.0	52.0	5.0
B19326	B15464/B15417	26	24.2	21.6	44.0	91.0	1.0	49.0	5.0
I19703	BL14506, **BLACK BEARD**	53	24.1	21.6	44.0	93.0	1.0	55.5	4.5
B19340	B16507/B15453	40	23.9	22.2	44.0	93.0	1.0	50.0	4.0
B19310	B15414/B16504	10	23.8	21.5	40.0	92.0	1.0	49.0	5.0
B19343	B16506/B16507	43	23.8	18.9	44.0	95.0	1.0	48.0	3.0
B19333	B16501/B16507	33	23.4	18.9	42.0	92.0	1.0	49.5	4.5
B19315	B15417/B16511	15	23.4	20.4	42.0	92.0	1.0	48.5	4.5
B19325	B15464/B15417	25	23.3	21.5	43.0	92.0	1.0	48.5	4.5

EXPERIMENT 9105 PRELIMINARY BLACK BEAN YIELD TRIAL								PLANTED: 6/18/19	
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**
B19339	B16507/B15453	39	23.1	21.7	45.0	91.0	1.0	50.0	4.5
B19338	B16504/B15417	38	23.1	18.9	40.0	92.0	1.0	49.5	5.0
B19331	B16501/B15414	31	23.0	19.4	41.0	92.0	1.0	48.0	4.5
B10244	B04644/ZORRO, **ZENITH**	48	23.0	19.3	44.0	94.0	1.0	49.5	5.0
B19307	B15414/B15464	7	22.9	21.3	44.0	92.0	1.0	50.5	5.5
B19317	B15453/B15408	17	22.9	19.0	44.0	92.0	1.0	51.0	5.0
B19342	B16506/B16507	42	22.9	19.9	40.0	91.0	1.0	48.5	4.5
B19329	B15464/B15417	29	22.8	20.7	42.0	93.0	1.0	50.0	4.5
B19324	B15464/B15417	24	22.6	23.0	43.0	92.0	1.0	51.5	5.0
I19702	BL14497, **SPECTRE**	52	22.3	21.1	44.0	94.0	1.5	52.5	5.0
B19320	B15453/B15464	20	22.3	20.8	44.0	92.0	1.0	49.5	4.5
B19323	B15464/B10244	23	22.3	17.8	44.0	91.0	1.0	51.0	4.5
B19327	B15464/B15417	27	22.3	22.0	43.0	92.0	1.0	51.0	5.0
B19334	B16501/B16507	34	22.2	18.5	44.0	91.0	1.0	47.5	4.0
I19710	MS Knight Rider	50	22.1	18.2	43.0	94.0	1.5	51.5	4.0
B04554	B00103*/X00822, **ZORRO**	47	21.9	17.7	45.0	94.0	1.0	51.0	4.5
B19321	B15453/B16504	21	21.6	18.6	42.0	93.0	1.0	50.0	4.0
B19337	B16504/B15417	37	21.5	20.5	43.0	91.0	1.0	49.0	4.5
B19304	B15451/X16730	4	21.4	17.9	45.0	92.0	1.0	49.5	5.0
I03390	ND9902621-2, **ECLIPSE**	56	21.3	19.0	42.0	90.0	1.0	47.0	4.0
B19306	B10244/B16504	6	21.2	18.5	44.0	92.0	1.0	49.5	4.5
B19303	B15434/X16723	3	21.0	20.6	43.0	92.0	1.0	50.5	5.5
B19318	B15453/B15464	18	19.8	20.2	46.0	92.0	1.0	51.5	5.5
B19319	B15453/B15464	19	19.6	21.6	45.0	92.0	1.0	49.5	4.5
I19711	NE14-18-4	51	19.2	24.2	39.0	94.0	1.5	47.0	4.0
I19701	NDF120287	55	18.0	18.2	43.0	92.0	1.5	50.0	4.0
MEAN(56)			23.6	20.1	42.8	92.2	1.1	49.9	4.7
LSD(.05)			3.1	1.1	2.3	2.1	0.3	2.5	1.0
CV%			9.8	4.0	3.1	1.4	17.9	3.0	12.8

EXPERIMENT 9106 STANDARD GREAT NORTHERN BEAN YIELD TRIAL								PLANTED: 6/19/19	
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE
G19620	X15405/G13444	38	29.1	37.9	48.0	98.0	1.5	53.0	4.1
G18512	G14525/P14815	6	26.8	39.4	44.0	93.0	1.0	55.5	6.0
G17418	G14530/G11431	11	26.4	33.8	43.0	93.0	1.0	56.5	6.5
G18502	G13444/G14506	5	24.6	31.9	41.0	93.0	1.0	50.5	6.0
G19607	G16346/G16318	25	24.2	43.1	40.0	93.0	1.0	55.5	6.0
G19609	G16346/G16318	27	24.0	42.2	42.0	91.0	1.0	53.5	5.0
G16351	Eldorado/G13467	3	23.8	36.3	43.0	94.0	1.0	55.0	6.0
G19613	G16351/P16902	31	23.3	40.3	40.0	92.0	1.0	51.0	5.5
G16345	G12508/G13455	4	23.1	32.3	39.0	93.0	1.1	49.0	5.0
G19623	G16339/G16318	41	23.1	34.1	39.0	92.0	1.0	50.0	5.0
G16305	Powderhorn/G12501	7	22.9	36.9	40.0	93.0	1.0	49.5	5.0
G19624	G16339/G16318	42	22.9	31.2	41.0	92.0	1.0	49.5	5.0
G19626	G16339/G16346	44	22.8	34.2	41.0	92.0	1.0	51.0	5.0
G19617	G16346/G16309	35	22.5	38.4	39.0	93.0	1.0	48.5	5.0
G16314	G11429/G11438	13	22.4	33.4	40.0	92.0	1.0	53.5	6.0
G17410	G13467/G13479	1	22.4	34.7	41.0	94.0	1.0	53.0	5.5
G19619	X15405/G13444	37	22.3	39.9	41.0	93.0	1.5	49.5	5.5
G19601	G13444/COSD-44	19	22.3	35.4	42.0	92.0	1.0	52.5	4.5
G19628	G16339/G16351	46	22.0	33.6	44.0	93.0	1.0	52.0	5.5
G19611	G16346/G16318	29	21.9	39.3	43.0	93.0	1.1	55.0	6.0
G19622	G16339/G16301	40	21.7	34.4	42.0	92.0	1.0	49.5	4.5
G19602	G16346/G16301	20	21.4	40.8	41.0	92.0	1.0	52.5	6.0
I17509	**TAURUS**	12	21.4	34.7	40.0	91.0	2.1	49.0	4.0
G19615	G16346/G16309	33	21.4	44.2	39.0	92.0	1.0	49.5	5.0
G16338	G12508/G11429	10	21.1	32.8	43.0	91.0	1.0	50.5	5.0
G16306	Powderhorn/G12501	16	21.1	35.6	41.0	92.0	1.0	51.0	5.5
G18506	G14525/G13444	8	21.0	40.8	39.0	92.0	1.0	50.5	5.5
G19630	G16339/G16351	48	21.0	29.0	45.0	93.0	1.0	54.0	5.5
G19621	X15413/G14506	39	21.0	30.9	42.0	92.0	1.0	52.5	5.5
I17544	GN16-7	18	20.9	37.0	40.0	91.0	1.0	53.0	5.5

EXPERIMENT 9106 STANDARD GREAT NORTHERN BEAN YIELD TRIAL									PLANTED: 6/19/19
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE
G19618	G16346/G16309	36	20.8	41.7	41.0	94.0	1.0	52.0	5.5
G19604	G16346/G16318	22	20.8	42.2	42.0	93.0	1.0	49.5	4.0
G19612	G16351/P16902	30	20.5	34.8	40.0	91.0	1.0	50.0	4.5
G19606	G16346/G16318	24	20.4	41.5	39.0	92.0	1.1	50.0	5.0
G19610	G16346/G16318	28	20.3	39.4	42.0	92.0	1.0	51.0	5.0
G18505	G14506/G13444	2	20.0	31.9	39.0	92.0	1.1	50.0	5.0
G19608	G16346/G16318	26	20.0	45.1	43.0	94.0	1.0	52.5	4.5
G19605	G16346/G16318	23	19.8	45.1	40.0	92.0	1.0	51.0	6.0
G18514	G14525/P14815	15	19.8	38.7	45.0	92.0	1.0	53.0	5.0
G19616	G16346/G16309	34	19.5	39.9	42.0	93.0	1.5	51.5	5.0
G16346	G13455/G13478	9	19.5	42.7	41.0	93.0	1.0	54.0	4.0
G19625	G16339/G16346	43	19.1	33.0	45.0	97.0	1.0	56.0	5.0
G19614	G16346/G16309	32	19.1	39.8	41.0	93.0	1.0	51.5	5.0
G19627	G16339/G16346	45	19.1	37.0	44.0	95.0	1.1	55.0	5.0
G19629	G16339/G16351	47	18.0	33.0	44.0	92.0	1.0	55.5	6.0
G19603	G16346/G16318	21	17.0	44.0	39.0	92.0	1.0	51.0	5.5
G16347	G13467/G11429	14	16.3	33.0	43.0	91.0	1.0	51.5	4.5
G08254	G04514/Matterhorn, **POWDERHORN**	17	11.7	34.3	38.0	90.0	1.0	48.5	4.0
MEAN(48)			21.4	37.2	41.3	92.4	1.1	51.9	5.2
LSD(.05)			3.5	1.9	2.3	1.8	0.3	2.8	1.1
CV%			13.8	4.4	3.3	1.1	16.3	3.2	12.7

EXPERIMENT 9107 STANDARD PINTO BEAN YIELD TRIAL								PLANTED: 6/19/19	
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE
P16902	P11519/P12610	13	22.9	36.6	43.0	93.0	1.0	50.5	5.5
P18608	P11522/LONG'S PEAK	4	22.8	34.3	43.0	92.0	1.0	51.5	5.0
P19702	P14815/I15643	19	22.7	35.7	44.0	94.0	1.5	54.0	5.5
P18603	P14815/G14525	12	22.2	44.8	48.0	93.0	1.0	53.0	5.5
P16901	Eldorado/P11519	1	22.2	38.0	45.0	93.0	1.0	56.0	5.0
P19703	I16706/P16901	20	21.2	34.2	44.0	93.0	1.0	54.5	5.5
P16905	P11519/P12610	10	21.1	35.9	45.0	94.0	1.0	50.0	5.5
P17510	SDP H/H BULK	2	20.6	37.5	39.0	91.0	1.0	50.5	4.5
I07113	PNE-6-94-75/Kodiak, **LAPAZ**	15	20.4	36.2	46.0	92.0	1.0	52.5	5.0
P19707	P16911/X16801	24	20.4	36.5	41.0	93.0	1.0	53.0	6.0
P19103	Eldorado*/Palomino//G13444 (SDP)	33	20.2	34.2	38.0	93.0	1.5	54.0	4.5
I15644	COSD-35, **STAYBRIGHT**	16	20.0	34.0	40.0	91.0	1.0	51.5	5.0
P19713	P16911/P16901	30	19.8	33.2	45.0	92.0	1.0	51.5	5.0
P18602	P14815/G14525	5	19.7	43.7	44.0	93.0	1.0	52.0	4.5
P14814	P11522/LONG'S PEAK	8	19.6	37.8	45.0	94.0	1.0	53.5	6.0
P19701	P14815/I15643	18	19.5	35.0	48.0	96.0	1.5	58.0	5.0
P16904	P11519/P12610	9	19.2	37.2	44.0	93.0	1.0	51.0	5.5
P17508	SDP H/H BULK	7	18.8	39.2	42.0	94.0	1.0	52.5	4.0
P18601	P14815/G14525	6	18.7	43.6	45.0	93.0	1.0	50.5	4.0
P19708	P16913/P16901	25	18.7	34.5	42.0	92.0	1.0	47.5	4.5
I18623	PT16-9	35	18.3	37.5	42.0	92.0	1.0	53.5	5.0
P07863	AN-37/P02630, **ELDORADO**	36	18.2	35.9	41.0	94.0	1.0	54.0	4.5
P19706	P16911/X16801	23	18.2	37.4	46.0	92.0	1.0	52.5	4.5
P19705	P16911/X16801	22	18.1	37.6	42.0	92.0	1.0	52.5	5.5
I14520	Santa Fe/PS08-108, SF103-8, **ND PALOMINO**	11	17.7	34.7	36.0	92.0	2.0	50.0	4.0
P19712	X16801/P14814	29	17.3	31.8	44.0	94.0	1.0	52.5	6.0
P19704	I16706/P16901	21	17.3	34.0	45.0	93.0	1.0	50.5	5.5
P17507	SDP H/H BULK	3	16.6	37.6	39.0	92.0	1.0	53.5	4.5
P17502	P07863/X14110	14	16.3	35.7	42.0	92.0	1.0	45.5	4.0
P19101	Eldorado*/Palomino//P14815 (SDP)	31	16.1	33.8	44.0	94.0	1.5	55.0	5.5
P19102	Eldorado*/Palomino//P14815 (SDP)	32	16.1	34.0	43.0	96.0	1.0	58.0	4.5
I16705	ND121448, **ND FALCON**	17	14.7	33.9	48.0	91.0	1.0	52.5	5.0
P19710	P16913/P16901	27	14.4	32.8	47.0	92.0	1.0	49.0	4.5
P19711	P16913/P16901	28	14.3	32.5	44.0	93.0	1.0	47.5	4.5
P19709	P16913/P16901	26	13.5	32.4	45.0	92.0	1.0	50.5	5.0
P19104	Eldorado*/Palomino//COSD-3 (SDP)	34	12.9	35.1	40.0	95.0	1.5	51.0	3.5
MEAN(36)			18.6	36.1	43.0	92.6	1.1	52.1	4.9
LSD(.05)			3.1	1.8	3.3	1.8	0.4	3.1	1.0
CV%			14.3	4.2	4.6	1.1	23.7	3.5	11.5

EXPERIMENT 9108 STANDARD RED AND PINK BEAN YIELD TRIAL								PLANTED: 6/19/19	
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE
S18903	S14706/R13752	39	28.3	36.0	47.0	98.0	1.5	51.5	4.5
S18904	S14706/R13752	5	26.4	35.0	46.0	95.0	1.0	52.5	6.0
S18909	S14706/R13752	9	25.8	36.9	45.0	95.0	1.0	50.5	5.5
R17604	R12859/R12844	19	24.4	31.2	44.0	95.0	1.0	52.5	6.0
S19304	X16803/P16809	32	24.3	36.5	43.0	95.0	1.0	49.5	4.5
S19307	X16804/S16804	35	24.1	32.0	43.0	93.0	1.0	50.0	5.0
S18907	S14706/R13752	6	23.8	38.0	46.0	97.0	1.0	52.5	6.0
S19305	X16803/P16809	33	23.8	32.2	44.0	97.0	1.0	53.5	6.0
R18402	R12859/R12844	16	23.5	35.1	45.0	95.0	1.0	51.0	5.0
R17605	R12859/R12844	11	23.4	33.0	45.0	94.0	1.0	49.0	5.0
I19704	Reds from Samurai	42	23.3	29.0	44.0	91.0	1.0	47.0	3.0
S19309	X16803/S16804	37	23.3	34.0	47.0	95.0	1.0	49.0	3.5
I18609	PK 16-7	40	23.1	32.4	44.0	94.0	1.0	49.5	4.5
R17602	R12845/R12859	18	22.8	33.5	44.0	92.0	1.0	50.5	5.0
R12844	SR9-5/R09508, **CAYENNE**	15	22.8	33.9	42.0	94.0	1.5	52.0	6.0
I13401	SR 09303, VIPER	10	22.1	28.2	46.0	94.0	1.0	50.0	4.5
R18403	R12859/R12844	17	22.1	33.1	44.0	93.0	1.0	51.0	5.5
S16804	S08418/S12904	7	21.6	32.0	39.0	94.0	1.0	48.0	4.0
R19506	S16807/R16518	27	21.4	32.3	43.0	94.0	1.0	48.0	4.5
R17603	R12859/R12844	20	21.2	32.6	46.0	96.0	1.0	54.0	6.0
R19501	R16519/R16503	22	21.1	30.1	41.0	95.0	1.5	49.0	4.0
R19503	R16519/R16518	24	20.9	30.1	44.0	97.0	1.0	48.5	5.0
R18401	R12859/R12844	13	20.8	34.2	46.0	95.0	1.5	53.0	4.5
S17706	S14708/X14117	14	20.8	32.5	48.0	94.0	1.5	54.0	5.5
R18409	R12859/R13506	1	20.7	34.0	45.0	97.0	1.0	53.5	5.0
R19504	R16519/R16518	25	20.6	34.5	43.0	96.0	1.0	49.0	4.5
S19303	S16809/X16804	31	20.5	34.7	44.0	95.0	1.0	50.5	5.5
S17705	S14708/X14117	12	20.5	37.8	47.0	94.0	1.0	57.0	5.0
S08418	S02754/S04503, **ROSETTA**	3	20.3	31.7	41.0	96.0	1.0	49.5	4.5
R19502	R16519/R16518	23	20.1	31.0	44.0	96.0	1.0	49.0	5.0

EXPERIMENT 9108 STANDARD RED AND PINK BEAN YIELD TRIAL								PLANTED: 6/19/19	
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**
R18406	R12859/R13506	2	19.8	35.7	45.0	97.0	1.0	53.5	5.0
S18901	S14706/S08418	41	19.7	33.4	40.0	93.0	1.0	49.0	4.5
S19306	X16804/S16804	34	19.7	32.1	41.0	93.0	1.0	48.5	5.5
S16809	S12906/R11614	8	19.3	30.8	43.0	95.0	1.0	50.5	5.0
R18405	R12859/R13506	4	19.2	34.2	42.0	96.0	1.0	49.5	4.5
S19308	X16803/S16804	36	19.1	35.2	44.0	95.0	1.0	50.5	4.5
R19507	X16804/S16804	28	19.1	32.5	38.0	98.0	1.5	54.0	5.0
R19505	R16519/R16518	26	19.0	32.7	43.0	95.0	1.0	48.5	4.5
S19302	R16519/R16518	30	18.8	33.2	44.0	96.0	1.0	48.5	4.5
S19310	X16804/S16807	38	18.7	36.5	47.0	95.0	1.0	49.5	4.5
R98026	R94037/R94161, **MERLOT**	21	18.6	38.0	43.0	92.0	1.0	48.0	4.0
S19301	R16519/R16518	29	18.1	33.5	44.0	94.0	1.0	48.5	5.0
MEAN(42)			21.6	33.5	43.7	94.6	1.1	50.5	4.9
LSD(.05)			3.4	1.4	2.5	2.4	0.5	3.0	1.1
CV%			13.3	3.7	3.4	1.5	25.0	3.6	12.8

