2022 RESEARCH REPORT

SAGINAW VALLEY

RESEARCH & EXTENSION CENTER

MICHIGAN STATE UNIVERSITY

AgBioRESEARCH

TABLE OF CONTENTS

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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. The Michigan Wheat Program and Michigan Corn Marketing Program are also contributing partners. The Michigan State University Office of AgBioResearch operates a 450 acre farm near Richville Michigan in Denmark Township and is established as an AgBioResearch center. The Education Center was completed in 2016 and in 2022 had numerous functions and hosted a Plant Diagnostic Day in August. 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 2022 season was the 14th season of research at the site. This research report is primarily a compilation of research conducted at the site in 2022. 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.

Weather – The monthly rainfall for 2022 collected with the automated rain gauge is given in Table 1. The monthly totals are given at the bottom of the table. Rainfall was 5 inches below average for the whole year, the dry months being January, February, October, November, and December, the precipitation during the growing season months were all near average. Maximum and minimum daily temperatures are given in Table 3. The 2022 season was warm during the three summer months of June, July, and August with 5 days above 90 degrees and 33 days above 85 degrees. The growing degree days for 2022 was 2266, which was above average. The average yields for crops grown on the farm were: corn at 170 bushels/acre, soybeans at 50 bushels/acre, wheat at 90 bushels/acre, dry beans at 30 cwt/acre, and sugarbeets at 40 tons/acre.

The Farm Manager, Paul Horny will be retiring March of 2023, after 39 years of service to MSU, and the industry groups associated with the center. The willingness of these groups to work toward common goals has made this center very successful and responsive to the needs of all groups involved, and is noted as such.

Table 1.

PRECIPITATION - SAGINAW VALLEY RESEARCH & EXTENSION CENTER- 2022

Day:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.01	0.12			0.04	0.04		1.39			0.01	
2		0.06		0.02								
3				0.07	0.38			0.35				0.08
4	0.01			0.29	0.02							
5						0.01	0.10					
6			0.08	0.49						0.11		0.03
7	0.01		0.20			0.32		0.29				0.01
8			0.01	0.10		0.54		0.20				
9						0.31						
10						0.08						
11		0.07	0.13	0.03		0.03	0.13		1.08	0.07		0.05
12						0.22			0.70	0.52		
13				0.40			0.64			0.09		
14				0.02	0.42	0.01					0.06	
15										0.02	0.28	0.17
16		0.16	0.01		0.09	0.01	0.01	0.13			0.07	
17		0.68								0.31		
18			0.30	0.23	0.14					0.26		
19			0.28						0.01	0.15		
20			0.03			0.39	0.02	0.16		0.04		
21			0.03	0.10	0.30			0.02	0.39			
22		0.39	0.05		0.05							0.04
23			1.14									
24			0.13	0.33			1.37		0.02			
25	0.01	0.01	0.05		0.05			0.21				
26			0.09	0.31	0.12			0.08	0.20	0.29		
27	0.01			0.01	0.03				0.10		0.27	
28							0.04		0.04			
29						0.19		0.28			0.02	
30			0.20								0.02	0.04
31			0.06							0.11		0.02
TOTAL	0.05	1.49	2.79	2.40	1.64	2.15	2.31	3.11	2.54	1.97	0.73	0.44

Rainfall is measured in inches

2022 YEAR END TOTAL - 21.62 INCHES

Table 2.

MONTHLY PRECIPITATION, SAGINAW VALLEY RESEARCH FARM													
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
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**
2020	2.30	0.32	2.07	2.08	3.75	1.35	3.24	3.36	2.75	2.37	1.50	1.84	**26.93**
2021	0.44	0.39	1.30	0.71	1.16	4.93	2.89	3.08	5.05	3.76	1.12	1.43	**26.26**
2022	0.05	1.49	2.79	2.40	1.64	2.15	2.31	3.11	2.54	1.97	0.73	0.44	**21.62**
AVG.	**1.26**	**1.09**	**1.32**	**2.79**	**2.91**	**2.85**	**2.58**	**3.13**	**2.45**	**2.62**	**2.06**	**1.37**	**26.43**

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

Table 3.

MAXIMUM-MINIMUM AIR TEMPERATURES (F)
SAGINAW VALLEY RESEARCH & EXTENSION CENTER - 2022

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
DAY	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
1	33	20	46	20	41	25	34	29	64	47	80	56
2	23	5	38	18	37	21	43	26	56	46	76	52
3	25	4	20	8	30	17	44	32	51	44	79	51
4	33	17	23	3	37	17	38	31	58	39	74	45
5	34	16	22	-5	56	29	51	37	64	34	63	52
6	21	2	32	15	58	32	51	35	65	46	74	56
7	16	-7	30	23	33	28	45	38	63	39	69	54
8	31	-5	29	11	36	15	45	33	68	32	69	48
9	34	9	37	26	42	25	40	29	73	44	73	53
10	13	6	34	27	34	24	54	29	82	54	76	50
11	29	0	37	26	30	15	68	42	81	63	77	55
12	34	29	27	12	19	7	65	33	89	56	74	57
13	31	24	20	4	37	7	70	50	87	58	80	50
14	28	14	19	0	49	25	62	38	88	62	85	58
15	19	2	28	16	41	30	51	36	79	55	96	67
16	26	-1	47	23	62	29	40	27	73	54	89	67
17	29	9	45	16	69	40	44	27	66	44	82	61
18	34	25	26	10	47	36	38	26	54	40	73	52
19	39	15	27	10	41	35	43	31	75	50	77	46
20	18	11	46	14	56	33	54	26	86	64	84	58
21	21	4	37	29	54	30	64	43	68	58	95	64
22	23	13	33	28	42	33	57	32	62	45	87	62
23	20	5	32	14	44	35	81	44	62	46	81	53
24	20	10	24	12	47	37	81	59	66	39	89	57
25	23	-4	27	7	44	34	65	42	69	46	90	65
26	20	-7	28	7	38	22	42	32	75	62	84	64
27	26	8	35	24	27	19	43	27	67	59	83	58
28	17	-4	32	16	30	16	53	24	72	51	82	45
29	19	-8			40	17	61	25	83	55	79	58
30	26	9			50	29	62	34	88	69	89	59
31	32	16			60	33			90	70		

Table 3. (cont.)

MAXIMUM-MINIMUM AIR TEMPERATURES (F)
SAGINAW VALLEY RESEARCH & EXTENSION CENTER - 2022 cont.

	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
DAY	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
1	85	59	82	64	81	49	69	36	64	43	34	23
2	82	53	79	56	85	63	64	36	68	37	51	29
3	86	54	82	64	88	61	69	31	71	46	51	22
4	88	58	86	69	68	59	72	36	70	53	37	20
5	86	67	86	64	70	59	73	42	71	52	38	27
6	78	57	89	68	79	53	73	46	64	42	42	34
7	83	52	87	73	77	46	50	34	52	33	42	35
8	76	50	81	65	83	47	54	29	54	27	37	29
9	78	45	77	57	84	55	64	41	66	29	33	29
10	83	45	80	54	86	61	64	33	75	52	35	29
11	83	60	75	54	72	64	76	40	61	35	38	23
12	80	60	80	49	68	51	69	47	41	31	35	31
13	76	57	66	55	74	45	53	38	35	22	32	25
14	81	51	73	59	73	54	54	38	37	17	35	26
15	82	52	81	54	72	48	52	39	34	20	41	32
16	81	63	80	51	82	57	55	39	34	28	35	28
17	84	61	82	52	83	59	44	33	32	19	29	25
18	89	63	83	53	82	66	40	37	30	23	30	25
19	92	67	83	55	79	57	43	36	26	16	25	22
20	89	71	80	62	77	52	44	33	24	13	31	20
21	89	67	80	62	82	58	68	32	39	19	24	11
22	89	63	81	59	62	42	75	52	41	19	36	23
23	89	68	81	54	66	38	74	51	54	25	32	5
24	82	66	85	58	57	48	76	53	55	35	15	6
25	75	55	79	58	62	48	74	54	47	32	17	14
26	80	55	77	58	59	50	63	36	53	32	21	14
27	81	58	80	50	52	47	53	30	42	35	26	18
28	80	60	85	54	55	45	59	30	40	33	40	25
29	79	56	83	65	63	41	63	29	52	33	50	37
30	81	54	76	58	68	35	65	32	53	25	55	40
31	84	58	80	56			58	46			41	33

Table 4.

	GROWING DEGREE DAYS - SAGINAW VALLEY RESEARCH FARM							
	Base 50 (max + min / 2 - 50)							
	APRIL	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**TOTAL**
1986	125	310	435	664	460	370	97	**2460**
1987	84	337	567	726	538	334	20	**2604**
1988	36	291	545	740	668	283	48	**2609**
1989	22	202	457	648	535	315	167	**2345**
1990	166	146	494	588	554	333	101	**2379**
1991	144	424	541	641	568	290	114	**2721**
1992	56	242	367	447	404	258	42	**1814**
1993	24	208	430	642	614	185	25	**2127**
1994	96	228	527	614	502	380	115	**2460**
1995	3	221	536	699	745	225	126	**2554**
1996	41	157	486	572	611	358	92	**2316**
1997	27	48	534	597	443	300	135	**2083**
1998	46	267	506	624	648	456	114	**2660**
1999	50	299	579	685	500	339	68	**2518**
2000	17	284	475	510	545	289	157	**2276**
2001	78	290	504	650	654	282	114	**2571**
2002	123	142	535	710	575	443	99	**2627**
2003	67	148	410	606	608	313	82	**2233**
2004	89	241	430	561	451	422	69	**2261**
2005	58	145	623	648	612	429	130	**2644**
2006	79	284	471	661	556	260	39	**2348**
2007	54	277	534	564	594	393	231	**2647**
2008	110	117	512	620	533	343	57	**2291**
***2009**	51	190	432	459	518	345	27	**2021**
2010	89	369	529	729	698	312	95	**2819**
2011	38	273	515	759	577	309	123	**2592**
2012	28	341	556	756	552	295	110	**2637**
2013	46	348	484	617	516	288	132	**2429**
2014	46	272	536	488	525	285	74	**2225**
2015	18	306	445	577	547	342	91	**2325**
2016	38	274	509	689	680	431	190	**2809**
2017	100	228	546	610	506	412	205	**2605**
2018	15	417	510	664	650	422	115	**2792**
2019	37	173	438	691	539	416	79	**2372**
2020	25	254	560	750	629	306	55	**2577**
2021	90	271	621	618	697	400	267	**2963**
2022	55	356	541	638	605	374	99	**2666**
AVERAGE	**61**	**253**	**506**	**634**	**565**	**339**	**105**	**2463**

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

2022 Michigan State Wheat Performance Trials

Dennis Pennington, Eric Olson, Amanda Noble

July 29, 2022

Planting last fall was a bit of a challenge. Frequent rainfall slowed drybean and soybean harvest which delayed wheat planting in some areas. Heavy rainfall after planting caused water stress including yellowing of plants and drown out in low areas of the field. Areas with wheel traffic from planting were affected the most. Fields planted that were able to get plants established before heavy rains did very well. In some cases, this was early planted wheat – in other cases it was later planted wheat. It just depended on where you were in the state and when the rain fell on your fields. Planted acres of wheat were 470,000, down 140,000 from a year ago. Water stressed plants that survived the fall did winterkill in many fields, reducing the stand and yield potential.

Spring conditions were fairly good for putting nitrogen, herbicides and fungicides on wheat. We had some cold temperatures that slowed herbicide application, but for the most part, spring applications went okay for most of the wheat crop. Due to the wet fall, crop condition ratings were down from a year ago through most of the spring and early summer.

Crop quality at harvest was much improved this year compared to last year. There have been no reports of preharvest sprout (low falling numbers) and due to dry conditions during flowering, fusarium head blight infections and vomitoxin levels are low or even not detectable. Test weights are widely ranging. Early harvested wheat had good yields (better than expected) with good test weights. Later harvested wheat has suffered from lower test weight. Once physiological maturity was reached, dry down was slow which extended our grain fill period. Then higher temperatures and dry conditions moved in and rapidly completed dry down.

Temperatures across the region were similar to '21. We did not have the excessive heat in '22 compared to '20. There were more days above 85 degrees compared with last year, but days above 90 degrees were similar. Total monthly rainfall was distributed more evenly between months, however there were dry periods in June and July. On June 28, most of the thumb and parts of central Michigan were listed on the drought monitor as abnormally dry (D0) and by July 19 most of that area had progressed to moderate drought (D1).

Figure 1. Number of days above 90 F, 85 F and rainfall data from Michigan Automated Weather Station Network, MSU for three of the MSU Wheat Variety Trial Locations for the 2020, 2021 and 2022 growing seasons. 2022 data was reported through July 26, 2022.

	2020			2021			2022		
	Pigeon	Richville	Mason	Pigeon	Richville	Mason	Pigeon	Richville	Mason
Above 90 F	10	13	10	2	4	2	5	5	2
Above 85 F	30	33	30	15	16	19	22	24	22
April (in)	2.2	2.1	2.6	1.8	0.7	1.5	2.19	2.4	4.03
May (in)	3.3	3.8	4.2	1.2	1.2	2.6	2.13	1.64	3.85
June (in)	1.9	1.4	5.8	1.9	4.9	7	1.58	2.15	2.43
July (in)	2.8	3.2	2.1	2.5	1	1.5	0.93	2.27	2.26

Choosing Varieties

Variety selection is best made using at least three years of data. Varieties selected using data across all locations and multiple years will likely perform well under a wide range of conditions; although, performance of a given variety will vary based on testing location. In selecting varieties for a specific location, it is important to identify varieties that perform well near the location where the variety will be grown. Table 1 provides information on which varieties are top performers in each of the seven trial locations in 2020 through 2022. Selection and planting of two or more varieties is recommended. As an example, planting varieties that differ in flowering date can allow for staggering of management applications, specifically, fungicides to control Fusarium head blight. When selecting varieties, look at disease resistance as well as yield potential.

Disclaimer: ***MSU makes no endorsement of any wheat variety or brand.***

Experimental Design

The 2022 State Wheat Performance Trial entries were planted in 7 counties: Isabella, Hillman, Ingham, Huron, Montcalm, Sanilac and Tuscola. Sanilac location was not harvested due to severe water damage from fall rains post-planting. Appendix A (below) presents information on each of these sites. Each plot contained 6 rows with 7.5” row spacing and was planted to a length of 18 feet. Plots were trimmed to a length of 12 feet long in the spring for harvesting purposes. Sites were designed as Alpha Lattice with three replications. All seed was treated, but the chemicals and rates used varied according to the preferences of the originating organization. Seeding rates per linear foot of row were standardized to the rate that would equate with a stand of 1.8 million seeds per acre in a solid stand planted in 7.5” rows. Fall fertilizer application varied with cooperator practice. Spring nitrogen was applied as urea (90 lbs/acre actual N) at green-up and Affinity BroadSpec was used for weed control at all sites.

All sites were coordinated under high management with the exception of additional conventionally managed trials at Tuscola and Isabella Counties. Under high management, an additional 30 pounds of nitrogen was applied using streamer nozzles and 28% UAN. Quilt Xcel fungicide was tank mixed with herbicide and applied at Feekes 6. Prosaro fungicide was applied to control late season fungal diseases with application coinciding with the average flowering date of the trial location.

All plots within a location were harvested on a single day. Yield was calculated using the entire area of the plot including the wheel tracks between plots leading to an underestimation of yield. For data reported on a 0-9 scale 0 is the best possible score.

Seven of our experimental sites are on private farmland. We are extremely grateful to those growers for accommodating our work and all of the associated inconveniences. Funding for the high-management trial inputs was provided by the Michigan Wheat Program. Questions and comments regarding the research reported here should be directed to Dennis Pennington at pennin34@msu.edu or (269) 832-0497. This report and previous reports, may also be accessed through the Web at http://www.varietytrials.msu.edu/wheat .

Multi-Year Performance Summary

The full trial included 125 entries (63 of which were experimental lines) from 13 organizations, including Michigan State University, and data analyses were conducted using all of these entries. Attached to this narrative is a list of the names and contact information for those organizations. Each row in these tables has data for a single entry. The columns contain averages for a given trait and time period. Data for all of the entries in this trial are not presented here. However, the averages and statistical parameters in this report are based on the entire set of evaluated materials. **Comparisons among entries are only valid within a column**. Tables 1 and 2 are sorted first by grain color, and then in descending order by yield for 2022. Tables 3, 4 and 5 are sorted in alphabetic order by company and entry name. In some instances (e.g. yield), data columns to the right of the 2022 data columns are multi-year averages. Only data for entries included in all of the relevant years' tests are found here. Not all entries have been tested in all years, so the tables have several blank cells. See the section titled 'Experimental Design' for details on how the trials were conducted and for more detail on what the data in each column represents.

At the bottom of most columns in the tables is the trial average (mean), LSD (least significant difference), and CV (coefficient of variation) for data in that column. LSD values vary among traits and data sets (combinations of sites and years). Differences between the means for two entries that are greater than the LSD for that column are very likely to reflect a genuine difference between the two varieties. If the difference between two means is smaller than the LSD for that column, one should conclude that there is **no evidence that those entries are different for that trait** in the years and sites considered.

MSU Wheat Performance Trial Report - SVREC

Line	Company	Seed Color	Awns	Tuscola			
				2022		2 Yr Avg	3 Yr Avg
				Bu/A	Rank	21-22	20-22
DF 271 W	DF Seeds, LLC	W	Awnletted	100.6	1	106.0	---
DF 261 W	DF Seeds, LLC	W	Awnletted	99.0	2	98.2	---
ISF 1115	Irrer Seed Farm	W	Awnletted	96.8	3	99.4	---
AgriMAXX Mackinac	AgriMAXX Wheat Company	W	Awnletted	96.6	4	---	---
MI18W1170	MSU	W	Awnletted	95.5	5	---	---
Ambassador	DF Seeds, LLC	W	Awnletted	94.8	6	90.9	92.0
DF 271 W	DF Seeds, LLC	W	Awnletted	94.7	7	---	---
Jupiter	MCIA	W	Awnletted	94.7	8	97.6	96.9
Dyna-Gro 9242W	Dyna-Gro	W	Awnletted	94.6	9	92.4	94.3
KWS428	KWS Cereals	W	Awnletted	93.7	10	---	---
DF 292 W	DF Seeds, LLC	W	Awned	93.3	11	---	---
KWS431	KWS Cereals	W	Awned	92.0	12	---	---
Moonlight	MCIA	W	Awnletted	91.9	13	94.5	95.6
KWS430	KWS Cereals	W	Awnless	91.5	14	---	---
AgriMAXX Piston	AgriMAXX Wheat Company	W	Awnless	91.1	15	---	---
MI20W0035	MSU	W	Awnletted	91.1	16	---	---
AC Mountain	MCIA	W	Awnletted	90.4	17	88.6	90.0
MI20W0121	MSU	W	Awnletted	89.8	18	---	---
Whitetail	MCIA	W	Awnletted	89.6	19	92.3	95.0
Dyna-Gro 9082W	Dyna-Gro	W	Awned	88.5	20	89.2	86.1
MI16W0133	MCIA	W	Awned	83.2	21	87.9	91.1
MCIA Flipper	MCIA	R	Awnletted	104.9	1	102.2	102.0
W 318	Wellman Seeds, Inc	R	Awned	102.1	2	---	---
W 313	Wellman Seeds, Inc	R	Awnless	101.4	3	101.5	99.1

RS 912	Rupp Seeds, Inc	R	Awnless	101.1	4	102.6	100.7
SY Viper	Grow Pro Genetics	R	Awnletted	100.7	5	95.6	97.7
WX22741	Dyna-Gro	R	Awned	100.7	6	---	---
MCIA MARLIN	MCIA	R	Awnletted	100.6	7	98.4	103.3
DF 131 R	DF Seeds, LLC	R	Awned	100.2	8	100.7	99.9
Tyson	Synergy Ag	R	Awned	99.9	9	100.0	---
MCIA .357	MCIA	R	Awnletted	99.9	10	101.5	102.3
W 324	Wellman Seeds, Inc	R	Awned	99.9	11	101.3	---
Dyna-Gro 9352	Dyna-Gro	R	Awnletted	99.8	12	---	---
W 322	Wellman Seeds, Inc	R	Awned	99.6	13	101.2	---
Dyna-Gro 9172	Dyna-Gro	R	Awned	98.3	14	100.4	98.8
DF 121 R	DF Seeds, LLC	R	Awned	98.1	15	102.7	---
Synergy EXP2141	Synergy Ag	R	Awnless	97.9	16	---	---
Dyna-Gro 9070	Dyna-Gro	R	Awned	97.8	17	102.3	101.5
W 304	Wellman Seeds, Inc	R	Awned	97.7	18	95.6	95.5
Dyna-Gro 9182	Dyna-Gro	R	Awnless	97.7	19	96.1	95.0
MCIA Wharf	MCIA	R	Awnletted	97.4	20	101.3	100.1
GP 747	Grow Pro Genetics	R	Awned	96.7	21	---	---
AgriMAXX 505	AgriMAXX Wheat Company	R	Awned	96.7	22	99.3	97.6
MI20R0013	MSU	R	Awnless	96.7	22	---	---
9xp051	Rupp Seeds, Inc	R	Awned	96.5	24	---	---
Synergy EXP2125	Synergy Ag	R	Awned	96.3	25	---	---
KWS414	KWS Cereals	R	Awned	95.7	26	---	---
W 328	Wellman Seeds, Inc	R	Awned	95.6	27	---	---
MI20R0210	MSU	R	Awned	95.5	28	---	---
Haubert	Synergy Ag	R	Awned	95.5	29	97.1	---
DF 121 R	DF Seeds, LLC	R	Awned	95.2	30	---	---
801	Albert Lea Seed - Viking	R	Awned	95.1	31	---	---
HS 338 R	Harrington Seeds, Inc	R	Awnletted	94.7	32	96.0	98.1
W 305	Wellman Seeds, Inc	R	Awnletted	94.7	33	98.2	98.5
MI20R0012	MSU	R	Awned	94.4	34	---	---
HS358R EXP	Harrington Seeds, Inc	R	Awned	94.2	35	---	---
MCIA 2000	MCIA	R	Awned	94.1	36	99.5	---
DF 112 R	DF Seeds, LLC	R	Awned	93.7	37	95.4	95.9
MI20R0011	MSU	R	Awnless	93.6	38	---	---
KWS415	KWS Cereals	R	Awnletted	93.4	39	---	---
Dyna-Gro 9002	Dyna-Gro	R	Awned	93.1	40	94.8	95.2
MCIA Red Dragon	MCIA	R	Awnless	93.0	41	97.0	95.5

9xp216	Rupp Seeds, Inc	R	Awnletted	92.8	42	---	---
W 326	Wellman Seeds, Inc	R	Awned	92.7	43	---	---
W 300	Wellman Seeds, Inc	R	Awned	92.7	44	93.5	---
DF 119 R	DF Seeds, LLC	R	Awnletted	92.5	45	95.2	98.2
GP 381	Grow Pro Genetics	R	Awnless	91.9	46	---	---
KWS405	KWS Cereals	R	Awnless	91.9	47	---	---
AgriMAXX 498	AgriMAXX Wheat Company	R	Awnletted	91.5	48	93.9	96.1
MCIA Jonah	MCIA	R	Awnletted	91.1	49	91.4	94.8
RS 977	Rupp Seeds, Inc	R	Awned	90.5	50	92.6	91.9
KWS394	KWS Cereals	R	Awnless	90.3	51	---	---
SY 576	Grow Pro Genetics	R	Awned	90.0	52	90.5	87.9
Sunburst	MCIA	R	Awnless	89.9	53	93.1	93.8
Dyna-Gro 9151	Dyna-Gro	R	Awned	89.7	54	95.2	94.3
KWS411	KWS Cereals	R	Awned	89.5	55	---	---
AgriMAXX 516	AgriMAXX Wheat Company	R	Awned	89.4	56	94.7	---
SY 547	Grow Pro Genetics	R	Awnless	88.1	57	94.8	94.8
WX22793	Dyna-Gro	R	Awned	86.9	58	---	---
MCIA Whale	MCIA	R	Awnletted	86.6	59	86.6	89.3
KWS398	KWS Cereals	R	Awnless	86.0	60	---	---
AgriMAXX 513	AgriMAXX Wheat Company	R	Awned	85.5	61	91.4	---
MI16R0906	MSU	R	Awnletted	83.2	62	93.4	94.9
AgriMAXX EXP 2222	AgriMAXX Wheat Company	R	Awned	---	---	---	---
AgriMAXX EXP 2105	AgriMAXX Wheat Company	R	Awned	---	---	---	---
AgriMAXX EXP 2110	AgriMAXX Wheat Company	R	Awned	---	---	---	---
		Mean		94.2		96.6	96.1
		CV		4.4		3.0	2.6
		LSD		6.7		4.7	4.2

2022 MI Craft Beverage Council Final Report
Proposal Title: Variety Selection for Oat Malting
(grant# 210000001194-A)

Principle Investigator: Dennis Pennington (MSU Wheat Extension Specialist)
Collaborators: Dr. Eric Olson (MSU Wheat Breeder), Vince Coonce (Independent Barley and Malt)

Abstract: Oats continue to gain in popularity among Craft Beverage producers. Traditionally used in oatmeal stouts (Great Britain) and Triples (Belgium), where they provide interesting and unique flavors and lend a soft, silky mouthfeel, oats today are used as flavor and texture contributors to many different Craft beer styles, and also to create a sensation of creaminess to Craft distilled beverages. Oat malts are among the most expensive brewing raw materials. Although a common crop in Michigan and the U.S., the majority of oats used in brewing are imported from Europe and Canada, where varieties are bred and grown specifically for their superior brewing characteristics. There are currently no oat varieties grown in the U.S. specifically for malting and brewing.

The lack of oat varieties in the U.S. bred specifically for brewing presents an opportunity for small grain breeders. However, developing new varieties is time consuming and expensive. As an alternative, existing oat varieties can be selected for a combination of their superior Michigan farm yield performance and their ability to produce high quality oat malts.

Specific methods and procedures: Oat varieties were selected for this trial by reaching out to our partners (Jim Sheppard, Legacy Seed Company, Paul Richter, Oat breeder for General Mills). Forty-five oat lines from the Midwest, northern plains and southern Canada were selected to be tested. Research plots were established and managed by the MSU wheat research team. Small plots (5 foot x 18 foot) were planted at three sites:

1. Saginaw Valley Research and Extension Center (SVREC) near Richville, MI;
2. Bartle Farm near Brown City, MI
3. Milligan Farm near Cass City, MI.

Plots were planted with an Almaco HD grain drill equipped with a packet planter in a randomized complete block design. Twenty-two of the varieties were experimental lines that have not yet been released for production. Testing these lines lets us get a sneak peak at the newest material coming out of breeding programs. The seeding rate was 1.5 million seeds per acre across all trials. Cass City and SVREC trials were planted on April 12, 2022 and Brown City trial was planted on April 22, 2022. Urea was applied at a rate of 70 pounds actual nitrogen per acre across all trials just prior to stem elongation. The Brown City trial was harvested on July 30, 2022; Cass City and SVREC were harvested on July 31, 2022. At harvest, grain samples were collected and submitted to General Mills and analyzed for grain protein content and plumpness. These two traits will be used as a proxy for malting quality. Twenty-three of the varieties were tested (experimental lines were removed to save cost).

Results and Discussion: Yields at SVREC and Brown City were highest. Cass City location was wet at planting, which affected emergence and yield suffered. A field day was held on June 16, 2022 at SVREC where about 125 farmers learned about this project and walked through the varieties and asked questions.

Table 1 contains yield, moisture and test weight data as well as an overall average across all three locations. Data is sorted descending, by overall yield. The overall average yield was 92.2 bushels per acre and a test weight of 35.6 pounds per bushel. The standard test weight for oats is 32. Most millers want to see test weight of 36.

Table 1. Oat harvest data for three locations in MI for 45 oat varieties.

	Brown City			Cass City			SVREC			Overall Average			
Line Name	Yield (bu/ac) Oats Mn	Moisture (%)	Test Weight (lb/bu)	Yield (bu/ac) Oats Mn	Moisture (%)	Test Weight (lb/bu)	Yield (bu/ac) Oats Mn	Moisture (%)	Test Weight (lb/bu)	Yield (bu/ac) Oats Mn	Rank	Moisture (%)	Test Weight (lb/bu)
CDC_ENDURE	127.6	10.8	33	94.8	12.2	34.3	121.8	10.7	34.8	114.7	1	11.2	34.1
OT3112	131.1	10.5	31.8	92.4	11.8	32.8	98.6	10.6	30.8	107.3	2	11	31.8
AAC_DOUGLAS	124.1	10.8	36.1	82.5	13.1	35.2	113.3	11	35.8	106.6	3	11.6	35.7
CDC_NORSEMAN	110.4	10.6	30.8	94.8	12.6	34.5	112.9	10.8	33.4	106.0	4	11.3	32.9
CDC_ARBORG	104.3	10.6	32.6	92.1	12.4	33.2	119.0	10.8	34.2	105.1	5	11.3	33.3
SD Buffalo	112.7	10.9	36.5	85.6	13.9	36.9	116.5	10.9	38	104.9	6	11.9	37.2
2018Y4811	110.7	11	33.9	92.9	13.6	34.5	110.9	10.9	35.7	104.8	7	11.8	34.7
2018Y0689	120.2	10.4	35.3	83.4	12.3	31.6	109.4	10.9	36	104.3	8	11.2	34.3
Hayden	107.0	10.8	38.2	87.0	12.2	37.8	112.7	10.6	37.5	102.2	9	11.2	37.8
CS_CAMDEN	113.0	10.5	34.2	83.3	12.3	34.8	109.7	10.8	34.7	102.0	10	11.2	34.6
ORe3541m	123.4	10.6	36.8	80.9	12.6	36.1	101.2	10.7	37.4	101.8	11	11.3	36.8
MN_PEARL	116.6	11	33.4	98.3	13.7	35.6	88.0	11	35.4	101.0	12	11.9	34.8
2015Y3857	127.6	10.8	35.6	69.8	12.0	34.6	103.7	10.7	35.7	100.3	13	11.1	35.3
ND131603	124.0	10.5	31.9	74.9	11.9	33.3	99.2	11.1	32.2	99.4	14	11.2	32.5
ND141338	107.2	10.7	36.1	85.5	13.1	35.9	104.0	10.8	35.9	98.9	15	11.5	36
ROCKFORD	102.7	11.1	37.1	83.4	13.2	37.4	110.6	11	37.7	98.9	16	11.8	37.4
ORe3542m	115.8	10.6	34.1	69.5	12.5	34.2	105.2	11	34.8	96.8	17	11.4	34.3
SD160067	97.8	10.9	36.7	91.0	13.4	37.5	100.2	11.2	37.7	96.3	18	11.8	37.3
SD170463	105.3	10.7	39.1	91.1	12.8	38.9	92.0	10.8	39.6	96.1	19	11.5	39.2
DEON	113.5	10.7	36.7	81.0	12.6	37.1	92.7	11.2	37.1	95.8	20	11.5	37
2018Y1334	120.9	10.7	33.9	68.2	12.9	34.7	97.5	11.1	34.7	95.6	21	11.5	34.4
KWS_Ocre	112.7	10.6	36.9	60.1	12.7	35.4	113.0	10.9	38.2	95.3	22	11.4	36.8
CDC_SKYE	110.3	10.7	33.3	76.8	12.5	34.8	93.1	11.1	35.8	93.4	23	11.5	34.6
2018Y2803	99.7	10.9	35.4	75.5	14.5	34.0	104.3	11.3	36.4	93.1	24	12.2	35.3
2018Y0255	108.9	10.8	31.2	64.9	14.8	34.0	101.7	10.8	34.2	91.8	25	12.1	33.1
Goliath	100.2	10.7	37.4	95.6	14.5	36.3	77.4	11.3	35.8	91.1	26	12.2	36.5
2018Y3614	99.3	10.8	35.5	92.7	12.5	33.9	80.1	11.2	34	90.7	27	11.5	34.5
Warrior	106.6	10.8	36.7	62.7	9.6	35.0	101.7	11.6	36.3	90.3	28	10.7	36
2018Y0147	107.6	10.9	33.7	63.0	13.2	31.5	100.2	10.5	32.9	90.3	29	11.6	32.7
Alka	112.5	10.4	32.4	85.6	12.7	32.4	72.1	10.8	35	90.1	30	11.3	33.3
RON	107.7	10.5	36.4	62.3	12.0	36.1	95.9	10.9	37	88.6	31	11.1	36.5
2018Y4019	99.2	11	35.3	70.5	12.6	33.2	91.5	10.9	35.5	87.0	32	11.5	34.7
IDA	93.5	10.7	35.8	67.3	11.9	33.0	99.3	10.8	35.9	86.7	33	11.1	34.9
2018Y1315	102.0	10.6	34.1	52.4	13.4	31.9	103.2	10.8	34	85.9	34	11.6	33.3
2018Y0435	106.0	10.9	35	60.3	14.3	33.2	90.9	11.4	34.9	85.7	35	12.2	34.3
NEWBERG	88.9	10.3	34.7	73.7	21.0	27.5	92.4	10.1	36	85.0	36	13.8	32.7
Betagene	92.7	11	34.8	73.5	14.8	34.4	82.7	12	34.5	83.0	37	12.6	34.6
2018Y5609	100.3	11	35.4	71.1	13.6	35.0	76.4	11.6	34.2	82.6	38	12.1	34.9
SABER	92.9	10.9	37.8	55.2	13.0	35.3	93.2	11.4	36.3	80.4	39	11.8	36.5
Rushmore	89.8	11.1	37	59.7	13.1	37.0	83.4	12	35.9	77.6	40	12.1	36.6
Horsepower	84.1	10.6	37.4	57.4	12.0	37.5	86.0	11.7	38	75.8	41	11.4	37.6
STREAKER	68.8	12.2	47.5	69.6	13.9	44.2	69.6	12.6	49.4	69.3	42	12.9	47
Reins	78.3	10.7	35.9	54.3	12.6	36.6	68.4	11.4	34.6	67.0	43	11.6	35.7
ND040341	72.8	12.1	42.7	54.5	14.2	42.5	69.2	12.4	44.3	65.5	44	12.9	43.2
Saddle	73.8	11	37.7	52.3	12.7	35.4	69.5	12.3	34.7	65.2	45	12	35.9
Mn	105.0	10.8	35.6	75.4	13.1	35.1	96.3	11.1	36.1	92.2		11.7	35.6
CVErr	8.9	2.1	3.7	19.3	18.2	7.7	12.0	3.5	3.2	7.5		6.9	3.0
LSD(.05)	15.1	0.4	2.1	23.6	3.9	4.4	18.7	0.6	1.9	9.4		0.9	1.1

This evaluation of already existing oat lines shows promise for Michigan where good yields and malt quality can be achieved. Historically, oat prices have been low and farmers have not planted large acreages in Michigan. The low prices make this a low input crop where management practices have been lowered in order to make a profit at the lower commodity price. Oat yields may respond to higher management similar to wheat. Additional nitrogen, sulfur and fungicide applications may increase yields, but prices have to be higher in order for farmers to make these investments.

This project has been the first step toward developing an oat malting industry in Michigan. There are existing oat varieties that have the potential for high yield and good test weight. Table 2 identified oat lines that are already grown for certified seed here in Michigan. There are several varieties outside of our area performed well and would be worth working with seed companies to introduce seed production and sales here. CDC Endure, AAC Douglas and CS Camden are Canadian lines that had high yield in our trials and had good plumpness.

Table 2 contains malting quality data including protein, plumpness and test weight. Samples were composited from three replications at Brown City to run malt quality analysis on. Experimental lines were not included because many of them may not even make it to the market. Plumpness is generally inversely related to test weight in our trials. Plump is a proxy used by maltsters to estimate extract. The test is relative inexpensive to run and only involved passing grain over a set of sieves. The interest in oats for malting comes from the unique flavor profiles, not yield of extract. Ideally, oat lines would be dual purpose – providing high yield for farmers and high quality for maltsters.

Protein levels are about double compared to wheat and barley, which reduces the extract output. This is a concern to maltsters because that means more oats have to be malted in order to obtain the same volume of fine extract. The tradeoff is flavor profile. While oats are not a primary malt grain, there could be specialty brews that meet market demands for unique flavors.

Table 2. Malting parameters from 23 oat lines. Percent plump is the amount of kernels retained on a 5.5/64 screen.

Line Name	Test Weight (lb/bu)	Plump[1] (%)	Protein (%)
Alka	32.4	88.5	17.8
CDC_Endure	33.0	84.9	16.7
CS_Camden	34.2	83.7	17.7
Hayden[2]	38.2	81.8	16.9
CDC_Arborg	32.6	80.4	17.4
Betagene	34.8	79.9	17.9
MN_Pearl	33.4	77.5	16.1
RON	36.4	77.3	19.9
Goliath[2]	37.4	76.1	17.2
Rockford	37.1	75.6	17.0
AAC_Douglas	36.1	75.0	17.3
CDC_Norseman	30.8	74.4	17.8
CDC_Skye	33.3	73.8	18.6
Rushmore	37.0	72.6	18.9
Warrior	36.7	70.2	17.9
Reins	35.9	69.3	18.4
Ida[2]	35.8	69.2	18.1
Deon	36.7	68.3	17.2
Newberg	34.7	64.9	17.3
Saber	37.8	60.5	18.3
Horsepower[2]	37.4	55.8	18.4
Saddle	37.7	51.5	18.4
Streaker	47.5	18.8	18.1

[1]Plump is percentage of kernels retained on 5.5/64th screen.
[2]Denotes lines currently grown in MI.

Future work on oats should include agronomic factors including higher nitrogen rates, fungicides and sulfur. This project provides a starting place for what lines of oats can be produced in Michigan.

2022 DRY BEAN YIELD TRIALS

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Plant, Soil and Microbial Sciences

The dry bean-breeding program initiated its fourteenth season on the 450-acre Saginaw Valley Research & Extension Center (SVREC) research farm near Frankenmuth, MI in 2022. The program conducted 24 yield trials 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 into moderately dry conditions (June 1-June 9). Bean trials received a total of 9.4" of rain following planting (June - mid Sept). The season was characterized by timely rains after planting (1.5" June 7-12) to aid germination, followed by a relatively dry period until significant rain (~0.6") fell the week of July 13. Late June thru early July was warm and dry with significant moisture stress and less vegetative growth going into flowering. However, the July 13 rain during the critical reproductive phase of the season signaled a shift to more frequent precipitation patterns through mid-August, resulting in overall average yields. Temperatures moderated later in the season and dry down was more typical rather than the extremely rapid maturation observed in 2021 due to accumulation of excess heat units. Harvest conditions were generally good, with most trials harvested at or near ideal seed moisture. Minimal root rot caused by *Rhizoctonia* strain AG2-2 was observed throughout the nurseries at SVREC, while root rot caused by *Fusarium* caused more significant damage to kidney bean yield trials in Montcalm Research Center. CBB was also present on some of the plots on both research farms and notes were collected in navy and black nurseries to identify those lines that showed some level of resistance. Yields were lower than 2021, averaging 19-27 cwt/acre at SVREC. Kidney and Yellow bean yields in Montcalm were higher at 30-32cwt/acre under irrigation. A total of 1720 single plant selections were made in F_2 and F_4 nurseries and these were sent to Puerto Rico for seed increase.

Similar to recent years, an F_4 augmented yield trial and spaced-planted nurseries were grown simultaneously to generate yield data to guide single plant selection towards higher yielding families. The use of unmanned aerial systems (UAS) continued this season to explore opportunities to efficiently collect plant height and maturity data more rapidly from the sky. Huron county testing was expanded this year to include a navy bean trial in addition to black bean trial initiated there in 2021. This location was near Bay Port in western Huron region alongside the Michigan Dry Bean Performance Trials. The aim of these trials is to ensure that future varieties are broadly adapted to the bean growing region of Michigan and place MSU breeding trials near where private seed companies are testing and selecting new cultivars in the largest bean growing county in the state.

Three nurseries were conducted at the Montcalm Research Farm (MRF) under irrigated conditions. These included a small kidney bean trial with the most advanced breeding lines, the National Sclerotinia white mold trial, and an additional white mold trial to screen new navy and black beans for tolerance to mold while allowing the implementation of genomic prediction for white mold and other agronomic traits. Plots were planted June 9, and harvested under favorable conditions. All trials were direct harvested and located on Comden 2 field, which has limited history of bean production for the past 20+ years. However, conditions were still favorable for *Fusarium* root rot infection in these nurseries in 2022. Disease pressure stunted plant growth but provided an excellent opportunity to rate disease severity across all kidney breeding lines by digging roots from border rows and assessing disease severity. Side-dress fertilizer was applied in mid-July to mitigate the loss of root function, and the field recovered to produce acceptable yields. Anthracnose Race 2 was not detected in the MSU trials at this location in 2022, suggesting several years of treatment with Priaxor® fungicide and careful note taking has reduced the disease pressure for this devastating seed born disease. Scouting will continue in 2023 to ensure it has been eliminated from our kidney bean seed lots. Due to persistent yield reduction from root rot at the research farm, kidney and yellow bean yield trials were established at Rader Farms near Lakeview this season alongside the performance trials. This strategy was effective as plots there were more vigorous and the on-farm kidney bean yield trial averaged 32cwt vs 20cwt for the similar trial near Entrican. Yellow beans were also productive, averaging 30cwt. These results were encouraging, and suggest that this on-farm testing strategy should be continued in 2023 to provide better crop rotation and reduced disease pressure that has confounded these trials on the research farm for several years.

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. 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. 2201: Standard Black Bean Yield Trial

This 36-entry trial included standard commercial black bean varieties and advanced breeding lines. Yields ranged from 18.0 to 28.6 cwt/acre with a test mean of 23.8 cwt/acre. Variability was moderate in this test, (CV=10.3%) and the LSD was 2.9 cwt/acre. Five entries significantly out yielded the test mean which included B20536 and B21710 for the second consecutive year. Adams (26.6cwt) and Zenith (26.1 cwt) were the top yielding varieties. Zenith continues to show stable and competitive yield potential in recent years. Given recent concerns about canning quality in the industry, this variety should not be overlooked by growers seeking black beans with good color retention for the canning market. In contrast, Nimbus (21.7 cwt) ranked below mean, and Black Beard (18.0 cwt) was the lowest yielding entry. While these varieties produce competitive yields for growers and in on-farm performance trials, they do not serve as useful checks in these breeding trials due to complete susceptibility to CBB which reduces their yield. Zorro (19.8 cwt) ranked unusually low this year as well. Several newer B217xx lines matched or exceeded the yield of Adams, demonstrating continued breeding progress. B19344 which has excellent canning quality similar to Zenith, ranked with Nimbus in this trial. It has produced ~35cwt 3-year average yield in on-farm performance trials suggesting it should be considered for release in response to the lack of canning quality among newer varieties currently in the marketplace. All entries will be canned to evaluate color retention and quality to inform decisions on advancement to 2023 testing.

Expt. 2202: Standard Navy Bean Yield Trial

This 30-entry trial included standard commercial navy bean varieties, and advanced lines from the MSU breeding program. Yields ranged from 15.6 to 28.0 cwt/acre with a mean of 23.9 cwt/acre. Variability in this trial was well controlled (CV= 9.6%) and the LSD needed for significance was 2.7 cwt/acre. Four breeding lines significantly outyielded the test mean, and overall navy yields were equivalent compared to those of black beans. Three of these entries were newer N215xx lines that yielded well in their first year of testing in 2021 and continued to look promising in 2022. The persistent yield potential of N19277, N19246, and N18105 which have ranked within the top ten entries consistently over the past four years despite contrasting seasons is noteworthy. N19246 appears to offer the best overall agronomic characteristics, with good upright architecture and efficient dry down at 98 days maturity. Given continued interest in enhancing sustainability and the current conversations regarding potential need for reduced desiccant use to satisfy consumer perception of environmental impacts of bean production, this line merits consideration for release. Commercial checks in this trial all ranked below the trial mean. As discussed above for newer black beans varieties, newer navies Liberty and HMS Bounty produced lower yields than expected due to complete susceptibility to CBB infection that reduced yield. The older MSU variety Alpena has proved a more stable check for these conditions, although it continues to move down in rank as newer breeding lines continue to add genetic yield gain over time. Canning tests will be conducted on all entries before being considered for advance to future trials.

Expt. 2203: Standard Great Northern and Pinto Bean Yield Trial

This 24-entry trial included MSU great northern (G-prefix) and pinto (P-prefix) breeding lines and standard commercial check varieties. The test ranged in yield from 9.1 to 25.4 cwt/acre with a mean yield of 19.1 cwt/acre. Variability was moderate (CV= 10.6%) resulting in an LSD value of 2.4 cwt/acre needed for significance. Four entries significantly outperformed the test mean. Charro, a consistent performer over the last 5-years, was the top yielding variety. Eldorado, ND Pegasus, and Lapaz, and Eiger ranked slightly above the mean. CBB was present and significantly reduced yield in Samurai, USDA Rattler, Powderhorn, and especially USDA Diamondback. Overall yields were disappointing, and it seems these market classes that tend to flower earlier were more impacted by dry conditions during flowering. However, G19613 ranked in the top 5 and yielded the same as ND Pegasus which has become the current yield check in recent years for the GN class in these breeding trials. G19607 and G19623 produced slightly more yield, but lack the overall agronomic refinement observed in the appearance of G19613. P19708 exhibited excellent dry down, efficient upright architecture, and good yield potential with 97 day maturity. There remains a market for earlier season pintos, so this line that matures 4-5 days earlier than Charro merits further testing. Overall, pinto and great northern yield gain appear to be limited in recent years, and Charro remains at the pinnacle. Seed size, quality, and canning appearance will be considered prior to advancing lines to further testing.

Expt. 2204: Standard Small Red and Pink Bean Yield Trial

This 18-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 18.3 to 29.7 cwt/acre with a mean yield of 24.0 cwt/acre. Variability was low (CV=8.9%) resulting in an LSD value of 2.5 cwt/acre for significance. Six entries significantly out yielded the test mean. Three R20-prefix entries ranked in this group, along with Cayenne. Seed size and marginal agronomic traits, due to severely restricted genetic variability, continue to present a challenge in the small red and pink classes. In pinks, the newly releases Coral produced equivalent yield to Cayenne with larger seed and good color. The other interesting pink was a new slow darkening pink from NDSU that ranked second in the trial. The slow darkening gene has been linked with delayed maturity and some level of yield drag in the past, but newer pintos seem to be reducing that drag. It appears that this pink may also demonstrate improved yield, while offering potential benefit to reduce post-harvest darkening that can make pink bean production in Michigan a challenge. Canning quality of all entries will be evaluated prior to advance to further testing. Strategies to introgress useful genetic diversity from other market classes into the small red seed class are ongoing.

Expt. 2205: Preliminary Navy Bean Yield Trial

This 40-entry trial included new navy bean lines (N22-prefix) and check varieties. Yields ranged from 18.6 to 31.0 cwt/acre with a mean of 26.1 cwt/acre. Variability among experimental entries was low (CV=9.0%) with an LSD of 3.8 cwt/acre. Two new lines significantly exceeded the test mean and also exceeded the yields of the best navies in test 2202 which suggests genetic progress in yield potential. It is interesting to see top yielding black beans in the pedigrees of several top new navies, suggesting this strategy of crossing among the two classes is producing yield potential. As discussed in 2202, Alpena was the top commercial check in this trial, while HMS Bounty and Liberty succumbed to CBB and ranked near the bottom of the trial. All entries will be canned and evaluated to guide selection decisions for 2023 testing. Selection for seed size will also continue, but it appears that selection against small seed size (<18g/100 seed) in recent years has improved this trait which now averages 22.1g/100 seed for this trial

Expt. 2206: Preliminary Black Bean Yield Trial

This large 84-entry trial included new black bean lines (B22-prefix) and check varieties. Yields ranged from 18.9 to 33.8 cwt/acre with a mean of 26.1 cwt/acre. Variability was very well controlled (CV=7.9%) producing an LSD of 2.8 cwt/acre. Zenith was the top yielding variety at 30.5 cwt/a, followed by Adams and Zorro. In contrast, Nimbus and Black Beard were the lowest yielding varieties in the trial. Despite sourcing clean western seed of all check varieties, the performance of these two varieties was confounded by CBB infection. Twelve entries significantly exceeded the trial mean, suggesting continued yield gains in this class. Canning quality, specifically color retention will be a primary selection criteria. Zorro will be used as a minimum quality standard, with preference for lines that remain darker like Zenith. Lack of color retention resulting in brown/red appearance like Nimbus or Adams will not be advanced in an effort to address widespread quality concerns in the industry.