EXPERIMENT 9109 MRPN/CDBN YIELD TRIAL									PLANTED: 6/19/19
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE
I16707	ND121315	10	27.2	36.5	37.0	93.0	1.5	47.5	4.0
I19718	PK9-15	18	27.1	36.7	37.0	93.0	1.5	52.0	4.5
I15652	ND121630, **ND PEGASUS**	33	27.0	36.8	37.0	94.0	1.0	54.0	5.5
R17604	R12859/R12844	8	26.3	32.7	46.0	96.0	1.0	52.0	5.5
P16901	Eldorado/P11519	5	25.8	39.4	45.0	95.0	1.0	55.0	6.0
R12844	SR9-5/R09508, **CAYENNE**	32	25.8	33.9	42.0	94.0	1.0	51.0	5.5
R17605	R12859/R12844	9	25.7	34.3	44.0	96.0	1.0	52.0	5.5
I19720	PT11-13-1	26	25.4	36.6	37.0	93.0	1.5	50.5	4.5
I19717	GN16-7-3	17	25.1	39.5	39.0	94.0	1.0	51.5	5.0
G08254	G04514/Matterhorn, **POWDERHORN**	35	24.7	37.0	36.0	92.0	1.0	48.5	4.5
I17546	PK16-1	16	24.5	35.4	37.0	92.0	1.0	51.0	4.0
I19716	NDF141506	15	24.2	35.6	39.0	94.0	1.0	52.0	5.0
P16905	P11519/P12610	6	24.1	37.4	46.0	94.0	1.0	51.5	5.5
I18623	PT16-9	27	24.1	38.6	39.0	94.0	1.0	53.0	5.5
I19722	NE4-17-10	31	24.1	41.8	37.0	93.0	1.0	50.0	4.5
I18601	ARIES	1	23.8	37.6	36.0	92.0	1.0	48.0	4.0
I07113	PNE-6-94-75/Kodiak, **LAPAZ**	2	23.6	38.5	42.0	93.0	1.0	50.0	4.5
G12901	G07321/Fuji, **SAMURAI**	36	23.6	24.9	40.0	93.0	1.0	51.0	5.0
R17603	R12859/R12844	7	23.5	33.5	44.0	96.0	1.0	51.5	5.5
I19731	NE2-17-45	24	23.3	42.2	36.0	92.0	2.0	48.5	4.0
I18603	NDF140722	12	23.0	33.3	40.0	93.0	1.5	48.5	4.5
I19730	NE2-17-40	23	22.9	42.1	40.0	92.0	2.0	47.0	3.5
I16705	ND121448, **ND FALCON**	28	22.5	37.5	43.0	95.0	1.0	53.0	5.5
R98026	R94037/R94161, **MERLOT**	3	22.2	37.8	40.0	96.0	1.5	51.0	4.0
I19715	ND131406	14	21.9	37.7	36.0	92.0	1.0	48.5	4.0
I18608	NE2-17-37	29	21.8	39.0	37.0	94.0	1.0	50.5	4.0
G16351	Eldorado/G13467	4	21.4	36.9	45.0	96.0	1.0	53.0	5.5
I19727	NE1-17-9	20	21.4	36.8	37.0	92.0	1.0	47.0	4.0
I18606	NE1-17-36	34	21.2	39.1	37.0	91.0	1.0	47.5	4.0
I19719	SR16-2	19	21.2	33.4	38.0	91.0	1.0	47.5	4.0

EXPERIMENT 9109 MRPN/CDBN YIELD TRIAL									PLANTED: 6/19/19
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE
I17520	NDF140813	11	20.7	42.0	36.0	93.0	1.0	49.5	4.5
I19729	NE1-17-41	22	19.9	40.6	36.0	92.0	1.5	47.5	4.0
I19728	NE1-17-19	21	19.6	40.1	36.0	94.0	1.5	50.5	4.5
I84002	NW410//VICTOR/AURORA, **OTHELLO**	25	18.1	38.7	33.0	90.0	2.5	43.0	3.5
I19714	ND112929	13	17.3	36.7	42.0	95.0	1.5	53.5	4.5
I19721	NE4-17-6	30	15.1	41.6	36.0	91.0	1.5	46.0	3.5
MEAN(36)			23.0	37.3	39.1	93.1	1.2	50.1	4.6
LSD(.05)			3.6	1.8	2.0	2.0	0.6	2.3	0.9
CV%			11.5	3.6	3.7	1.2	29.3	2.8	11.7

EXPERIMENT 9110 DRY BEAN DROUGHT NURSERY YIELD TRIAL								PLANTED: 6/19/19	
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE
R12844	SR9-5/R09508, **CAYENNE**	21	26.2	33.7	42.0	93.0	1.0	50.5	5.0
I19718	PK9-15	9	25.9	36.5	37.0	92.0	1.0	51.0	5.0
I19739	NE4-18-23	14	25.8	40.4	43.0	96.0	1.0	53.0	5.5
I19706	B13SR1-1	27	25.5	19.8	43.0	96.0	1.0	50.0	4.5
P16901	Eldorado/P11519	31	25.2	38.7	45.0	94.0	1.0	53.0	6.0
I18623	PT16-9	8	24.8	39.4	40.0	93.0	1.0	51.5	5.0
G16351	Eldorado/G13467	30	24.5	35.8	44.0	95.0	1.0	53.0	6.0
B18504	Zenith//Alpena*/B09197	19	23.9	19.5	41.0	94.0	1.0	51.0	6.0
I19720	PT11-13-1	7	23.5	35.5	40.0	92.0	1.5	51.0	5.0
I19717	GN16-7-3	10	23.3	40.0	39.0	91.0	1.0	50.5	4.5
S18903	S14706/R13752	22	22.9	39.3	48.0	98.0	2.0	51.0	4.5
I19736	MIB 780/Matterhorn, SB3_0314	4	22.9	37.6	37.0	91.0	1.5	47.0	4.0
I17546	PK16-1	11	22.7	33.8	39.0	90.0	1.5	49.0	4.0
N18102	N13120/PR0806-81	32	21.6	21.0	47.0	94.0	1.0	52.0	6.0
I19738	Matterhorn/PT7-2, SB3_0143	6	21.5	34.0	37.0	91.0	1.5	47.0	3.5
I19741	NE2-18-3	16	21.5	43.2	38.0	95.0	2.0	49.5	4.0
B10244	B04644/ZORRO, **ZENITH**	20	21.3	20.4	47.0	94.0	1.0	49.0	5.0
G93414	**MATTERHORN**	23	20.8	36.1	36.0	92.0	1.0	46.0	4.5
I19732	NE13-18-2	29	20.8	40.4	37.0	94.0	1.5	49.0	4.0
I19733	MIB 780/Matterhorn, SB3_0363	1	20.6	34.6	37.0	92.0	1.0	48.0	3.5
I05834	ND020351, **STAMPEDE**	26	20.2	35.9	41.0	91.0	1.0	48.0	4.0
R98026	R94037/R94161, **MERLOT**	25	20.0	37.1	39.0	93.0	1.0	50.0	4.0
I19743	NE2-18-22	18	19.9	39.4	38.0	95.0	1.0	50.0	5.0
I19742	NE4-18-63	17	19.8	37.9	38.0	91.0	1.5	48.5	4.0
I19707	B13SR1-2	28	19.8	19.1	44.0	96.0	1.0	46.5	3.5
I19734	MIB 780/Matterhorn, SB3_0347	2	19.7	36.4	38.0	92.0	1.5	48.0	4.0
I16708	XRAV-40-4	13	19.3	22.1	38.0	90.0	1.0	47.0	3.5
I19740	NE2-18-2	15	19.0	41.8	37.0	93.0	1.5	46.5	4.0
I17540	1765 (689-736)	12	16.7	22.2	43.0	91.0	1.0	49.0	4.0
I09151	**MARQUIS**	24	16.4	30.4	36.0	91.0	3.5	43.0	2.5
I19735	MIB 780/Matterhorn, SB3_0325	3	15.8	34.5	38.0	92.0	1.5	47.0	3.0
I19737	SER 109/Matterhorn, SB3_0454	5	15.1	30.6	37.0	90.0	1.5	46.0	3.0
MEAN(32)			21.5	33.4	40.2	92.7	1.3	49.1	4.4
LSD(.05)			3.1	1.4	2.0	1.8	0.6	2.3	0.9
CV%			10.5	3.2	3.7	1.1	26.3	2.8	12.1

EXPERIMENT 9211 STANDARD KIDNEY YIELD TRIAL								PLANTED: 6/8/19		
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE	CBB (1-5)
K17704	K11714*/K13902	9	39.7	64.0	36.0	100.0	1.0	50.3	5.0	1.0
K18907	SNOWDON/UYOLE 98	30	39.3	63.4	43.0	98.0	2.0	49.0	4.7	2.0
K17703	K11714*/K13902	3	37.9	63.9	44.0	102.0	1.0	51.0	5.0	2.0
K16924	K11917/SNOWDON	8	37.6	68.3	37.0	98.0	1.0	49.3	5.7	2.0
K16911	SNOWDON/K12214	24	37.1	67.7	39.0	95.0	1.0	48.3	6.0	3.0
I19724	14-C2, **OAC RACER**	40	37.1	70.9	36.0	93.0	1.0	46.0	4.3	1.0
K17201	RED CEDAR//DRAKE/K12205	16	36.7	55.3	42.0	98.0	1.0	49.3	5.0	1.0
K16640	K11914/K12209	13	36.2	65.6	45.0	102.0	2.0	50.0	4.7	1.0
K18312	RED CEDAR/K14104	38	35.8	57.4	41.0	99.0	1.0	49.7	5.0	1.0
K08961	K04604/USDK-CBB-15, **SNOWDON**	12	35.1	70.8	35.0	93.0	1.0	47.0	5.0	3.0
K17701	K11714*/ISABELLA	4	35.0	62.1	36.0	101.0	1.0	51.0	4.7	1.0
K17702	K11714*/ISABELLA	11	34.6	64.3	38.0	101.0	1.0	50.0	5.7	1.0
K16136	K12206/ND02-385-14	21	33.8	58.6	42.0	97.0	1.0	49.3	5.7	2.0
K11306	K06621/USDK-CBB-15, **RED CEDAR**	20	33.6	57.9	41.0	97.0	1.0	49.0	5.3	2.0
K15601	RED CEDAR/K11916, **COHO**	2	33.3	52.8	43.0	102.0	1.3	51.3	5.0	2.0
K74002	MDRK/CN(3)-HBR(NEB#1), **MONTCALM**	25	33.2	61.9	41.0	102.0	1.0	49.3	3.7	3.0
K16131	K11914/K12209	7	33.0	65.5	39.0	101.0	1.7	50.0	4.3	2.0
K18314	TALON/RED CEDAR	37	32.8	58.2	44.0	100.0	1.3	51.3	4.3	2.0
K18912	SNOWDON/UYOLE 98	35	32.7	59.3	38.0	93.0	1.0	45.3	4.3	2.0
K16957	K12206/SNOWDON	27	32.7	65.7	41.0	100.0	1.3	50.3	4.7	1.0
I11201	Pink Panther//ZAA/Montcalm, **CLOUSEAU**	17	32.5	68.8	38.0	96.0	1.0	49.0	4.0	5.0
K16934	CBB-15/SNOWDON	15	32.4	63.3	43.0	97.0	1.3	50.7	4.7	3.0
K90101	CHAR/2*MONT, **RED HAWK**	28	31.6	61.2	37.0	97.0	1.0	49.0	4.0	4.0
K17804	K11714//CLOUSEAU/SNOWDON	14	31.3	63.0	41.0	104.0	2.0	52.7	4.3	3.0
K18914	SNOWDON/K15302	33	30.3	57.3	40.0	96.0	1.0	48.7	5.0	4.0
K18501	RED CEDAR/ROSIE	32	29.7	56.6	40.0	99.0	2.3	48.0	3.7	2.0
K16950	K12219/SNOWDON	6	29.4	59.6	47.0	103.0	1.7	52.3	4.7	2.0
K17815	RED CEDAR/SNOWDON	5	29.0	58.0	46.0	95.0	1.0	49.0	4.0	3.0
K17209	RED CEDAR/SNOWDON	1	28.4	67.4	38.0	103.0	1.7	51.3	4.0	1.0
I13421	ND061106, **ROSIE**	22	28.2	58.7	42.0	103.0	2.0	51.0	4.0	2.0
K18908	SNOWDON/UYOLE 98	36	27.8	60.2	38.0	93.0	1.3	47.0	4.3	4.0
K90902	BEA/50B1807//LASSEN, **BELUGA**	19	27.7	64.5	43.0	105.0	1.0	51.0	3.7	4.0
K18905	SNOWDON/UYOLE 98	34	27.3	58.5	38.0	94.0	3.0	48.3	4.0	4.0
K18915	SNOWDON/K15302	31	25.5	56.2	42.0	95.0	1.0	48.7	4.0	2.0
I15619	LRK 09351, **BIG RED**	23	25.2	60.5	36.0	94.0	1.0	47.3	4.0	3.0

EXPERIMENT 9211 STANDARD KIDNEY YIELD TRIAL							PLANTED: 6/8/19			
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**	**CBB (1-5)**
K18302	RED CEDAR/DYNASTY	39	24.8	61.2	42.0	94.0	2.0	48.3	3.3	4.0
I15620	Red Kanner/Emperor, **CHAPARRAL**	10	24.7	49.5	47.0	96.0	2.7	46.3	2.7	2.0
I90013	**CELRK**	26	23.6	65.8	36.0	90.0	1.0	42.0	4.0	5.0
I19726	NE9-18-3	42	23.4	60.9	38.0	95.0	1.0	47.0	3.0	2.0
I19723	**AAC Scotty**	29	19.8	65.2	36.0	95.0	1.0	45.7	3.7	1.0
K17819	K14101/K14804	18	18.4	58.8	41.0	96.0	1.0	48.7	4.3	3.0
I19725	15-C2, **OAC CANDYCANE**	41	17.5	68.4	43.0	92.0	1.0	47.0	3.3	2.0
MEAN(42)			30.8	61.8	40.1	97.7	1.3	49.0	4.4	2.4
LSD(.05)			3.9	3.5	2.3	2.9	0.5	1.9	0.9	-
CV%			10.8	4.8	3.4	2.2	26.6	2.9	15.4	47.6

EXPERIMENT 9213 PRELIMINARY WHITE KIDNEY YIELD TRIAL								PLANTED: 6/8/19		
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE	CBB (1-5)
K19832	K16981/K16962	32	35.0	69.5	48.0	106.0	1.5	53.5	4.5	1.0
K19803	K15901/X16734	3	34.7	58.2	45.0	100.0	2.0	49.5	3.0	2.0
K19817	K15901/K16980	17	33.8	62.7	48.0	102.0	1.0	53.5	4.5	1.0
K19805	K15901/X16735	5	32.0	63.3	51.0	110.0	2.0	54.0	3.5	1.0
K19825	K16980/K15901	25	31.9	69.0	51.0	105.0	1.0	56.0	5.0	2.0
K19828	K16638/K16980	28	31.8	65.7	49.0	104.0	1.5	52.5	4.5	1.0
K19818	K15901/K16980	18	31.7	66.3	45.0	110.0	2.0	54.5	3.5	1.0
K19808	K15901/X16735	8	31.7	66.9	51.0	108.0	1.5	55.5	3.5	2.0
K19830	K16638/K16980	30	31.2	66.4	46.0	103.0	1.0	52.5	6.0	2.0
K19831	K16638/K16980	31	29.9	72.2	48.0	101.0	1.5	52.5	4.5	1.0
K19811	K16136/K16980	11	29.8	60.2	43.0	97.0	1.0	50.5	4.5	1.0
K19829	K16638/K16980	29	28.1	61.9	47.0	98.0	1.5	52.0	3.5	2.0
K19810	K15901/X16735	10	27.7	62.6	50.0	108.0	1.5	55.0	3.5	1.0
K19804	K15901/X16734	4	27.5	57.2	48.0	96.0	1.0	51.0	3.5	1.0
K19809	K15901/X16735	9	27.4	68.2	50.0	108.0	1.0	55.5	4.0	1.0
K19835	K15901/K16640	35	27.4	61.4	51.0	99.0	2.0	50.5	3.5	3.0
K19806	K15901/X16735	6	27.0	67.0	50.0	107.0	1.0	54.5	4.0	2.0
K19812	K16136/K16980	12	26.4	57.4	42.0	99.0	1.5	50.0	4.0	1.0
K19827	K16638/K16980	27	26.3	62.8	49.0	95.0	1.5	51.5	5.0	1.0
K19814	K15901/K16941	14	26.0	62.0	48.0	102.0	1.5	52.5	3.5	1.0
K19836	K15901/K16640	36	26.0	60.7	51.0	101.0	2.5	50.5	3.0	2.0
K19807	K15901/X16735	7	25.6	62.3	50.0	99.0	2.0	53.5	3.5	2.0
K19833	K16981/K16955	33	25.6	62.1	47.0	97.0	1.0	53.0	4.0	2.0
K19822	K15901/K16981	22	25.0	57.3	48.0	102.0	1.0	52.0	4.5	2.0
K90902	BEA/50B1807//LASSEN, **BELUGA**	38	24.9	60.0	43.0	104.0	1.5	52.5	4.5	4.0
K19820	K15901/K16981	20	24.6	63.6	45.0	100.0	1.0	49.5	3.5	1.0
K08961	K04604/USDK-CBB-15, **SNOWDON**	37	24.3	67.4	35.0	92.0	1.0	47.5	4.0	3.0
K19821	K15901/K16981	21	23.3	58.2	49.0	102.0	1.5	54.5	3.5	1.0
K19819	K15901/K16981	19	22.5	64.6	50.0	104.0	1.0	51.0	4.5	2.0
K19816	K15901/K16980	16	21.7	50.4	48.0	93.0	2.5	48.0	3.0	3.0
K19813	K15901/K16941	13	21.3	50.9	36.0	97.0	1.5	47.5	3.5	3.0
K19824	K16962/K16941	24	21.2	58.2	50.0	94.0	1.5	48.5	3.0	3.0
K19823	K15901/K16981	23	21.0	56.7	50.0	98.0	2.0	50.0	3.5	2.0
I19705	Row 164 White Kidney	40	20.6	74.7	49.0	109.0	2.0	53.0	3.0	3.0
K19802	K15901/X16732	2	20.4	65.3	50.0	95.0	2.0	49.5	3.0	3.0

EXPERIMENT 9213 PRELIMINARY WHITE KIDNEY YIELD TRIAL							PLANTED: 6/8/19			
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**	**CBB (1-5)**
K19826	K16980/K15901	26	20.4	61.0	52.0	97.0	1.0	49.5	4.0	3.0
I17507	ND122386, **ND WHITETAIL**	39	20.3	59.8	43.0	95.0	2.5	46.0	3.0	3.0
K19815	K15901/K16980	15	18.1	53.9	50.0	94.0	1.5	51.5	4.0	3.0
K19801	K15901/X16732	1	18.0	65.6	49.0	92.0	2.0	49.0	3.0	3.0
K19834	K16981/K16955	34	17.6	53.0	49.0	97.0	1.0	52.0	3.5	2.0
MEAN(40)			26.0	62.2	47.4	100.3	1.5	51.6	3.8	2.0
LSD(.05)			3.5	3.5	3.1	6.4	0.8	3.8	1.0	-
CV%			9.8	4.1	3.8	3.8	31.7	4.4	15.5	44.3