Expt. 2207: Preliminary Great Northern and Pinto Yield Trial

This 40-entry trial included MSU great northern (G-prefix) and pinto (P-prefix) breeding lines and standard commercial check varieties. Yield ranged from 21.4 to 30.0 cwt/acre with a mean yield of 21.4 cwt/acre. Variability was moderate (CV= 11.4%) resulting in an LSD value of 3.3 cwt/acre needed for significance. Ten entries significantly outperformed the test mean. Charro and Eiger were the top ranking varieties, followed by ND Pegasus. No pinto exceeded the yield of Charro, but it was encouraging to see several new great northern lines exceed the yield of Eiger. Some entries exhibited late maturity and increased lodging which will eliminate them from advancing. Seed size, quality, and canning traits will be evaluated to guide selections for further testing.

Expt. 2208: Preliminary Small Red and Pink Bean Yield Trial

This 32-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 15.5 to 30.9 cwt/acre with a mean yield of 24.9 cwt/acre. Variability was moderate (CV=10.6%) resulting in an LSD value of 3.6 cwt/acre for significance. Four entries significantly out yielded the test mean including Viper which remains the dominant variety in the marketplace. Cayenne and Coral ranked together, as observed in several previous years, suggesting Coral offers equivalent yield potential in pinks to that of Cayenne small red. Genetic yield gain remains elusive, despite three of the top ten yielding entries having parents from outside the MSU program. Canning quality will be evaluated on the top yielding half of this trial, and selections will also be made based on lodging and maturity data.

Expt. 2209: Otebo Observation Trial

This small un-replicated 24 entry trial was planted to increase seed and observe MSU otebo germplasm that had been in storage for the past 5 years. Samurai was the most recent release in this market class and is currently being grown in Ontario for the export market to Japan. Breeding in this class has completely ceased in North America, however there may be future interest and support to develop new varieties that meet the unique pasting properties of this class. This trial was the first step to increase seed and select parents for crossing. Overall this class lacks efficiency, architecture, and dry down. Seed size remains a concern and will be closely scrutinized in future work. Future breeding efforts in this class will depend on support from the Ontario processing and export industry.

Expt. 2210: F4 Navy and Black Bean Yield Trial

This large 261-entry trial was planted as an un-replicated, augmented design to evaluate the yield potential of F4 families and provide data to guide final single plant selections in the space planted breeding nurseries. Checks included current varieties, as well as top yielding breeding lines from 2021 trials. The trial was among the first harvested, and yield data were used to target the highest yielding families for further single plant selection in the F4 space planted nurseries. Those selections will be grown in the 2022-23 winter nursery, and enter a more typical three rep preliminary yield trial next season. Yields ranged from 19.1 to 41.1 with a mean of 27.3 cwt/acre. The highest yielding entry was advanced breeding line B20536, but there several other navies and blacks with similar yield potential. While these large trials of segregating families add significant work, they provide useful information to guide selections in the field. Top yielding entries have also been targeted in recent years for use as parents in the greenhouse crossing block. Anecdotal evidence suggests that several of those parents selected via this process are producing superior progeny in F2 nurseries, effectively bringing improved genetic yield potential back into crossing a year sooner than if they were identified in a typical F6 generation preliminary yield trial. No canning trials will be conducted at this point, but marker assisted selection for canning quality may be implemented on this type of trial in 2023.

Expt. 2211: F4 Great Northern, Pinto, Small Red, and Pink Bean Yield Trial

As described above, this large augmented design trial was designed to improve selection efficiency in the corresponding F4 space planted nurseries. For this 99-entry trial, yields ranged from 12.0 to 43.1 with a mean of 30.1 cwt/acre. Charro was the highest yielding variety at 36.9 cwt followed by Coral, Eiger, and Cayenne. This trial outperformed the corresponding navy and black augmented trial, and 10 entries exceeded the yield of Charro, suggesting excellent yield potential in the newer breeding populations. These were the highest bean yields on the SVREC farm this year, and it will be interesting to get selections back from winter nursery and into proper replicated preliminary yield trials in 2023. One of the limitations of augmented trials is the large LSD value that makes mean separation difficult, but it appears that some of these progeny of Charro and Eiger may have more yield potential. The other interesting observation is that when small reds and pinks are trialed together here with pintos, they do not appear in the upper yield group and rank further down the pack. This underscores the need for continued introgression of diversity from other classes to bring small red bean yields up to par with pintos such as Charro.

Expt. 2212: Cooperative Dry Bean Nursery (CDBN) Yield Trial

The CDBN is a national trial and includes all classes, but only medium-sized entries were included in this trial this year. The 16-entry trial ranged in yield from 4.6 to 29.1 cwt/acre with a mean of 20.0 cwt/acre. Variability was moderate (CV=10.6%) resulting in a LSD value (2.9 cwt/acre) for significance. As a result, six lines were significantly higher in yield than the test mean including Adams, Charro, Lapaz, Eiger, and USDA Basin. NE14-20-6, a breeding line from Nebraska was also in this top yielding group. Several other Nebraska entries did appear well adapted to local conditions and ranked at the bottom of the trial. BRG-3 is a small brown bean that was also not well suited to Michigan and thus was the lowest yielding entry on the farm in 2022. This cooperative trial continues to be a valuable opportunity to evaluate potential new lines from other breeding programs in the US prior to their release. Canning quality will also be evaluated for all entries and shared with the other breeders to inform further decisions and aide in improving canning quality for the bean industry.

Expt. 2213: Midwest Regional Performance Nursery (MRPN) Yield Trial

The MRPN is conducted annually in cooperation with North Dakota (ND-prefix), Nebraska (NE-prefix) and Washington (GN, PK, PT, SR-prefix) to test new pinto, great northern, small red, and pink lines from all four programs and assess their potential in the different regions. The 32-entry trial ranged in yield from 11.1 to 31.6 cwt/acre with a mean of 21.4 cwt/acre. Variability was low (CV=9.3%) resulting in a LSD value (2.7 cwt/acre) for significance. Eleven lines were significantly higher in yield than the test mean including Charro, Lapaz, Cayenne and Eiger varieties. Several NDSU pintos and MSU GN, pinto, and small red were also in the top yielding group. The entries from USDA program in WA were mid-pack this season, despite looking the best during the early season dry weather stress. As with the CDBN, several NE entries lacked local adaptation and therefore did not mature properly nor yield well. This trial is a valuable group effort among breeders to provide multi-location yield data on early stage breeding lines. While not every entry is suited for every environment, it provides an avenue for exchange of germplasm and comparison of local breeding lines with peers' material well in advance of variety release.

Expt. 2214: National Dry Bean Drought Nursery

This 24-entry trial was conducted 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 collaborators at various locations across the US and PR. Yields ranged from 13.6 to 35.4 cwt/acre with a mean of 23.5 cwt/acre. Variability was well controlled (CV=9.7%) and the LSD needed for significance was 3.1 cwt/acre. Seven lines significantly out yielded the test mean, including B20536, B20591, B20599 black breeding lines from MSU. Two shuttle breeding lines were in this top group, as well as the pinto variety Stampede, and PT20-16 from USDA WA program. Although this trial is planted to evaluate abiotic stress, primarily drought tolerance, favorable conditions throughout most of the growing season did not provide suitable conditions for that purpose. This trial still serves as an opportunity to screen breeding lines under severe drought conditions imposed by collaborators in more arid environments, but it also allows identification of those stress tolerant lines that possess high yield potential when grown under more favorable conditions. The ability to tolerate variable environmental conditions year to year may be important in developing resilient varieties that are adapted to increasing climate variability in Michigan.

Expt. 2215: Preliminary Navy and Black Bean Yield Trial

This 72-entry trial was conducted to evaluate additional navy and black bean breeding lines that were grown in a new winter nursery location in Honduras where no selection was practiced. Seed arrived in early June and a simple 2-rep yield trial was planted due to limited remaining land. Given the weather pattern of 2022, this planted trial appeared to have better growth and visual appearance throughout the season. Yields were likewise better than trials planted 2 weeks earlier. Yields ranged from 17.0 to 34.1 cwt/acre with a mean of 26.8 cwt/acre. Variability was well controlled (CV=8.1%) and the LSD needed for significance was 3.6 cwt/acre. Nine entries exceeded the test mean, including the variety Adams. No entries yielded significantly more than Adams despite excellent visual appearance and vigorous growth. Black entries generally outperformed navies in this trial. As with test 2206, canning will largely dictate selection for future testing, with special attention given to advancing black beans with superior color retention.

Expt. 2216: Preliminary Small Red and Pink Bean Yield Trial

This 36-entry trial was conducted to evaluate additional small red and pink bean breeding lines grown in the Honduras winter nursery as described above. These late planted beans also had better vegetative growth than the early planted trial. Yields ranged from 20.0 to 35.1 cwt/acre with a mean of 28.6 cwt/acre. Variability was well controlled (CV=8.6%) and the LSD needed for significance was 4.2 cwt/acre. Three entries exceeded the test mean, each selections from unique pedigrees. Five of the top eight entries were sibs, and two more were half sibs of that large family. This grouping supports the genetic performance of these families, as well as the precision of the experiment. Viper and Cayenne both yielded ~31cwt, and due to the large LSD inherent to 2-rep yield trials, the 35.1 cwt yield of R22073 was not significantly better, but it will be interesting to see if this yield advantage separates in future trials. Canning evaluation will guide selections to future testing in 2023.

Expt. 2217: NSI White Mold Yield Trial

This large 128-entry trial was funded by the National Sclerotinia Initiative (NSI) and conducted to evaluate white mold tolerance of new MSU navy and black breeding lines as compared to commercial checks and selected germplasm previously identified as possessing confirmed white mold (WM) resistance QTL. A second objective was to genotype all entries and use this data to build a genomic prediction (GP) model as a proof of concept that could be used to predict white mold tolerance and other agronomic traits in future breeding lines. UAS was also deployed to collect data towards the objective of phenotyping WM development and rating resistance from aerial imagery. Yields ranged from 11.3 to 30.7 cwt/acre with a mean of 19.9 cwt/acre. Variation was higher in this trial (CV=16.9%) due to severe white mold infection that developed as a result of natural infection managed via high fertility, supplemental irrigation, and the use of susceptible spreader rows (Black Bear) to border all plots. As a result, an LSD of 4.5 cwt/acre was needed for significance. These conditions were ideal for the objectives of the trial, and WM was rated on a scale of 1-9 as with the National WM trial. As in 2021, SR9-5 was the highest yielding entry (28.3cwt) with confirmed resistance QTL, followed by USPT-WM12. Merlin, which has long been said to tolerate WM better than most navy beans was the highest yielding navy variety. Zorro, Adams, Zenith, and Black Bear all grouped mid-pack (20.5-21.9 cwt/acre). Meanwhile Bunsi (18.2), Alpena (15.1), susceptible check Bunsi (14.1), and resistant check G122 (11.4) were all lower yielding. These results support 2021 conclusions that newer germplasm releases developed by USDA-Prosser program may serve as more appropriate resistant checks for white mold trials in the future, particularly in MI under direct harvest conditions.

Expt. 2218: National White Mold Yield Trial

This 16-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. Entries included navy, black, great northern, pinto, and kidney breeding lines entered as part of the National Sclerotinia Initiative (NSI) Nursery. Entries in the National trial were developed at MSU, USDA-WA, NDSU, and WI. As with test 2117, entries were planted in two row plots with two rows of susceptible spreader variety Black Bear between plots and were direct harvested. Plots were fertilized with 120 lbs N/acre to promote vegetative growth and supplemental overhead irrigation was applied to maintain adequate levels of moisture for favorable disease development at the critical flowering period. Overall disease development was excellent. 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 scores ranged from 3.7 to 9.0 with a mean value of 7.8 underscoring the severity of white mold infection in this trial. The susceptible check Beryl had the highest white mold rating. The test ranged in yield from 9.7 to 32.3 cwt/acre with a mean yield of 21.4 cwt/acre. Variability was low for a disease trial (CV=12.2%), with a LSD value of 3.6 cwt/acre needed for significance. Eight lines significantly out-yielded the test mean and breeding lines from MI, ND, and WA. Slow dark pinto P19103 was the highest yielding line and susceptible check Beryl was the lowest. Bunsi ranked tenth at 19.2 cwt, while G122 ranked thirteenth at 10.9 cwt. The severe WM infection and drastic yield reductions observed in this trial serve as a reminder of the continued breeding effort needed towards physiological resistance.

Expt. 2219: Advanced Kidney Bean Yield Trial

This 24-entry trial was conducted at Montcalm Research Center to compare the performance of the most advanced light red kidney (LRK), dark red kidney (DRK), and white kidney (WK) breeding lines with commercial varieties under supplemental irrigation. The trial was also direct harvested for the first time to bias selection towards plant types with the most upright architecture and greatest pod to ground distance. Harvest loss was greater in some shorter varieties as expected, but overall data quality was acceptable as evidenced by the CV. This may be a viable method to breed for kidneys that possess the architecture necessary for this management practice. As in 2021, there was significant *Fusarium* Root Rot (FRR) disease pressure which delayed plant growth following persistent rains during late June. This natural disease pressure presented an opportunity to dig and evaluate root rot symptoms from the border rows of this trial. Canopy closure was delayed, and overall plant size reduced. Yields ranged from 11.4 to 29.9 cwt/acre with a mean of 19.7 cwt/acre. Variability was moderate (CV=13.8%) resulting in an LSD value of 3.7 cwt/acre needed for significance. Seven entries significantly out-yielded the test mean, including four WK and three LRK breeding lines. Significant differences were noted for root rot rating using the average of five roots (LSD=1.0). K19817 appeared to have the healthiest roots overall, rating an average 2.6, while the worst rating was K20744 rated at 5.4 on a 1-7 scale. Coho and Snowdon yields approximated the mean, while Clouseau, Red Cedar, and Denali were among the lowest yielding entries in the trial. Red Cedar had a particularly bad root score at 5.3. In general, there is more work to be done in breeding for improved root rot resistance, but it was encouraging to see significant variability for tolerance in this trial suggesting that continued breeding progress can be made. Canning trials will be conducted prior to advancing these lines for further testing.

Expt. 2220: Andean Cooperative Dry Bean Nursery Yield Trial

The purpose of CDBN is described above for trial 2212. In order to grow the Andean kidney and cranberry entries for this trial under representative irrigated production conditions, the large-seeded entries were grown as a small four entry trial at MRC rather than under dryland conditions at SVREC. Yields ranged from 15.6 to 27.3 cwt/acre with a mean of 21.4 cwt/acre. Variability was very low in this small trial (CV=6.9%) and the resulting LSD=3.0 cwt/acre. Top yielding entry CR-17-1-7-B2 from USDA-Prosser program was a new cran line with large seed and excellent yield potential. It exceeded the yield of CELRK which was the only check variety grown. The remaining two entries were crans from Univ. of Nebraska that yielded below the trial mean. This trial will be canned, and results shared with colleagues.

Expt. 2221: Standard Kidney Bean Yield Trial

This 56-entry trial was conducted at Rader Farms alongside the Kidney Bean Performance Trial to compare the performance of the most advanced light red kidney (LRK), dark red kidney (DRK), and white kidney (WK) breeding lines with commercial varieties under supplemental irrigation. FRR has been severe at the Montcalm Research Center in recent years and the goal of moving our kidney and yellow bean breeding trials off that site was to eliminate the confounding disease factor to facilitate selection and advancement of breeding lines with the best genetic yield potential. Towards that goal, this trial was rod pulled and windrowed to minimize harvest loss. Yields ranged from 19.7 to 37.0 cwt/acre with a mean of 31.7 cwt/acre. Variability was well controlled (CV=9.9%) resulting in an LSD value of 4.3 cwt/acre needed for significance. Three entries significantly outyielded the test mean, including two new LRK and one older WK. Overall yields were excellent and forty entries exceeded 30 cwt/acre which is exceptional productivity. For comparison, the maximum yield at MRC kidney trial was 29.9 cwt. These results suggest that an on-farm kidney trial site should be maintained in 2023. White kidneys Snowdon and Denali were the top yielding varieties which contrasted with older WK Beluga as the lowest yielding. Coho, ND Whitetail, Red Hawk and Clouseau yielded slightly above the mean, while Montcalm and Red Cedar were slightly below. Dark red kidneys in general have produced disappointing yields in recent trials. K22104 was ~3cwt > Red Hawk and was the only new DRK breeding line that challenged this trend. Light red kidneys appear to be leading recent yield gains, along with white kidneys, and efforts to move this yield potential into the DRK class have not been as successful. Canning trials will be conducted on all entries to guide final selections for 2023 trials.

Expt. 2222: Standard Yellow Bean Yield Trial

This 16-entry trial was conducted at Rader Farms next to the standard kidney trial to evaluate yellow bean breeding lines and commercial varieties. Yields ranged from 23.6 to 36.5 cwt/acre with a mean of 30.4 cwt/acre. Variability was low (CV=8.8%) and the LSD needed for significance was 3.7 cwt/acre. Two entries significantly outyielded the test mean including Y17502 and Y19817. Both of these have yielded well in past trials and Y19817 in particular exhibits excellent dry seed color. Patron was the top yielding variety (32cwt), SVS-0863 ranked near the mean

(31cwt), and new varieties Claim Jumper, Yellowstone, and Motherlode were among the lowest yielding entries (24-27cwt). It was unclear why these newer varieties failed to produce better yields as conditions were conducive to good growth and high yield. Larger seed size and bright yellow color will continue to be important selection criteria in this class. Breeding objectives currently include incorporating anthracnose resistance into this seed class as all yellow beans in the trial are completely susceptible as well as introgression of additional genetic diversity.

Expt. 2223: Huron Standard Black Bean Yield Trial

This 36-entry trial included standard commercial black bean varieties and advanced breeding lines and was grown on-farm at Richmond Brothers near Bayport. In general, this location remained dryer throughout the season resulting in less early growth but mean yield was ~6cwt higher than the SVREC location underscoring the productivity of beans grown in Huron county. Yields ranged from 24.8 to 35.9 cwt/acre with a test mean of 30.3 cwt/acre. Variability was moderate (CV=11.0%) and the LSD was 5.7 cwt/acre. No entries significantly out yielded the test mean due to the high LSD for this two-rep trial. Black Beard and Zenith were the top yielding varieties, followed by Nimbus, Zorro, and Adams. These ranking were quite different than the SVREC location which highlights the value of maintaining multiple locations. B19344, B21713, and B20591 which have performed well elsewhere continued to show excellent adaptation and yield potential here. All entries will be canned to evaluate color retention and quality. Zorro will be used as a minimum quality standard with preference for superior color retention like Zenith.

Expt. 2224: Huron Standard Navy Bean Yield Trial

This 30-entry trial included standard commercial navy bean varieties, and advanced lines from the MSU breeding program. Yields ranged from 19.0 to 32.5 cwt/acre with a mean of 28.0 cwt/acre. The average yield for these navies in Huron county was 4 cwt/acre greater than at SVREC. As with the blacks, the goal of this trial was to assess local adaptation and performance in the county with the most bean acres in the state of Michigan. Variability in this trial was moderate (CV= 11.9%) and the LSD needed for significance was 5.6 cwt/acre. No entries significantly outyielded the test mean, and overall navy yields were slightly lower than black beans. N19246 and N18105 that performed well at SVREC also were among the top yielding entries here. Newer breeding lines N21526, N21510, and N21524 also yielded well which was encouraging. Maturity was earlier overall compared to SVREC, ranging from 88-93 days. Dry down was rated on a 1-5 scale to assess differences with no entries exceeding 3.0. Surprisingly no checks exceeded the trial mean, suggesting that newer breeding lines may offer a yield advantage in this environment. HMS Bounty was the highest yielding variety (28.0cwt) followed by Liberty (26.6 cwt), and then Alpena (21.8cwt). Canning tests will be conducted on all entries before selections are advanced.

Expt. 2225: Tepary Introgression Observation Nursery

This 24-entry trial included fifteen tepary bean x common bean F6 introgression entries developed by Dr. Timothy Porch at USDA-TARS Mayaguez, PR. These breeding lines were developed with the aim of bringing the superior abiotic stress tolerance, specifically drought tolerance, from improved tepary bean germplasm into several market classes of common bean. A secondary objective was to expand genetic diversity of common bean. For comparison, several tepary bean breeding lines were included, as well as local navy and black bean checks. This nursery was un-replicated and space planted due to limited seed availability, so yield estimates should be considered as preliminary. Overall these materials were impressive in their agronomic appearance and exhibited good common bean plant type and upright architecture with early and efficient dry down. Seed size was slightly larger than common, ranging from 23.1 to 28.5 g/100-seed for navy and black beans while small red types were smaller than desired at 25.5 and 31.1 grams. Yield ranged from 4.5 to 27.7 cwt/acre overall. The lowest yielding entries were tepary seed types which were expected to produce lower yields and smaller seed, while the highest yields were observed from MSU breeding lines used as local checks. Overall, this nursery provided encouraging initial observations that these introgression lines offer useful genetic variability that could be exploited to benefit our local breeding program and may offer resilience traits not available in our current germplasm. Selections were made for crossing and progeny will be planted in the 2023 F2 nursery. All fifteen introgression lines will be canned and evaluated for canning quality and data provided to Dr. Porch. The best yielding lines with acceptable canning quality will be included in replicated yield trials next year to better assess performance.

Early Generation Breeding Material grown in Michigan in 2022

F3 through F5 lines
Navy and Black - 464 lines
Pinto - 44 lines
GN - 22 lines
Pinks and Reds - 36 lines
Kidneys (DR, LR, White) - 46 lines

F2 populations
Navy and Black -391 populations
Pinto - 20 populations
GN - 40 populations
Pinks and Reds - 58 populations
Kidneys (DR, LR, White) - 39 populations
Yellow – 31 populations
Cran – 21 populations

F1 populations: 586 different crosses among ten contrasting seed types.

EXPERIMENT 2201 STANDARD BLACK BEAN YIELD TRIAL									PLANTED: 6/1/22			
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)	Dry Down (1-5)	Stand
B21713	B16501/B16504	29	28.6	25.5	47.3	100.8	2.5	45.8	4.3	1.0	2.8	147.5
B20536	B15430/B16504	1	27.7	24.0	49.0	100.5	2.0	49.3	5.8	1.0	2.0	149.5
B21710	B16501/B15430	24	27.5	23.2	47.8	100.3	1.8	46.8	5.0	1.0	2.0	145.0
B21715	B16501/B16504	33	27.2	22.9	47.8	100.0	1.5	43.0	4.3	1.5	1.8	143.5
B20542	B16501/B15430	18	27.0	25.1	47.3	99.0	1.0	39.5	4.5	1.0	1.5	152.0
B18504	Zenith//Alpena*/B09197, **ADAMS**	4	26.6	22.9	48.5	99.8	2.3	39.8	4.8	1.0	2.0	106.0
B20547	B16501/B16504	20	26.2	24.5	47.3	100.0	1.3	38.0	3.5	1.0	2.0	155.0
B10244	B04644/ZORRO, **ZENITH**	17	26.1	25.7	47.3	100.3	1.5	39.0	3.8	1.0	2.0	133.0
B20639	B17730/B15430	11	25.2	23.1	48.5	102.0	2.0	46.5	6.3	1.0	2.5	149.5
B21714	B16501/B16504	26	24.8	24.3	47.8	99.3	1.0	41.5	3.8	1.0	1.0	149.0
B20602	B16506/B16504	12	24.8	26.3	47.0	95.5	1.0	40.3	4.0	1.0	1.5	154.0
B19309	B15414/B16504	6	24.7	23.0	49.3	101.3	1.8	42.5	5.5	1.0	1.5	158.5
B20617	B17106/N14218	14	24.6	22.6	47.0	97.0	1.0	39.3	4.3	2.0	1.3	151.5
B20549	B16501/B16504	10	24.5	26.6	47.3	95.5	1.5	42.0	4.3	1.0	1.5	156.0
B21711	B16501/B15430	34	24.4	25.9	47.0	98.0	1.3	41.5	4.5	1.0	1.3	138.0
B20532	B15430/B16504	13	24.4	22.7	48.8	100.3	2.0	38.3	5.0	1.5	2.0	145.5
B21720	B16505/B16504	35	24.2	23.1	48.0	98.5	1.5	38.3	4.3	2.0	1.8	156.0
B19332	B16501/B15464	15	24.0	23.9	48.0	99.3	1.0	38.8	4.5	1.3	2.0	149.5
B20599	B16506/B15430	2	23.8	22.9	48.3	99.8	2.0	44.0	4.8	1.3	2.3	148.0
B21706	B15430/B16504	32	23.8	23.3	50.5	101.3	2.3	43.5	5.0	2.0	2.3	145.0
B19340	B16507/B15453	16	23.8	25.7	49.5	100.0	1.3	46.3	4.5	1.0	1.3	136.5
B21724	B17996/B17540	28	23.3	19.4	47.8	102.0	3.0	42.0	3.3	1.0	2.8	139.5
B21707	B15430/B16504	31	23.2	21.4	47.5	100.3	2.3	47.3	4.8	1.0	1.8	134.0
B21705	B14302/B15430	36	23.1	24.2	48.0	101.5	2.3	47.8	5.5	1.0	2.0	145.5
B21717	B16504/B17106	30	22.9	21.8	48.5	100.3	1.5	40.0	5.3	1.0	2.0	148.5
B20597	B16506/B15430	8	22.7	25.8	48.3	97.3	1.3	44.8	4.3	1.0	1.5	141.5
B20538	B15430/B16504	9	22.3	23.5	47.5	100.3	2.5	47.0	4.8	1.0	2.5	145.5
B19344	B16506/B16507	7	21.9	24.5	46.5	99.3	1.0	40.3	4.5	1.3	2.3	133.0
B20591	B16505/B16504	3	21.8	23.5	47.0	99.5	1.5	40.5	4.5	1.0	2.3	153.0
I21901	BL14500, **NIMBUS**	21	21.7	25.1	51.0	102.5	2.5	51.8	4.0	1.5	3.5	86.5
B21712	B16501/B16504	27	21.7	24.1	47.5	97.5	2.0	39.5	4.8	1.8	2.0	144.5
B21708	B15430/B16504	25	21.1	23.9	48.0	100.0	1.8	37.5	5.0	1.0	1.5	143.5
B20616	B17106/B17259	19	20.4	21.2	47.0	98.8	1.0	44.5	4.5	3.0	1.8	153.0
B04554	B00103*/X00822, **ZORRO**	23	19.8	21.8	47.8	101.0	3.0	44.8	3.8	1.0	3.5	120.0
B20590	B16505/B16504	5	18.5	22.7	47.8	99.3	1.5	38.3	4.3	3.8	2.5	149.5
I19703	BL14506, **BLACK BEARD**	22	18.0	25.0	48.5	102.5	2.3	53.5	5.0	1.8	3.8	134.0
MEAN (36)			23.8	23.7	48.0	99.7	1.7	42.9	4.6	1.3	2.0	142.8
LSD (.05)			2.9	1.0	1.0	1.4	0.5	7.1	0.7	0.6	0.7	11.3
CV%			10.3	3.6	1.8	1.2	24.7	14.1	13.9	38.9	30.1	4.7

EXPERIMENT 2202 STANDARD NAVY BEAN YIELD TRIAL									PLANTED: 6/1/22		
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)**	**Dry Down (1-5)**
N19277	N14229/N14218	4	28.0	19.9	48.8	100.3	1.8	46.0	4.3	1.0	3.3
N21526	N17506/N14229	23	27.3	20.3	50.8	99.3	1.8	49.5	4.3	1.8	2.0
N21532	B16504/B11519	25	26.9	21.3	50.0	100.0	1.5	50.8	4.0	1.8	2.0
N21510	N15306/N14229	20	26.6	20.9	49.0	98.8	2.3	47.0	3.5	1.5	2.3
N19246	N15331/N16405	7	26.3	21.4	48.8	98.3	2.3	44.8	4.5	2.0	1.8
N18105	N13131/N14201	6	26.1	20.7	49.8	99.8	2.0	49.3	4.5	2.0	2.0
N20401	B16505/N17504	1	25.8	20.4	51.0	100.3	2.0	49.5	4.5	1.5	1.8
N20317	N14218/N17504	10	25.4	20.4	51.3	96.8	2.0	46.3	4.5	1.8	2.5
N21514	N15306/N17504	24	25.3	19.0	50.3	99.5	2.0	47.3	4.8	2.8	2.3
N21520	N17504/N14229	19	25.0	19.4	50.5	97.8	1.8	50.5	4.8	2.3	2.0
N22639	B19330/B19302	14	25.0	20.1	49.8	99.8	1.5	48.8	4.5	2.3	1.8
N20404	B16505/N17504	5	24.9	21.7	49.8	98.0	2.3	45.3	4.5	1.8	2.5
N21503	N14218/N17504	30	24.6	17.4	50.5	99.5	2.0	48.3	4.5	2.3	2.3
N19243	N15331/N16405	9	24.5	21.8	50.5	98.0	1.5	46.8	4.5	1.8	2.5
N21513	N15306/N16405	29	24.3	19.5	49.8	99.0	1.8	44.8	4.5	2.3	2.5
N21528	N17506/B15430	28	24.3	20.2	50.8	97.8	2.5	51.5	4.5	3.0	2.3
N21511	N15306/N15337	21	24.2	22.2	49.8	97.0	1.8	46.3	4.5	1.8	2.0
N20395	B16504/N17504	3	24.1	20.6	49.8	100.3	2.0	46.8	4.3	1.8	2.3
N21522	N17504/B15430	22	23.8	19.4	50.3	99.5	1.8	49.8	4.3	3.0	2.8
N19284	G14505/X16708	8	23.6	18.6	52.0	101.0	2.5	54.3	4.3	2.3	2.8
N21525	N17506/N14229	18	23.6	19.8	50.3	98.3	2.3	49.0	4.3	2.5	2.0
N21524	N17504/B17106	27	23.4	20.2	50.8	99.0	2.0	48.8	4.0	2.5	3.5
N11283	MEDALIST/N08003, **ALPENA**	15	22.5	19.5	48.5	100.0	2.0	49.8	4.0	1.8	2.5
I22001	**LIBERTY**	17	22.2	22.9	48.0	100.5	2.3	45.5	4.5	2.3	2.3
N20388	B15430/N14229	2	21.8	20.9	48.3	99.5	2.0	47.3	4.3	3.5	2.3
N20384	N14229/N17506	12	21.7	20.0	49.8	98.8	2.3	48.5	4.0	1.5	2.3
N21523	N17504/B15430	26	21.3	20.0	50.8	99.3	2.3	45.8	4.3	3.0	2.3
N18122	N15334/N15335	11	19.0	25.1	49.8	101.5	2.0	56.8	4.5	2.3	2.0
I21920	**HMS BOUNTY**	16	18.7	19.2	48.5	101.0	1.8	46.8	4.5	3.8	2.3
N18103	N13120/PR00806-81	13	15.6	22.5	49.8	101.3	2.8	44.8	3.8	1.8	3.0
MEAN (30)			23.9	20.5	49.9	99.3	2.0	48.2	4.3	2.2	2.3
LSD (.05)			2.7	0.8	1.0	1.0	0.7	3.9	0.4	0.7	1.0
CV%			9.6	3.4	1.7	0.8	30.9	6.9	8.5	28.9	35.1

EXPERIMENT 2203 STANDARD GREAT NORTHERN AND PINTO BEAN YIELD TRIAL									PLANTED: 6/1/22	
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**	**Dry Down (1-5)**
P16901	Eldorado/P11519, **CHARRO**	13	25.4	41.7	51.0	100.8	2.3	46.3	5.3	2.8
G19623	G16339/G16318	7	24.8	39.1	49.0	98.8	2.8	47.8	3.3	2.3
P19708	P16913/P16901	21	21.9	42.5	48.5	97.0	1.0	40.8	5.0	2.0
G19607	G16346/G16318	8	21.6	49.6	49.5	101.3	2.0	43.3	3.8	3.3
G19613	G16351/P16902	3	21.4	43.3	49.5	101.3	2.3	53.3	3.8	3.0
P18608	P11522/Long's Peak	18	21.3	40.9	50.0	101.3	2.0	52.8	4.8	3.3
P07863	AN-37/P02630, **ELDORADO**	17	21.1	40.7	48.5	101.8	3.5	41.3	2.0	4.5
I15652	ND121630, **ND PEGASUS**	6	20.7	39.8	48.5	100.5	2.8	46.0	3.5	2.8
G21809	G16306/G17411	9	20.5	41.6	49.5	99.5	2.3	44.0	4.3	2.3
I07113	PNE-6-94-75/Kodiak, **LAPAZ**	20	20.4	40.6	49.5	99.5	2.3	45.5	2.5	2.8
G17410	G13467/G13479	2	20.3	37.6	49.5	101.0	2.3	47.3	3.8	4.0
P19103	Eldorado*/Palomino//G13444 (SDP)	19	20.3	37.2	48.5	102.8	3.3	43.3	3.0	4.5
G21816	G17410/G14510	24	19.8	38.2	49.0	101.0	2.3	48.3	3.5	3.5
P19713	P16911/P16901	14	19.7	40.0	49.0	100.5	2.0	51.5	4.5	2.3
P21901	P16901/G16306	16	19.7	39.6	48.5	100.0	2.0	46.0	4.8	2.8
G16351	Eldorado/G13467, **EIGER**	5	19.5	36.5	48.5	102.0	2.5	46.8	3.5	4.5
G19609	G16346/G16318	1	19.3	44.4	49.0	101.8	2.3	46.0	3.3	4.0
G21817	G17411/P16901	10	18.6	36.7	50.0	101.0	2.8	50.3	3.8	3.0
P19707	P16911/X16801	15	17.7	40.5	49.0	102.0	1.8	51.0	4.5	4.0
G21811	G16306/G17411	4	17.6	36.6	48.5	99.8	2.3	49.3	3.0	2.5
G12901	G07321/Fuji, **SAMURAI**	11	16.0	26.4	47.5	99.5	2.3	45.5	3.0	3.0
I20801	PT11-13-31, **USDA RATTLER**	22	11.7	47.0	48.0	101.0	1.3	46.0	3.3	3.0
G08254	G04514/Matterhorn, **POWDERHORN**	12	10.5	35.8	46.5	102.3	2.8	40.3	1.8	4.5
I18623	PT16-9, **USDA DIAMONDBACK**	23	9.1	39.7	48.5	100.0	2.5	44.0	1.5	2.8
MEAN (24)			19.1	39.8	48.9	100.7	2.3	46.5	3.5	3.2
LSD (.05)			2.4	1.8	1.3	0.7	0.6	4.1	1.0	0.6
CV%			10.6	3.8	1.5	0.6	20.6	7.5	22.9	16.1

EXPERIMENT 2204 STANDARD RED AND PINK BEAN YIELD TRIAL										PLANTED: 6/1/22	
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**	**Dry Down (1-5)**
R20653	I13401/R17603	2	29.7	35.5	49.5	101.5	2.5	52.3	3.5	3.5
I21905	ND171703-SD	17	28.6	37.1	50.0	101.8	2.3	44.5	4.3	3.5
R20624	R17605/R16503	11	28.3	38.2	50.0	102.5	2.0	46.0	3.0	4.0
S18904	S14706/R13752, **CORAL**	15	27.8	43.1	49.0	100.3	1.3	42.0	5.0	3.3
R12844	SR9-5/R09508, **CAYENNE**	5	27.0	35.5	49.5	102.3	3.0	51.8	2.5	4.5
R20683	I13401/R17605	4	26.8	33.9	49.5	101.8	2.8	50.3	3.3	4.3
I13401	SR99238/Merlot, **VIPER**	7	25.6	30.3	50.5	102.0	2.0	50.0	3.3	4.3
R20637	R17605/R16503	10	25.5	38.6	50.0	101.0	2.0	53.3	3.5	3.8
R20684	I13401/R17605	3	24.9	35.0	49.0	101.5	2.8	45.3	3.0	4.3
R20659	I13401/R17603	6	23.8	31.4	49.5	102.5	1.8	52.3	3.5	4.8
I21913	PK9-15-4-B	16	23.2	38.9	48.5	96.3	3.8	45.5	1.0	2.0
S20405	S17702/R17604	9	22.4	41.8	50.0	103.3	3.0	49.3	3.0	5.0
R20667	I13401/R17603	12	22.3	33.7	48.0	101.8	2.0	49.8	3.3	4.0
R20669	I13401/R17603	1	21.6	32.5	49.0	102.8	2.3	52.3	3.5	4.8
S08418	S02754/S04503, **ROSETTA**	18	19.3	37.9	48.5	99.8	3.3	47.0	1.5	3.5
R20633	R17605/R16503	13	18.7	36.6	49.5	102.5	2.8	48.5	2.8	4.8
R20639	R17605/R16503	8	18.4	35.2	48.5	102.0	2.0	53.5	3.3	4.3
R20627	R17605/R16503	14	18.3	34.4	48.0	102.0	2.0	49.5	2.3	4.3
MEAN (18)			24.0	36.1	49.3	101.5	2.4	49.0	3.1	4.0
LSD (.05)			2.5	1.7	1.4	1.0	0.5	7.5	0.7	0.8
CV%			8.9	3.9	1.6	0.8	19.0	13.0	20.3	16.4

EXPERIMENT 2205 PRELIMINARY NAVY BEAN YIELD TRIAL									PLANTED: 6/1/22		
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)**	**Dry Down (1-5)**
N22616	N19216/N17505	16	31.0	21.2	50.0	100.0	2.7	45.3	4.3	1.3	2.3
N22622	N19216/B18224	22	30.7	21.7	51.0	101.3	2.3	40.3	4.0	1.7	2.7
N22624	N19241/N18122	24	29.0	23.7	50.7	101.3	2.0	55.0	4.3	2.0	2.7
N22630	N19253/B19309	30	28.9	20.4	50.7	101.0	1.7	57.3	5.0	2.3	2.7
N22637	B18504R/N17505	37	28.7	21.8	51.3	101.3	2.7	48.3	4.3	1.7	3.7
N22605	N17505/B18224	5	28.3	22.9	50.3	98.0	2.7	51.3	4.0	1.7	2.3
N22618	N19216/N17505	18	28.3	20.7	49.0	101.3	2.3	47.0	4.0	3.0	2.3
N22623	N19241/N18103	23	27.8	23.8	50.7	98.7	2.0	51.0	3.7	2.0	1.7
N22629	N19253/B18504R	29	27.8	19.1	51.7	101.0	2.7	51.0	4.0	2.0	2.7
N22603	N17505/N18122	3	27.7	22.6	51.3	99.0	2.0	46.3	4.0	2.0	4.3
N22617	N19216/N17505	17	27.7	19.4	51.0	100.3	2.0	53.0	4.0	1.7	3.0
N22634	N18128/B18231	34	27.7	24.7	49.3	100.0	2.0	50.0	4.3	2.0	2.7
N22602	N17505/N18122	2	27.7	24.2	50.7	100.0	2.0	45.0	3.7	1.7	2.3
N22636	B16501/N15306	36	27.5	21.9	51.7	100.7	2.3	40.0	4.3	3.3	2.7
N22627	N19241/B19302	27	27.4	21.8	50.0	101.3	2.3	36.3	3.7	2.0	3.0
N11283	MEDALIST/N08003, **ALPENA**	28	27.1	22.2	50.3	101.0	2.0	42.7	3.3	1.7	2.3
N22610	N18122/N19253	10	27.0	22.5	51.0	101.3	2.3	52.0	4.0	2.0	2.0
N22621	N19216/N18130	21	27.0	21.9	50.0	98.0	2.0	45.3	4.3	2.3	2.7
N22609	N18122/N19253	9	26.9	24.8	50.7	101.7	2.7	50.0	4.3	2.7	1.7
N22608	N18122/N19253	8	26.7	23.8	50.7	102.0	2.7	49.7	4.3	2.3	2.3
N22607	N18122/N19241	7	26.3	23.8	50.3	101.7	2.0	59.7	5.0	2.0	2.0
N22606	N18122/N19241	6	26.3	21.5	51.0	102.0	2.3	49.3	3.7	2.7	3.3
N19246	N15331/N16405	11	26.3	22.4	50.0	100.0	2.0	45.3	4.7	2.3	2.3
N22612	N18130/N17505	12	25.9	20.2	50.7	98.0	2.3	51.3	4.3	2.3	2.7
N22619	N19216/N17505	19	25.8	21.5	50.0	100.0	2.0	50.0	4.0	2.7	2.3
N22613	N18130/N17505	13	25.7	21.7	51.0	98.0	2.0	51.0	4.7	2.0	2.3
N22620	N19216/N18130	20	25.5	24.4	50.0	101.3	2.3	36.3	4.3	2.7	2.7
N22614	N18130/N17505	14	25.4	20.5	49.3	98.0	2.0	44.0	3.3	2.3	2.3
N22615	N18130/N17505	15	25.0	21.9	50.0	99.7	2.0	45.7	4.7	2.3	2.7
N22633	N18122/B18504	33	24.5	20.7	51.7	101.0	2.0	52.3	4.3	2.3	2.7
N22601	N17505/N18122	1	24.3	22.8	51.3	101.0	2.0	50.7	4.0	2.0	2.3
N22626	N19241/B19302	26	23.8	21.0	50.3	101.3	2.0	45.7	4.7	2.0	2.3
N22635	N18128/B18231	35	23.6	25.4	48.7	98.7	2.3	48.3	4.0	2.7	3.0
N22638	B18504R/N17505	38	23.1	21.0	51.7	101.3	2.3	46.1	4.6	2.1	1.8
N22631	N15306/B10244	31	22.7	21.0	50.3	101.7	1.7	42.3	4.7	3.0	2.7
I21920	**HMS BOUNTY**	39	22.3	19.4	48.7	102.3	2.3	49.3	3.3	4.3	2.3
I22001	**LIBERTY**	40	22.3	23.7	49.0	99.7	1.7	41.7	3.7	3.3	2.0
N20404	B16505/N17504	25	22.0	24.0	50.7	98.7	1.3	48.3	5.0	2.0	2.3
N22632	N18112/B10244	32	21.9	21.3	51.3	100.7	1.8	47.1	4.6	2.6	3.3
N18103	N13120/PR00806-81	4	18.6	22.6	50.3	100.3	1.7	43.0	3.3	3.7	3.0
MEAN (40)			26.1	22.1	50.5	100.4	2.1	47.6	4.2	2.3	2.6
LSD (.05)			3.8	1.1	1.2	1.4	0.9	8.6	1.0	0.9	1.2
CV%			9.0	3.5	1.7	1.1	31.3	13.3	17.7	29.3	34.6

EXPERIMENT 2206 PRELIMINARY BLACK BEAN YIELD TRIAL										PLANTED: 6/1/22
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)**
B22803	N17505/B18504R	3	33.8	22.4	49.0	101.0	1.3	52.0	5.3	1.7
B22817	B16501/B18224	17	30.9	25.1	47.3	100.0	2.0	45.0	4.3	3.3
B22855	B15447/B18504	55	30.8	24.6	48.3	101.0	1.9	40.1	3.5	3.5
B22832	B17922/B18232	32	30.6	23.4	48.0	97.3	1.3	43.7	4.0	3.3
B10244	B04644/ZORRO, **ZENITH**	78	30.5	25.6	47.7	101.3	1.7	44.3	4.3	2.3
B22854	B19309/B18222	54	30.2	26.0	50.0	101.7	2.0	50.3	5.0	2.5
B22504	Adams 22	72	29.9	21.6	48.0	99.0	2.3	44.7	4.0	3.3
B22874	B18231/B18233	74	29.9	25.4	49.3	101.0	2.0	46.0	4.7	2.7
B21710	B16501/B15430	51	29.7	23.3	48.7	101.7	1.7	44.0	4.7	1.7
B22844	B18232/B17207	44	29.6	25.8	48.3	99.0	1.7	42.3	5.0	1.7
B22843	B18232/B16501	43	29.3	24.3	47.7	99.0	1.0	43.0	5.0	3.0
B20536	B15430/B16504	82	29.3	24.0	48.0	102.0	1.7	44.0	4.7	1.7
B22827	B17897/B18204	27	28.8	26.1	47.7	101.0	1.3	50.7	3.7	3.0
B22853	B19309/B18222	53	28.3	23.0	48.3	103.0	2.9	37.7	3.0	3.0
B22806	N18122/B18504R	6	28.2	22.4	48.7	97.7	1.0	47.0	4.7	2.3
B22875	B18231/B18233	75	28.1	24.4	48.7	100.0	1.9	44.6	5.5	3.0
B20547	B16501/B16504	24	28.0	24.1	47.7	101.0	1.3	46.3	4.3	2.7
B22826	B17897/B18204	26	28.0	24.0	47.7	100.0	2.3	40.7	4.3	3.3
B22873	B18231/B18233	73	28.0	23.2	49.7	100.3	1.3	47.3	4.0	3.0
B22815	N18122/B18504	15	28.0	23.3	49.0	102.0	2.0	50.3	4.0	2.3
B22837	B18204/B18232	37	27.6	22.8	48.0	99.0	1.0	41.7	4.0	3.3
B22845	B18232/B17207	45	27.5	22.9	47.0	101.7	2.7	38.3	3.7	2.7
B22835	B17922/B19309	35	27.5	21.2	48.7	101.0	1.3	51.0	5.0	3.0
B22846	B18232/B18204	46	27.5	25.0	47.7	99.0	2.0	44.7	5.0	2.3
B22805	N18122/B18224	5	27.4	24.3	48.0	100.0	1.7	47.3	4.7	3.0
B20599	B16506/B15430	84	27.3	20.6	47.0	101.3	2.3	43.0	3.7	3.7
B22818	B16501/B18224	18	27.2	22.0	48.7	98.0	2.0	46.3	3.7	3.3
B22870	B18201/B10244	70	27.2	23.9	48.3	99.0	1.3	40.0	4.0	3.0
B22836	B18204/B18224	36	27.1	24.4	48.3	102.3	2.0	48.3	3.3	2.3
B21708	B15430/B16504	58	27.1	24.4	48.3	100.0	2.3	43.7	5.0	2.0
B20591	B16505/B16504	83	27.1	23.9	47.0	100.0	1.7	41.3	4.3	3.7
B22812	N15306/B10244	12	26.8	22.8	47.7	97.7	2.0	43.0	4.0	3.7
B21713	B16501/B16504	71	26.8	24.2	47.7	101.0	2.3	46.7	3.7	4.0
B20597	B16506/B15430	49	26.7	25.7	48.0	97.7	1.3	40.7	5.0	3.0
B19309	B15414/B16504	8	26.6	20.6	48.0	101.7	2.0	40.7	4.0	2.3