EXPERIMENT 9214 PRELIMINARY LIGHT AND DARK RED KIDNEY YIELD TRIAL							PLANTED: 6/8/19			
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE	CBB (1-5)
K19608	K16640/K16638	40	36.0	66.1	50.0	109.0	1.0	54.0	4.0	1.0
K16131	K11914/K12209	55	35.1	66.8	46.0	105.0	1.5	53.5	4.5	2.0
K19604	K16638/K16640	36	32.9	65.7	49.0	103.0	1.5	53.5	5.5	1.0
K19605	K16638/K16647	37	32.6	70.0	41.0	103.0	1.0	52.5	6.0	1.0
K19610	K16126/K11306	42	32.3	58.5	43.0	101.0	1.5	51.5	5.0	2.0
K19122	K16136/K16117	22	31.3	60.9	45.0	107.0	2.5	50.0	3.5	1.0
K19611	K15601/K16117	43	30.5	47.2	50.0	108.0	2.0	51.5	3.5	1.0
K16136	K12206/ND02-385-14	56	29.8	58.7	41.0	100.0	1.5	49.5	5.0	2.0
K19111	K16119/K16109	11	29.4	54.0	50.0	100.0	1.0	53.0	6.0	2.0
K19606	K16638/K16657	38	29.3	64.8	38.0	109.0	2.0	52.5	3.5	2.0
K19609	K16657/K16638	41	29.0	65.9	49.0	108.0	1.0	53.0	4.0	3.0
K19119	K16109/K16119	19	28.1	53.2	49.0	101.0	1.0	52.5	4.5	1.0
K19124	K11306/K16126	24	27.4	54.9	46.0	103.0	1.5	52.5	4.5	2.0
K11306	K06621/USDK-CBB-15, **RED CEDAR**	52	27.2	56.7	45.0	99.0	1.0	52.0	5.0	2.0
K19117	K15304/K16119	17	26.9	47.6	47.0	106.0	2.0	52.5	4.5	2.0
K19114	K16119/K16109	14	26.8	54.4	49.0	104.0	2.0	50.0	4.0	2.0
K15601	RED CEDAR/K11916, **COHO**	49	26.7	51.9	47.0	105.0	1.0	53.0	5.0	1.0
K19120	K16109/K16119	20	26.4	54.8	47.0	102.0	1.0	52.0	5.0	2.0
K19601	I13421/X16739	33	26.4	63.6	50.0	109.0	2.0	51.5	3.5	2.0
K74002	MDRK/CN(3)-HBR(NEB#1), **MONTCALM**	54	25.4	64.6	44.0	106.0	1.0	51.0	4.0	2.0
K19123	K11306/K16126	23	25.2	49.6	49.0	101.0	2.5	49.0	4.0	2.0
K19110	K16107/K16119	10	24.0	50.3	50.0	101.0	2.0	50.0	4.5	2.0
K90101	CHAR/2*MONT, **RED HAWK**	53	23.8	60.0	39.0	99.0	1.0	49.0	4.5	3.0
K19118	K15304/K16119	18	23.2	48.1	50.0	101.0	1.5	49.0	5.0	1.0
K19109	I15622/X16742	9	23.1	58.7	46.0	95.0	1.0	48.0	3.0	3.0
K19113	K16119/K16109	13	23.1	53.6	50.0	99.0	1.0	51.0	4.0	2.0
K19102	I13421/X16737	2	22.9	61.8	46.0	110.0	2.0	52.0	3.5	2.0
K19607	K16638/K16657	39	22.8	67.4	50.0	109.0	1.5	51.5	3.0	3.0
K19603	K16107/K16119	35	22.7	47.5	50.0	106.0	1.0	54.5	3.5	1.0
K19104	I15622/X16740	4	22.1	54.3	50.0	101.0	2.5	49.0	4.0	3.0
K19116	K16119/K16109	16	21.8	51.8	49.0	101.0	1.0	49.0	5.0	1.0
K19101	I13421/X16737	1	20.4	58.4	43.0	98.0	1.5	50.0	4.0	3.0
K19106	I15622/X16742	6	19.1	64.1	49.0	103.0	1.5	50.5	4.0	3.0
K19129	TARS-HT2/TARS-HT1	29	18.3	56.5	49.0	109.0	2.0	51.5	3.5	3.0
K19612	TARS-HT2/TARS-HT1	44	18.3	60.8	47.0	102.0	2.0	49.5	3.0	3.0

EXPERIMENT 9214 PRELIMINARY LIGHT AND DARK RED KIDNEY YIELD TRIAL						PLANTED: 6/8/19			
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE	CBB (1-5)
K19132	TARS-HT2/TARS-HT1	32	18.0	53.9	44.0	106.0	1.0	47.0	3.0	3.0
K19107	I15622/X16742	7	17.4	56.8	48.0	98.0	1.5	49.0	4.0	4.0
K19121	K16119/K15304	21	17.4	54.6	42.0	98.0	1.0	47.5	5.0	1.0
K19130	TARS-HT2/TARS-HT1	30	17.4	54.6	38.0	102.0	1.0	45.0	2.5	3.0
K19127	TARS-HT2/TARS-HT1	27	16.9	49.0	50.0	108.0	1.0	48.0	3.0	4.0
K19112	K16119/K16109	12	16.5	52.3	50.0	109.0	3.0	50.0	3.5	1.0
K19131	TARS-HT2/TARS-HT1	31	16.5	53.3	39.0	94.0	1.0	44.0	2.5	3.0
K19115	K16119/K16109	15	15.8	49.2	49.0	97.0	2.5	47.5	3.0	1.0
K19103	I15622/X16740	3	15.3	50.3	49.0	100.0	2.0	47.5	1.5	4.0
K19126	TARS-HT2/TARS-HT1	26	14.7	48.9	49.0	98.0	1.0	46.0	3.0	4.0
K19128	TARS-HT2/TARS-HT1	28	14.7	50.7	39.0	105.0	1.0	48.5	3.0	3.0
K19615	TARS-HT2/TARS-HT1	47	13.6	53.5	49.0	101.0	2.5	46.5	2.0	3.0
I11201	Pink Panther//ZAA/Montcalm, **CLOUSEAU**	50	13.1	67.4	39.0	97.0	1.5	48.5	4.0	4.0
K19108	I15622/X16742	8	13.0	54.9	50.0	96.0	1.5	47.5	3.0	4.0
K19602	I13421/X16739	34	12.9	55.0	49.0	99.0	2.0	48.5	3.5	4.0
K19613	TARS-HT2/TARS-HT1	45	12.6	55.1	48.0	103.0	2.0	49.0	3.5	3.0
K19614	TARS-HT2/TARS-HT1	46	11.8	51.7	47.0	96.0	1.0	46.0	2.5	4.0
I90013	**CELRK**	51	11.6	65.0	36.0	91.0	1.0	44.5	3.5	4.0
K19105	I15622/X16740	5	11.0	47.1	50.0	96.0	2.0	47.5	3.0	4.0
K19125	TARS-HT2/TARS-HT1	25	10.5	53.0	38.0	95.0	1.0	41.5	2.5	4.0
K19616	TARS-HT2/TARS-HT1	48	5.4	57.6	36.0	96.0	1.0	44.0	2.5	4.0
MEAN(56)			21.7	56.4	45.9	101.7	1.5	49.6	3.8	2.5
LSD(.05)			3.1	3.2	2.9	4.2	0.8	2.5	1.3	-
CV%			10.7	4.2	3.8	2.5	31.6	3.0	21.0	43.4

EXPERIMENT 9215 NATIONAL WHITE MOLD YIELD TRIAL								PLANTED: 6/8/19			
NAME	PEDIGREE	ENTRY	YIELD /ACRE	CWT 100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE	WM (1-9)	WM %
G17410	G13467/G13479	23	44.7	38.7	44.0	102.0	1.0	53.3	5.3	2.3	25.9
R17605	R12859/R12844	32	42.0	36.3	50.0	102.0	2.3	51.3	4.0	5.3	59.2
P17510	SDP H/H BULK	26	39.5	43.8	47.0	98.0	2.0	52.3	4.3	5.7	63.0
R12844	SR9-5/R09508, **CAYENNE**	27	39.2	37.3	48.0	97.0	2.3	51.3	4.3	3.7	40.7
P16905	P11519/P12610	25	38.1	43.8	49.0	95.0	1.3	51.7	5.7	3.0	33.3
R17603	R12859/R12844	31	38.0	37.6	50.0	101.0	1.7	52.3	5.3	3.7	40.7
I09203	SR9-5	4	37.1	34.5	47.0	105.0	2.3	51.7	4.0	3.3	37.0
G16351	Eldorado/G13467	6	36.2	38.6	46.0	96.0	2.0	52.7	4.0	7.0	77.8
N18122	N15334/N15335	16	36.2	26.3	49.0	102.0	1.3	57.0	6.0	3.7	40.7
P16901	Eldorado/P11519	7	36.1	41.5	50.0	97.0	1.7	51.0	5.0	5.0	55.5
I19714	ND112929	10	35.4	41.8	48.0	95.0	1.7	51.3	4.3	4.7	51.9
I19701	NDF120287	9	34.4	24.7	47.0	93.0	1.7	47.3	4.0	3.0	33.3
R17604	R12859/R12844	8	33.0	34.7	50.0	100.0	2.0	51.7	4.7	5.0	55.5
G18505	G14506/G13444	24	32.5	34.8	45.0	92.0	1.0	50.3	5.3	4.7	51.9
B18201	B10244/B13218	22	31.7	21.9	48.0	95.0	1.3	50.0	4.3	6.0	66.7
B17922	B14302/B10244	20	31.3	22.7	49.0	95.0	1.0	51.7	5.0	4.0	44.4
N18117	N14201/N15334	17	31.2	21.1	49.0	105.0	2.0	54.0	5.0	2.7	29.6
B10244	B04644/ZORRO, **ZENITH**	28	31.1	24.2	47.0	94.0	1.0	51.0	5.3	5.3	59.3
B16504	Zenith//Alpena*/B09197	18	30.9	21.2	49.0	98.0	1.0	53.3	5.0	4.3	48.1
B18204	B10244/B15430	21	28.8	24.7	48.0	94.0	1.0	49.7	5.0	3.7	40.7
G08254	G04514/Matterhorn, **POWDERHORN**	30	28.0	36.6	44.0	91.0	1.3	47.7	5.0	3.0	33.3
B18231	B15430/B10244	12	27.8	24.8	49.0	95.0	1.0	53.3	5.3	4.3	48.1
B18504	Zenith//Alpena*/B09197	19	27.6	22.7	49.0	98.0	1.3	50.0	4.7	4.0	44.4
N18102	N13120/PR0806-81	14	25.9	23.2	50.0	95.0	1.7	52.7	4.3	6.0	66.7
I11264	COOP 03019, **MERLIN**	29	25.5	20.0	46.0	99.0	2.0	49.3	4.0	4.7	51.9
I08933	37-2, USPT-WM-12	5	24.7	45.3	45.0	94.0	1.7	48.3	4.3	4.0	44.4
N18109	N13131/B14302	15	21.2	23.2	49.0	96.0	1.3	51.7	4.3	7.0	77.8
N17506	N14230/N12447	13	18.8	21.7	49.0	94.0	1.3	51.0	4.3	6.3	70.4
I81010	JAPON3/MAGDALENE, **BUNSI**	1	16.9	21.6	44.0	94.0	3.7	43.7	3.0	6.3	70.4
I96417	**G122 MAGNUSON**	3	12.4	44.9	48.0	106.0	1.0	46.7	2.3	2.0	22.2
I89011	RB, **BERYL**	2	12.4	32.8	43.0	91.0	5.0	40.0	2.0	8.7	96.3
Y16507	PR1146-123/Y11405	11	11.1	44.0	45.0	93.0	1.0	46.7	4.0	3.7	40.7
MEAN(32)			30.0	31.6	47.2	96.9	1.7	50.5	4.5	4.6	50.7
LSD(.05)			6.5	2.3	1.9	2.7	0.6	2.7	0.9	2.6	29.3
CV%			15.9	5.4	2.4	2.0	27.2	3.9	14.1	42.4	42.4

EXPERIMENT 9416 RAINOUT SHELTER YIELD TRIAL							PLANTED: 6/28/19			
NAME	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**	**BIOMASS (Kg)**	**STAND (Plants)**
B18504	4	20.3	20.5	43.0	101.0	1.0	49.3	5.0	1.5	51.8
Rosetta_Rainout	7	19.4	34.6	42.0	104.0	1.0	52.5	5.0	1.8	31.8
Rosetta	8	18.8	34.5	41.0	103.0	1.0	51.8	5.0	1.8	35.5
B18504_Rainout	3	18.8	20.5	42.0	100.0	1.0	49.0	5.5	1.2	50.8
Cayenne_Rainout	5	18.6	36.4	41.0	98.0	1.0	50.3	5.0	1.3	44.0
Cayenne	6	18.2	35.3	41.0	97.0	1.0	49.8	4.5	1.2	52.3
R99	2	11.6	18.8	44.0	108.0	1.5	48.0	3.8	1.7	33.5
R99_Rainout	1	7.9	18.3	43.0	110.0	1.5	48.3	3.8	1.8	31.3
MEAN(8)		16.7	27.4	41.9	102.5	1.1	49.8	4.7	1.5	41.3
LSD(.05)		4.6	1.7	0.5	1.4	0.3	1.7	0.8	0.3	3.8
CV%		22.9	5.1	1.1	1.1	23.8	2.7	14.3	17.6	7.5

EXPERIMENT 9417 ADVANCED PIC YIELD TRIAL								PLANTED: 6/28/19	
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE
15Arusha_47	KIJIVU/Montcalm	15	18.4	52.1	40.0	104.0	1.0	55.0	5.0
15Mbeya_28	CANADA/CAL 143	5	18.2	58.0	40.0	102.0	1.0	55.0	5.0
K15601	RED CEDAR/K11916, **COHO**	22	10.6	49.6	40.0	99.0	1.0	49.0	5.0
16PR_15	ADP-37/Dolly (ADP-624)	14	9.6	66.9	37.0	98.0	1.0	49.5	5.0
K17703	K11714*/K13902	21	8.1	55.4	37.0	100.0	1.0	51.0	5.5
K16136	K12206/ND02-385-14	19	6.8	50.7	38.0	99.0	1.0	48.5	4.5
16Mbeya_104	Mrondo (ADP-41)/A 197 (ADP-532)	3	6.7	48.4	37.0	96.0	1.0	46.5	3.5
15Arusha_30	CAL143 (ADP-526)/Blush (ADP-658)	8	6.3	53.0	39.0	99.0	1.0	46.0	4.0
16PR_8	Dolly(ADP-0624)/IJR(ADP-0683)	11	5.9	43.7	35.0	97.0	1.0	45.5	3.5
16PR_24	PR1013-3(ADP-0430)/CAL 143(ADP-0526)	16	5.9	46.2	40.0	98.0	1.0	46.5	4.5
K90101	CHAR/2*MONT, **RED HAWK**	23	5.9	49.6	35.0	98.0	1.0	49.0	4.5
K11306	K06621/USDK-CBB-15, **RED CEDAR**	24	5.1	48.6	40.0	96.0	1.0	48.0	4.5
16PR_52	NY 105(ADP-0607)/TARS HT 1(ADP-0632)	9	4.8	44.9	37.0	98.0	1.0	45.0	3.5
16PR_43	NY 105(ADP-0607)/TARS HT 1(ADP-0632)	13	4.8	55.6	35.0	104.0	1.0	46.0	3.0
15Mbeya_55	KIJIVU/Montcalm	10	4.6	51.9	39.0	103.0	1.0	50.0	5.0
16Mbeya_92	Kijivu (ADP-33)/Dolly (ADP-624)	17	4.1	50.2	40.0	101.0	1.0	46.0	4.0
16PR_5	NY 105(ADP-0607)/TARS HT 1(ADP-0632)	12	3.9	47.4	35.0	99.0	1.0	44.5	3.5
16PR_2	NY 105(ADP-0607)/G 6415(ADP-0225)	2	3.8	45.2	35.0	100.0	1.0	44.5	3.5
16PR_66	PR9920-171 (ADP-0429)/TARS HT 1(ADP-0632)	4	2.9	47.6	35.0	99.0	1.0	44.0	3.5
16PR_51	NY 105(ADP-0607)/TARS HT 1(ADP-0632)	6	2.8	52.5	38.0	98.0	1.0	46.0	3.5
16Arusha_129	Bwana Shamba (ADP-10)/Dolly (ADP-624)	18	2.5	44.3	38.0	96.0	1.0	43.0	3.0
Y16507	PR1146-123/Y11405	20	2.5	39.9	37.0	101.0	1.0	45.5	4.0
15Arusha_59	ND061106/TARS-HT1	7	2.1	48.7	39.0	103.0	1.0	46.5	4.0
16Arusha_54	AC Elk(ADP-0618)/KIJIVU(ADP-0033)	1	1.2	46.9	34.0	103.0	1.0	43.0	3.0
MEAN(24)			6.1	49.9	37.5	99.4	1.0	47.2	4.1
LSD(.05)			1.8	2.6	1.8	5.0	-	3.1	1.0
CV%			21.5	3.8	3.5	2.9	-	3.8	14.4

USDA-ARS Cranberry and Yellow Bean Breeding Progress

Karen Cichy and Scott Shaw

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Yellow Bean Trial: An 84 entry trial was planted at the Montcalm Research Farm on June 12, 2019 with two replications per entry. The top 36 lines, based on agronomic and seed characteristics were also evaluated for cooking time. The data of these 36 along with three check varieties is shown in Table 1. Average yields for the trial were 15.9 CWT which was higher than the yields of the checks, ADP0781 (L11YL012) from Agriculture and Agrifood Canada at 9.6 CWT, Y11405 a Mexican mayacoba line at 10.9 CWT and Patron from Oregon State University at 10.2 CWT. Cooking time was also evaluated since it is an expectation that yellow beans have the greatest potential to be sold as dry seeds. Therefore developing lines with fast cooking times is a priority of this program. Anything under 25 min was classified as fast cooking. Beans from the top twelve lines that combine good agronomic characteristics and fast cooking times will be evaluated for nutritional and flavor characteristics.

Cranberry Bean Trial: A 19 entry cranberry bean trial was planted at the Montcalm Research Farm on June 12, 2019 with two replications per entry. The entries included 16 breeding lines and three checks: Etna, Bellagio, and MICRAN. The average yield for the trial was 17 CWT which was higher than the yields of the checks, Etna at 16.1 CWT, Bellagio at 16.1 CWT and MICRAN at 16.4 CWT. The top yielding line 14L1203B also exhibits resistance to common bacterial blight. Beans from this trial will also be evaluated for canning quality, cooking time, and flavor.

Table 1. USDA-ARS 2019 Yellow Bean Advanced Yield Trial at the Montcalm Research Farm in Entrican, Michigan

ID	Seed type	Parents	Seed Yield	Flowering	Maturity	Lodging[1]	Agronomic Desirability[2]	Seed wt.	Cooking time[3]
			CWT/acre	days	days	1 to 5	1 to 5	g /100 seeds	min
Y1608-07	manteca	Y11405\ADP0521	23.6	47	96	2.5	4.5	37.5	64
Y1608-09	manteca	Y11405\ADP0521	22.3	41	94	1	3	40.9	32
Y1702-22	mayacoba	ADP0781\Akaryose	21.3	37.5	98	1	2.5	38.2	17
Y1608-14	manteca	Y11405\ADP0521	21.3	38.5	93	1	2	37.4	22
Y1608-03	manteca	Y11405\ADP0521	20.1	40.5	95	1.5	2	38.5	>45
Y1608-15	manteca	Y11405\ADP0521	19.3	43.5	93	1	2.5	36.7	19
Y1612-01	manteca	ADP0679 \ADP0512	19.2	46	97	2.5	4	56.8	25
Y1702-03	mayacoba	ADP0781\Akaryose	18.8	38.5	96	1	4	43.0	21
Y1702-14	mayacoba	ADP0781\Akaryose	18.3	40.5	96	1	3.5	38.1	21
Y1608-04	manteca	Y11405\ADP0521	18.2	40	93	1	3.5	42.0	>45
Y1703-21	mayacoba	ADP0781\Y11405	17.8	38	94	1	3	47.0	21
Y1609-01	manteca	Y11405\ADP0512	17.1	38.5	92	1	2.5	47.2	24
Y1703-04	mayacoba	ADP0781\Y11405	16.9	40	96	1	2.5	42.6	23
Y1703-14	mayacoba	ADP0781\Y11405	16.8	39.5	94	1	2.5	37.2	>45

Y1703-22	mayacoba	ADP0781\Y11405	16.6	40.5	98	1.5	4.5	44.3	>45
Y1612-05	manteca	ADP0679 \ADP0512	16.5	42	95	1	3	51.3	21
Y1701-03	round yellow	ADP0781\Marafax	16.4	35	91	1	5	36.4	24
Y1609-02	manteca	Y11405\ADP0512	16.1	40.5	91	1	3	43.5	22
Y1702-10	mayacoba	ADP0781\Akaryose	15.8	36	97	1	4.5	41.4	30
Y1608-02	manteca	Y11405\ADP0521	15.7	40.5	92	1	2	41.6	24
PIC86	manteca	ADP0037\Dolly	15.6	42	98	2.5	3.5	66.5	28
Y1609-14	mayacoba	Y11405\ADP0512	14.9	40	93	1	3	43.4	18
Y1703-25	mayacoba	ADP0781\Y11405	14.7	37.5	96	1.5	3	45.1	17
Y1702-05	mayacoba	ADP0781\Akaryose	14.4	38.5	98	1	3.5	39.8	22
Y1701-22	round yellow	ADP0781\Marafax	14.0	38.5	96	1	4.5	39.9	22
Y1612-02	manteca	ADP0679 \ADP0512	13.8	45	98	2	4	48.6	>45
Y1609-09	mayacoba	Y11405\ADP0512	13.4	41.5	91	1	4	43.3	>45
Y1609-08	mayacoba	Y11405\ADP0512	13.2	41	92	1	3.5	40.4	>45
Y1703-06	mayacoba	ADP0781\Y11405	12.8	39.5	94	1	4.5	39.4	>45
Y1609-10	mayacoba	Y11405\ADP0512	12.5	40.5	90	1	4	37.5	>45
Y1703-02	mayacoba	ADP0781\Y11405	12.4	40	98	1	4	43.6	>45
Y1703-01	mayacoba	ADP0781\Y11405	11.6	40	98	1	4	40.3	>45

Y1610-01	manteca	DYB-28-1\ADP0521	10.8	45.5	93	3.5	4.5	45.2	20
Y1701-12	round yellow	ADP0781\Marafax	10.4	42	90	1	5	39.2	27
Y1701-21	mayacoba	ADP0781\Marafax	9.4	43	91	1	5	36.4	21
Checks									
YBC122	ADP0781		9.6					40.2	18
YBC126	Y11405		10.9					45.6	32
YBC127	Patron		12.2					40.8	28
		Means	15.9	40.5	94.6	1.3	3.6	42.4	.
		CV	15.5	4.4	2.5	54	36.3	5.0	.
		LSD	.	3.6	4.8	.	2.6	.	.