EXPERIMENT 2206 PRELIMINARY BLACK BEAN YIELD TRIAL									PLANTED: 6/1/22	
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)**
B22823	B17207/B18504R	23	26.6	20.5	48.3	101.0	1.7	48.7	4.7	3.7
B22868	B17922/B10244	68	26.6	22.0	47.7	101.0	1.9	48.1	2.5	2.5
B22857	B17887/B18231	57	26.5	23.1	49.0	101.0	1.0	40.8	5.0	3.0
B22810	N15306/B10244	10	26.5	20.8	49.7	99.3	2.0	43.0	4.7	2.7
B18504	Zenith//Alpena*/B09197, **ADAMS**	77	26.4	23.1	47.7	101.0	2.7	48.0	3.7	2.7
B22816	N18128/B18231	16	26.3	22.7	49.0	99.3	1.0	44.0	5.0	3.0
B22852	B19302/B18232	52	26.3	22.8	48.3	98.7	1.3	40.0	4.7	2.3
B22829	B17897/B18232	29	26.3	22.1	48.7	101.3	1.7	49.3	3.3	2.7
B22802	N17505/B18224	2	26.2	25.0	48.0	99.0	1.3	49.0	5.3	2.0
B22828	B17897/B18204	28	26.2	23.0	48.3	101.3	2.0	48.3	4.3	3.0
B22841	B18224/B17897	41	26.1	24.1	48.3	100.0	1.7	38.3	4.3	2.7
B22825	B17220/B17897	25	25.9	21.9	48.7	101.0	2.3	39.3	3.7	2.3
B22819	B16501/B18224	19	25.9	22.4	47.0	97.7	2.0	44.3	3.0	3.7
B22814	N18116/B10244	14	25.8	22.8	49.7	101.0	3.0	43.3	3.0	3.3
B21724	B17996/B17540	69	25.8	20.5	48.3	102.7	2.7	36.3	2.7	1.0
B22804	N18122/B18224	4	25.8	24.5	49.0	102.0	2.3	45.0	3.7	2.0
B22856	B17887/B18231	56	25.7	22.3	49.3	102.0	2.0	48.0	3.3	3.3
B22867	B17536/B18504	67	25.7	25.5	48.7	99.7	1.3	40.0	4.7	3.0
B22848	B18236/B19309	48	25.6	20.3	48.0	99.7	2.3	38.3	3.7	3.3
B22838	B18204/B18504R	38	25.5	24.0	50.0	101.7	2.7	43.3	4.0	2.3
B22831	B17922/B16501	31	25.5	20.1	48.7	102.3	2.0	51.3	4.0	3.3
B22859	B17922/B18204	59	25.0	22.2	47.3	101.0	1.9	47.7	4.0	4.0
B22866	B17536/B18504	66	25.0	25.9	47.7	99.0	1.3	37.3	4.7	2.3
B22811	N15306/B10244	11	25.0	21.0	49.0	99.0	2.3	46.7	4.3	2.3
B22833	B17922/B18232	33	24.9	22.0	47.7	97.7	1.3	42.7	4.7	4.0
B22839	B18204/B19302	39	24.5	21.6	47.7	102.0	1.7	47.0	4.0	2.7
B22865	B15453/B18504	65	24.4	19.7	49.3	102.7	3.0	57.3	3.0	3.5
B22850	B18504R/B18236	50	24.3	21.2	50.3	102.0	2.4	42.6	3.0	3.0
B22842	B18224/B17897	42	24.3	23.0	48.0	101.0	1.7	47.7	4.0	2.7
B04554	B00103*/X00822, **ZORRO**	79	24.3	22.4	48.7	101.3	2.0	39.7	3.7	3.3
B22813	N18112/B18504	13	24.2	21.7	48.3	101.0	1.4	48.6	4.5	2.5
B22860	B17922/B18231	60	24.0	20.7	49.0	102.3	2.3	43.7	3.0	3.0
B22876	B18504/B17402	76	23.9	22.3	49.3	102.0	1.4	57.1	4.0	2.5
B22861	B17922/B18231	61	23.9	21.2	48.3	101.0	2.3	46.0	4.0	3.3
B21714	B16501/B16504	64	23.8	24.2	48.7	100.0	1.0	39.0	4.0	3.0

EXPERIMENT 2206 PRELIMINARY BLACK BEAN YIELD TRIAL										PLANTED: 6/1/22
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)**
I21901	BL14500, **NIMBUS**	80	23.7	23.9	49.3	101.7	2.7	50.7	3.3	3.7
B22801	N17505/B18224	1	23.6	24.6	48.0	98.0	1.3	47.3	5.7	3.0
B22834	B17922/B18504R	34	23.0	22.3	48.0	97.7	1.0	38.0	4.0	3.0
B22863	B18231/B17922	63	22.7	21.7	49.3	101.3	2.4	43.6	3.5	3.0
I19703	BL14506, **BLACK BEARD**	81	22.7	22.6	47.7	102.7	2.3	53.0	3.0	4.3
B22821	B16501/N15306	21	22.3	20.9	50.0	98.3	1.3	41.3	4.0	4.0
B22830	B17897/B18232	30	22.3	23.4	49.3	100.0	1.7	41.7	4.3	4.3
B22820	B16501/B18504R	20	22.2	21.7	48.0	98.0	1.7	44.7	2.7	4.7
B19344	B16506/B16507	9	22.0	22.5	47.3	102.0	1.7	45.3	3.7	3.3
B22862	B17922/B18231	62	20.4	19.8	48.3	100.3	1.7	39.7	3.7	4.3
B22847	B18236/B18204	47	20.3	20.8	47.0	98.0	1.3	42.3	4.3	3.0
B22840	B18204/N19283	40	20.3	19.9	49.3	101.7	2.7	43.7	3.3	4.7
B22807	N19216/N17505	7	19.0	18.6	48.3	99.0	2.3	52.7	3.3	4.7
B22822	B17207/B18224	22	18.9	22.0	48.3	100.7	2.3	40.0	3.7	4.0
MEAN (84)			26.1	22.8	48.4	100.4	1.9	44.7	4.1	3.0
LSD (.05)			2.8	1.4	0.9	1.2	0.6	6.8	0.8	0.8
CV%			7.9	4.4	1.4	0.9	24.6	11.2	14.0	20.3

EXPERIMENT 2207 PRELIMINARY GREAT NORTHERN AND PINTO BEAN YIELD TRIAL									PLANTED: 6/1/22	
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE	Dry Down (1-5)
G22004	G17410/G18351	4	30.0	35.2	49.5	107.0	2.1	48.6	4.0	3.3
P16901	Eldorado/P11519, **CHARRO**	37	28.8	41.7	51.0	103.8	2.3	40.2	4.5	1.8
G22001	G17410/G18351	1	28.0	39.9	51.0	105.3	2.6	50.1	4.4	2.5
P22204	P18603/P16901	29	27.8	42.4	51.0	103.3	2.1	46.2	4.6	1.6
G22002	G17410/G18351	2	26.7	36.1	50.0	107.2	2.8	44.2	4.1	3.6
G22009	G19628/I19717	9	26.2	37.2	48.5	106.2	2.8	36.4	4.1	3.4
P22208	P18603/P16901	33	26.1	46.0	51.5	105.1	2.6	39.4	3.6	1.9
G22019	P19707/G18351	19	26.0	39.8	51.0	105.6	2.2	42.3	5.3	2.8
G22008	G19607/I15652	8	25.7	41.8	48.5	107.9	2.6	51.0	3.9	3.7
G22005	G17418/I19717	5	25.0	38.7	48.5	105.7	1.9	41.1	3.4	2.7
P22205	P19103/G18351	30	24.6	44.0	49.5	108.7	2.5	41.3	3.2	3.8
G22003	G17410/G18351	3	24.3	34.5	49.0	108.5	1.8	45.1	2.7	3.7
G22010	G19628/I19717	10	24.3	38.1	49.5	104.7	1.3	52.1	4.7	2.3
G22020	P16905/G16351	20	23.6	35.1	49.5	105.1	1.5	45.5	5.7	2.6
P22209	P18603/P16901	34	23.6	37.6	51.5	106.6	3.4	44.8	2.4	2.7
G16351	Eldorado/G13467, **EIGER**	35	22.5	35.7	50.0	106.1	2.3	47.4	3.8	3.6
G22022	X18505/P17401	22	22.3	34.9	50.0	108.1	2.4	42.2	2.9	4.2
G22006	G17418/I19717	6	22.3	34.7	49.5	103.0	2.3	48.5	3.3	2.1
G19613	G16351/P16902	26	21.9	43.2	50.0	107.1	2.1	56.5	3.9	3.0
P22203	P18603/P16901	28	21.3	40.7	50.5	104.2	2.0	42.3	4.7	2.4
P22103	P16905/I18623	25	21.2	39.5	50.0	105.6	1.2	55.7	4.4	2.9
G22015	G18505/G16346	15	20.9	40.1	50.5	106.4	3.6	36.4	2.8	2.8
G22018	P16901/I15652	18	20.8	35.3	50.0	102.2	2.4	44.6	3.8	1.6
G22014	G18505/G16346	14	20.7	42.6	50.0	106.1	3.5	45.0	2.8	2.5
I15652	ND121630, **ND PEGASUS**	36	20.7	41.0	49.0	105.3	3.1	47.4	3.0	2.3
P22102	P16905/I18623	24	20.6	41.8	49.5	108.1	2.8	51.6	3.4	3.5
G22016	G18505/G16346	16	20.4	35.7	49.5	107.2	1.9	43.9	3.7	3.6
G22007	G19607/P19707	7	19.9	47.4	48.5	106.9	2.3	46.3	4.0	3.1
G22013	G16345/G08254	13	19.0	35.3	48.0	105.0	1.4	48.2	4.3	2.7
P19103	Eldorado*/Palomino//G13444 (SDP)	39	18.9	36.6	49.0	109.2	4.1	31.6	2.2	4.1
P22207	P18603/P16901	32	18.7	41.2	52.0	106.6	2.6	39.2	3.9	3.3
G22021	P16905/G16351	21	18.3	34.7	51.0	107.5	1.6	52.5	4.0	3.4
P19713	P16911/P16901	40	18.3	41.8	49.0	104.2	2.1	50.6	4.7	2.1
G22017	G16301/G17418	17	17.8	38.7	48.5	109.2	2.5	45.9	2.8	4.1
G22011	I15652/G17410	11	17.6	36.2	49.0	108.2	2.0	52.4	4.1	3.6
G22012	G16318/I17544	12	16.8	43.2	49.0	107.3	1.7	38.9	2.7	3.6
G21811	G16306/G17411	27	15.6	35.2	48.0	102.1	2.0	45.6	3.4	2.6
P22101	P16901/I18623	23	13.6	41.8	49.0	103.2	1.6	46.0	4.2	1.9
I18623	PT16-9, **USDA DIAMONDBACK**	38	8.2	38.6	48.0	102.6	3.6	44.5	0.9	2.0
P22206	P16901/X18504	31	6.4	35.9	48.0	107.5	3.1	38.3	2.2	4.0
MEAN (40)			21.4	39.0	49.6	106.0	2.4	45.3	3.7	2.9
LSD (.05)			3.3	0.9	0.8	2.3	0.8	10.8	1.3	0.8
CV%			11.4	1.7	1.0	1.6	23.9	17.4	25.2	20.1

EXPERIMENT 2208 PRELIMINARY SMALL RED AND PINK BEAN YIELD TRIAL										PLANTED: 6/2/22	
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	100 SEED WT. (g)	DAYS TO FLOWER	DAYS TO MATURITY	LODGING (1-5)	HEIGHT (cm)	DES. SCORE	Dry Down (1-5)
S22502	Cayenne//R17604/S18909	18	30.9	43.6	47.0	107.3	2.7	43.0	3.3	2.7
R22704	R17604/I19718	4	30.2	38.8	47.0	105.3	3.0	42.0	3.0	2.0
S22507	S18909/R18403	23	29.7	41.8	46.5	106.7	3.3	35.3	2.7	2.7
I13401	SR99238/Merlot, **VIPER**	26	28.9	30.5	47.0	106.0	3.3	46.7	2.0	2.0
S22506	S18909/R18403	22	28.4	42.2	49.0	108.7	2.7	34.0	2.3	4.0
R22714	R18401/R17603	14	28.4	41.9	45.5	105.0	1.7	61.0	4.0	1.7
R22705	I19718/R17604	5	28.3	42.4	47.5	106.3	2.0	49.0	3.7	3.0
R22716	S18907/R17605	16	27.8	40.4	49.5	105.7	1.3	54.3	5.0	1.7
R12844	SR9-5/R09508, **CAYENNE**	25	27.6	37.7	46.0	106.7	3.3	43.3	2.0	3.3
R22703	R17604/I19718	3	27.5	42.0	46.5	106.0	2.0	48.0	3.3	2.3
R22715	R18401/R17603	15	27.2	42.3	46.0	105.3	1.7	55.7	5.0	1.7
S18904	S14706/R13752, **CORAL**	30	27.1	40.9	46.5	105.3	1.7	43.3	2.3	2.3
R22707	R17602/R18401	7	26.8	35.9	47.0	109.0	3.0	42.0	1.0	4.0
R20667	I13401/R17603	28	26.7	36.3	47.0	106.3	2.3	48.7	3.3	2.7
R22713	R17605/S18904	13	26.2	37.8	46.5	109.0	3.3	45.0	1.0	4.3
R22706	R17602/R18401	6	26.2	39.4	46.5	109.0	3.3	50.3	1.7	4.0
S22508	S18907/R17605	24	24.7	41.3	49.5	108.0	4.0	32.0	1.3	3.0
R22710	R17605/R18403	10	24.5	38.3	47.5	108.3	3.0	44.0	2.3	3.7
R22708	R17602/R18401	8	24.4	38.5	46.5	104.3	2.3	49.7	2.7	1.3
R22702	R17604/B18504R	2	23.8	28.9	46.5	107.7	2.3	56.0	3.0	3.3
R20669	I13401/R17603	27	23.8	32.8	47.5	106.7	4.0	46.7	1.0	2.3
R17604	R12859/R12844	11	23.4	34.5	46.5	105.7	3.3	53.7	2.0	2.0
S22501	R17604/B18504R	17	23.0	26.9	45.0	105.7	2.3	54.0	3.7	2.0
R22712	R17605/S18904	12	22.5	35.3	47.5	109.7	2.7	45.0	1.0	4.7
S08418	S02754/S04503, **ROSETTA**	31	22.2	40.4	46.0	103.7	3.3	45.7	1.0	1.0
S22504	R17605/S18909	20	21.7	34.7	48.0	108.0	1.7	50.0	3.3	3.3
R22709	R17603/S18909	9	21.6	39.4	49.0	109.7	2.7	49.7	1.0	4.3
R17605	R12859/R12844	32	21.4	35.3	46.5	107.3	2.7	42.3	2.3	3.3
R22701	R17604/B18504R	1	21.2	34.1	45.5	109.0	3.7	40.7	1.7	4.7
S22505	R17605/S18909	21	18.8	36.8	49.0	104.0	3.3	48.0	2.0	1.0
S22503	R17604/S18909	19	16.5	30.5	47.5	106.3	3.7	42.0	1.0	3.3
R20627	R17605/R16503	29	15.5	33.8	46.5	109.0	2.3	52.0	1.7	4.0
MEAN (32)			24.9	37.4	47.1	106.9	2.8	46.7	2.4	2.9
LSD (.05)			3.6	2.1	1.1	1.0	0.9	7.7	1.4	0.7
CV%			10.6	4.2	1.4	0.7	24.7	12.1	44.1	18.4

EXPERIMENT 2209 TEBO OBSERVATION AND YIELD TRIAL								PLANTED: 6/2/22	
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**HEIGHT (cm)**	**Dry Down (1-5)**	**Race 73**
G17923	G14505/G12901	3	31.5	29.2	48.0	104.0	52.0	2.0	6R
G17806	G12901/G13424	4	30.4	27.6	46.0	104.0	46.0	3.0	6S
G18901	G12901/B14302	15	29.9	26.6	46.0	105.0	56.0	4.0	
G18903	G12901/B14302	17	28.8	22.6	45.0	104.0	50.0	2.0	
G17805	G12901/G13424	6	27.8	25.5	46.0	104.0	29.0	3.0	6S
G17807	G12901/G13424	13	26.9	25.8	45.0	105.0	52.0	4.0	6S
G18902	G12901/B14302	16	26.8	23.8	47.0	104.0	48.0	3.0	
G18904	G12901/B14302	18	26.0	22.8	46.0	105.0	46.0	4.0	
G18910	G12901/B14303	24	24.9	26.0	47.0	101.0	56.0	1.0	
G18905	G12901/B14302	19	24.8	22.0	46.0	104.0	50.0	2.0	
G17932	G12901/G15479	10	24.5	30.8	45.0	104.0	44.0	3.0	1S,5R
G18907	G12901/B14303	21	24.3	23.4	47.0	104.0	47.0	1.0	
G17802	G12901/G11431	11	23.9	24.7	46.0	105.0	46.0	4.0	6S
G17926	G14505/G12901	8	23.9	27.6	46.0	104.0	30.0	3.0	6R
G17804	G12901/G11431	9	23.6	27.1	45.0	104.0	44.0	2.0	6S
G17803	G12901/G11431	12	23.1	24.7	46.0	104.0	54.0	3.0	6S
G17916	G14505/G12901	5	22.4	29.9	46.0	104.0	46.0	3.0	6R
G18908	G12901/B14303	22	22.0	21.1	47.0	101.0	55.0	1.0	
G12901	G07321/Fuji, **SAMURAI**	7	21.3	27.5	46.0	101.0	48.0	4.0	6S
G17925	G14505/G12901	2	21.3	28.8	47.0	106.0	48.0	4.0	6R
G17913	G14505/G12901	1	21.2	27.8	45.0	106.0	31.0	4.0	6R
G18906	G12901/B14303	20	20.8	26.5	47.0	104.0	50.0	2.0	
G18909	G12901/B14303	23	19.7	23.5	45.0	101.0	58.0	1.0	
G17901	G14505/G12901	14	16.8	27.0	46.0	105.0	42.0	4.0	4S,8R
MEAN (24)			24.5	25.9	46.1	103.9	47.0	2.8	
LSD (.05)			-	-	-	-	-	-	
CV%			14.7	10.0	1.8	1.4	16.6	39.5	

EXPERIMENT 2210 F4 NAVY BLACK AUGMENTED YIELD TRIAL PLANTED: 6/2/22			
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**
B20536	B15430/B16504	266	37.6
21B364-05-	B20597/B18201	242	36.3
21B353-09-	B19346/B19309	220	36.2
21B360-05-	B20591/B19346	233	35.7
21B371-05-	B20617/B20591	255	35.2
21N126-07-	N18128/B19346	30	35.0
21N139-05-	N19226/N20388	48	35.0
21N159-01-	N19269/B19344	72	35.0
21B369-05-	B20617/B19309	247	34.5
21N159-02-	N19269/B19344	73	34.4
21B365-03-	B20599/B19330	244	34.4
21B362-02-	B20591/I20820	239	34.4
21B360-07-	B20591/B19346	234	34.3
21N161-02-	N19269/B20617	76	34.3
21N181-02-	N20335/N20351	98	34.1
21N160-02-	N19269/B20597	74	34.0
21B303-04-	B18201/B19345	144	34.0
21B333-06-	B19330/B19309	191	33.8
21B323-02-	B19309/B18201	177	33.6
21B361-03-	B20591/B20597	237	33.6
N21511	N15306/N15337	271	33.2
21B364-06-	B20597/B18201	243	33.1
21B358-01-	B20549/B20591	230	33.0
B20591	B16505/B16504	267	33.0
21N183-04-	N20335/B20599	106	32.8
21B364-04-	B20597/B18201	241	32.8
21N158-03-	N19269/N20351	71	32.8
21N110-01-	N18122/N19285	13	32.8
21N181-01-	N20335/N20351	97	32.7
21B344-03-	B19344/B19330	205	32.4
21N109-01-	N18122/N19284	12	32.4
21B364-01-	B20597/B18201	240	32.4
21N161-01-	N19269/B20617	75	32.3
21B361-05-	B20591/B20597	238	32.2
21B355-04-	B19346/B20597	227	32.2
21B369-09-	B20617/B19309	250	32.0
21B370-01-	B20617/B19344	251	32.0
21B353-03-	B19346/B19309	217	31.9
21N142-03-	N19226/B19309	54	31.7
21N125-02-	N18128/B19309	27	31.7
21N140-05-	N19226/N20404	50	31.6
21N140-04-	N19226/N20404	49	31.6
21N194-03-	N20388/N20335	127	31.5
21N178-05-	N19302/B20599	92	31.4
21N107-04-	N18122/N19226	11	31.4

EXPERIMENT 2210 F4 NAVY BLACK AUGMENTED YIELD TRIAL PLANTED: 6/2/22			
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**
21N190-03-	N20351/N20355	120	31.4
21B361-02-	B20591/B20597	236	31.2
21N125-03-	N18128/B19309	28	30.9
21B369-08-	B20617/B19309	249	30.9
21N165-02-	N19284/N19226	82	30.8
21B353-06-	B19346/B19309	218	30.8
21N142-02-	N19226/B19309	53	30.8
21N180-03-	N20335/N19285	96	30.8
21B328-01-	B19309/B20591	182	30.8
21B353-01-	B19346/B19309	215	30.8
21B369-06-	B20617/B19309	248	30.8
21N144-03-	N19226/B20597	56	30.6
21B353-08-	B19346/B19309	219	30.6
B20599	B16506/B15430	268	30.6
21B306-02-	B18204/B19346	145	30.6
21B370-04-	B20617/B19344	253	30.6
21N143-03-	N19226/B19346	55	30.5
21B360-02-	B20591/B19346	232	30.5
21B336-03-	B19330/B20617	194	30.5
21N181-06-	N20335/N20351	99	30.4
21B370-03-	B20617/B19344	252	30.3
21N126-06-	N18128/B19346	29	30.3
21B306-04-	B18204/B19346	147	30.2
21B323-07-	B19309/B18201	178	30.2
B10244	B04644/ZORRO, **ZENITH**	265	30.2
21B358-02-	B20549/B20591	231	30.1
21N187-02-	N20351/N19285	113	30.0
21N194-01-	N20388/N20335	125	30.0
21N192-04-	N20351/N20404	122	30.0
21B301-01-	B18201/B18204	142	29.9
21N180-02-	N20335/N19285	95	29.8
21N193-04-	N20388/N19302	123	29.8
21B306-03-	B18204/B19346	146	29.8
21B371-06-	B20617/B20591	256	29.8
21B353-02-	B19346/B19309	216	29.8
21B353-10-	B19346/B19309	221	29.8
21B355-05-	B19346/B20597	228	29.8
21B354-03-	B19346/B19344	223	29.7
21B324-01-	B19309/B18204	179	29.7
21B320-01-	B19302/B19346	174	29.7
21N133-02-	N18130/I17527	36	29.7
21N111-03-	N18122/N20351	15	29.6
21N183-03-	N20335/B20599	105	29.3
21B371-01-	B20617/B20591	254	29.3
21N179-06-	N20335/N19269	94	29.3

EXPERIMENT 2210 F4 NAVY BLACK AUGMENTED YIELD TRIAL PLANTED: 6/2/22			
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**
21N203-01-	I17527/N19226	140	29.3
21B309-04-	B18204/I20820	150	29.3
21B313-06-	B18236/B19346	160	29.3
21B349-02-	B19345/B20617	209	29.3
21B320-02-	B19302/B19346	175	29.2
B21710	B16501/B15430	278	29.2
B18504	Zenith//Alpena*/B09197, **ADAMS**	279	29.2
21N183-01-	N20335/B20599	103	29.2
21N134-08-	N18130/B20597	41	29.1
21B354-01-	B19346/B19344	222	29.1
21N144-05-	N19226/B20597	58	29.1
21B318-06-	B19302/B19330	170	29.0
21N178-03-	N19302/B20599	91	29.0
21B340-01-	B19330/N19285	201	28.9
21B360-10-	B20591/B19346	235	28.8
21B366-02-	B20599/B20549	245	28.8
21B306-06-	B18204/B19346	148	28.7
21N141-05-	N19226/I17527	52	28.7
21B369-04-	B20617/B19309	246	28.7
21B339-01-	B19330/N18122	200	28.6
21B330-03-	B19330/B18201	184	28.6
21B350-01-	B19345/I20819	211	28.5
21B314-07-	B18236/B20549	162	28.4
B04554	B00103*/X00822, **ZORRO**	281	28.4
21N189-01-	N20351/N20302	116	28.4
21B309-03-	B18204/I20820	149	28.4
21N164-01-	N19284/N18130	80	28.3
21B355-01-	B19346/B20597	226	28.3
21N186-05-	N20351/N19253	110	28.3
21B354-06-	B19346/B19344	224	28.2
21B335-02-	B19330/B20597	193	28.1
21N189-02-	N20351/N20302	117	28.0
21B331-01-	B19330/B18204	185	27.8
21N195-04-	N20388/N20404	130	27.8
21B331-02-	B19330/B18204	186	27.7
21B348-05-	B19345/B19344	208	27.7
21N164-03-	N19284/N18130	81	27.7
I22001	**LIBERTY**	272	27.6
21N107-03-	N18122/N19226	10	27.5
21B302-02-	B18201/B19309	143	27.5
B19309	B15414/B16504	277	27.5
21B337-04-	B19330/I20819	196	27.4
21B318-01-	B19302/B19330	168	27.4
21B334-02-	B19330/B19344	192	27.4
21N193-05-	N20388/N19302	124	27.4

EXPERIMENT 2210 F4 NAVY BLACK AUGMENTED YIELD TRIAL PLANTED: 6/2/22			
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**
21B349-05-	B19345/B20617	210	27.3
21N144-07-	N19226/B20597	59	27.2
21N179-05-	N20335/N19269	93	27.2
21B348-04-	B19345/B19344	207	27.2
21N183-02-	N20335/B20599	104	27.1
21B341-05-	B19344/B18201	204	27.0
21N125-01-	N18128/B19309	26	27.0
21B378-06-	I20820/B19302	262	26.9
21B325-01-	B19309/B19302	180	26.9
21B333-02-	B19330/B19309	190	26.9
21B326-02-	B19309/B19344	181	26.8
21N188-02-	N20351/N19302	114	26.8
21N116-01-	N18128/N19253	19	26.8
21B347-01-	B19344/N19285	206	26.8
21N187-01-	N20351/N19285	112	26.8
21N191-04-	N20351/N20388	121	26.8
21N189-04-	N20351/N20302	118	26.6
21N116-02-	N18128/N19253	20	26.5
21N182-03-	N20335/N20404	100	26.4
21N186-02-	N20351/N19253	108	26.3
21N134-07-	N18130/B20597	40	26.3
21N113-04-	N18122/B19309	16	26.3
21N195-02-	N20388/N20404	128	26.2
21N186-06-	N20351/N19253	111	26.2
21N141-03-	N19226/I17527	51	26.2
21N202-03-	N20404/N20388	139	26.1
21B352-03-	B19346/B18236	214	26.1
21B332-01-	B19330/B18236	188	26.1
21N163-03-	N19284/N18128	78	26.1
21B313-04-	B18236/B19346	158	26.1
21B329-01-	B19309/I20820	183	25.9
21B331-05-	B19330/B18204	187	25.9
21N144-04-	N19226/B20597	57	25.8
21B319-05-	B19302/B19345	171	25.8
21N194-02-	N20388/N20335	126	25.8
21B338-01-	B19330/I20820	197	25.7
21B315-03-	B18236/B20591	164	25.7
21B379-01-	I20820/B19309	264	25.7
21N188-03-	N20351/N19302	115	25.6
21B355-06-	B19346/B20597	229	25.6
21B340-02-	B19330/N19285	202	25.5
21B319-07-	B19302/B19345	173	25.4
21N134-02-	N18130/B20597	39	25.4
21N186-04-	N20351/N19253	109	25.4
21N110-03-	N18122/N19285	14	25.4

EXPERIMENT 2210 F4 NAVY BLACK AUGMENTED YIELD TRIAL PLANTED: 6/2/22			
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE
21B311-03-	B18236/B18204	153	25.4
21N133-03-	N18130/I17527	37	25.3
21N182-05-	N20335/N20404	102	25.0
21B309-05-	B18204/I20820	151	25.0
21N177-03-	N19302/B20591	89	24.8
21B350-02-	B19345/I20819	212	24.8
21B319-06-	B19302/B19345	172	24.7
21N177-02-	N19302/B20591	88	24.7
21B315-01-	B18236/B20591	163	24.7
21B338-02-	B19330/I20820	198	24.7
21N184-03-	N20351/N18128	107	24.6
21N128-01-	N18130/N18122	32	24.5
21B313-01-	B18236/B19346	155	24.5
21B318-03-	B19302/B19330	169	24.5
21B377-01-	I20820/B18201	259	24.4
21B313-03-	B18236/B19346	157	24.4
21N107-01-	N18122/N19226	9	24.3
21B315-04-	B18236/B20591	165	24.2
21N190-01-	N20351/N20355	119	24.1
21B332-02-	B19330/B18236	189	24.0
21B375-04-	I20819/B19302	257	24.0
21B313-05-	B18236/B19346	159	24.0
21N154-02-	N19269/N18130	70	23.9
21B313-02-	B18236/B19346	156	23.9
21N122-03-	N18128/N20404	21	23.8
21B378-09-	I20820/B19302	263	23.5
21N150-01-	N19253/I17527	63	23.4
21B338-03-	B19330/I20820	199	23.3
21N138-03-	N19226/N20351	44	23.3
21N202-01-	N20404/N20388	138	23.1
N19246	N15331/N16405	269	22.9
21B321-04-	B19302/I20820	176	22.9
21B317-02-	B18236/N19284	166	22.8
21N200-01-	N20404/N20351	131	22.5
21N127-01-	N18130/N18103	31	22.2
21N145-03-	N19253/N18122	61	22.1
21N200-05-	N20404/N20351	134	22.1
21N201-03-	N20404/N20355	136	22.0
21N146-01-	N19253/N18128	62	22.0
21N201-04-	N20404/N20355	137	21.9
21N106-01-	N18103/B19344	8	21.8
21N145-01-	N19253/N18122	60	21.8
I21920	HMS BOUNTY	280	21.8
21N203-06-	I17527/N19226	141	21.7
21N153-02-	N19269/N18122	66	21.7

EXPERIMENT 2210 F4 NAVY BLACK AUGMENTED YIELD TRIAL PLANTED: 6/2/22			
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE
21N195-03-	N20388/N20404	129	21.5
21N162-01-	N19284/N18103	77	21.5
21N135-01-	N19226/N18103	42	21.1
21B317-03-	B18236/N19284	167	21.0
21N201-01-	N20404/N20355	135	20.9
21N175-01-	N19285/B20599	87	20.8
21N123-03-	N18128/I17527	23	20.7
21N163-04-	N19284/N18128	79	20.7
21N101-04-	N18103/N20335	2	20.6
21N131-04-	N18130/N19286	35	20.5
N18103	N13120/PR00806-81	270	20.5
21N172-03-	N19285/N19253	84	20.4
N20395	B16504/N17504	275	20.3
21N122-04-	N18128/N20404	22	20.3
21N105-03-	N18103/B19309	7	20.2
21N139-02-	N19226/N20388	46	19.9
N20404	B16505/N17504	276	19.9
21N135-02-	N19226/N18103	43	19.9
21N104-01-	N18103/N20404	5	19.8
21N101-07-	N18103/N20335	4	19.8
21N153-06-	N19269/N18122	68	19.6
21N139-04-	N19226/N20388	47	19.4
21N174-01-	N19285/B20591	85	19.2
21B310-04-	B18204/I17527	152	19.0
21N104-02-	N18103/N20404	6	18.3
21N124-04-	N18128/B19302	25	18.3
21N114-02-	N18128/N18103	17	18.2
N20388	B15430/N14229	274	17.2
21N101-06-	N18103/N20335	3	17.0
21N101-01-	N18103/N20335	1	17.0
21N152-01-	N19269/N18103	64	16.7
21N153-01-	N19269/N18122	65	16.4
21N124-03-	N18128/B19302	24	16.2
21N138-04-	N19226/N20351	45	14.0
21N153-04-	N19269/N18122	67	13.5
21N114-03-	N18128/N18103	18	10.3
MEAN (261)			27.3
LSD (.05)			
CV%			-

EXPERIMENT 2211 F4 GN, PINTO, SM. RED AUGMENTED YIELD TRIAL PLANTED: 6/2/22			
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE
21G405-01-	G16351/G19613	4	43.1
21P509-03-	P16902/P16901	31	40.8
21P525-01-	P19713/G16351	46	40.4
21P509-01-	P16902/P16901	30	39.0
21S710-04-	I19718/R20667	102	38.7
21G422-03-	G19607/I15652	7	38.7
21P516-06-	P19707/G19613	38	38.7
21G401-02-	G16351/G17410	1	38.3
21P526-02-	P19713/P19103	49	37.4
21G402-03-	G16351/G18502	2	37.2
P16901	Eldorado/P11519, **CHARRO**	11	36.9
21P507-03-	P16901/I19720	28	36.7
21G421-01-	G19607/G16351	6	36.7
21S710-03-	I19718/R20667	101	36.4
21P509-04-	P16902/P16901	32	35.8
21P516-01-	P19707/G19613	36	35.8
21P526-03-	P19713/P19103	50	35.7
21P548-01-	I19720/G19613	60	35.6
21G443-02-	I15652/P19709	22	35.5
21G434-03-	G19613/I15652	15	35.1
21P525-02-	P19713/G16351	47	35.1
S18904	S14706/R13752, **CORAL**	110	34.8
P19103	Eldorado*/Palomino//G13444 (SDP)	105	34.7
21P526-01-	P19713/P19103	48	34.7
21P516-03-	P19707/G19613	37	34.6
R20669	I13401/R17603	108	34.4
21P507-02-	P16901/I19720	27	34.1
21G438-04-	I15652/G18512	17	34.1
21G425-04-	G19611/P16902	10	34.0
21P524-03-	P19708/G18502	45	33.8
21P518-05-	P19708/P16901	41	33.8
21S708-03-	I19718/R17602	97	33.8
21G439-03-	I15652/G19607	18	33.5
21P548-06-	I19720/G19613	61	33.3
21G440-02-	I15652/G19613	20	33.2
21G422-04-	G19607/I15652	8	33.1
P19713	P16911/P16901	106	32.8
21P518-03-	P19708/P16901	39	32.7
21R636-06-	I19719/R20627	92	32.6
21P528-01-	I16705/P16901	51	32.4
21R604-01-	R17602/R20667	69	32.4
21G440-05-	I15652/G19613	21	32.3
21R623-05-	R20627/S18904	79	32.0
21R622-03-	R20627/I19718	77	31.8
21G433-01-	G19613/P19708	13	31.5
21P542-02-	I18623/G19613	56	31.5
21R637-02-	I19719/R20652	93	31.2
21P542-05-	I18623/G19613	57	30.9
21G403-01-	G16351/G19607	3	30.5
21P524-02-	P19708/G18502	44	30.5
R20627	R17605/R16503	107	30.2

EXPERIMENT 2211 F4 GN, PINTO, SM. RED AUGMENTED YIELD TRIAL PLANTED: 6/2/22			
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE
21R625-05-	R20652/R20667	82	29.8
G16351	Eldorado/G13467, **EIGER**	112	29.8
21P530-02-	I16705/P19708	52	29.6
21S701-02-	S18904/R17602	96	29.6
21P540-02-	I18623/G17410	55	29.5
21R623-03-	R20627/S18904	78	29.5
21G425-03-	G19611/P16902	9	29.3
21R620-05-	R20627/R17605	94	29.2
21R636-05-	I19719/R20627	91	28.9
21R622-02-	R20627/I19718	76	28.7
21P515-03-	P19707/G18502	34	28.6
21S708-05-	I19718/R17602	99	28.5
21P512-01-	P18603/I15652	62	28.2
21R630-03-	R20667/R20652	84	28.2
21R632-03-	R20667/I19718	87	27.9
21R602-02-	R17602/R20627	67	27.8
21R602-03-	R17602/R20627	68	27.7
21P518-04-	P19708/P16901	40	27.7
21G440-01-	I15652/G19613	19	27.6
21R633-04-	R20667/S18904	88	27.4
R12844	SR9-5/R09508, **CAYENNE**	113	27.4
21R636-03-	I19719/R20627	90	27.3
21P542-06-	I18623/G19613	58	27.1
21P510-05-	P16902/P19708	66	27.1
G19613	G16351/P16902	103	26.8
21R630-01-	R20667/R20652	83	26.7
21R632-01-	R20667/I19718	85	26.4
21R604-03-	R17602/R20667	70	26.3
21R620-07-	R20627/R17605	95	26.0
G21811	G16306/G17411	104	25.0
21G412-01-	G17410/G16351	5	24.0
21R614-01-	R17605/R20652	75	23.9
21P508-01-	P16901/I20801	29	23.5
21R632-02-	R20667/I19718	86	23.5
21R613-03-	R17605/R20627	74	23.4
21P510-03-	P16902/P19708	65	22.9
21P501-02-	P16901/P18603	24	21.4
21S708-04-	I19718/R17602	98	21.2
21P519-01-	P19708/P19103	42	21.1
I18623	PT16-9, **USDA DIAMONDBACK**	109	20.6
21P539-01-	I18623/P19708	64	20.5
21P544-01-	I19716/G19611	59	19.7
21P530-03-	I16705/P19708	53	18.8
21G438-03-	I15652/G18512	16	18.7
21P540-01-	I18623/G17410	54	18.6
21P541-01-	I18623/G19607	63	17.7
21R613-01-	R17605/R20627	73	16.5
21R633-05-	R20667/S18904	89	12.1
MEAN (99)			30.1
LSD (.05)			-
CV%			-

EXPERIMENT 2212 COOPERATIVE DRY BEAN NURSERY (CDBN) YIELD TRIAL									PLANTED: 6/2/22
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**
B18504	Zenith//Alpena*/B09197, **ADAMS**	6	29.1	25.8	47.0	100.3	1.3	44.7	5.3
I22002	CR17-1-7-B2	1	27.3	76.2	37.0	103.0	3.0	33.0	4.0
P16901	Eldorado/P11519, **CHARRO**	2	26.7	45.1	50.0	99.7	2.0	53.7	5.3
I07113	PNE-6-94-75/Kodiak, **LAPAZ**	4	26.1	47.2	46.0	99.7	1.7	45.3	4.3
I22006	NE14-20-6	7	25.3	29.2	46.0	100.7	2.3	41.0	3.7
G16351	Eldorado/G13467, **EIGER**	12	25.3	41.1	46.0	102.0	2.0	46.3	5.3
I17512	PT10-12-1, **USDA BASIN**	1	24.2	47.3	46.5	93.7	2.3	47.0	4.0
I22009	SR16-2-6	11	22.8	38.6	45.5	94.7	2.0	41.7	3.7
I03390	ND9902621-2, **ECLIPSE**	9	22.6	22.3	46.0	93.0	1.7	47.0	4.7
I90013	**CELRK**	4	22.4	65.3	38.0	100.0	1.0	29.5	3.0
I22008	**OAC Equinox**	10	21.6	29.1	44.0	102.7	2.0	40.3	3.3
I22004	NE9-20-7	3	20.5	65.8	36.5	100.0	1.0	38.0	4.0
I22007	NE14-20-8	8	18.8	22.3	46.5	98.0	2.3	41.7	3.7
I22011	NE1-21-22	14	17.0	45.9	45.0	100.0	2.7	42.0	3.0
I22010	NE1-21-9	13	16.1	52.8	45.5	96.3	3.0	42.3	2.7
I22003	NE9-20-8	2	15.6	72.0	36.5	100.0	1.0	27.5	3.5
I84002	NW410//VICTOR/AURORA, **OTHELLO**	5	14.7	44.4	39.5	88.7	4.0	28.7	1.0
I22005	NE2-21-41	3	14.3	47.6	38.5	91.3	2.7	34.7	1.7
I22012	NE1-21-34	15	10.5	45.1	44.0	95.0	2.7	43.7	2.7
I22013	BRG-3	16	4.6	19.2	38.0	90.0	3.0	29.7	1.0
MEAN (20)			20.0	37.7	44.6	96.6	2.4	41.9	3.5
LSD (.05)			2.9	0.6	1.4	2.4	0.7	8.4	0.7
CV%			10.6	1.1	1.7	1.1	21.2	8.9	13.7

EXPERIMENT 2213 MIDWEST REGIONAL PERFORMANCE NURSERY (MRPN) YIELD TRIAL									PLANTED: 6/2/22
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**
R20669	I13401/R17603	12	31.6	36.4	40.0	102.0	2.0	48.7	4.3
P16901	Eldorado/P11519, **CHARRO**	30	31.1	45.9	43.0	99.0	1.7	51.3	5.3
I22031	ND171707	20	30.2	40.8	42.5	100.3	1.7	50.0	4.7
I07113	PNE-6-94-75/Kodiak, **LAPAZ**	28	29.6	40.9	41.0	99.7	2.7	49.3	4.0
P19103	Eldorado*/Palomino//G13444 (SDP)	9	27.2	37.9	40.0	104.5	2.7	44.3	3.0
I22033	ND181987	22	25.8	44.7	40.0	100.7	2.3	48.3	4.3
P19713	P16911/P16901	10	25.8	42.8	40.0	99.7	2.0	51.7	4.0
G19613	G16351/P16902	7	25.3	39.1	41.5	101.3	2.0	49.3	4.0
R12844	SR9-5/R09508, **CAYENNE**	31	24.6	42.1	40.0	99.0	2.3	48.0	4.3
G16351	Eldorado/G13467, **EIGER**	29	24.5	40.5	40.0	102.3	2.0	50.7	4.3
I22030	NDF150111-2	19	24.5	40.6	42.5	100.0	3.7	47.3	2.0
I22014	PT20-16	1	24.0	44.0	39.0	93.3	3.0	47.0	3.0
I21902	ND172568	24	23.1	44.3	39.5	101.7	2.7	44.3	2.7
I22015	PK20-7	3	22.4	39.7	39.0	94.7	3.3	45.3	2.7
R98026	R94037/R94161, **MERLOT**	27	22.4	42.4	39.5	99.0	2.3	45.3	3.3
I16705	ND121448, **ND FALCON**	25	22.1	40.7	43.5	97.7	1.7	46.3	4.7
I17546	PK16-1	2	21.9	35.0	34.0	91.3	4.0	38.7	1.0
I22016	SR20-11	4	20.8	38.4	39.5	94.3	2.0	43.7	2.3
R20627	R17605/R16503	11	20.4	38.5	40.0	99.3	2.0	48.7	4.0
G21811	G16306/G17411	8	20.1	38.1	40.5	95.3	1.7	50.0	3.7
I22034	ND181989	23	19.4	43.3	40.0	97.7	2.7	44.0	2.7
I22009	SR16-2-6	5	18.0	37.9	39.0	95.0	1.7	38.3	2.3
I22018	NE1-21-1	13	17.7	39.2	39.0	99.0	2.3	42.7	3.0
I18601	Matterhorn/NE94-75, **ARIES**	26	17.0	39.0	37.0	92.0	3.7	39.7	2.0
I18623	PT16-9, **USDA DIAMONDBACK**	32	16.2	40.3	39.5	96.3	2.0	46.3	2.7
I22017	GN20-10	6	16.1	39.3	39.5	95.0	2.0	45.0	3.3
I22022	NE1-21-41	17	16.0	36.3	38.0	94.7	3.3	40.3	1.7
I22032	ND172529	21	15.3	44.9	39.5	96.3	2.3	42.7	3.0
I22021	NE1-21-25	16	14.3	39.8	39.0	97.3	2.0	41.0	2.7
I22023	NE1-21-42	18	12.5	36.4	36.5	98.3	3.3	41.0	1.0
I22019	NE1-21-20	14	12.3	40.6	38.5	101.7	3.7	42.3	1.7
I22020	NE1-21-24	15	11.1	37.7	39.5	101.7	3.7	41.0	1.3
MEAN (32)			21.4	40.2	39.7	98.1	2.5	45.4	3.1
LSD (.05)			2.7	2.5	0.9	3.1	0.7	5.9	1.0
CV%			9.3	4.5	1.3	2.3	21.5	9.5	24.4

EXPERIMENT 2214 DRY BEAN DROUGHT NURSERY (DBDN) YIELD TRIAL				PLANTED: 6/2/22		
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**HEIGHT (cm)**
B20599	B16506/B15430	10	35.4	46.0	100.0	46.3
B20536	B15430/B16504	8	34.2	46.0	100.3	50.7
I21924	INB 870/Matterhorn, SB3-289	20	30.2	46.0	99.7	32.3
B20591	B16505/B16504	9	29.6	46.0	99.0	42.7
I22014	PT20-16	1	29.1	45.5	97.0	48.3
I05834	ND020351, **STAMPEDE**	24	28.8	46.0	99.7	46.7
I16716	SB2-171, MATT/G21212///MATT/DOR364//USPT-ANT1/H405-8-1-1	17	26.9	46.5	100.7	31.0
I22007	NE14-20-8	16	25.9	46.0	99.0	40.7
R98026	R94037/R94161, **MERLOT**	23	25.2	46.0	101.3	44.3
I22009	SR16-2-6	6	24.1	45.0	96.7	44.7
I22015	PK20-7	4	23.9	46.0	96.3	45.3
I22024	PT21-3	2	23.5	45.0	98.0	44.7
I17546	PK16-1	3	23.3	42.0	95.3	36.7
I17537	Matterhorn/EMP509,SB2-89-9	18	22.8	45.0	98.0	47.3
I22020	NE1-21-24	13	20.7	45.5	101.3	40.7
G93414	**MATTERHORN**	21	20.0	46.0	100.7	38.0
I18606	NE1-17-36	15	19.5	46.5	104.0	35.0
I22011	NE1-21-22	12	19.3	45.0	102.7	43.3
I22010	NE1-21-9	11	19.2	46.0	101.3	44.3
I22016	SR20-11	5	18.8	45.5	96.7	38.0
I21923	Matterhorn/PT7-2, SB3-144	19	18.4	42.0	101.7	34.3
I22017	GN20-10	7	17.3	46.0	98.7	41.3
I09151	**MARQUIS**	22	13.7	44.0	104.7	29.0
I22022	NE1-21-41	14	13.6	40.0	99.0	37.0
MEAN (24)			23.5	45.2	99.7	40.9
LSD (.05)			3.1	0.9	2.7	3.7
CV%			9.7	1.2	1.9	6.6

EXPERIMENT 2215 PRELIMINARY NAVY AND BLACK BEAN YIELD TRIAL					PLANTED: 6/14/22		
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**LODGING (1-5)**	**DES. SCORE**
B22026	N18122/B18504	23	34.1	22.9	46.5	1.0	4.5
B22041	B17536/B18504	34	32.6	22.4	47.5	1.5	4.0
B22042	B17536/B18504	35	32.3	21.2	48.5	2.0	3.5
B22003	N15306/B10244	2	32.2	19.6	49.0	1.5	3.5
B18504	Zenith//Alpena*/B09197, **ADAMS**	64	32.2	21.3	46.5	2.5	4.0
B22056	B18210/B18504	47	31.4	20.3	48.5	2.0	4.1
B22061	B18231/B18233	51	31.0	22.7	47.0	1.5	4.5
B22033	B15434/B18204	26	30.6	20.9	47.5	1.5	4.0
B22815	N18122/B18504	56	30.6	22.5	47.5	2.5	3.0
B22063	B18231/B18233	53	30.2	21.9	49.0	3.5	2.5
B22043	B17536/B18504	36	30.1	21.5	47.5	1.0	3.5
B22047	B18201/B10244	39	30.1	21.4	46.5	2.5	3.5
B22057	B18210/B18504	48	29.5	20.9	47.5	2.5	3.0
B22872	B18210/B18504	60	29.4	22.2	47.5	1.5	3.0
B22062	B18231/B18233	52	29.3	21.1	49.0	2.5	3.5
B22008	N17506/B18201	7	29.2	18.8	49.5	3.0	3.5
N22012	N18112/B10244	11	29.0	20.6	48.5	3.0	3.5
B22035	B15434/B18504	28	28.7	20.4	48.5	1.0	5.5
B20536	B15430/B16504	68	28.4	21.6	48.0	1.5	4.5
B22045	B17536/B18504	38	28.2	18.8	47.5	2.0	3.5
B22051	B18204/B18504	43	28.2	20.7	48.0	1.0	4.0
B22875	B18231/B18233	63	28.0	21.8	49.0	2.0	4.0
B22040	B15434/B18504	33	27.9	19.9	48.5	1.5	5.0
B22060	B18231/B18233	50	27.9	23.2	47.5	1.5	4.0
B22053	B18210/B18232	45	27.7	22.6	48.5	3.5	2.5
B22874	B18231/B18233	62	27.6	22.0	48.5	2.0	4.0
B20591	B16505/B16504	69	27.6	21.2	45.5	3.0	3.0
N22632	N18112/B10244	54	27.5	18.8	48.0	1.5	4.5
N22013	N18112/B10244	12	27.4	20.8	46.5	3.0	3.0
N22005	N15306/B17023	4	27.4	21.2	47.0	1.0	4.5