[1]Lodging: Based on a scale of 1 to 5 where 1 is completely upright and 5 is completely prostrate.

[2]Agronomic Desirability: Evaluation of plant growth characteristics in the field where 1 is the most desirable and 9 is the least desirable.

[3]Cook Time: The time required to cook 80% of a 25 seed sample in distilled water following a 12 hr soak in distilled water.

Table 2. USDA-ARS 2019 Cranberry Bean Advanced Yield Trial at the Montcalm Research Farm in Entrican, Michigan

ID	Parents	Seed Yield	Flowering	Maturity	Lodging[1] (1 to 5)	Agronomic Desirability[2]	Seed wt.
		CWT/acre	days	days	1 to 5	1 to 9	g/100 seeds
14L1203B	.	25.1	40.5	99	1	2.5	60.0
CR1701-3	ADP0562\ADP0663	24.8	39	91	1	4	63.0
CR1701-2	ADP0562\ADP0663	24.6	40.5	90	1	4.5	58.7
CR1701-1	ADP0562\ADP0663	23.9	40	95	1.5	4	58.4
CR1503_4	CR1405\Dolly	20.4	39	97	3.5	4.5	51.8
CR1704-2	ADP0562\CR1220	18.9	40.5	96	1	2	62.9
CR1703-1	ADP0562\14L1203C	18.7	38	95	1	4	49.6
CR1702-1	ADP0562\13-L903	17.5	40.5	98	1	4	51.2
CR1703-2	ADP0562\14L1203C	17.4	41	96	1	1.5	49.1
CR1503_1	CR1405\Dolly	15.8	43	99	2.5	5	60.8
CR1704-3	ADP0562\CR1220	14.9	40.5	97	1	4.5	57.1
CR1502_3	Dolly\CR1405	14.2	47.5	98	1	5.5	55.5
CR1703-3	ADP0562\14L1203C	12.8	38	95	1	3	46.4
CR1704-4	ADP0562\CR1220	11.0	40	96	1	4	54.9
CR1704-1	ADP0562\CR1220	10.4	39.5	94	1	5.5	49.6
CR1716-1	CR1220\CM433	5.2	38.5	100	2	7	31.4
Checks							
Etna		16.1	40.5	94	1	2	57.2
Bellagio		16.1	42	100	3	2.5	59.8
MI Cran		16.4	48	104	4	5.5	56.3
	mean	17.0	40.9	96.2	1.5	4	54.3
	CV	19.8	5.3	2.1	30	25.9	5.1
	LSD	.	4.6	.	.	2.2	.

[1]Lodging: Based on a scale of 1 to 5 where 1 is completely upright and 5 is completely prostrate.

[2]Agronomic Desirability: Evaluation of plant growth characteristics in the field where 1 is the most desirable and 9 is the least desirable.

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan State University AgBioResearch

Response of Dry Bean to Nitrogen Application

Christian Terwillegar, Andrew Chomas, and Kurt Steinke, Michigan State University
See soil.msu.edu for more information

Location: Saginaw Valley Research and Extension Center	**Tillage**: Conventional
Planting Date: June 19, 2019 (Harvest 09/25/19)	**Row Width**: 20-inch
Soil Type: Clay Loan; 2.6% OM; 7.8 pH; 8 ppm P (Olsen); 124 ppm K	**Trts**: See below
Varieties: Zenith (black bean), Black Bear (black bean)	**Population**: 5.5 seeds/ft
Viper (small red bean), Merlin (navy bean)	**Replicated**: 4 replications

N Rate (Total lb. N/A)	Yield[b] (cwt/A)	Biomass[c] (lbs/A)	Nodule Count[d] (nodules/plant)
0 N	23.2	3,650	4.3
30 N	21.1	4,231	3.2
60 N	22.0	4,692	1.9
90 N	23.4	5,229	2.6
120 N	22.8	4,654	0.9
150 N	23.4	5,314	1.0
LSD$_{(0.10)}$[a]	**NS**	**607**	**NS**

[a] LSD, least significant difference between means within a column at (α=0.10)
[b] Yield adjusted to 18% moisture.
[c] Total biomass accumulation collected at R5.
[d] Average number of nodules on a per plant basis obtained 6 weeks after emergence.

Summary: Trial quality was fair to good as some soil borne disease pressure unrelated to treatments was evident at emergence. Treatments consisted of four dry bean varieties: Zenith (black bean), Black Bear (black bean), Viper (small red bean), and Merlin (navy bean). Urea was pre-plant incorporated at nitrogen rates of 0, 30, 60, 90, 120, and 150 lb. N/A. Cumulative growing season precipitation (June-September) totaled 14.2 inches and was near the 30 year mean. However, June rainfall was 97% greater and August rainfall was 67% reduced as compared to the 30 year means, respectively. Pre-plant residual soil N was 18 lbs. N/A available in the top one foot of soil. Variety did not affect response to N applications thus data were combined across varieties. Wet emergence conditions combined with lack of August rainfall likely decreased yield potential, overall growth, and total N uptake. No yield differences occurred due to N application at this location. Total biomass production significantly differed by N rate, but results did not correspond to yield. Biomass accumulation did not differ beyond 60 lb. N/A. Nodulation counts per plant were not significantly impacted by N applications but data were highly variable. Biomass accumulation may not translate directly into additional yield potential. Thus do not confuse an aboveground plant growth response with a grain yield response. Applying above recommended N rates may increase biomass production resulting in decreased air movement and greater pathogen growth. Trial will repeated in 2020.

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan State University AgBioResearch

Dry Bean Response to Phosphorus Application

Kurt Steinke and Andrew Chomas, Michigan State University

See soil.msu.edu for more information

Location: Saginaw Valley Research and Extension Center	**Tillage**: Conv., 20-in. row
Planting Date: June 19, 2019 (Harvest 9/25/19)	**P Rates**: See below
Soil Type: Clay loam; 2.6% OM; 7.8 pH; 8 ppm P (Olsen); 124 ppm K;	**Population**: 5.5 seeds/ft
Varieties: Zenith (black bean), Black Bear (black bean)	**Replicated**: 4 replications
Viper (small red bean), Merlin (navy bean)	

P Trt. (Total lb. P_2O_5/A)	Yield[b] (cwt/A)
0 – Check	25
25	23
50	23
100	21
150	22
200	23
$LSD_{(0.10)}$[a]	**NS**

[a] LSD, least significant difference between means within a column at ($\alpha = 0.10$).

[b] Yield adjusted to 18% moisture.

Summary: Trial quality was fair to good. Phosphorus source was monoammonium phosphate (MAP, 11-52-0) applied pre-plant incorporated with N contributions from the MAP accounted for in overall total N application rates. All treatments received 60 lbs. N/A total. Variety did not affect response to P applications thus data were combined across varieties. Two inches of rainfall within 48 hours of planting resulted in some crusting and emergence issues. Lack of soil moisture during August (1.06 inches rainfall) likely limited both nutrient availability and plant growth. No yield differences occurred across the spectrum of P application rates in this study. Critical Bray-P soil test concentration for dry bean is 15 ppm with a maintenance range of 15-40 ppm. When converting the Olsen P measurement to the Bray P equivalent, this location resulted in a soil test P concentration slightly above the critical level of 15 ppm. Dry soil conditions likely limited P availability, plant growth, and yield potential thus limiting response to P applications. Trial will be repeated in 2020. Don't Guess Soil Test! Have a current soil test report on hand for the coming season and decide on the likelihood of observing a P grain yield response prior to making any 2020 fertilizer decisions.

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan State University AgBioResearch

Dry Bean Response to Potassium Application

Kurt Steinke and Andrew Chomas, Michigan State University

See soil.msu.edu for more information

Location: Saginaw Valley Research and Extension Center	**Tillage**: Conv., 20-in. row
Planting Date: June 19, 2019 (Harvest 9/25/19)	**K Rates**: See below
Soil Type: Clay loam; 2.6% OM; 7.8 pH; 8 ppm P (Olsen); 124 ppm K	**Population**: 5.5 seeds/ft
Varieties: Zenith (black bean), Black Bear (black bean)	**Replicated**: 4 replications
Viper (small red bean), Merlin (navy bean)	

K Trt. (Total lb. K_2O/A)	Yield[b] (cwt/A)
0 – Check	24
25	25
50	24
100	26
150	23
200	24
$LSD_{(0.10)}$[a]	**NS**

[a] LSD, least significant difference between means within a column at ($\alpha = 0.10$).

[b] Yield adjusted to 18% moisture.

Summary: Trial quality was fair to good. Potassium source was potassium chloride (MOP, 0-0-60) applied pre-plant incorporated. All treatments received 60 lbs. N/A total as urea applied pre-plant incorporated. Variety did not affect response to K applications thus data were combined across varieties. Critical soil test K concentration for dry bean at this location was 112 ppm with a maintenance range of 112-142 ppm. Due to residual soil test K concentrations, no yield differences occurred across the spectrum of K application rates in this study nor was a yield response expected. Differences in overall biomass growth were observed in response to K application but did not correspond to yield. Two inches of rainfall within 48 hours of planting resulted in some crusting and emergence issues. Lack of soil moisture during August (1.06 inches rainfall) likely limited both nutrient availability and plant growth. Although no visual K tissue deficiencies were observed during the course of this study, the dry soil conditions likely limited the diffusive movement of K to plant roots thus further limiting the effectiveness of the fertilizer applications. Trial will be repeated in 2020. Don't Guess Soil Test! Have a current soil test report on hand for the coming season and consider the current soil test K concentration, the likelihood of yield response, and the rate of drawdown prior to making 2020 fertilizer decisions.

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan State University AgBioResearch

Manganese and Zinc Application in Dry Bean

Kurt Steinke and Andrew Chomas, Michigan State University

See soil.msu.edu for more information

Location: Saginaw Valley Research and Extension Center	**Tillage**: Conv., 20-in. row
Planting Date: June 19, 2019 (Harvest 9/25/19)	**K Rates**: See below
Soil Type: Clay loam; 2.6% OM; 7.8 pH; 8 ppm P (Olsen); 124 ppm K 37 ppm Mn; 3.7 pm Zn	**Population**: 5.5 seeds/ft
Variety: Zorro (black bean)	**Replicated**: 4 replications

Mn Trt. (Total lb. Mn/A)	Yield[b] (cwt/A)
0 – Check	21
1 (25 DAE)	22
1 (25 DAE) 1 (35 DAE)	23
LSD$_{(0.10)}$[a]	**NS**

[a] LSD, least significant difference between means within a column at ($\alpha = 0.10$).
[b] Yield adjusted to 18% moisture.

Zn Trt. (Total lb. Zn/A)	Yield[b] (cwt/A)
0 – Check	24
5	25
10	23
LSD$_{(0.10)}$[a]	**NS**

[a] LSD, least significant difference between means within a column at ($\alpha = 0.10$).
[b] Yield adjusted to 18% moisture.

Summary: Trial quality was fair to good. Manganese was foliar applied using a 5% soluble Mn solution at rates of 1 lb Mn/A at 25 days after emergence and another treatment as 1 lb Mn/A at 25 and 35 days after emergence (2 lb Mn/A total). Zinc was pre-plant incorporated using zinc sulfate at 5 and 10 lb Zn/A. All treatments received 60 lbs. N/A total as urea applied pre-plant incorporated. Critical soil test Mn concentrations for dry bean on mineral soils are near 6 ppm at a 6.3 soil pH and 12 ppm at a 6.7 soil pH. At the current soil test level of 37 ppm, a yield response to Mn was not expected. Under dry soil conditions such as those observed in July and

August 2019, Mn availability is reduced due to decreased rates of diffusion to the root and increases in the oxidized, less available form of Mn (Mn^{4+}). Despite some visual confirmation of Mn tissue deficiency during the dry mid-summer period, dry bean plants did not respond to the foliar Mn treatments at this location. Visual tissue deficiencies dissipated upon receiving rainfall.

Critical soil test Zn concentrations for dry bean are near 2 ppm at 6.6 soil pH and 7 ppm at 7.0 soil pH. At the current soil test level of 3.7 ppm, a yield response to Zn application was probable but not realized during the 2019 growing season at this location. Zinc is predominately transported within the rooting zone by diffusion, and the lack of sufficient mid-summer soil moisture coinciding with peak dry bean growth likely limited the effectiveness and uptake of the Zn fertilizer application. Due to the diffusive movement of Zn in the soil, banded Zn applications at planting are often preferred as compared to broadcast pre-plant applications. Both trials will be repeated in 2020.

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan State University AgBioResearch

Sulfur Rate and Source Response for Dry Bean

Christian Terwillegar, Andrew Chomas, and Kurt Steinke, Michigan State University
See soil.msu.edu for more information

Location: Saginaw Valley Research and Extension Center	**Tillage**: Conventional
Planting Date: June 19, 2019 (Harvest 09/25/19)	**Row Width**: 20-inch
Soil Type: Clay Loan; 2.6% OM; 7.8 pH; 8 ppm P (Olsen); 124 ppm K	**Trts**: See below
Varieties: Zenith (black bean), Black Bear (black bean)	**Population**: 5.5 seeds/ft
Viper (small red bean), Merlin (navy bean)	**Replicated**: 4 replications

S Rate (Total lb. S/A)	Yield[b] (cwt/A)	NDVI[c]	Nodule Count[d] (nodules/plant)
CHECK	21.8	0.63	4.3
25 S	22.1	0.61	3.2
50 S	22.1	0.66	1.9
100S	21.8	0.62	2.6
LSD$_{(0.10)}$[a]	**NS**	**NS**	**NS**

[a]LSD, least significant difference between means within a column at (α=0.10)
[b]Yield adjusted to 18% moisture.
[c]NDVI data collection occurred on 18 Jul 2019.
[d]Average number of nodules on a per plant basis obtained 6 weeks after emergence.

S Source (25 lb. S/A)	Yield[b] (cwt/A)	NDVI[c]
Gypsum	22.1	0.62
AMS	20.4	0.62
MESZ	19.8	0.57
LSD$_{(0.10)}$[a]	**NS**	**0.02**

[a]LSD, least significant difference between means within a column at (α=0.10)
[b]Yield adjusted to 18% moisture.
[c]NDVI data collection occurred on 18 Jul 2019.

Summary: Trial quality was fair to good. Treatments consisted of four dry bean varieties: Zenith (black bean), Black Bear (black bean), Viper (small red bean), and Merlin (navy bean). Gypsum was utilized as the S source within the S rate study and was pre-plant incorporated at 0, 25, 50, and 100 lb. S/A. For the S source study, gypsum, AMS (21-0-0-24), and MESZ (12-40-0-10-1) were utilized as S sources and pre-plant incorporated at 25 lb. S/A. Nitrogen was balanced to 60 lb. N/A for all treatments in the form of pre-plant incorporated urea. Variety did not affect response to S rate or sources thus data were combined across varieties. Yield, NDVI, and nodulation counts were not affected by S rate in this study. Wet planting conditions and limited precipitation in August limited plant growth, development, and yield. NDVI responded to S source but no yield response occurred. Trial will repeated in 2020.

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan State University AgBioResearch

Preharvest herbicides for common lambsquarters desiccation in dry beans

Christy Sprague, Gary Powell and Brian Stiles, Michigan State University

Location:	Richville (SVREC)	**Tillage:**	Conventional
Planting Date:	June 19, 2019	**Row width:**	30-inch
Replicated:	4 times	**Dates treated:**	Sept. 16 (80% pods yellow)
Varieties:	'Merlin' navy beans		Sept. 19 (+3 days)

Table 1. Effect of preharvest treatments on common lambsquarters desiccation (%).

	Common lambsquarters	
Treatments	**7 DAT[a]**	**14 DAT**
Homeplate (3% v/v)	4 de[b]	4 d
Homeplate (5% v/v)	5 de	4 d
Homeplate (7% v/v)	6 de	6 d
Sharpen (1 fl oz) + MSO + AMS	8 d	6 d
Gramoxone 3L (1.33 pt) + NIS	94 ab	94 a
Valor (1.5 oz) + MSO	8 d	6 d
Roundup (22 fl oz) + AMS	63 c	75 c
Aim (2 fl oz) + MSO	3 de	5 d
Sharpen (1 oz) + Gramoxone 3L (1.33 pt) + MSO + AMS	89 a	85 b
Valor (1.5 oz) + Gramoxone 3L (1.33 pt) + MSO + AMS	83 b	79 bc
Aim (2 fl oz) + Gramoxone 3L (1.33 pt) + MSO + AMS	96 a	96 a
Sharpen (1 fl oz) + MSO + AMS fb. Sharpen (1 fl oz) + MSO + AMS	85 b	88 b
Sharpen (1 fl oz) + MSO + AMS fb. Gramoxone 3L (1.33 pt) + NIS	86 b	88 b
Gramoxone 3L (1.33 pt) + NIS fb. Sharpen (1 fl oz) + MSO + AMS	96 a	94 a
Untreated	0 e	0 d

[a] Abbreviations: DAT = days after treatment, MSO = methylated seed oil, AMS = ammonium sulfate, NIS = non-ionic surfactant

[b] Means within a column with different letters are significantly different from each other

Summary: This study was conducted to evaluate the effects of preharvest herbicide treatments on weed and bean desiccation. Dry bean desiccation (dry down) was uniform across all treatments including the untreated control, so bean desiccation could not be evaluated in this trial. Uniform dry down was likely due to drier conditions at SVREC as the beans matured. One new product that we examined was Homeplate (44% Caprylic acid:36% Capric acid) a new non-selective organic herbicide. This herbicide had very little effect on lambsquarters desiccation. Gramoxone alone, in combination, or in sequential applications were the most consistent for common lambsquarters desiccation. While these results were fairly consistent, we did observe some slight differences, depending on tank-mix partner. Over the years if you are trying desiccate weeds, including Gramoxone in preharvest treatment has been the most consistent. Please be aware if you are using Gramoxone there are new requirements for training prior to use. These requirements and more information on preharvest treatments for dry beans can be found in the 2020 MSU Weed Control Guide (E-434). This research was supported by the Michigan Dry Bean Commission through the Michigan Department of Agriculture Specialty Crops grant.

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan State University AgBioResearch

Sugarbeet tolerance to postemergence applications of Ultra Blazer – Year 2

Christy Sprague, Gary Powell and Brian Stiles, Michigan State University

Location: Richville (SVREC)	**Application timings**: 2-lf beets (May 24), 6 lf beets (June 12), 12-lf beets (July 2)
Planting Date: April 24, 2019	**Herbicides:** see treatments
Soil Type: Clay loam	**O.M.:** 2.5 **pH:** 7.1
Replicated: 4 times	**Variety:** Crystal G675

Table 1. Sugarbeet tolerance to POST applications of Ultra Blazer (aciflurofen) applied at various sugarbeet stages.

Herbicide treatments[a]	Timing	Injury (June 19)	Injury (July 17)	Injury (Sept. 18)	Yield	RWSA
		—%—	—%—	—%—	– ton/A –	– lb/A –
Roundup PowerMax (22/22/22 fl oz)		0	0	0	19.2	5796
Ultra Blazer (8/8/8 fl oz)	2, 6, 12 lf	73*[b]	55*	26*	11.2*	2936*
Ultra Blazer (16/16/16 fl oz)	2, 6, 12 lf	70*	63*	23*	8.4*	2132*
Ultra Blazer (16 fl oz)	2-lf	63*	50*	23*	13.6*	3704*
Ultra Blazer (24 fl oz)	2-lf	69*	48*	26*	12.3*	3146*
Ultra Blazer (16 fl oz)	6-lf	38*	11	1	16.8	4732
Ultra Blazer (24 fl oz)	6-lf	31*	14	3	16.9	4967
Ultra Blazer (16 fl oz)	12-lf	-	24*	3	15.6	4671
Ultra Blazer (24 fl oz)	12-lf	-	20*	2	15.7	4306
Ethotron (12 fl oz) + Ultra Blazer (16 fl oz)	6-lf	33*	13	2	13.9*	3957*
Stinger (4 fl oz) + Ultra Blazer (16 fl oz)	6 lf	23*	5	5	19.7	5689
$LSD_{0.05}$[c]		*10*	*16*	*12*	*3.53*	*1175*

[a] Roundup PowerMax was included in all postemergence treatments at the rates listed in the first treatment. These treatments also included AMS at 17 lb/100 gal.

[b] Sugarbeet injury, yield and RWSA data with asterisks (*) are significantly different from the Roundup alone control.

[c] Means within a column greater than least significant difference (LSD) value are different from each other.

Summary: Options are extremely limited for POST control of glyphosate-resistant pigweed (waterhemp and Palmer) in sugarbeet. Ultra Blazer (aciflurofen) is an older Group 14 herbicide that has activity on pigweed species. This is the second year in which we have conducted a field trial to evaluate sugarbeet safety to POST applications of Ultra Blazer. All applications of Ultra Blazer resulted in sugarbeet injury. Injury symptoms from Ultra Blazer consist of leaf speckling/bronzing of the sugarbeet leaves and in the case of applications to 2-leaf sugarbeet severe stand loss. This is the first year where we have observed severe injury from applications to 2-leaf sugarbeets that reduced stand and yield. Ultra Blazer applications to 6- and 12- leaf sugarbeet still resulted in injury, however sugarbeet was able to recover over time and sugarbeet yield and recoverable white sugar were not affected. The only exception to this was the tank-mix of Ultra Blazer and Ethotron applied to 6-leaf sugarbeet. Examining our research and that of it of colleagues in North Dakota, it appears if an Ultra Blazer is ultimately pursued applications would have to be on larger beets (>6-leaf). The question still remains for use: 1) What level of sugarbeet injury are growers comfortable with if there is no effect on yield.

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan State University AgBioResearch

Rotational crop safety with postemergence applications of ethofumesate -Year 2

Christy Sprague, Gary Powell and Brian Stiles, Michigan State University

Location: Richville (SVREC)	**Sugarbeet planting date:** April 30, 2018
Corn planting date: May 7, 2019	**Soil Type:** Clay loam
Soybean planting date: May 7, 2019	**O.M.:** 3.0 **pH:** 7.5
Dry bean planting date: June 19, 2019	**Replicated:** 4 times

Table 1. Tolerance of corn, soybean, and black beans the year following postemergence applications of high rates of ethofumesate[a].

		30 d after planting		
Herbicide treatments[b]	**Timing**	**Injury**	**Stand**	**Yield**
Corn 'Stine 9316'		—%—	- #/30' row -	—bu/A—
No herbicide		0	20	94.0
Ethofumesate (32/32/32/32 fl oz)	2-lf, + 2 WAT – 4 times	0	19	99.5
Ethofumesate (128 fl oz)	June 15	0	19	86.5
Ethofumesate (128 fl oz)	July 15	0	19	92.4
Ethofumesate (128 fl oz)	August 15	0	19	90.3
Soybean 'Stine 14RD62'				—bu/A—
No herbicide		0	44	53.2
Ethofumesate (32/32/32/32 fl oz)	2-lf, + 2 WAT – 4 times	0	48	47.4
Ethofumesate (128 fl oz)	June 15	0	45	49.2
Ethofumesate (128 fl oz)	July 15	0	44	51.6
Ethofumesate (128 fl oz)	August 15	0	44	49.3
Black bean 'Zenith'				—cwt/A—
No herbicide		0	55	12.1
Ethofumesate (32/32/32/32 fl oz)	2-lf, + 2 WAT – 4 times	0	56	14.3
Ethofumesate (128 fl oz)	June 15	0	54	13.8
Ethofumesate (128 fl oz)	July 15	0	57	14.6
Ethofumesate (128 fl oz)	August 15	0	55	14.2

[a] Plots were kept weed-free with the Roundup PowerMax in corn and soybean and with Dual Magnum + Prowl H2O in dry bean.

[b] Herbicide treatments were applied postemergence to sugarbeet in 2018.

Summary: Ethofumesate is a Group 18, selective herbicide used for weed control in sugarbeet. Historically, ethofumesate was primarily used preemergence as part of an overall program for residual weed control of key Michigan weeds. However, it can be used POST and over the past couple of years we have observed some positive results with split-POST ethofumesate at rates as high as 2 pt/A for glyphosate-resistant waterhemp control. The recent label change increased the POST ethofumesate rates from 12 to 128 fl oz/A. However, one of the issues with using some of these higher rates of ethofumesate POST is the current crop rotation restrictions. The current ethofumesate label states: do not rotate to any crops other than sugarbeets or ryegrass for 12 months following applications totaling more than 12 fl oz/A or 6 months following postemergence applications of 12 fl oz/A or less. In 2017 and 2018 we established a plant back studies to examine the crop safety of corn, soybean and dry bean the year following high application rates of ethofumesate. Our two year's results have been extremely positive, in that there did not appear to be any ethofumesate carryover issues with any of the three crops.

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan State University AgBioResearch

Sugarbeet tolerance to overlapping residual herbicide programs

Christy Sprague, Gary Powell and Brian Stiles, Michigan State University

Location: Richville (SVREC)	**Application timings**: PRE (April 24), 2-lf beets (May 24), 6-8 lf beets (June 12)
Planting Date: April 24, 2019	**Herbicides:** see treatments
Soil Type: Clay loam	**O.M.:** 2.5 **pH:** 7.1
Replicated: 4 times	**Variety:** Crystal G675

Table 1. Comparison of sugarbeet tolerance of two-passes of overlapping residual herbicide programs applied POST alone and with ethofumesate (PRE) or a low rate of Dual II Magnum (PRE).

Herbicide treatments[a]		Injury[b] (14 DA-6-lf)	Harvest Stand	Yield	RWSA
PREs	***POST at 2- and 6-lf beets***	— % —	- #/100' row -	- ton/A -	— lb/A —
None	Roundup PowerMax (32/22 fl oz)	0	216	19.2	5666
None	Dual II Magnum (1/1 pt)	6	209	20.4	5808
None	Warrant (3/3 pt)	11	199	16.8	4844
None	Outlook (12/12 fl oz)	13	208	20.1	5753
None	Ethofumesate[a] (2/2 pt)	3	202	18.3	5647
Ethofumesate (2 pt)	Dual II Magnum (1/1 pt)	10	200	17.6	5015
Etho. (2 pt)	Warrant (3/3 pt)	10	194	17.3	5134
Etho. (2 pt)	Outlook (12/12 fl oz)	3	192	18.8	5588
Etho. (2 pt)	Ethofumesate[a] (2/2 pt)	18*	177	16.6	4691
Dual II Magnum (0.5 pt)	Dual II Magnum (1/1 pt)	8	171*	17.4	4759
Dual II Magnum (0.5 pt)	Warrant (3/3 pt)	14	179	17.7	4794
Dual II Magnum (0.5 pt)	Outlook (12/12 fl oz)	15*	184	18.3	4787
Dual II Magnum (0.5 pt)	Ethofumesate[a] (2/2 pt)	13*	169*	17.8	5082
$LSD_{0.05}$[c]		*14.6*[c]	*43.5*	*- NS -*	*- NS -*

[a] Roundup PowerMax was included in all postemergence treatments at the rates listed in the first treatment. These treatments also included AMS at 17 lb/100 gal. All POST applications of ethofumesate was applied with 1.5 pt/A of Destiny HC.
[b] Injury, stand, yield and RWSA data with asterisks (*) are significantly different from the Roundup PowerMax alone control.
[c] Means within a column greater than least significant difference (LSD) value are different from each other.

Summary: Overlapping residual herbicide programs may be the only way to effectively control glyphosate-resistant pigweed (waterhemp and Palmer) in sugarbeet. This is the second year, where a field trial was conducted at the Saginaw Valley Research and Extension Center to determine what effect multiple applications of residual herbicides have on sugarbeet injury, stand, yield and recoverable white sugar per acre (RWSA). The Group 15 herbicides, Dual II Magnum, Outlook and Warrant were all evaluated at maximum rates allowed per season. These treatments were also evaluated after a preemergence application of ethofumesate or Dual II Magnum at a low rate (currently not labeled). Postemergence ethofumesate was also evaluated. Sugarbeet injury was greatest when Ethofumesate was applied 3-times, or when Outlook or Ethofumesate followed PRE Dual II Magnum. Over the two years of this research none of these treatments resulted in a loss of yield or RWSA. These treatments were also examined for waterhemp control and should be continues to be examined over more environments.

Sugar beet activities of the USDA-ARS East Lansing conducted in cooperation with Saginaw Research & Extension Center during 2019

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Evaluation and rating plots were planted at the Saginaw Valley Research & Extension Center (SVREC) in Frankenmuth, MI in 2019 focusing on Cercospora leaf spot (CLS) and Rhizoctonia root and crown rot (RRCR) disease performance of a range of *Beta vulgaris* materials. CLS and CRR trials were conducted in conjunction with the Beet Sugar Development Foundation (BSDF) and CLS trials included USDA-ARS cooperator germplasm. All trials were planted following normal fall and spring tillage operations with a USDA-ARS modified John Deere / Almaco research plot planter. The BSDF CLS nursery was planted on May 6, 2019, the BSDF RRCR Roundup Ready nursery was planted on May 7, 2019, and the conventional RRCR nursery and the USDA Cercospora nursery were planted on May 8. All plots were 15 ft long planted on 20 in rows. BSDF entries were commercial or near- commercial varieties, and weeds were controlled with glyphosate at the recommended rates. For non-commercial entries, weeds were controlled by a preemergence application of ethofumesate May 11, followed by 4 times with mixtures of phenmedipham, desmedipham, triflusulfuron methyl, and clopyralid (May 21, May 31, June 9 and June 17) and once with metolachlor (June 19).
Hand weeding was done as needed to control larger weeds. The BSDF trials were thinned by hand with the generous help of Michigan Sugar Cooperative. Bolting beets were removed throughout the season. In the CLS nurseries, Quadris 2.08SC (azoxystrobin) was applied at 0.0091 kg/100 m row in a 14 cm band in-furrow at planting to help manage Rhizoctonia damping-off.

Cercospora / Agronomic Nurseries:

The BSDF cooperative CLS evaluation nursery had entries from two companies, with a total of 146 entries evaluated (including 10 non-Roundup Ready entries). This nursery was 2-row with 4 replications. The nursery was inoculated on July 9 with a liquid spore suspension (approximately 1 x 10^3 spores/ml) of *Cercospora beticola*. Inoculum was produced from a mixture of leaves collected from the 2018 inoculated leaf spot nursery at the SVREC and naturally infected leaves from the Rhizoctonia root and crown rot nursery at SVREC. Visual evaluations of the plot were conducted with a disease index (DI) on a scale from 0-10 where 0=no symptoms, 1=a few scattered spots, 2=spots coalescing or in large numbers on lower leaves only, 3= some dieback on lower leaves, but leaves not entirely dead, 4-8 are increasing amounts of dead and diseased tissue, 9= mostly dead with few remaining living leaves with large dead patches, and 10=all leaves dead. Disease severity peaked in late August, after which regrowth started to outpace new disease development. In addition, powdery mildew was present in the field unusually early (usually not observed until mid to late September). This caused difficulties in rating other leaf spots in some plots. One end of the field had damage from early flooding, with delayed plant emergence and disease development. In addition to commercial entries 62 USDA-ARS breeding lines and checks from one USDA cooperator (Ft. Collins, CO) and East Lansing, MI were evaluated in randomized replicated trials and rated for disease reaction on two dates. Fort Collins' entry ratings (56 entries) ranged from 3.5 to 7.0 at the last rating. East Lansing's entry ratings (6 entries) ranged from 4.5 to 5.7. The overall mean for the USDA materials was 5.5 (LSD 0.05 = 0.9) with the checks EL50/2 (score 4.5) and F1042 (score 7.5) at the last rating.

In addition to the inoculated nursery, a commercial table beet variety (ruby queen) was planted in a non-inoculated field. Plants were examined periodically for Cercospora leaf spot to identify when natural infection occurred. Leaves with spots were collected for 2020 inoculum.

Rhizoctonia nurseries:

The BSDF cooperative CRR Eastern Evaluation Nursery had entries from five companies, with a total of 312 entries (10 entries were conventional varieties) plus two control varieties evaluated. This nursery was 1-row with 5 replications conducted in a double-blind fashion. In addition, susceptible or moderately resistant varieties were planted to collect sacrificial samples through the season and assess root rot development. The nursery was inoculated on July 11 with a dry ground barley inoculum of *Rhizoctonia solani* anastomosis group 2-2 (highly virulent isolate) at 0.7 g per foot of row using a Gandy applicator to apply inoculum directly to the rows. The nursery was sprayed with water following inoculum application to ensure sufficient moisture for infection. Roots in the Roundup Ready nursery were dug with a single row harvester on August 14-16 (part of harvest was delayed due to rain), and the conventional nursery on August 20. Each root was rated for disease severity using a 0-7 scale where 0=no visible lesions and 7=root completely rotted. A weighted disease index was calculated for each replicate. Variety disease index means for the 2019 nursery ranged from 3.3 to 5.1 (avg. ~4.3), with controls averaging 4.3 and 4.9 for the moderately resistant and susceptible respectively.

We extend our gratitude to Paul Horny and Dennis Fleischmann for their help with nursery and farm operations.

We also thank Michigan Sugar for their generous assistance in thinning and agronomic evaluations.

We also thank the Michigan State University students who assisted with many aspects of conducting the nursery: Andy Funk, Paul Galewski, Malini Jayawardana, Saltanat Mambentova, and Doug Minier.

Developing a consistent and efficient inoculation method for Alternaria leaf spot

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Alternaria leaf spot (ALS) was considered a minor foliar disease in Michigan sugar beets before 2015. Since then ALS has been an increasing issue in Michigan fields. Therefore, identifying and developing management strategies such as resistant varieties is important. Developing a reliable inoculation method would be helpful to screen sugar beet varieties for resistance, as well as test other types of management practices. The research reported here is part of an ongoing effort to develop a reliable inoculation method in combination with tests in the greenhouse and lab.

Twenty sugar beet germplasm were planted in plots at the Saginaw Valley Research and Extension Center (SVREC) in Frankenmuth, MI in 2019. In addition, an ALS susceptible sugar beet variety, C059 and a moderately resistant sugar beet variety, HM9616 were planted in the greenhouse in late March and transplanted to the field in May. This was done to assess the potential for early season inoculation, prior to main onset of diseases like Cercospora leaf spot. Based on the preliminary inoculation experiments done in the greenhouse and lab, a virulent *Alternaria alternata* species complex (AASC) isolate (P23) was selected for the field inoculation. The pathogen was grown on half strength V8 agar and kept in the dark for 10 days for sporulation. Inoculum was prepared by suspending AASC spores (1×10^4 spores/ml) in 0.2% malt extract broth (Becton Dickinson and Company, Sparks, MD, USA). Inoculation was done on sugar beet plants at the 8-10 leaf stage in June for transplants and in August for field grown with a back-pack sprayer. Control plots were mock-inoculated with 0.2% malt extract broth. Disease rating was initiated three weeks after inoculation and rating was continued biweekly until there was too much interference by other diseases, such as Cercospora leaf spot (earlier inoculation) and powdery mildew (later inoculation). A 0-10 rating scale was used where 0 – no spots, 1: 1-2 spots throughout the plot, 2: few spots on <3 plants, 3: spots on <5 plants, 4: spots on 6-10 plants, 5: spots on >10 plants, 6: spots enlarging on at least 10 plants, 7: coalescing spots, 8: 1-2 dead leaves; 9: >2 dead leaves, 10: total defoliation.

The only significant difference between the control and AASC treated plants was found three weeks after inoculation in the later inoculated field trial (Figure 1). Later in the season, the ALS rating was difficult to separate from other diseases. This is likely to be one of the reasons for having non- significant difference between control and treated plants later in the season (Figure 1). Natural infection also increased, late in the season, and the inoculum may not have differed significantly due to favorable conditions for disease at the end of the season with the later inoculation date. Unfavorable weather conditions such as high temperature after the early season inoculation might be another reason for lack of differences. Inoculation of AASC on sugar beet plants either earlier or later in the season might be helpful to overcome this problem because ALS develops more in cool temperature in late spring and early fall. However, the transplant test for this did not clearly show improved results with the earlier inoculation (Figure 2).

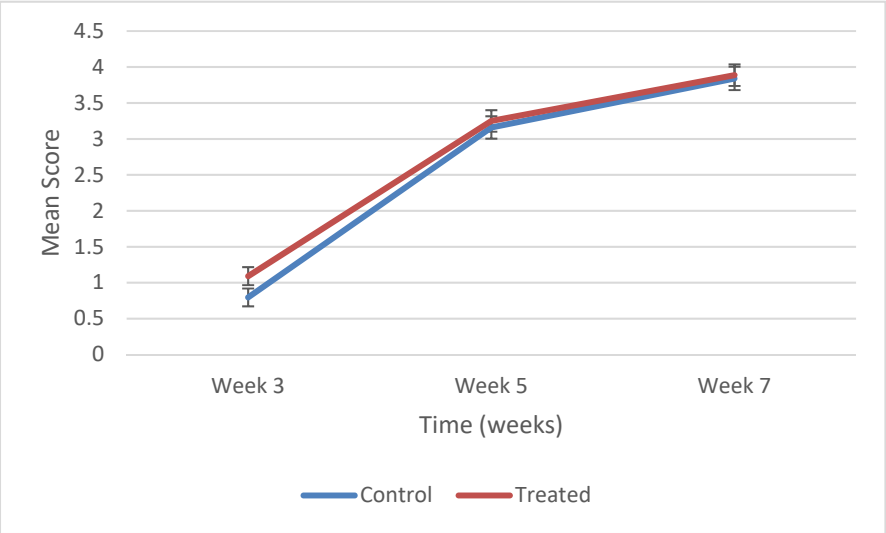

Figure 1: Mean disease score (0-10 where 0 is no spots in the plot) over four weeks between sugar beets inoculated in August with AASC or control in the field. Scores on twenty varieties were averaged for each treatment. Non overlapping error bars indicate significant difference between the treatments at 0.05 significance level.