EXPERIMENT 2215 PRELIMINARY NAVY AND BLACK BEAN YIELD TRIAL						PLANTED: 6/14/22	
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**LODGING (1-5)**	**DES. SCORE**
B22015	N18116/B15430	13	27.3	20.0	49.5	2.5	3.0
B20599	B16506/B15430	70	27.1	20.6	48.5	1.5	4.0
B22037	B15434/B18504	30	27.1	21.2	48.5	1.0	4.5
B22044	B17536/B18504	37	27.1	19.7	49.0	1.5	4.0
B22054	B18210/B18232	46	27.0	22.3	48.0	1.0	4.5
B22039	B15434/B18504	32	26.9	18.8	48.5	1.0	4.5
B22019	N18116/ B15434	17	26.8	20.5	48.5	1.0	4.5
B22864	B15434/B18204	57	26.7	21.6	48.0	1.0	4.0
B22031	B15434/B18204	25	26.7	21.9	48.0	2.0	4.0
I21901	BL14500, **NIMBUS**	65	26.6	23.0	49.0	2.0	4.0
B22058	B18210/B18504	49	26.5	19.5	47.0	2.0	3.5
B22016	N18116/B15430	14	26.5	18.9	50.0	2.0	3.0
N22009	N17506/B18201	8	26.2	17.7	47.5	2.0	3.5
B22870	B18201/B10244	58	26.2	20.6	48.0	2.0	4.0
B22038	B15434/B18504	31	26.1	17.7	47.5	1.5	4.0
B22873	B18231/B18233	61	26.0	21.3	48.5	1.0	5.0
N22004	N15306/B17023	3	26.0	17.9	48.5	1.5	4.5
B22050	B18204/B18504	42	25.9	21.5	48.0	1.5	4.5
B22048	B18201/B10244	40	25.8	19.8	48.0	1.5	4.0
N22007	N15306/B17023	6	25.6	17.8	48.5	1.0	4.0
B22871	B18210/B18232	59	25.5	21.7	48.5	1.5	4.5
B22017	N18116/B15430	15	25.5	18.9	49.5	2.0	3.0
B22036	B15434/B18504	29	25.4	20.1	47.5	1.0	4.5
B22018	N18116/B15430	16	25.3	19.7	49.0	2.5	3.5
B22020	N18116/ B15434	18	25.2	21.3	47.5	1.5	4.0
B22052	B18210/B18232	44	25.0	19.8	49.0	1.5	4.5
I22001	**LIBERTY**	66	25.0	22.5	42.5	2.5	3.5
B22022	N18116/ B15434	20	24.9	20.2	49.5	1.5	4.0
N22633	N18122/B18504	55	24.7	19.8	48.0	1.5	5.0
B22024	N18116/ B15434	22	24.6	19.0	48.0	1.0	4.0

EXPERIMENT 2215 PRELIMINARY NAVY AND BLACK BEAN YIELD TRIAL					PLANTED: 6/14/22		
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**LODGING (1-5)**	**DES. SCORE**
N22011	N18112/B10244	10	24.4	18.4	47.0	1.5	4.5
B22034	B15434/B18504	27	24.1	20.8	47.0	1.0	4.5
B22049	B18204/B18504	41	24.1	23.0	48.0	2.0	2.5
N19246	N15331/N16405	71	23.6	20.2	47.0	2.0	4.0
N22028	N18126/B10244	24	23.4	20.7	45.0	1.5	3.5
I21920	**HMS BOUNTY**	67	22.7	19.1	41.0	2.0	5.1
N22010	N17506/B18201	9	22.7	19.8	48.0	1.5	4.5
B22021	N18116/ B15434	19	22.1	19.3	49.5	1.5	4.5
N22006	N15306/B17023	5	21.9	18.8	49.0	1.5	4.5
N22023	N18116/ B15434	21	18.4	20.7	48.5	1.0	3.0
N18103	N13120/PR00806-81	72	17.9	20.3	42.5	1.5	3.5
B22002	N15306/B10244	1	17.0	23.0	49.0	3.0	3.0
MEAN (72)			26.8	20.6	47.8	1.8	3.9
LSD (.05)			3.6	1.4	1.9	1.2	1.3
CV%			8.1	4.2	2.3	41.4	20.0

EXPERIMENT 2216 PRELIMINARY SMALL RED AND PINK BEAN YIELD TRIAL					PLANTED: 6/14/22		
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**LODGING (1-5)**	**DES. SCORE**
R22073	R17602/R18401	3	35.1	36.1	43.0	2.5	3.5
S22088	R17605/S18909	13	34.1	39.2	45.0	2.5	3.5
R22093	R18401/R17603	15	32.8	35.8	42.0	1.5	4.0
R22092	R18401/R17603	14	32.7	42.5	41.5	1.0	5.0
R22706	R17602/R18401	19	32.5	36.2	42.0	2.5	4.0
R22072	R17602/R18401	2	31.9	36.3	43.5	2.0	4.5
R22707	R17602/R18401	20	31.6	36.7	42.5	2.5	4.5
R22708	R17602/R18401	21	31.2	39.6	42.0	2.5	3.5
I13401	SR99238/Merlot, **VIPER**	32	31.2	33.5	42.5	2.0	4.0
R12844	SR9-5/R09508, **CAYENNE**	31	30.7	37.8	41.5	1.5	3.5
R22070	R17602/R18401	1	30.3	35.2	43.5	2.5	4.0
R22094	R18401/R17603	16	30.2	43.3	44.0	1.0	5.5
S22076	R17604/S18909	6	29.8	35.9	43.0	2.0	4.0
R22082	R17605/S18904	9	29.6	35.8	43.5	2.5	3.5
R22079	R17605/R18403	8	29.5	38.2	42.5	2.0	5.0
S18904	S14706/R13752, **CORAL**	33	29.3	41.2	42.5	1.0	4.5
R22715	R18401/R17603	29	28.8	45.2	42.0	1.0	5.5
R22710	R17605/R18403	23	28.7	39.5	44.0	1.5	5.0
R22712	R17605/S18904	25	28.6	36.5	44.0	2.0	4.0
S22503	R17604/S18909	22	28.5	34.8	43.0	2.0	5.0
S22085	R17605/S18909	10	28.3	37.9	45.5	2.5	4.5
S22078	R17604/S18909	7	28.2	36.1	44.0	2.5	4.0
S22505	R17605/S18909	27	28.2	40.0	45.0	3.0	3.0
R22714	R18401/R17603	28	27.4	42.8	42.0	1.0	5.0
S22086	R17605/S18909	11	27.3	40.5	44.5	2.0	5.0
R22713	R17605/S18904	26	27.1	38.2	43.5	2.0	4.5
S22506	S18909/R18403	30	26.8	40.1	44.5	2.5	2.5
S22087	R17605/S18909	12	26.1	38.2	45.0	2.5	3.5
R22711	R17605/R18403	24	26.1	37.3	42.5	3.0	3.0
S22100	S18909/R18403	18	26.0	38.0	43.5	1.5	4.0
R22074	R17602/R18401	4	25.4	38.6	44.0	1.5	4.5
R20669	I13401/R17603	35	25.3	33.9	43.5	1.0	4.5
S22099	S18909/R18403	17	25.1	42.4	42.5	1.0	5.0
R22075	R17602/R18401	5	22.5	33.8	43.0	1.5	4.0
R20627	R17605/R16503	36	22.2	37.8	41.5	1.5	4.5
S08418	S02754/S04503, **ROSETTA**	34	20.0	37.9	42.5	3.1	2.9
MEAN (36)			28.6	38.1	43.2	2.0	4.2
LSD (.05)			4.2	3.2	1.0	0.7	0.7
CV%			8.6	4.9	1.4	21.2	9.2

EXPERIMENT 2217 NSI WHITE MOLD YIELD TRIAL					PLANTED: 6/9/22
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**DAYS TO FLOWER**	**WHITE MOLD (1-9)**
B22826	B17897/B18204	65	30.7	47.3	8.0
B20536	B15430/B16504	90	29.1	47.3	8.7
N22631	N15306/B10244	31	27.9	47.0	5.7
B22827	B17897/B18204	66	27.7	46.7	8.0
N22622	N19216/B18224	22	27.5	49.0	7.3
B22861	B17922/B18231	100	27.2	48.0	7.7
N22619	N19216/N17505	19	26.4	46.3	8.0
B22810	N15306/B10244	49	26.2	50.3	9.0
B22862	B17922/B18231	101	26.0	47.0	8.0
B22825	B17220/B17897	64	25.6	47.3	8.3
I09203	SR9-5	125	25.5	45.0	8.0
B22807	N19216/N17505	46	25.3	48.0	9.0
B22823	B17207/B18504R	62	25.2	46.7	9.0
B19309	B15414/B16504	63	24.8	48.7	8.7
B22850	B18504R/B18236	89	24.3	48.3	8.3
B22831	B17922/B16501	70	24.2	48.7	7.7
N22623	N19241/N18103	23	24.0	47.0	9.0
B22876	B18504/B17402	115	23.8	47.7	8.7
I08933	37-2, USPT-WM-12	124	23.8	43.7	9.0
B22820	B16501/B18504R	59	23.7	46.0	8.7
B22812	N15306/B10244	51	23.7	46.0	8.7
B22870	B18201/B10244	109	23.6	46.3	9.0
B20547	B16501/B16504	97	23.5	49.7	7.7
B22804	N18122/B18224	43	23.3	48.0	9.0
B22836	B18204/B18224	75	23.3	47.0	8.3
B22828	B17897/B18204	67	23.2	49.0	8.0
N22602	N17505/N18122	2	23.2	48.3	7.0
B22844	B18232/B17207	83	23.2	46.3	9.0
I11264	COOP 03019, **MERLIN**	121	23.1	46.0	8.0
B22874	B18231/B18233	113	23.0	48.0	9.0

EXPERIMENT 2217 NSI WHITE MOLD YIELD TRIAL **PLANTED: 6/9/22**

NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	DAYS TO FLOWER	WHITE MOLD (1-9)
N22624	N19241/N18122	24	22.9	48.0	8.7
B22843	B18232/B16501	82	22.8	46.3	8.7
N22616	N19216/N17505	16	22.4	45.7	8.0
B22830	B17897/B18232	69	22.4	48.7	9.0
B22855	B15447/B18504	94	22.3	46.7	7.7
B22835	B17922/B19309	74	22.3	46.0	8.0
B22854	B19309/B18222	93	22.3	48.0	9.0
B22848	B18236/B19309	87	22.2	49.3	9.0
B22857	B17887/B18231	96	22.1	47.3	9.0
B22834	B17922/B18504R	73	22.0	47.0	8.0
B22814	N18116/B10244	53	21.9	50.0	8.3
B04554	B00103*/X00822, **ZORRO**	118	21.9	46.0	9.0
B22841	B18224/B17897	80	21.8	45.3	7.7
B22860	B17922/B18231	99	21.8	48.7	8.3
B22840	B18204/N19283	79	21.8	48.3	7.7
N22634	N18128/B18231	34	21.6	48.0	8.7
B18504	Zenith//Alpena*/B09197, **ADAMS**	116	21.6	46.3	6.7
B22853	B19309/B18222	92	21.4	47.7	8.3
N21511	N15306/N15337	48	21.4	48.0	8.3
B10244	B04644/ZORRO, **ZENITH**	117	21.2	46.3	7.7
B22801	N17505/B18224	40	21.1	46.7	8.7
N22605	N17505/B18224	5	20.8	49.3	6.7
B22829	B17897/B18232	68	20.8	48.3	8.7
B22837	B18204/B18232	76	20.8	46.0	9.0
N22636	B16501/N15306	36	20.6	49.0	8.7
I17501	Jaguar/BL05222, **BLACK BEAR**	119	20.5	46.0	9.0
B22842	B18224/B17897	81	20.4	47.7	8.7
B21708	B15430/B16504	110	20.4	47.3	7.7
N22630	N19253/B19309	30	20.3	49.7	7.7
B22818	B16501/B18224	57	20.0	47.3	8.7

EXPERIMENT 2217 NSI WHITE MOLD YIELD TRIAL					PLANTED: 6/9/22
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	DAYS TO FLOWER	WHITE MOLD (1-9)
B22821	B16501/N15306	60	20.0	49.7	8.7
BC216	I9365-31	123	20.0	45.7	9.0
B22873	B18231/B18233	112	19.9	47.0	9.0
B22856	B17887/B18231	95	19.9	47.0	9.0
N22620	N19216/N18130	20	19.8	47.7	8.3
B20599	B16506/B15430	108	19.8	49.0	7.7
B22811	N15306/B10244	50	19.6	50.3	9.0
B22863	B18231/B17922	102	19.5	46.0	8.7
B22815	N18122/B18504	54	19.2	45.7	8.0
B22875	B18231/B18233	114	18.9	45.7	9.0
B22803	N17505/B18504R	42	18.8	48.0	9.0
B22832	B17922/B18232	71	18.8	46.3	8.7
N20404	B16505/N17504	47	18.8	48.0	8.3
N22635	N18128/B18231	35	18.8	46.3	9.0
B22859	B17922/B18204	98	18.7	48.0	8.7
B22868	B17922/B10244	107	18.7	46.7	9.0
N22629	N19253/B18504R	29	18.7	47.7	8.7
B22822	B17207/B18224	61	18.6	46.3	9.0
N22606	N18122/N19241	6	18.6	49.7	8.7
B22866	B17536/B18504	105	18.5	46.7	8.7
B22846	B18232/B18204	85	18.2	46.0	9.0
I81010	JAPON3/MAGDALENE, **BUNSI**	126	18.2	45.0	9.0
B22867	B17536/B18504	106	18.1	48.0	8.0
N22609	N18122/N19253	9	18.1	47.3	8.7
N22607	N18122/N19241	7	18.0	46.7	8.7
N22637	B18504R/N17505	37	18.0	46.3	7.3
N22610	N18122/N19253	10	18.0	49.0	8.3
N22601	N17505/N18122	1	17.9	50.0	8.7
B20591	B16505/B16504	103	17.9	45.0	7.3
B22865	B15453/B18504	104	17.8	50.0	7.0

EXPERIMENT 2217 NSI WHITE MOLD YIELD TRIAL					PLANTED: 6/9/22
NAME	PEDIGREE	ENTRY	YIELD CWT /ACRE	DAYS TO FLOWER	WHITE MOLD (1-9)
B22838	B18204/B18504R	77	17.5	48.0	9.0
N22626	N19241/B19302	26	17.4	47.3	9.0
N22614	N18130/N17505	14	17.4	50.3	9.0
N20388	B15430/N14229	25	17.3	47.3	8.0
B22839	B18204/B19302	78	17.3	46.0	9.0
N22608	N18122/N19253	8	17.1	46.7	9.0
N18103	N13120/PR00806-81	4	16.9	46.0	7.7
B22819	B16501/B18224	58	16.8	45.7	9.0
N22613	N18130/N17505	13	16.7	49.7	9.0
N22621	N19216/N18130	21	16.6	49.0	8.7
N22627	N19241/B19302	27	16.6	48.7	8.3
N22603	N17505/N18122	3	16.5	48.0	8.7
B22806	N18122/B18504R	45	16.3	47.0	9.0
B22845	B18232/B17207	84	16.3	45.0	9.0
B22816	N18128/B18231	55	16.3	46.0	9.0
BC269	I9365-25	122	16.2	44.0	8.7
N20395	B16504/N17504	28	16.2	47.7	8.7
N22615	N18130/N17505	15	16.1	49.3	8.7
B22805	N18122/B18224	44	16.0	45.7	9.0
B21710	B16501/B15430	111	15.9	49.3	8.7
B22847	B18236/B18204	86	15.9	45.7	9.0
N19246	N15331/N16405	11	15.6	45.7	8.3
B19344	B16506/B16507	88	15.5	45.7	8.7
B22813	N18112/B18504	52	15.5	49.7	8.7
N11283	MEDALIST/N08003, **ALPENA**	120	15.1	47.3	8.3
N22617	N19216/N17505	17	15.0	47.7	7.3
N22618	N19216/N17505	18	14.9	46.7	9.0
N22632	N18112/B10244	32	14.8	48.3	8.3
B22833	B17922/B18232	72	14.7	47.3	9.0
N22633	N18122/B18504	33	14.6	50.7	8.0

EXPERIMENT 2217 NSI WHITE MOLD YIELD TRIAL					PLANTED: 6/9/22
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**DAYS TO FLOWER**	**WHITE MOLD (1-9)**
I89011	**BERYL**	127	14.1	43.3	9.0
B22817	B16501/B18224	56	14.0	46.0	9.0
N22639	B19330/B19302	39	13.6	50.3	9.0
B22802	N17505/B18224	41	13.6	47.3	9.0
B22852	B19302/B18232	91	13.1	46.7	9.0
N22638	B18504R/N17505	38	12.1	48.7	6.3
I96417	**G122**	128	11.4	44.0	4.7
N22612	N18130/N17505	12	11.3	49.3	8.7
MEAN (128)			19.9	47.4	8.4
LSD (.05)			4.5	1.8	1.0
CV%			16.9	2.8	8.8

EXPERIMENT 2218 NATIONAL WHITE MOLD YIELD TRIAL				PLANTED: 6/9/22		
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**WHITE MOLD (1-9)**
P19103	Eldorado*/Palomino//G13444 (SDP)	16	32.3	39.3	44.7	7.0
P19713	P16911/P16901	15	31.2	40.3	45.3	8.0
B20590	B16505/B16504	8	31.2	22.7	45.7	7.7
I21929	SR16-1	11	27.6	39.4	45.0	7.7
G21811	G16306/G17411	14	26.0	39.2	43.7	8.7
G19613	G16351/P16902	13	26.0	40.7	44.3	8.0
I21902	ND172568	6	25.4	43.9	45.0	8.7
I22028	WMM-820-1	9	25.1	41.7	44.0	8.7
I22009	SR16-2-6	10	21.6	38.9	44.0	9.0
I81010	JAPON3/MAGDALENE, **BUNSI**	3	19.2	21.6	44.3	7.7
N21511	N15306/N15337	7	19.2	21.3	50.0	6.7
I22029	Ex 2143-P	12	17.2	37.8	44.7	8.0
I96417	**G122**	1	10.9	44.8	42.5	3.7
I20817	ND122454(2131)	4	10.4	56.3	43.0	7.3
I22027	ND151660	5	9.9	57.8	41.0	8.7
I89011	**BERYL**	2	9.7	34.6	43.3	9.0
MEAN (16)			21.4	38.8	44.4	7.8
LSD (.05)			3.6	2.3	1.0	1.5
CV%			12.2	3.5	1.6	13.6

EXPERIMENT 2219 ADVANCED KIDNEY BEAN YIELD TRIAL												PLANTED: 6/9/22
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**	**DRY DOWN (1-5)**	**ROOT ROT (1-7)**	
K19831	K16638/K16980	1	29.9	69.1	42.7	107.3	2.0	40.7	4.0	3.0	3.9	
K19817	K15901/K16980	5	27.3	62.3	43.0	109.0	1.3	46.0	3.0	4.5	2.6	
K20734	K15601/K16131	16	25.9	60.7	42.0	107.0	2.3	40.7	3.3	4.5	3.4	
K20717	K16640/K17702	4	24.5	62.0	42.3	106.7	1.7	43.7	4.0	3.0	3.1	
K19832	K16981/K16962	7	24.4	70.6	43.7	107.3	1.7	40.0	4.0	4.0	3.0	
K20721	K16640/K17702	10	24.3	60.2	43.3	107.7	2.7	46.0	3.7	3.5	3.8	
K19830	K16638/K16980	13	23.7	68.3	42.3	107.0	1.0	39.0	3.7	3.5	3.6	
K19610	K16126/K11306	19	22.2	57.3	42.7	106.3	2.3	43.7	3.3	3.5	4.1	
K20730	K17703/K17702	18	21.7	61.5	42.7	107.0	2.0	39.3	3.3	3.5	3.4	
K20745	K17703/K17816	2	20.9	58.7	42.0	107.7	2.0	37.3	3.7	4.0	2.9	
K20715	K16136/K16640	12	20.9	59.7	41.3	105.7	1.3	37.3	4.3	2.0	4.1	
K15601	RED CEDAR/K11916, **COHO**	6	19.1	54.6	42.7	108.3	2.7	41.3	3.3	4.0	4.3	
K20743	K17703/K17816	9	19.0	59.6	42.0	106.0	1.3	38.3	3.7	3.5	3.9	
K08961	K04604/USDK-CBB-15, **SNOWDON**	24	18.8	64.5	39.0	104.0	1.0	36.0	3.7	1.5	4.1	
K20742	K17703/K17816	11	18.3	64.1	42.0	107.0	1.0	37.7	3.0	4.0	3.7	
K20217	K17209/K17703	17	18.0	65.7	42.3	107.3	1.0	38.3	3.3	4.0	4.5	
K20732	K17703/K17702	15	16.9	64.4	41.7	107.3	1.7	37.3	4.0	4.0	4.6	
K20221	K17206/K16136	3	16.4	55.8	42.0	106.3	2.7	39.7	3.4	3.5	3.7	
K20744	K17703/K17816	8	16.3	60.2	42.3	108.0	2.0	34.7	3.7	4.0	5.4	
K20239	K16957/K17703	14	14.1	57.9	42.0	105.0	1.7	33.7	3.7	2.5	4.7	
I11201	Pink Panther//ZAA/Montcalm, **CLOUSEAU**	23	13.0	69.2	40.3	103.7	1.0	35.7	4.0	1.5	3.9	
K11306	K06621/USDK-CBB-15, **RED CEDAR**	21	12.4	55.5	43.0	105.3	2.0	34.3	3.7	2.5	5.3	
K16924	K11917/SNOWDON, **DENALI**	22	12.4	60.5	41.7	105.7	1.0	30.3	4.0	1.5	4.2	
K20212	K16131/K11306	20	11.4	57.5	42.0	104.7	1.0	34.3	4.3	2.0	4.3	
MEAN (24)			19.7	61.7	42.1	106.6	1.7	38.6	3.7	3.2	3.9	
LSD (.05)			3.7	3.9	1.2	1.5	0.7	5.6	1.0	1.2	1.0	
CV%			13.8	3.8	2.0	1.0	29.5	10.5	18.7	20.5	19.1	

EXPERIMENT 2220 ANDEAN COOPERATIVE DRY BEAN NURSERY (CDBN)								**PLANTED: 6/10/22**	
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**
I22002	CR17-1-7-B2	1	27.3	76.2	37.0	103.0	3.0	33.0	4.0
I90013	**CELRK**	4	22.4	65.3	38.0	100.0	1.0	29.5	3.0
I22004	NE9-20-7	3	20.5	65.8	36.5	100.0	1.0	38.0	4.0
I22003	NE9-20-8	2	15.6	72.0	36.5	100.0	1.0	27.5	3.5
MEAN (4)			21.4	69.8	37.0	100.8	1.5	32.0	3.6
LSD (.05)			3.0	1.6	1.4	1.7	0.0	4.1	0.8
CV%			6.9	1.4	1.6	0.7	0.0	5.4	9.8