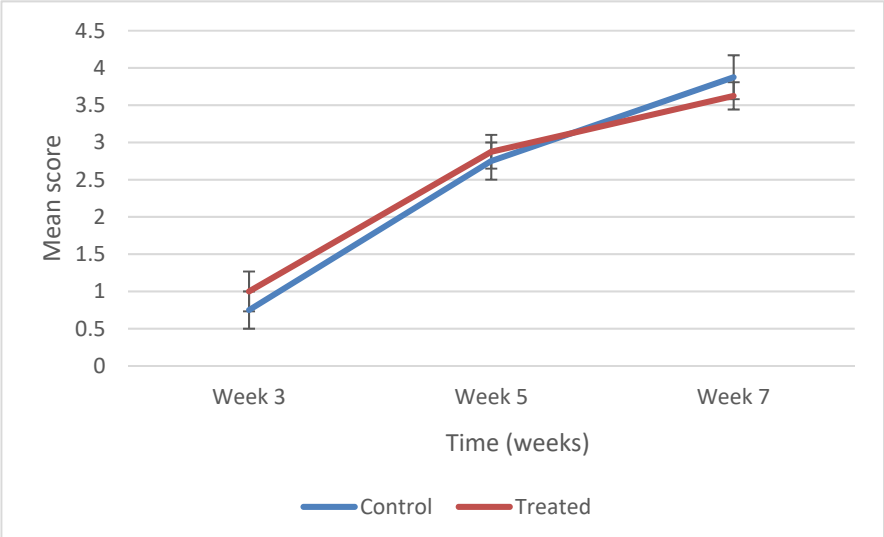

Figure 2: Mean disease score (0-10 where 0 is no spots in the plot) over four weeks in transplanted sugar beet varieties (C059 and HM9616) treated with control (0.2% malt extract broth) or inoculum of AASC (treated) in early June. Overlapping error bars indicate no significant difference between the treatments at 0.05 significance level.

Summary:

Based on these results we aim to test more factors by reducing the number of sugar beet varieties. We will increase testing with varying levels of inoculum and are negotiating to run test in different growing environments. Using more susceptible varieties of sugar beets for ALS would also be helpful for examining treatment effects. Management of other foliar pathogens by spraying fungicides to plots tested for ALS also will be examined for the potential to use in ALS screening to reduce loss of leaf tissue due to other diseases.

Microsatellite analysis of native populations of *Rhizoctonia solani* AG2-2 from two fields at the Saginaw Valley Research & Extension Center

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Michigan State University and

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Rhizoctonia solani AG2-2 is the primary causal agent of Rhizoctonia root and crown rot (RRCR) of sugarbeet (*Beta vulgaris*) and can occur in all major growing regions throughout the world. Typical symptoms include dark, shallow lesions that can expand and lead to rot of the entire root. The disease causes sudden and permanent wilting of the leaves, usually occurring in irregular patches that primarily spread up and down rows. RRCR threatens economic returns on approximately 24% of the acres growing sugarbeet in the United States (Windels et al., 2009). Losses vary from field to field but can be greater than 50% in severe cases.

There is surprisingly little known about the population structure of *R. solani* AG2-2 despite the importance of the disease to sugarbeet growers and to other crops such as soybean and dry bean. We have developed a set of microsatellite markers that can be used to genotype *R. solani* AG2-2 populations and provide evidence regarding population structure. This information can then be utilized to improve management practices, such as crop rotation strategies, and may ultimately help to reduce the impact of the disease.

Microsatellites are an important genetic tool that can distinguish between very closely related individuals. A well designed set of microsatellite provides a DNA fingerprint that is unique to an individual and can be used to measure or infer population history, gene flow between populations, reproductive or breeding system employed by the population, and relatedness of subpopulations. In the current study, we analyze two native populations from the Saginaw Valley Research and Extension Center.

Materials and Methods

Samples were isolated from infected sugarbeets in 2016 and 2017 from the USDA Cercospora leaf spot nursery located at the Saginaw Valley Research and Extension Center in Frankenmuth, MI (43.39861, -83.68847). The USDA Cercospora nursery consists of four adjacent fields that are approximately 10 acres (4 hectares) each (Fig. 1). Sugarbeets are grown in successive fields on a four year rotation following wheat. Soybeans and corn also are included in the rotation. Sugarbeets were grown in the Northwest field in 2016 and in the Northeast field in 2017. These fields have never been inoculated with *R. solani* and are assumed to contain native populations.

Isolates were genotyped using a set of eight microsatellite markers developed by our lab and assigned a multi-locus genotype (MLG). To determine genetic subgroup (Martin et al., 2014), representative genotypes were included in a phylogeny with isolates of known genetic group and assigned to subgroup based on phylogenetic relationship (Fig. 2). A microsatellite distance matrix was generated using GenoType 1.2 (Meirmans & Teinderen, 2004). A phylogenetic tree was generated from the microsatellite distance matrix using the Neighbor-joining method (Saitou & Nei, 1987) in Mega 10.0.4 (Kumar et al., 2018). Genetic differentiation, Hardy-Weinburg test and F_{ST} values were determined using Genpop 4.5.1 (Rousset, 2008).

Figure 1. Cercospora leaf spot nursery located at the Saginaw Valley Research and Extension Center showing fields where populations were sampled in 2016 and 2017.

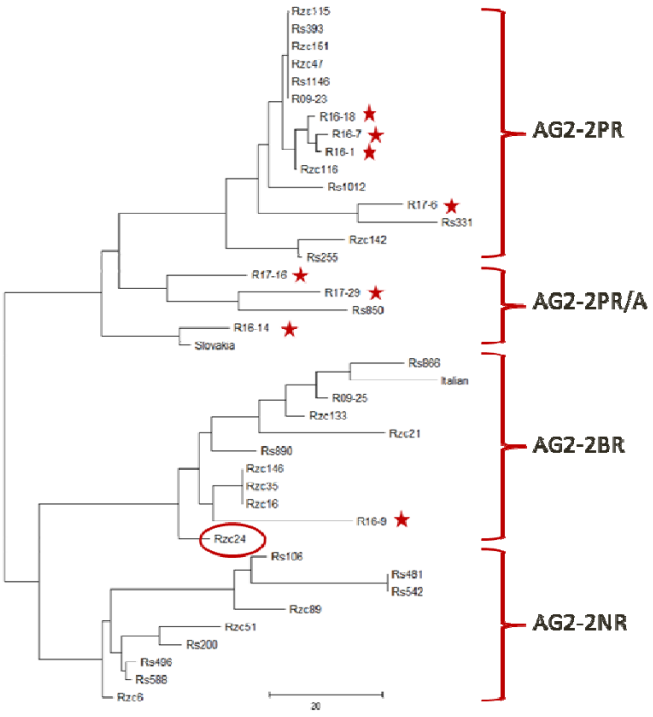

Figure 2. Neighbor-joining tree showing how 8 representative genomes collected from the Saginaw Valley research and Extension Center (red stars) are related to isolates whose genetic group (listed on right) is known. Isolated used to inoculate USDA Rhizoctonia nursery, Rzc24 (R1), is circled in red.

Results and Discussion

A total of forty-five isolates were collected and genotyped including 19 isolates collected in 2016 and 26 in 2017. Eight unique genotypes were identified with the most common genotype representing 27 (60%) isolates. Five genotypes were recovered from only a single field. Thirty-two (71%) isolates were identified as belonging to subgroup AG2-2PG, eleven (24%) belonging to subgroup AG2-2PG/A and two (4%) belonging to AG2-2BR (Fig. 3). An important finding of the current study is that none of the isolates recovered from the Cercospora nursery were identical to our research isolate (R1) that is used to inoculate the Rhizoctonia nursery also located at the Saginaw Valley Research and Extension Center.

A Hardy-Weinberg test was highly significant ($P < 0.0001$) for both populations indicating a significant excess of heterozygotes. Linkage disequilibrium tests were also significant ($P < 0.001$) for all loci signifying a highly clonal population. Sexual recombination is expected to break linkage of loci and highly linked loci imply a lack of sexual recombination. The sexual stage for *R. solani* AG2-2 has been reported very rarely but there has been a lack of genetic confirmation of the absence of sexual recombination in field settings. Our results support the premise that sexual recombination does not regularly occur in the field.

Genotypic differentiation tests evaluate the distribution pattern of genotypes in subpopulations. A significant P-value resulting from this test indicates that genotypes in the subpopulations are drawn from different distributions, inferring that the subpopulations are distinct. Genic differentiation tests are similar to genotypic differentiation tests but evaluate allelic distribution rather than genotypic distribution. The two subpopulations evaluated in the current study had significant P-values for both genotypic and genic differentiation tests ($P = 0.004$ and $P = 0.002$ respectively). This differentiation was mainly due to the number of genotypes that were found in only one population. The 2016 population had two genotypes (3 individuals) that were not present in the 2017 population and the 2017 population had three genotypes (9 individuals) not present in the 2016

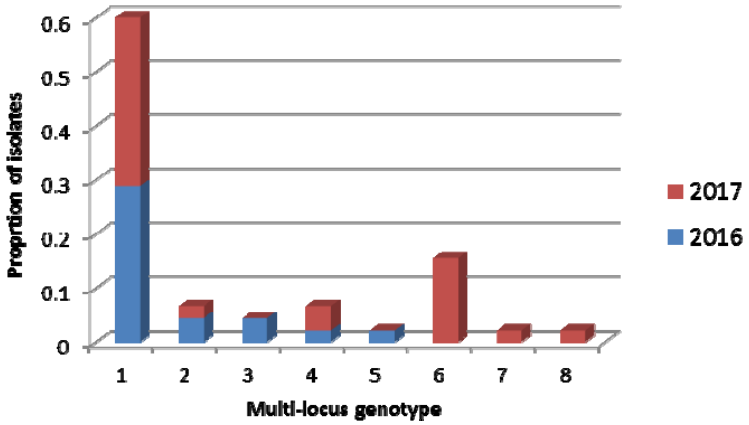

Figure 3. Histogram showing proportion of isolates recovered for each genotype. Blue bars represent isolates collected in 2016 and red bars represent isolates collected in 2017. Genotypes 1, 2, 5 and 7 were identified as AG2-2PR, genotypes 4, 6 and 8 as AG2-2PR/A and genotype 3 as AG2-2BR.

population (Fig. 3). This data indicates the population collected from 2016 is likely a distinct, separate population from the one collected in 2017 rather than being a single, large population.

The fixation index (F_{ST}) is a measure of population differentiation due to genetic structure and indicates how divergent two populations are from one another, or how close each population is to being completely fixed and independent of each another. Typically, a value below 0.05 indicates the populations are not divergent. However, we expect F_{ST} values to be much lower for clonal populations than for sexually reproducing populations. The F_{ST} value for the populations included in the current study was 0.023. Normally a value this low would indicate little to no differentiation between the populations, but since these populations are largely clonal, we interpret this F_{ST} value to indicate slight differentiation between populations. These findings are rather unexpected since these populations are very close spatially with only a 25 foot (8 meters) unplowed grass border separating the fields.

One aspect that is unclear from our data is whether population differentiation is due to spatial isolation or temporal variations. Cultural practices were very similar between the two fields and it is not expected that cultural practices played a significant role in the divergence of these populations. A factor that caused some uncertainty in our results was the sampling methodology. Samples were recovered from infected beets and so were biased by host. In addition, samples were not collected systematically but randomly so it is unclear if the population is representative of the entire field or a subsection.

Future sampling will use toothpicks to bait for *R. solani* and will be placed systematically throughout the field. This should provide a more complete assessment of the population within a field and allow better comparisons between fields. We plan to work with Michigan Sugar during the summer of 2020 to assess several grower fields in the Michigan growing region. As a long-term goal, we propose investigating the effect of rotational crops and cultural practices on *R. solani* populations. These projects can help us develop management strategies that might reduce the impact of RRCR in sugarbeet growing regions.

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Sugarbeet (*Beta vulgaris* 'Crystal G351NT')
Rhizoctonia Crown and Root Rot; *Rhizoctonia solani*
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Control of Rhizoctonia crown and root rot with fungicides in sugarbeet-Richville 2019

Sugar beet cv. Crystal G351NT was PAT-treated and planted at the Michigan State University Bean and Beet Farm, Richville, MI on 7 May. Seed was planted at 1" depth into four-row by 15-ft plots (ca. 2.5 in. between plants to give a target population of 480 plants/100 ft. row) with 20" between rows replicated four times in a randomized complete block design. Fertilizer was drilled into plots immediately before planting, formulated according to results of soil tests (125 lb 46-0-0/A). No additional nitrogen was applied. All fungicides were applied with a hand-held R&D spray boom delivering 10 gal/A (50 p.s.i.) and using one XR8002VR nozzle per row in a 6" band at planting (A) or on 21 Jun at GS 6-8 (B). Weeds were controlled by cultivation and with Roundup Original Max 2.0 pt/A applied at GS 6-8. Insects were controlled as necessary. Plant stand was rated 17, 24 and 31 days after planting (DAP) and relative rate of emergence was calculated as the Relative Area Under the Emergence Progress Curve [RAUEPC from 0 – 31 DAP, maximum value = 1]. Plots were inoculated on 11 Jul [65 days after planting (DAP)] by spreading *R. solani* Anastomosis Group 2.2 (IIIB) infested barley across all plants in each plot. Plots were hand hoed at 8 days after inoculation (DAI) to achieve ca. 6 in between plants to give a target population of 200 plants/100 ft. and the relative rate of disease progression was calculated as the Relative Area Under the Disease Progress Curve [RAUDPC from 0 – 22 DAI, maximum value = 1]. Beetroots were machine-harvested on 26 Aug and individual treatments were weighed. Two rows of beets per plot were harvested 112 DAP (15 ft from start of each plot from two center rows) and assessed for crown and root rot (*R. solani*) incidence (%) and severity. Sugar content was measured at the Michigan Sugar Company analytical service laboratory. Severity of crown and root rot was measured as an index calculated by counting the number of roots falling in class 0 = 0%; 1 = <5% (inactive lesions); 2 = <5% (active lesions, no cracking); 3 = 6 - 25% (surface area of root affected by lesions); 4 =26 - 50% (surface area of root affected by lesions); 5 = 51 - 75% (surface area of root affected by lesions); 6 = >75% (surface area of root affected by lesions); and 7 = dead and/or extensively decayed root. The number in each class is multiplied by the class number and summed. The sum is multiplied by a constant to express as a percentage. Increasing index values indicated the degree of severity. The number of beets falling into classes 0 – 3 was summed and a percentage calculated as marketable beets.

Meteorological Data

Meteorological variables were measured with a Campbell weather station located at the farm, latitude 43.3995 and longitude -83.6980 deg. Average daily air temperature (ºF) was 55.0, 65.1, 70.4, and 67.9 (May, Jun, Jul and Aug respectively) and the number of days with maximum temperature >90ºF over the same period was 2 for Jul and May, Jun and Aug with 0 days. Average daily relative humidity (%) over the same period was 58.8, 56.1, 54.8 and 57.6. Average daily soil temperature at 4" depth (ºF) over the same period was 52.4, 63.1, 71.0 and 73.1. Average daily soil moisture at 4" depth (% of field capacity) over the same period was 35.7, 39.0, 40.7 and 41.7. Precipitation (in.) over the same period was 5.0, 7.0, 2.4 and 1.1.

Results

Soil temperature and moisture conditions did not enhance development of crown and root rot throughout the season until. Plots treated with Quadris 2.08SC 0.581 fl/oz 1000 ft. row (A) and Elatus 45WG 0.168 oz/A 1000 ft. row (B) were significantly lower in final plant stand in comparison to the non-treated, non-inoculated control, Elatus 45WG 0.168 oz/A 1000 ft. row (B) and Quadris 2.08SC 0.581 fl/oz 1000 ft. row (A); Elatus 45WG 0.168 oz/A 1000 ft. row (B). Plots treated with Quadris 2.08SC 0.581 fl/oz 1000 ft. row (A); Quadris 2.08SC 0.581 fl/oz 1000 ft. row (B) were significantly lower in final plant stand in comparison to the non-treated and Elatus 45WG 0.168 oz/A 1000 ft. row (B). Plots treated with Elatus 45WG 0.168 oz/A 1000 ft. row (B) and the non-treated control had significantly lower RAUEPC compared to Quadris 2.08SC 0.581 fl/oz 1000 ft. row (A), Quadris 2.08SC 0.581 fl/oz 1000 ft. row (A); Quadris 2.08SC 0.581 fl/oz 1000 ft. row (B) and Elatus 45WG 0.168 oz/A 1000 ft. row (A). Plots treated with Quadris 2.08SC 0.581 fl/oz 1000 ft. row (A) and Elatus 45WG 0.168 oz/A 1000 ft. row (A) had significantly higher RAUEPC compared to the non-treated control, non-inoculated control, Elatus 45WG 0.168 oz/A 1000 ft. row (B) and Quadris 2.08SC 0.581 fl/oz 1000 ft. row (A); Elatus 45WG 0.168 oz/A 1000 ft. row (B). Plots treated with Quadris 2.08SC 0.581 fl/oz 1000 ft. row (A) had significantly higher RAUDPC compared to all other treated plots, non-treated control plots and non-inoculated plots. There was no significant difference among treatments in crown and root rot severity at 112 DAP compared to the non-treated plots. Crown and root rot severity at 112 DAP was lower in non-inoculated check plots compared to the non-treated control plots. There was no significant difference in yield (t) and sugar content (%) among treatments. Treatments with Quadris 2.08SC 0.581 fl/oz 1000 ft. row (A) was significantly higher based on RWST compared to the non-treated, non-inoculated and plots treated with Quadris 2.08SC 0.581 fl/oz 1000 ft. row (A); Elatus 0.168 oz/A 1000 ft. row (B). Plots treated with Quadris 2.08SC 0.581 fl/oz 1000 ft. row (A); Elatus 45WG 0.168 oz/A 1000 ft. row (B) and non-inoculated had significantly higher marketable beets (%) compared to the non-treated check and Quadris 2.08SC 0.581 fl/oz 1000 ft. row (A). No phytotoxicity was observed from any treatments.

Table 1. Efficacy of fungicides against Rhizoctonia crown and root rot.

Treatment and rate/1000 ft. row (A)= at planting; (B)= at GS 6-8[z]	Plant stand[y] 31 DAP[x,w] (%)	RAUEPC[v] 0 – 31 DAP	RAUDPC[u] 0 – 22 DAI[t]	Crown and root rot severity[s] 112 DAP (%)	Yield (t)	Sugar content (%)	RWST[r] (lb)	Marketable beets (%)[q]
1. Non-treated	73.9 a	0.278 c	0.820 bc	31.8 ab	3.6	16.8	222.0 b	31.1 bc
2. Non-inoculated	69.3 ab	0.320 bc	0.831 bc	29.0 c	4.1	16.7	219.2 b	45.2 a
3. Quadris 2.08SC 0.581 fl/oz (A)	52.5 c	0.483 a	0.875 a	33.9 a	3.3	17.2	241.8 a	27.9 c
4. Quadris 2.08SC 0.581 fl/oz (A); Quadris 2.08SC 0.581 fl/oz (B)	60.6 bc	0.406 ab	0.829 bc	29.6 bc	3.6	16.4	228.9 ab	39.8 ab
5. Elatus 45WG 0.168 oz/A (A)	57.5 c	0.440 a	0.846 b	31.0 abc	4.2	16.7	234.9 ab	35.8 abc
6. Elatus 45WG 0.168 oz/A (B)	74.4 a	0.275 c	0.807 c	29.2 bc	3.5	16.2	231.0 ab	41.5 ab
7. Quadris 2.08SC 0.581 fl/oz (A); Elatus 45WG 0.168 oz/A (B)	69.9 ab	0.321 bc	0.822 bc	29.0 bc	4.8	17.1	223.2 b	42.7 a

[z] Application dates; A= 7 May; B= 20 Jun.
[y] Means followed by same letter are not significantly different at $p = 0.10$ (Fishers LSD).
[x] Plant stand expressed as a percentage of the target population of 480 plants/100ft. row from a sample of 2 x 15 ft rows per plot.
[w] DAP = days after planting on 7 May.
[v] RAUEPC=Relative area under the emergence progress curve from planting to 31 days after planting.
[u] RAUDPC=Relative area under the disease progress curve from inoculation to 22 days after inoculation.
[t] DAI = days after inoculation on 11 Jul.
[s] Severity of crown and root rot was measured as an index calculated as described in the text.
[r] RWST = Recoverable White Sucrose per Ton.
[q] The number of beets falling into classes 0 – 3 was summed and a percentage calculated as marketable beets.

Evaluation of in-furrow and banded fungicides treatments to manage Rhizoctonia root and crown rot of sugar beet

Chris Bloomingdale and Jaime Willbur, Michigan State University

Location: Frankenmuth (SVREC)	**Treatment Timings:** In-Furrow & Banded at 6-8 leaves
Planting Dates: May 6, 2019	**Pesticides:** see table
Soil Type: Loam	**O.M.:** 5.0 **pH:** 7.5
Replicates: 4	**Variety:** C-G351NT

Summary: Stand counts from 5 Aug show significant differences in percent stand loss among treatment programs (P<0.001). Mean values for stand death ranged between 7.1-74.2%. Programs 4, 6, 7, and 12 all exhibited significantly lower percent stand loss than program 1, the non-treated control. DX values were significantly different among programs (P<0.0001). Programs 4, 6, 7, 8, 12, and 13 resulted in statistically similar DX values (15.4-29.0%) and were significantly lower than the control (55.3%). There were also significant differences among mean yields of treatment programs (P<0.0001). Programs 6, 7, 8, 12, and 13, ranging from 6.8 to 10.1 t/A, yielded significantly higher than the non-treated control (3.9 t/A). All other tested programs did not have yields significantly different from the control. Overall, disease pressure was high in this trial and greater than would be expected in most commercial fields. All data presented should be interpreted relative to the trial, and not as averages for Michigan production.

Table 1. Disease index (root rating at harvest), seasonal plant loss, and yield parameters of fungicide programs.

No.	Treatment, Rate[a]	Application Type[b]	Stand Loss (%)[c]	Disease Index (%)[d]	Yield (t/A)
7	Excalia, 3 fl oz	Banded	7.1 e	18.0 gh	10.1 a
6	Excalia, 2 fl oz	Banded	19.4 de	29.0 d-h	9.3 ab
12	Serenade ASO, 2 qt Quadris, 9.2 fl oz Proline, 5.7 fl oz	In-Furrow In-Furrow Banded	20.9 de	27.1 e-h	6.9 bc
4	Quadris, 12 fl oz	Banded	21.1 de	26.9 f-h	4.5 c-f
15	Serenade ASO, 2 qt Proline, 5.7 fl oz	In-Furrow Banded	25.9 c-e	37.0 b-f	5.3 c-e
2	Quadris, 12 fl oz	In-Furrow	26.7 c-e	33.1 c-g	4.5 c-f
8	Excalia, 4 fl oz	Banded	28.3 c-e	15.4 h	4.0 d-f
13	Exp[f] 2, 12.8 fl oz Quadris, 9.2 fl oz Proline, 5.7 fl oz	In-Furrow In-Furrow Banded	32.7 b-e	24.9 f-h	3.1 ef
3	Vertisan, 30 fl oz	Banded	34.6 b-e	50.1 ab	6.2 cd
9	Moncut, 25 fl oz	In-Furrow	39.1 b-d	34.7 b-f	3.9 d-f
5	Priaxor, 8 fl oz	Banded	42.5 b-d	43.0 a-e	7.0 bc
1	Non-Treated Control	-	55.5 a-c	55.3 a	5.3 c-e
11	Exp 1, 4.65 fl oz	In-Furrow	55.8 a-c	56.8 a	6.8 bc
10	Exp 1, 3.1 fl oz	In-Furrow	60.4 ab	43.9 a-d	2.0 f
14	Serenade ASO, 2 qt	In-Furrow	74.2 a	48.0 a-c	4.8 c-f

[a] All rates are listed as measure of a product per acre.
[b] In-furrow treatments were applied at planting, banded applications were applied at the 6-8 leaf stage.
[c] Column values followed by the same letter were not significantly different based on Fisher's Protected LSD (α=0.05); if no letter, then the effect was not significant.
[e] Disease index was calculated by multiplying the disease incidence (0-100%) by the mean symptomatic root severity (1-7) and dividing by 7.
[f] Exp=Experimental Compound.

Evaluation of in-furrow fungicides tank-mixed with fertilizer to manage Rhizoctonia root and crown rot of sugar beet

Chris Bloomingdale and Jaime Willbur, Michigan State University

Location: Frankenmuth (SVREC)	**Treatment Timings:** In-Furrow at Planting
Planting Dates: May 6, 2019	**Pesticides:** see table
Soil Type: Loam	**O.M.:** 5.0 **pH:** 7.5
Replicates: 4	**Variety:** C-G351NT

Summary: Treatments of AZteroid alone, in combination with Redline, or in combination with Redline/Regalia provided significant Rhizoctonia root rot control.

All yields were well below the 29 T/A averages for Michigan in 2018. The high Rhizoctonia root rot pressure likely accounts for the severely low yields observed in this trial. As a result, no samples were collected for sugar quality and yield results should be considered relative to the non-treated and grower standard programs.

Table 1. End of season disease index and yield from the tested fungicide programs.

No.	Treatment, Rate[a]	Disease Index[b,c]	Yield (t/A)
3	AZteroid, 0.24 fl oz	34.5 b	8.2 a
4	AZteroid, 0.24 fl oz Redline, 3 gal/A	36.2 b	7.4 a
5	AZteroid, 0.24 fl oz Regalia, 1.35 fl oz Redline, 3 gal/A	37.8 b	6.8 a
2	Redline, 3 gal/A (Fertilized Control)	64.8 a	3.5 b
1	Non-Treated Control	67.8 a	3.4 b

[a] All rates, unless otherwise specified, are listed as a measure of product per 1000 rw-ft.
[b] Column values followed by the same letter were not significantly different based on Fisher's Protected LSD (α=0.05); if no letter, then the effect was not significant.
[c] Disease index was calculated by multiplying the disease incidence (0-100%) by the mean symptomatic root severity (1-7) and dividing by 7.

Evaluation of foliar fungicide treatments to manage Cercospora leaf spot of sugar beet

Chris Bloomingdale and Jaime Willbur, Michigan State University

Location: Frankenmuth (SVREC)	**Treatment Timings:** 14 day interval starting at 35 DSV
Planting Dates: April 24, 2019	**Pesticides:** see table
Soil Type: Loam	**O.M.:** 5.0 **pH:** 7.5
Replicates: 4	**Variety:** C-G333NT

Summary: CLS pressure was strong at this location, and differences were detected among treatments. Disease severity ratings from 11 Sep were significantly different among treatments ($P<0.0001$). All programs, with the exception of 37, had significantly lower disease than program 1 (control). Programs 3, 4, 7, 8, 9, 10, 35, and 36 were the only treatments by the end of season with a severity below 6, which is considered the threshold for economic loss. Significant differences were detected among mean yield values of the programs ($P<0.0001$). All programs except for 31 and 37 yielded significantly higher than the control, which had a mean yield of 13.6 t/A. Numerically, the highest yield was obtained by program 4 (23.3 t/A), which performed similarly to 12 other programs. Percent sugar and RWST differed significantly among programs ($P<0.0001$); in general, the range of values was comparable to commercially harvested sugar beets.

Table 1. End of season disease severity and yield parameters from the tested fungicide programs.

No.	Treatment, Rate[a], and Timing[b]	Disease Severity[c,d]	Yield (t/A)	Sugar (%)	RWST[e]
8	Manzate Max (1.6 qt) ABCDEF + Proline (5.7 fl oz) B + Topsin (20 fl oz) B + Super Tin (8 fl oz) CE + Delaro (11 fl oz) D + Proline (1.71 fl oz) D + Propulse (13.6 fl oz) F	4.3 n	20.5 b-j	18.2 b-f	260.1 a-c
10	Manzate Max (1.6 qt) ABCDEF + Delaro (11 fl oz) B + Proline (1.71 fl oz) B + Super Tin (8 fl oz) CE + Proline (5.7 fl oz) D + Topsin (20 fl oz) D + Flint Extra (3.6 fl oz) F	4.3 n	23.0 a-c	18.3 b-e	250.4 a-e
3	Exp[f] 1 (2 lb) ABCDEF	5.0 mn	22.8 ab	18.9 bc	250.7 a-e
9	Manzate Max (1.6 qt) ABCDEF + Propulse (13.6 fl oz) B + Super Tin (8 fl oz) CE + Delaro (11 fl oz) D + Proline (1.71 fl oz) D + Topsin (20 fl oz) F + Proline (5.7 fl oz) F	5.0 mn	22.4 a-e	19.2 b	255.1 a-e
4	Proline (5.1 fl oz) ABCDEF + Manzate Max (1.6 qt) ABCDEF	5.3 lm	23.3 a	18.5 bd	277.4 a-d
7	Topsin (20 fl oz) A + Exp 1 (2 lb) AE + Dexter Max (2.1 lb) BD + Super Tin (8 fl oz) CF + Manzate Max (1.6 qt) CF	5.3 lm	22.8 ab	18.4 b-d	248.3 a-e
35	Manzate Max (1.6 qt) ABDF + Exp 4 (7 fl oz) BD + Priaxor (8 fl oz) BF + Serifel (4 oz) CE + Super Tin (8 fl oz) CE + Topsin (20 fl oz) D	5.3 lm	22.5 a-e	18.5 b-d	269.4 a-c
36	Manzate Max (1.6 qt) ABDF + Exp 4 (7 fl oz) BD + Priaxor (8 fl oz) BF + Super Tin (8 fl oz) CE + Topsin (20 fl oz) D	5.5 k-m	21.3 a-g	19.0 ab	256.8 a-e
2	Inspire XT (7 fl oz) AC + Manzate Max (1.6 qt) ABCDEF + Super Tin (8 fl oz) BD	6.0 j-l	21.2 a-g	19.0 ab	265.4 a-c
5	Super Tin (8 fl oz) ACE + Manzate Max (1.6 qt) ACE + Exp 1 (2 lb) BDF	6.0 j-l	21.5 a-f	19.0 ab	285.7 a
28	Koverall (2 lb) ABCEF + Topguard (14 fl oz) BD + Super Tin (8 fl oz) CE + Badge SC (2 pt) D	6.0 j-l	21.4 a-g	18.9 ab	272.9 a-g
19	Proline (5.7 fl oz) AD + Super Tin (8 fl oz) BE + Koverall (1.5 lb) BE + Minerva Duo (16 fl oz) CF	6.3 i-k	20.7 b-j	18.9 ab	263.1 a-c
27	Koverall (2 lb) ABCEF + Topguard (14 fl oz) B + Super Tin (8 fl oz) CE + Lucento (5.5 fl oz) + Badge SC (2 pt) D	6.3 i-k	21.9 a-d	18.6 b-d	253.5 a-e
42	Headline (12 fl oz) ACE + Manzate Max (1.6 qt) ABCDEF	6.3 i-k	20.8 b-j	18.4 b-d	238.8 c-h
25	Koverall (2 lb) ABCEF + Lucento (5.5 fl oz) B + Super Tin (8 fl oz) CE + Topguard (14 fl oz) D	6.5 h-j	22.2 a-d	18.9 bc	257.2 a-c
29	Koverall (2 lb) ABCEF + Lucento (5.5 fl oz) B + Super Tin (8 fl oz) CE + Badge (2 pt) C + Proline (5 fl oz) D	6.5 h-j	21.5 a-f	18.5 b-d	277.2 a-d
30	Koverall (2 lb) ABCEF + Topguard (14 fl oz) B + Super Tin (8 fl oz) CE + Badge (2 pt) C + Proline (5 fl oz) D	6.5 h-j	20.2 d-k	18.8 bc	267.1 a-c
33	ManKocide (4.3 lb) ABCDEF	6.5 h-j	18.3 i-l	18.1 a-f	235.7 c-h
34	Double Nickel 55 (0.5 lb) ABCDEF + ManKocide (4.3 lb) ABCDEF	6.5 h-j	18.1 k-m	18.6 b-d	253.2 a-e
6	Inspire XT (7 fl oz) A + Manzate Max (1.6 qt) ACE + Dexter Max (2.1 lb) BD + Super Tin (8 fl oz) CE + Cuprofix Ultra 40 (48 oz) F	6.8 g-j	19.4 f-k	19.0 ab	264.6 a-c

14	Brixen (21 fl oz) AD + Minerva Duo (16 fl oz) BE + Super Tin (8 fl oz) CF + Koverall (1.5 lb) CF	6.8 g-j	20.4 d-j	18.1 b-f	264.5 a-c
17	Minerva (13 fl oz) AD + Super Tin (8 fl oz) BE + Koverall (1.5 lb) BE + Minerva Duo (16 fl oz) CF	6.8 g-j	18.8 j-l	18.3 b-e	251.1 a-e
18	Inspire XT (7 fl oz) A + Super Tin (8 fl oz) BE + Koverall (1.5 lb) BE + Minerva Duo (16 fl oz) CF	6.8 g-j	20.3 d-k	18.6 b-d	259.0 a-c
26	Koverall (2 lb) ABCEF + Lucento (5.5 fl oz) BD + Super Tin (8 fl oz) CE + Badge SC (2 pt/a) D	6.8 g-j	22.0 a-d	18.8 bc	263.2 a-c
11	Brixen (21 fl oz) AD + Super Tin (8 fl oz) BE + Koverall (1.5 lb) BE + Minerva Duo (16 fl oz) CF	7.0 f-i	20.4 d-k	18.9 ab	267.7 a-c
15	Minerva Duo (16 fl oz) ACDF + Inspire XT (7 fl oz) BE +	7.0 f-i	18.7 j-l	18.1 b-f	258.3 a-c
16	Minerva Duo (16 fl oz) AD + Super Tin (8 fl oz) BE + Koverall (1.5 lb) BE + Inspire XT (7 fl oz) CF	7.0 f-i	18.6 j-l	18.1 a-f	232.0 c-i
22	Badge SC (1.5 pt) ABCDEF + Manzate Max (1.6 qt) ABCDEF	7.0 f-i	19.1 g-k	18.1 b-f	216.6 e-i
24	Manzate Max (1.6 qt) AD + Super Tin (8 fl oz) B + Badge SC (1.5 pt) BCDE + Eminent (13 fl oz) C + Topguard (14 fl oz) E + Badge SC (2 pt) F	7.3 e-h	18.6 j-l	18.8 bc	273.2 a-f
32	LifeGard WG (4.5 oz/100gal) ABCDEF + Inspire XT (7 fl oz) AC + Super Tin (8 fl oz) BD	7.3 e-h	18.7 j-l	18.2 b-e	248.5 a-e
12	Exp 2 (32 fl oz) AD + Super Tin (8 fl oz) BE + Koverall (1.5 lb) BE + Minerva Duo (16 fl oz) CF	7.5 e-g	19.3 f-k	17.8 c-f	243.9 c-g
20	Exp 3 (8 fl oz) AD + Super Tin (8 fl oz) BE + Koverall (1.5 lb) BE + Minerva Duo (16 fl oz) CF	7.5 e-g	20.8 b-j	18.2 b-f	245.1 c-g
23	Manzate Max (1.6 qt) AC + Eminent (13 fl oz) B + Badge SC (1.5 pt) BCDE + Super Tin (8 fl oz) D + Proline (5.7 fl oz) E + Badge SC (2 pt) F	7.5 e-g	20.4 d-j	18.6 b-d	253.4 a-e
13	Super Tin (8 fl oz) AD + Koverall (1.5 lb) BE + Exp 2 (32 fl oz) BE + Minerva Duo (16 fl oz) CF	7.8 d-f	18.4 h-l	17.6 d-f	231.5 c-i
38	Inspire XT (7 fl oz) AC + Stargus (1 qt) ABCDEF + Super Tin (8 fl oz) BD	7.8 d-f	19.3 f-k	18.5 b-d	232.7 c-i
40	Headline (12 fl oz) ACE + Manzate Max (1.6 qt) BDF	8.0 c-e	19.4 f-k	17.3 e-g	237.1 c-h
41	Manzate Max (1.6 qt) ABDF + Headline (12 fl oz) CE	8.0 c-e	19.9 d-k	17.9 a-f	227.9 b-i
21	Badge SC (2 pt) ABCDEF	8.5 b-d	16.7 l-n	17.6 d-f	246.1 a-e
39	Regalia (1 qt) ABCDEF + Badge SC (2 pt) ABCDEF	8.5 b-d	16.7 l-n	17.1 fg	237.7 c-h
31	LifeGard WG (4.5 oz/100gal) ABCDEF	8.8 bc	15.7 m-o	16.2 gh	198.9 hi
37	Stargus (2 qt) ABCDEF	9.0 ab	14.5 no	15.4 h	200.3 hi
1	Non-Treated Control	9.8 a	13.6 o	15.2 h	194.5 i

[a] All rates, unless otherwise specified, are listed as a measure of product per acre. MasterLock was added to all tank mixes at a rate of 0.25 % v/v.

[b] Application letters code for the following dates: A=26 Jun, B=8 Jul, C=22 Jul, D=31 Jul, E=14 Aug, F=23 Aug.

[c] Disease severity based on a 0-10 scale with the following breakdown of leaf area: 1=0.1% (1-5 spots/leaf), 2=0.35% (6-12 spots/leaf), 3=0.75% (13-25 spots/leaf), 4=1.5% (26-50 spots/leaf), 5=2.5% (51-75 spots/leaf), 6=3%, 7=6%, 8=12% 9=25%, 10=50%.

[d] Column values followed by the same letter were not significantly different based on Fisher's Protected LSD (α=0.05); if no letter, then the effect was not significant.

[e] Pounds of recoverable white sugar per ton of beets.

[f] Exp=experimental compound.

Official Variety Trial
Michigan Sugar Company
Average of 5 Locations - 2019

Trial Quality: Very Good
Plant/Harv: see trial pages
Plots: 2 rows x 38 ft.
Row Spacing: 22 inches
Seeding Rate: 2 inches, thinned to 200 beets/100 ft.

Locations: Deshano, Gerstenberger, Grekowicz, Maurer, Trost

Cerc Control: see trial pages
Rhizoc Control: see trial pages

Variety	$/A	RWSA	RWST		Yield		Sugar		CJP		Emerge	
			Lb/T	Rank	T/A	Rank	%	Rank	%	Rank	%	Rank
C-G752NT	**$1,852**	**10759**	**265**	**4**	**40.7**	**1**	**17.7**	**8**	**95.6**	**9**	64.8	22
B-1606N	**$1,807**	**10502**	259	15	**40.7**	**2**	17.4	16	95.3	18	64.6	24
B-188N	**$1,779**	**10324**	**270**	**3**	38.3	8	**17.9**	**3**	**95.8**	**5**	64.8	23
B-1893	$1,760	10216	**265**	**6**	38.5	7	**17.9**	**4**	95.2	21	66.5	15
C-G675	$1,760	10213	**265**	**7**	38.6	5	**17.8**	**5**	**95.4**	**11**	67.0	14
B-1703	$1,744	10125	263	8	38.6	6	**17.7**	**9**	95.3	16	70.8	6
HIL-9865	$1,734	10067	**271**	**1**	37.1	16	**18.0**	**1**	**95.9**	**2**	65.1	21
B-1690	$1,711	9930	256	21	38.9	3	17.4	14	94.7	26	66.3	16
SX-2283	$1,709	9921	**265**	**5**	37.4	14	**17.7**	**6**	**95.9**	**3**	**72.6**	**4**
C-G333NT	$1,707	9913	256	22	38.8	4	17.3	18	95.2	22	65.3	20
SX-RR1278N	$1,704	9893	260	12	38.1	10	17.4	17	**95.4**	**13**	69.0	9
C-G861	$1,697	9851	259	14	37.9	11	**17.7**	**7**	94.9	25	66.1	17
SX-RR1264	$1,693	9825	**271**	**2**	36.3	20	**17.9**	**2**	**96.0**	**1**	56.8	26
C-RR059	$1,670	9681	257	18	37.8	12	17.4	15	95.0	24	68.5	11
C-G855	$1,652	9584	257	16	37.3	15	17.2	22	**95.7**	**7**	67.3	13
SX-RR1275N	$1,643	9542	253	25	37.7	13	17.1	25	**95.5**	**10**	70.1	7
B-1399	$1,643	9535	250	26	38.3	9	16.7	26	**95.6**	**8**	68.6	10
SX-RR1245N	$1,628	9454	257	17	36.7	18	17.2	23	**95.7**	**6**	66.1	18
MA-709	$1,621	9394	262	9	35.8	22	**17.6**	**10**	**95.4**	**15**	70.1	8
SX-RR1243	$1,616	9381	254	23	36.9	17	17.1	24	**95.8**	**4**	68.4	12
MA-814	$1,613	9355	257	20	36.5	19	17.3	20	95.3	19	**73.6**	**3**
HIL-2240	$1,607	9313	259	13	36.0	21	**17.6**	**11**	95.2	20	71.4	5
HIL-2238NT	$1,559	9050	253	24	35.7	23	17.3	21	95.2	23	**75.2**	**1**
HIL-9908	$1,525	8840	261	10	33.8	25	17.5	12	**95.4**	**12**	65.3	19
HIL-9879NT	$1,503	8713	260	11	33.5	26	17.4	13	**95.4**	**14**	63.5	25
MA-813NT	$1,502	8701	257	19	33.9	24	17.3	19	95.3	17	**73.7**	**2**
Average	$1,670.7	9695.5	260.1		37.31		17.48		95.43		67.75	
LSD 5%	84.9	508.6	6.7		1.6		0.4		0.6		3.0	
CV %	4.1	4.2	2.1		3.5		1.8		0.5		3.6	

$/A: Gross dollars per acre assuming a $45 payment and trial average RWST.
Bold: Results are not statistically different from top-ranking variety in each column.

Comments: The Official Variety Trials in 2019 were planted during 3 different planting windows. Some were planted in early April, Others in mid-April, and the majority in mid-May. Disease control at all locations was very good. All locations suffered a dry period from mid-July through August. September rains boosted yield at all locations. The majority of these trials were havested in October. Two trials had roots placed into storage.

Cercospora Nursery
Michigan Sugar Company
Average of 2 years, 2018 & 2019

Trial Quality: Good
Locations: 2018 - Blumfield East, SVREC
2019 - Blumfield East, SVREC

Plot Size: MSC - 2 Rows X 17.5 ft., 5 reps
SVREC - 2 Rows X 20 ft., 5 reps
Inoculation: Trials are Inoculated

Variety	Avg of 2 Years CLS Rate 0-9	2018 CLS Rate 0-9	2019 CLS Rate 0-9
HIL-9908	3.9	3.6	4.2
C-G855	4.4	3.9	5.0
B-1399	4.5	4.4	4.7
HIL-9879NT	4.5	3.7	5.4
HIL-2240	4.6	4.1	5.0
MA-813NT	4.6	3.5	5.6
MA-709	4.7	4.2	5.2
B-1703	4.7	4.4	5.1
HIL-2238NT	4.9	4.4	5.4
MA-814	5.0	4.6	5.3
SX-RR1264	5.2	4.5	5.8
C-G675	5.2	4.9	5.5
SX-RR1243	5.2	4.7	5.6
SX-2283	5.2	4.5	6.0
Resistant Check	5.3	5.0	5.5
C-G861	5.4	4.9	5.8
HIL-9865	5.4	4.7	6.0
C-G752NT	5.4	4.9	5.8
B-1690	5.4	4.8	6.1
B-1893	5.5	5.2	5.8
SX-RR1245N	5.5	4.8	6.2
B-1606N	5.6	5.0	6.2
SX-RR1275N	5.6	5.0	6.1
B-188N	5.7	5.1	6.2
C-RR059	5.8	5.0	6.6
C-G333NT	5.9	5.4	6.4
SX-RR1278N	5.9	5.1	6.7
Susceptible Check	6.0	5.3	6.7
Average	5.17	4.63	5.72

Cercospora Rating (0-9 Scale): 0 = no spots, 1 = very few spots, 2 = up to 10 spots/leaf, 2.5 = up to 50 spots/leaf, 3 = 100 to 200 spots/leaf (approx 3% leaf injury), 4 = up to 10 % injury, 5 = up to 25 % injury, 6 = up to 50% injury, 7 = up to 75% injury, 8 = up to 90% injury, 9 = leaves completely dead.

Comments: These are inoculated trials. Ratings begin when the disease level approaches economic damage. Each trial is rated at least 5 times, until most varieties begin to burn down. Ratings are averaged to provide results.

Rhizoctonia Nursery
Michigan Sugar Company
Average of 2 years, 2018 & 2019

Trial Quality: Good
Location: 2018 - Blumfield East, SVREC, 2019 - Blumfield East, SVREC
Plot Size: 2 rows X 25 ft., 6 reps
Inoculation: Inoculated with Rhizoctonia Solani AG 2-2 IIIB

Variety	Root Rating* 0-7	Estimated Root Rot %
C-G855	**3.6**	**16.7**
C-G861	**3.6**	**17.1**
C-G675	**3.8**	**20.3**
C-RR059	**3.9**	**23.6**
B-1690	4.0	**25.3**
HIL-9908	4.0	**26.1**
B-1399	4.0	**26.2**
B-1703	4.1	28.9
B-188N	4.1	29.2
C-G752NT	4.1	28.8
Resistant Check	4.2	29.7
B-1606N	4.2	29.0
B-1893	4.2	31.1
C-G333NT	4.2	31.4
HIL-9865	4.3	32.7
HIL-9879NT	4.4	35.6
MA-813NT	4.4	35.9
MA-814	4.5	36.3
SX-RR1243	4.5	36.9
SX-RR1264	4.5	37.5
SX-RR1275N	4.5	38.3
HIL-2238NT	4.6	39.3
MA-709	4.6	39.3
SX-RR1245N	4.6	40.4
SX-2283	4.7	42.5
SX-RR1278N	4.8	44.9
HIL-2240	4.9	47.0
Susceptible Check	4.9	48.5
Average	4.01	29.12
LSD 5%	0.4	10.3
CV %	5.1	17.2

Bold: Results are not significantly different from the top ranking variety in each column
***Rating System:**

0 = No Infection
1 = less than 2% rooted roots
2 = less than 5% rooted roots
3 = 5 to 25% rotted roots
4 = 26 to 50% rooted roots
5 = 51 to 75% rooted roots
6 = 76 to 95% rotted roots
7 = 100% rotted roots

During evaluations, roots were dug and assigned values from 0 to 7. Each plot contained approximately 50 roots and each root was rated.

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Sugarbeet Response to Starter Fertilizer, N Rate, and Plant Population

Seth Purucker, Andrew Chomas, and Kurt Steinke, Michigan State University

See soil.msu.edu for more information

Location: Saginaw Valley Research and Extension Center	**Tillage**: Conv., 30-in. row
Planting Date: April 25, 2019 (Harvest 10/14/19)	**Trts:** See below
Soil Type: Clay Loam; 2.4% OM; 8.2 pH; 15 ppm P (Olsen), 29 ppm P (Bray); 137 ppm K	**Population**: 3 ½ & 4 in. spacing
Variety: C-G675	**Replicated**: 4 replications

Treatment	RWSA	RWST	Tons/A	% Sugar	% CJP
Population, seeds A^{-1}					
50,000	7222	282	26	18.3	97.0
60,000	7373	283	28	18.3	97.1
$LSD_{(0.10)}$[a]	**NS[b]**	**NS**	**NS**	**NS**	**NS**
N Rate, lbs. N A^{-1}					
0	5262	281	19	18.2	97.3
80	7164	290	24	18.7	97.2
160	8452	285	30	18.5	97.0
240	8313	274	30	17.9	96.8
$LSD_{(0.10)}$	**612**	**5**	**2**	**0.3**	**0.2**
Starter Fertilizer					
2x2	7403	283	26	18.4	97.1
No 2x2	7192	282	25	18.3	97.0
$LSD_{(0.10)}$	**NS**	**NS**	**NS**	**NS**	**NS**

a LSD, least significant difference between means within a column at ($\alpha = 0.10$).

[b] NS, not significant

Summary: Trial quality was good. Treatments consisted of two populations (3½ and 4 inch spacing which resulted in 50,000 or 60,000 seeds per acre), four N rates (0, 80, 160, 240 lbs. N/A), and 2x2 applied starter fertilizer (with and without). All treatments with starter fertilizer received 40 lbs. N/A as 28%, 20 lbs. P2O5/A, 50 lbs. K2O/A, and 2 lbs. Mn/A applied 2 inches below and two inches to the side of the seed. Treatments at the 0 lbs. N/A rate did not receive any N in starter application only P, K, and Mn. Starter N was subtracted from sidedress N application rates. Sidedress N applications occurred June 4 at the 2-4 leaf stage using 28% UAN.

No yield or quality differences occurred due to population or starter fertilizer. In this study, a total N rate of 80 lb. N/A resulted in the greatest RWST, but total N rates of 160 lb. N/A resulted in the greatest RWSA, tonnage, and expected net return. Gross grower payment maximized at 160 lbs. N/A. With N fertilizer and trucking costs taken into consideration, 160 lbs N/A still resulted in the greatest expected net return. Although not observed in 2019, starter (2x2) applied N may provide opportunities to increase N efficiency, decrease overall N rates, and help address mid-season variable weather patterns. Increased tonnage and expected return may not always offset input costs and greater input intensities must be balanced with impacts on disease development.

Treatment	Gross Grower Payment ($/A)	Expected Net Economic Return Minus N Costs ($/A)[a]	Expected Net Economic Return Minus N Costs and Trucking ($/A)[b]
Population, seeds A^{-1}			
50,000	1415	1362	1266
60,000	1444	1392	1294
$LSD_{(0.10)}$[c]	**NS[d]**	**NS**	**NS**
N Rate, lbs. N A^{-1}			
0	1031	1031	961
80	1403	1368	1275
160	1656	1585	1474
240	1629	1523	1409
$LSD_{(0.10)}$	**120**	**120**	**112**
Starter Fertilizer			
2x2	1450	1397	1299
No 2x2	1409	1356	1261
$LSD_{(0.10)}$	**NS**	**NS**	**NS**

[a, b] Gross grower payment and net economic returns based upon harvest date adjustment factor for tonnage and RWST, an N price of $0.44/lb., and trucking costs of $3.75/T.

[c] LSD, least significant difference between means within a column at ($\alpha = 0.10$).

[d] NS, not significant.

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan State University AgBioResearch

Sugarbeet Nitrogen Response Following Corn

Kurt Steinke and Andrew Chomas, Michigan State University

See soil.msu.edu for more information

Location: Saginaw Valley Research and Extension Center	**Tillage**: Conv., 30-in. row
Planting Date: April 25, 2019 (Harvest 10/14/19)	**N Rates**: See below
Soil Type: Clay loam; 2.9% OM; 7.9 pH; 14 ppm P (Olsen); 163 ppm K	**Population**: 4 in. spacing
Variety: C-G675	**Replicated**: 4 replications

N Trt. (Total lb. N/A)	RWSA	RWST	Tons/A	% Sugar	% CJP
0 – Check	4275	277	15.4	17.9	97.2
40	6651	283	23.5	18.5	96.6
80	6450	285	22.6	18.5	97.0
120	6780	290	23.4	18.8	96.8
160	9063	282	32.1	18.4	96.7
200	8210	277	29.6	18.1	96.6
240	8723	259	33.7	17.1	96.3
$LSD_{(0.10)}$[a]	**1208**	**12**	**4.0**	**0.7**	**0.3**

[a] LSD, least significant difference between means within a column at ($\alpha = 0.10$).

N Trt. (Total lb. N/A)	Gross Grower Payment ($/A)	Net Economic Return Minus N Costs ($/A)[a]	Net Economic Return Minus N Costs and Trucking ($/A)[b]
0 – Check	845	845	787
40	1317	1301	1213
80	1276	1244	1159
120	1344	1296	1208
160	1793	1729	1609
200	1624	1544	1433
240	1729	1633	1507

[a, b] Gross grower payment and net economic returns based upon harvest date adjustment factor for tonnage and RWST, an N price of $0.40/lb., and trucking costs of $3.75/T.

Summary: Trial quality was good. All treatments received 40 lbs. N/A as 28%, 20 lbs. P_2O_5/A, 50 lbs. K_2O/A. and 2 lbs. Mn/A as starter placed 2x2 on April 25 with 10 lb. N/A available in the top foot of soil. Sidedress N applications completed at the 2-4 leaf stage on June 4. Cool, wet early spring soil conditions slowed emergence and early-season plant development with two-inch soil temperatures staying above 50F after May 15. Five and seven inches of rainfall in May and

June, respectively, likely caused some degree of N loss via denitrification. Lack of soil moisture during July and August (2.3 and 1.0 inches rainfall, respectively) limited tonnage and bulking. Optimal tonnage and RWSA were near 160 lb N/A. Gross grower payment and net returns were all maximized at 160 lb N/A (40 N 2x2 with 160 N sidedress). Noticeable declines in sugar quality occurred at or near 240 lb N/A. Bulk N applications, in this study coulter-inject sidedress, occurred after the cool, moist May weather conditions thus avoiding some degree of N loss as compared to pre-plant N management practices. Bulk N applications during early vegetative growth allow the grower to avoid some N loss opportunities in between planting and early vegetative development. However, dry soil conditions during early vegetative growth stages (not observed in 2019) can create difficulties with getting N into the plant and affect the efficacy of sidedress N application strategies (surface applied N as compared to subsurface coulter-inject N).

MICHIGAN STATE UNIVERSITY EXTENSION

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Potassium Effects on Sugar Quality and Sugarbeet Removal Rates

Sarah MacDonald, Andrew Chomas, and Kurt Steinke, Michigan State University

See soil.msu.edu for more information

Location: Saginaw Valley Research and Extension Center	**Tillage**: Conv., 30-in. row
Planting Date: April 26, 2019 (Harvest 10/14/19)	**Trt's**: See below
Soil Type: Clay loam; 2.4% OM; 7.9 pH; 16 ppm P (Olsen); 148 ppm K; CEC 15.6	**Population**: 4 in. spacing
Variety: C-G675	**Replicated**: 4 replications

Treatment (Total lb. /A)[a]	RWST	% CJP
0 N + 0 K	279	97.0
0 N + 150 K	279	97.0
0 N + 300 K	277	96.7
80 N + 0 K	281	97.0
80 N + 150 K	281	96.8
80 N + 300 K	284	96.9
160 N + 0 K	268	96.2
160 N + 150 K	276	96.6
160 N + 300 K	286	96.8
LSD$_{(0.10)}$[b]	**7**	**0.3**

[a] Total lb./A refers to lb. N and K_2O respectively.

[d] LSD, least significant difference between means within a column at ($\alpha = 0.10$).

Treatment (Total lb. /A)[a]	Tons/A	RWSA	% Sugar	K Root Conc. (%)	K Root Removal (lb. K_2O/T)
0 N	14	3786	18.1	0.73	6.5
80 N	19	5429	18.3	0.75	6.4
160 N	24	6729	18.1	0.75	6.2
LSD$_{(0.10)}$[b]	**3**	**912**	**NS**	**NS**	**NS**
0 K	18	5002	18.0	0.75	6.3
150 K	19	5376	18.2	0.73	6.0
300 K	20	5566	18.4	0.76	6.7
LSD$_{(0.10)}$	**NS**	**NS**	**NS**	**NS**	**0.5**

[a] Total lb./A refers to lb. N and K_2O respectively.

[b] LSD, least significant difference between means within a column at (α = 0.10).

Treatment (Total lb. /A)[a]	Gross Grower Payment ($/A)	Net Economic Return Minus N and K Costs ($/A)[b]	Net Economic Return Minus N, K, and Trucking Costs ($/A)[c]
0 N	750	710	659
80 N	1076	1000	929
160 N	1333	1222	1132
$LSD_{(0.10)}$[d]	**181**	**181**	**170**
0 K	990	955	887
150 K	1065	990	917
300 K	1104	987	914
$LSD_{(0.10)}$	**NS**	**NS**	**NS**

[a] Total lb./A refers to lb. N and K_2O respectively.

[b,c] Gross grower payment and net economic returns based upon harvest date adjustment factor for tonnage and RWST, an N price of $0.44/lb., K price of $0.27/lb., and trucking costs of $3.75/T.

[d] LSD, least significant difference between means within a column at (α = 0.10).

Summary: Trial quality was average to good due to some standing water soon after planting. Treatments consisted of three N rates (0, 80, 160 lb. N/A using 28% UAN) and three K rates (0, 150, 300 lb. K_2O/A using MOP) in a randomized complete block design including a check. All treatments other than the 0 N rate received 40 lb. N/A as 2x2 at planting on April 26. The remainder total N was applied sidedress at the 2-4LF stage on June 4 using 28% UAN. All three K rates were pre-plant incorporated on April 25. An interaction between N rate and K rate significantly affected RWST and CJP. The 160 N w/ 0 K treatment was the only combination that significantly reduced RWST. Purity significantly decreased in the 0 N w/ 300 K, 160 N w/ 0 K, and 160 N w/ 150 K combinations. Due to no interaction between N and K rate, main effects are displayed for tonnage, RWSA, % sugar, % K, and K removal. Tonnage and RWSA increased as N rate increased however, % sugar, % K, and K removal in root tissue were not affected. No differences were observed in RWSA, tonnage, percent sugar, or % K due to K rate. The K removal in root tissue significantly increased for the 300 K treatment. Nitrogen rates continued to significantly increase gross grower payment and net economic returns up to 160 lb. N/A. No differences were observed for gross grower payment and net economic returns due to K rate. Potassium removal rates averaged 6.3 – 6.4 lb. K_2O/T across both N and K rates. Lack of yield response to K rate was likely due to pre-plant soil K concentrations being above the critical value for sugarbeet. May through June precipitation was 89% above 30-year means indicating sufficient soil moisture which has been shown to increase the ability of sugarbeet to utilize available K. When soil test values are at or above critical K concentrations, response to K application is unlikely under adequate soil moisture conditions. Trial will be repeated in 2020.

MICHIGAN STATE UNIVERSITY EXTENSION

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Does Sugarbeet Row Spacing Affect the Need for Starter Nitrogen?

Kurt Steinke[1], Brian Groulx[2], Seth Purucker[1], and Andrew Chomas[1]
[1] Michigan State University and [2] Michigan Sugar Company

See soil.msu.edu for more information

Location: Saginaw Valley Research and Extension Center	**Tillage**: Conv.
Planting Date: April 25, 2019 (Harvest 10/11/19)	**Trts:** See below
Soil Type: Clay Loam; 2.4% OM; 8.2 pH; 15 ppm P (Olsen), 29 ppm P (Bray); 137 ppm K	**Population**: 4 in. spacing
Variety: C-G675	**Replicated**: 4 replications

Treatment	RWSA	RWST	Tons/A	% Sugar	% CJP
Row Spacing					
22 inch	8906	247	36	16.4	96.2
30 inch	6960	275	25	18.0	96.5
LSD$_{(0.10)}$[a]	**1084**	**7**	**4**	**0.4**	**NS[b]**
N Placement					
28% N, 2x2	7890	258	31	17.0	96.4
Urea w/UI[c], PRE	7975	264	31	17.4	96.3
LSD$_{(0.10)}$	**NS**	**NS**	**NS**	**0.4**	**NS**

[a] LSD, least significant difference between means within a column at (α = 0.10).

[b] NS, not significant

[c] UI, Urease inhibitor

Summary: Trial quality was good. Four treatments were evaluated in a split-plot design and included: 1) 22 inch rows with 40 lbs. N/A 2x2 and 120 N sidedressed (2-4 lf), 2) 22 inch rows with 40 lbs. N/A applied PRE and 120 N sidedressed (2-4 lf), 3) 30 inch rows with 40 lbs. N/A 2x2 and 120 N sidedressed (2-4 lf), and 4) 30 inch rows with 40 lbs. N/A applied PRE and 120 N sidedressed (2-4 lf). Treatments with 2x2 received 40 lbs. N/A using 28% UAN two inches below and two inches to the side of the seed at planting. Treatments with N applied PRE received 40 lbs. N/A using urea with a urease inhibitor broadcast applied immediately following planting. Sidedress N applications were completed at the 2-4 leaf stage on June 4 for a total N application rate of 160 lb./A. There was no interaction between row spacing and starter N, only main effects of row spacing or N placement on specific parameters. Percent (%) sugar and RWST were significantly greater when utilizing 30 inch rows. However tonnage and RWSA were significantly greater utilizing 22 inch rows.