EXPERIMENT 2221 STANDARD KIDNEY BEAN YIELD TRIAL										PLANTED: 6/10/22
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**	**Dry Down (1-5)**
K22604	K15601/K19605	43	37.0	59.0	40.0	104.3	2.3	46.0	3.7	3.7
K19830	K16638/K16980	13	36.9	66.4	40.5	105.7	1.7	49.0	4.3	4.0
K22601	K15601/K17703	40	36.0	56.5	39.5	103.3	2.0	45.0	4.0	3.3
K20745	K17703/K17816	2	35.6	55.9	38.0	104.3	2.0	42.3	4.3	3.3
K19832	K16981/K16962	7	35.5	68.6	40.5	104.3	2.3	43.7	4.3	3.7
K20743	K17703/K17816	9	35.4	56.7	38.5	104.0	2.7	43.0	2.7	3.0
K22104	15Arusha_47/K16136	33	35.4	60.0	39.5	104.3	3.0	44.3	3.0	4.0
K20717	K16640/K17702	4	35.4	57.6	40.5	105.0	2.3	46.7	3.3	4.3
K20730	K17703/K17702	18	35.2	58.4	38.5	106.3	2.3	40.3	3.7	4.0
K22602	K15601/K17703	41	35.0	57.2	39.5	104.0	2.0	40.7	3.7	4.0
K22610	K15601/K17703	49	34.9	50.8	40.0	105.0	2.3	43.0	3.9	4.0
K20721	K16640/K17702	10	34.8	56.5	40.5	104.3	3.0	47.0	3.3	2.7
K19831	K16638/K16980	1	34.2	67.3	41.0	105.0	2.0	51.0	3.3	3.7
K08961	K04604/USDK-CBB-15, **SNOWDON**	29	34.2	66.1	35.5	101.3	2.3	45.7	3.0	2.0
K20742	K17703/K17816	11	34.1	60.2	38.5	104.7	2.0	48.0	3.7	4.0
I90013	**CELRK**	28	34.0	63.6	36.5	101.3	1.7	43.3	3.7	2.0
K22801	K18912/K15601	55	33.5	58.6	38.5	104.0	2.3	46.0	3.3	3.7
K22612	K16131/I18645	51	33.5	53.9	39.5	104.3	2.7	42.7	3.3	3.3
K22609	K15601/K17703	48	33.4	50.3	39.5	103.0	2.0	40.7	3.7	3.0
K19610	K16126/K11306	19	33.3	54.4	40.0	104.0	2.0	45.3	4.3	3.3
K20732	K17703/K17702	15	33.2	59.0	39.0	105.0	2.0	41.3	3.7	4.3
K16924	K11917/SNOWDON, **DENALI**	23	33.1	62.6	39.5	102.7	1.3	44.7	5.3	2.6
K22605	K17703/15Mbeya_55	44	32.9	61.1	39.0	103.3	1.7	43.0	4.0	3.3
K22603	K15601/K17703	42	32.8	52.7	41.0	104.0	1.7	44.0	4.3	2.7
K22110	K16136/I18633	39	32.8	58.5	39.0	102.7	2.3	43.3	4.0	3.6
K20715	K16136/K16640	12	32.8	55.3	39.0	101.3	2.0	44.7	3.0	2.0
K15601	RED CEDAR/K11916, **COHO**	6	32.7	52.4	39.5	102.7	2.0	45.0	4.0	3.0
K22611	K16131/I18645	50	32.4	55.7	38.5	103.3	2.4	47.0	4.0	3.0
I17507	ND122386, **ND WHITETAIL**	21	32.3	58.5	39.5	104.0	2.0	42.3	4.0	3.7
K90101	CHAR/2*MONT, **RED HAWK**	24	32.3	56.6	39.5	104.7	2.3	39.0	3.3	4.0
K22613	K17703/I18642	52	32.3	57.2	39.5	104.0	2.0	45.0	4.0	3.7
K22107	15Arusha_30/K11306	36	32.3	54.0	40.0	104.7	2.3	44.3	4.0	2.0
I11201	Pink Panther//ZAA/Montcalm, **CLOUSEAU**	26	32.2	68.3	39.0	103.3	2.3	38.7	3.3	3.7
K20239	K16957/K17703	14	32.2	57.8	40.5	102.0	1.3	42.3	3.7	2.7
K20734	K15601/K16131	16	32.0	60.5	40.5	106.7	2.3	44.0	3.0	4.7
K22614	K17703/I18642	53	31.7	60.2	40.0	104.3	2.3	43.0	2.3	4.0
K22608	K18501/I18633	47	31.7	52.0	40.5	101.7	2.1	43.3	2.3	1.7
K74002	MDRK/CN(3)-HBR(NEB#1), **MONTCALM**	27	31.3	56.2	40.0	105.3	2.3	46.7	3.0	3.3
K22103	K15601/K11306	32	31.3	56.7	40.0	101.0	1.1	48.0	6.7	1.3
K19817	K15901/K16980	5	31.0	62.1	40.0	106.7	1.7	48.7	3.0	4.7

EXPERIMENT 2221 STANDARD KIDNEY BEAN YIELD TRIAL										PLANTED: 6/10/22
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**	**Dry Down (1-5)**
K22802	K08961/I18635	56	30.3	55.3	40.5	102.7	2.0	41.7	4.0	1.7
K20744	K17703/K17816	8	30.0	60.1	39.0	104.3	2.3	36.7	3.3	3.0
K22101	K11306/K17703	30	29.9	50.7	40.0	101.3	2.3	41.3	3.7	1.3
K11306	K06621/USDK-CBB-15, **RED CEDAR**	22	29.8	56.7	39.0	101.7	2.0	45.3	5.0	1.7
K22615	I18641/K17703	54	28.6	55.6	41.0	102.3	3.0	46.3	3.0	4.0
K22102	K11306/15Arusha_30	31	28.3	48.6	40.5	104.0	2.0	39.7	4.0	3.3
K22109	K11306/K16136	38	28.1	49.5	41.0	102.7	1.3	43.0	4.0	2.3
K90902	BEA/50B1807//LASSEN, **BELUGA**	25	27.8	61.3	40.0	104.3	1.7	46.0	4.0	3.7
K22606	15Arusha_30/K11306	45	27.6	61.9	41.0	107.7	2.0	47.7	3.0	5.0
K22105	15Arusha_47/K17703	34	27.6	57.6	41.0	105.3	1.9	41.7	3.0	3.7
K22106	15Arusha_30/K11306	35	26.6	61.8	39.0	105.0	1.7	40.0	4.0	3.3
K20221	K17206/K16136	3	26.3	54.0	41.0	101.3	1.3	50.0	5.0	2.5
K22607	K16640/I18640	46	25.8	66.3	41.5	106.7	2.0	54.3	3.3	4.7
K20217	K17209/K17703	17	25.6	62.7	39.5	103.3	2.0	44.7	4.0	3.0
K20212	K16131/K11306	20	20.1	56.6	40.5	103.3	2.0	42.7	3.7	3.0
K22108	15Arusha_30/K17703	37	19.7	54.0	42.0	104.7	2.3	43.7	3.0	3.7
MEAN (56)			31.7	58.0	39.7	103.9	2.1	44.2	3.7	3.3
LSD (.05)			4.3	3.2	1.3	1.6	0.7	5.4	0.9	1.0
CV%			9.9	4.1	2.0	1.2	22.9	9.1	17.5	22.3

EXPERIMENT 2222 STANDARD YELLOW BEAN YIELD TRIAL									PLANTED: 6/10/22	
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**	**Dry Down (1-5)**
Y17502	Y11405/PR1146-123 (round)	5	36.5	46.0	41.5	102.7	2.0	38.5	3.3	3.6
Y19817	X16908/Y16507	9	35.5	43.7	42.5	103.8	2.9	32.5	3.7	3.3
I14515	DBY-60-1, **PATRON**	1	32.4	47.2	42.5	101.0	2.6	31.3	3.0	2.0
Y22501	Y16507/Y17501	12	31.9	50.8	41.0	100.4	3.2	33.1	3.0	0.9
Y18703	X15305/X15302	7	31.6	43.6	40.0	103.0	2.3	37.1	3.3	3.7
Y19804	Y16503/Y16507	4	31.6	42.2	41.5	104.2	2.4	38.1	3.7	3.2
Y22504	Y17604/Y16507	15	31.6	44.3	41.0	103.0	2.2	39.0	4.3	3.0
Y22503	Y17604/Y16507	14	31.3	43.6	42.5	100.8	1.6	36.7	4.3	1.7
I17506	**SVS-0863**	3	31.2	46.5	42.5	103.2	3.4	20.5	3.0	3.7
Y19815	X16908/Y16507	10	31.2	47.5	42.5	103.3	1.7	38.2	4.0	3.1
Y19801	Y16503/Y16507	6	29.8	50.2	42.0	104.0	2.0	39.0	3.7	4.0
Y19808	Y16503/X16908	8	28.9	45.7	43.0	104.2	2.1	39.6	3.7	3.9
I22025	**Claim Jumper**	13	26.8	48.0	42.5	104.7	3.2	28.4	3.0	4.3
Y19810	Y16507/Y16503	2	26.8	46.9	44.0	105.2	2.3	45.2	3.7	4.2
Y16507	PR1146-123/Y11405, **YELLOWSTONE**	11	26.4	41.3	40.5	100.8	3.0	33.4	3.0	1.8
I22026	**Motherlode**	16	23.6	52.2	42.0	103.4	2.4	33.7	3.0	3.9
MEAN (16)			30.4	46.2	42.0	103.0	2.5	35.3	3.5	3.2
LSD (.05)			3.7	2.5	1.0	1.4	0.7	6.7	0.6	1.2
CV%			8.8	3.9	1.4	1.0	19.6	13.4	13.0	26.8

EXPERIMENT 2223 HURON STANDARD BLACK BEAN YIELD TRIAL										PLANTED: 6/8/22	
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**	**Dry Down (1-5)**
B19344	B16506/B16507	7	35.9	22.7	45.5	88.5	1.5	42.5	5.0	2.0
B21713	B16501/B16504	29	34.6	23.8	45.5	91.5	2.0	39.5	4.5	2.5
B20591	B16505/B16504	3	34.0	22.9	45.5	87.5	1.0	30.5	5.0	2.0
B21711	B16501/B15430	34	33.4	23.2	46.0	88.5	1.5	38.5	5.0	2.0
B21720	B16505/B16504	35	33.0	21.2	46.5	88.0	1.0	38.0	5.0	2.0
B21706	B15430/B16504	32	33.0	22.8	45.5	91.0	2.0	42.0	4.5	1.5
B20549	B16501/B16504	10	32.4	24.0	45.5	88.0	1.0	37.5	4.5	2.0
B20590	B16505/B16504	5	32.0	19.2	45.5	88.0	1.5	40.5	5.5	2.0
B20639	B17730/B15430	11	31.5	21.7	45.5	90.0	2.0	44.0	4.5	2.0
B20542	B16501/B15430	18	31.2	23.3	45.5	89.5	1.0	36.0	4.5	2.0
I19703	BL14506, **BLACK BEARD**	22	31.1	24.8	46.0	91.0	2.0	41.5	4.5	2.5
B20602	B16506/B16504	12	31.1	24.3	45.0	87.5	1.5	34.5	4.0	2.0
B21707	B15430/B16504	31	30.9	22.0	45.5	88.5	2.0	39.5	6.0	2.0
B20532	B15430/B16504	13	30.9	21.6	46.0	91.0	2.5	35.5	4.0	3.0
B19332	B16501/B15464	15	30.8	21.9	45.5	90.5	1.5	40.0	4.5	2.5
B21724	B17996/B17540	28	30.7	20.7	45.5	89.5	2.0	39.0	5.0	2.0
B21710	B16501/B15430	24	30.6	21.6	45.0	89.0	2.0	40.0	4.5	2.0
B21715	B16501/B16504	33	30.5	22.4	45.5	90.5	2.0	38.0	5.0	2.0
B20599	B16506/B15430	2	30.5	21.7	45.0	89.5	1.5	38.5	4.0	2.5
B20616	B17106/B17259	19	30.5	20.9	45.5	88.0	1.0	39.0	5.0	1.5
B10244	B04644/ZORRO, **ZENITH**	17	30.3	22.0	45.0	89.5	1.5	39.0	5.0	2.0
B20617	B17106/N14218	14	30.1	21.1	46.5	90.0	2.0	34.0	3.5	2.0
B20538	B15430/B16504	9	30.1	22.4	46.5	89.5	2.0	42.0	4.5	2.0
B20547	B16501/B16504	20	30.1	23.1	45.5	90.0	1.5	38.0	4.0	2.0
B20536	B15430/B16504	1	30.1	23.3	46.0	89.0	2.0	38.5	5.5	2.0
B21712	B16501/B16504	27	29.7	22.7	45.0	90.5	2.0	35.0	4.0	2.0
I21901	BL14500, **NIMBUS**	21	29.3	26.4	45.0	93.0	2.0	42.0	4.0	2.5
B21714	B16501/B16504	26	29.0	22.2	45.5	89.5	1.0	41.0	4.5	2.0
B21708	B15430/B16504	25	28.3	22.9	44.0	89.5	2.0	42.0	5.0	2.0
B21705	B14302/B15430	36	28.3	22.4	45.5	91.0	1.0	34.5	4.5	2.0
B19309	B15414/B16504	6	28.2	22.9	46.0	91.0	2.0	32.0	3.5	2.5
B04554	B00103*/X00822, **ZORRO**	23	27.0	22.2	45.5	89.5	1.5	33.0	4.0	2.0
B19340	B16507/B15453	16	26.5	25.5	45.5	90.0	1.5	36.5	4.0	2.0
B20597	B16506/B15430	8	26.5	23.9	45.5	88.0	1.5	35.5	4.0	2.0
B18504	Zenith//Alpena*/B09197, **ADAMS**	4	25.4	22.5	46.0	91.5	2.5	38.0	3.5	3.5
B21717	B16504/B17106	30	24.8	22.4	46.5	91.0	1.5	35.5	3.5	2.0
MEAN (36)			30.3	22.6	45.6	89.7	1.7	38.1	4.5	2.1
LSD (.05)			5.7	1.4	1.5	0.7	0.8	5.5	1.3	0.5
CV%			11.0	3.6	1.9	0.5	29.3	8.6	16.7	15.0

EXPERIMENT 2224 HURON STANDARD NAVY BEAN YIELD TRIAL									PLANTED: 6/8/22	
NAME	**PEDIGREE**	**ENTRY**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DAYS TO FLOWER**	**DAYS TO MATURITY**	**LODGING (1-5)**	**HEIGHT (cm)**	**DES. SCORE**	**Dry Down (1-5)**
N21526	N17506/N14229	23	32.5	20.9	47.0	91.5	2.0	38.0	5.5	2.5
N19284	G14505/X16708	8	32.3	20.5	47.0	92.0	1.5	36.5	5.0	3.0
N21510	N15306/N14229	20	32.3	20.6	47.0	90.5	1.5	38.0	5.5	2.5
N21513	N15306/N16405	29	31.7	19.7	47.0	89.5	2.0	39.5	5.0	2.0
N19246	N15331/N16405	7	31.2	20.6	45.0	87.0	1.5	34.5	4.5	2.0
N21524	N17504/B17106	27	31.0	22.4	47.0	91.5	1.5	39.5	6.0	2.5
N21523	N17504/B15430	26	30.8	22.5	48.5	93.0	2.0	37.5	5.0	3.0
N18105	N13131/N14201	6	30.7	22.0	46.5	91.0	2.0	41.5	5.0	2.5
N20395	B16504/N17504	3	30.6	22.0	46.0	90.0	2.0	37.5	4.5	2.5
N18122	N15334/N15335	11	30.1	26.0	47.0	93.0	2.0	39.0	4.5	3.0
N21511	N15306/N15337	21	30.0	22.9	46.0	89.5	2.0	34.5	6.0	2.0
N18103	N13120/PR00806-81	13	29.4	23.2	46.0	91.0	2.0	35.0	3.5	1.9
N20401	B16505/N17504	1	29.2	22.1	46.5	89.5	1.5	41.0	5.0	1.5
N21532	B16504/B11519	25	29.1	20.5	47.5	93.0	2.0	38.0	5.0	2.5
N21503	N14218/N17504	30	28.7	19.2	47.0	92.5	2.5	36.5	4.5	2.5
N19243	N15331/N16405	9	28.7	21.6	46.0	91.0	2.0	35.0	6.0	2.0
N21520	N17504/N14229	19	28.6	20.5	45.5	88.0	1.0	38.5	5.0	2.0
I21920	**HMS BOUNTY**	16	28.0	19.6	45.5	93.0	2.0	38.5	4.0	3.5
N19277	N14229/N14218	4	27.7	18.8	46.5	90.0	1.5	34.0	5.0	2.5
N20317	N14218/N17504	10	27.6	20.6	47.0	88.5	1.0	40.5	6.0	2.0
N21522	N17504/B15430	22	27.3	21.0	47.5	90.5	1.5	36.0	4.5	2.0
I22001	**LIBERTY**	17	26.6	23.7	46.0	88.5	1.5	35.0	4.0	2.5
N21514	N15306/N17504	24	26.2	22.5	47.0	91.0	1.5	35.5	4.0	3.0
N22639	B19330/B19302	14	26.1	21.1	47.5	88.5	1.5	39.0	5.5	2.0
N21525	N17506/N14229	18	25.0	21.3	47.0	89.5	1.5	35.5	5.5	2.0
N20388	B15430/N14229	2	24.7	23.2	46.0	91.0	2.0	37.0	4.0	3.0
N20384	N14229/N17506	12	23.0	20.8	47.0	90.5	1.5	36.0	5.0	2.0
N11283	MEDALIST/N08003, **ALPENA**	15	21.8	20.8	47.0	90.5	3.0	36.0	4.5	2.5
N21528	N17506/B15430	28	20.0	22.6	47.0	90.0	1.5	35.5	4.5	2.0
N20404	B16505/N17504	5	19.0	22.7	45.0	88.5	1.0	31.0	4.0	1.5
MEAN (30)			28.0	21.5	46.6	90.5	1.7	37.0	4.9	2.4
LSD (.05)			5.6	1.3	1.3	1.7	1.0	3.6	1.7	0.8
CV%			11.9	3.6	1.7	1.1	32.2	5.7	20.2	18.9

EXPERIMENT 2225 TEPARY INTROGRESSION OBSERVATION NURSERY				PLANTED: 6/2/22		
NAME	**PEDIGREE**	**ENTRY**	**SEED CLASS**	**YIELD CWT /ACRE**	**100 SEED WT. (g)**	**DES. SCORE**
B20536	B15430/B16504	22	Black	27.7	23.6	6.0
N19246	N15331/N16405	24	Navy	25.2	22.4	5.0
I22103	ICA Pijao/G40001, IS7874	3	Black	23.7	27.7	4.0
I22109	ICA Pijao/G40001, IS7963	9	Red	21.8	31.1	5.0
I22120	TARS-Tep 112	20	Brown Speckle	21.4	16.5	2.0
I22102	ICA Pijao/G40001, IS7873	2	White	19.8	28.5	4.0
N18103	N13120/PR00806-81	23	Navy	19.5	25.5	4.0
I22101	ICA Pijao/G40001, IS7872	1	White	19.4	28.1	5.0
I22111	ICA Pijao/G40001, IS7973	11	Red	18.3	25.2	4.0
I22112	ICA Pijao/G40001, IS7988	12	Black	16.9	25.0	3.0
I22104	ICA Pijao/G40001, IS7878	4	White	16.9	25.8	3.0
I22110	ICA Pijao/G40001, IS7966	10	Black	16.4	27.0	5.0
B18504	Zenith//Alpena*/B09197, **ADAMS**	21	Black	16.3	22.3	4.0
I22113	ICA Pijao/G40001, IS7996	13	Black	16.2	25.0	4.0
I22114	ICA Pijao/G40001, IS8001	14	Black	15.3	24.6	3.0
I22105	ICA Pijao/G40001, IS7896	5	Black	15.2	23.5	3.0
I22115	ICA Pijao/G40001, IS8013	15	Black	13.8	23.1	4.0
I22107	ICA Pijao/G40001, IS7934	7	Black	13.6	26.7	3.0
I22119	TARS-Tep 101	19	White	13.1	15.7	2.0
I22106	ICA Pijao/G40001, IS7919	6	Black	12.4	25.0	4.0
I22108	ICA Pijao/G40001, IS7959	8	Black	12.0	23.9	3.0
I22118	TARS-Tep 93	18	Black Speckle	11.3	16.1	2.0
I22117	TARS-Tep 23	17	Black	5.8	15.6	2.0
I22116	PI 502217-s/Neb T-1-s, TARS-Tep 22	16	White	4.5	14.4	2.0
MEAN (24)				16.5	23.4	3.6

USDA-ARS 2022 Dry Bean Breeding Progress: Black, Cranberry, Kidney and Yellow Classes

Karen Cichy and Madalyn Scanlan

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Black Bean Trials: Two black bean trials were planted at the Saginaw Valley Research Farm (SVREC) in Richville, MI on May 31, 2022. The advanced yield trial consisted of 20 entries and 4 check varieties with three field replications each (Table 1). The preliminary yield trial consisted of 55 entries with two field replications. Each trial was planted in a randomized complete block design. (Table 2). The trials were planted in 4 row plots 20 ft. long with 22 inch spacing between rows. The advance yield trial was harvested on September 15, 2022 and the preliminary yield trial on September 16, 2022 both by direct harvesting the center 15 ft. of the center two rows with a Hege plot thresher. Seed yields ranged from 9.7 to 25.4 CWT/acre with an average of 18.9 CWT/acre for the advanced yield trial and 7.9 to 29.0 CWT/acre with an average of 21.9 CWT/acre for the preliminary yield trial (Tables 1 and 2). Cooking time was measured on the advanced and preliminary lines and canning quality, including canned bean appearance and color was assessed on the advanced lines (Tables 1 and 2).

Cranberry Bean Trials: Two cranberry bean trials were planted at two locations, the at the Saginaw Valley Research Farm on May 31, 2022 and the Montcalm Research Farm (MRF) in Entrican, MI on June 10, 2022. The advanced yield trial consisted of 32 entries and 4 check varieties with three replications of each entry (Table 3). The preliminary yield trial consisted of 52 entries with two replications of each entry (Table 4). The trials were planted in 4 row plots 20 ft. long with 22 inch spacing between rows. The advanced yield trial was harvested on September 16, 2022 at SVREC and on September 30, 2022 at MRF. The preliminary yield trial was harvested on September 16, 2022 at SVREC and on October 4, 2022 at MRF. For both trials the center 15 ft. of the center two rows were direct harvested with a Hege plot thresher. Seed yields ranged from 3.8 to 26.9 CWT/acre with an average of 20.1 CWT/acre for the advanced yield trial at MRF and from 7.0 to 29.4 CWT/acre with an average of 20.1 CWT/acre at SVREC. The preliminary trial yields at MRF ranged from 1.7 to 29.3 CWT/acre with an average of 13.3 CWT/acre and at SVREC ranged from 2.4 to 13.6 CWT/acre with an average of 7.7 CWT/acre (Tables 3 and 4). Many of the entries had very low yields at both locations (less than 10 CWT/acre) due to poor germination and stand establishment at MRF and heavy soils and no supplemental irrigation at SVREC. Additionally, all plots were direct harvested, and although this is not typical for cranberry beans, we are screening for germplasm that is amenable to direct harvest. Hardshell and cooking time were measured on the advanced and preliminary lines and canning quality appearance was also assessed on the advanced lines (Tables 3 and 4).

Kidney Bean Trials: Two kidney bean trials were planted at the Montcalm Research Farm on June 10, 2022. The advanced yield trial consisted of 26 entries and 10 check varieties with three replications of each entry (Table 5). The preliminary yield trial consisted of 92 entries with two replications of each entry (Table 6). The trials were planted in 4 row plots 20 ft. long with 22 inch spacing between rows. The advanced yield trial was harvested on September 30, 2022 and the preliminary yield trial was harvested on October 4, 2022. For both trials the center 15 ft. of the center two rows were direct harvested with a Hege plot thresher. Seed yields ranged from 3.8 to 22 CWT/acre with an average of 13.8 CWT/acre for the advanced yield trial and 1.3 to 15.9 CWT/acre with an average of 6 CWT/acre for the preliminary yield trial (Tables 5 and 6). Cooking time was measured on the advanced and preliminary lines and canning quality appearance was assessed on the advanced lines (Tables 5 and 6).

Yellow Bean Trials: Two yellow bean trials were planted at two locations, the at the Saginaw Valley Research Farm on May 31, 2022 and the Montcalm Research Farm on June 10, 2022. The advanced yield trial consisted of 31 entries and 5 check varieties with three replications of each entry (Table 7). The preliminary yield trial consisted of 42 entries with two replication of each entry (Table 8). The trials were planted in 4 row plots 20 ft. long with 22 inch spacing between rows. The advanced yield trial was harvested on September 9, 2022 at SVREC and September 29, 2022 at MRF. The preliminary yield trial was harvested on September 15, 2022 at SVREC and on September 29, 2022 at MRF. For both trials the center 15 ft. of the center two rows were direct harvested with a Hege plot thresher. Seed yields ranged from 3.0 to 25.0 CWT/acre with an average of 14.0 CWT/acre for the advanced yield trial at MRF and from 3.5 to 16.8 CWT/acre with an average of 9 CWT/acre for the advanced yield trial at SVREC. The preliminary yield trials at MRF ranged from 1.0 to 14.2 CWT/acre with an average of 5.1 CWT/acre and at SVREC they ranged from 3.8 to 15.9 CWT/acre with an average of 9.1 CWT/acre (Tables 7 and 8). As with the cranberry and kidney trials, many of the yellow entries had very low yields (less than 10 CWT/acre), especially in the yellow preliminary trial. This was due to poor germination and stand establishment. The poor stands were likely caused poor stand establishment at MRF, heavy soils and dry conditions at SVREC, and direct harvest at both locations. Cooking time was measured on the advanced and preliminary lines and canning quality, appearance was assessed on the advanced lines (Tables 7 and 8).

Table 1. USDA-ARS 2022 Black Bean Advanced Yield Trials at the Saginaw Valley Research Farm in Richville, Michigan

Genotype	Pedigree	Flowering	Maturity	Lodging	Plant Desirability	Plant Height	Seed Wt.	Seed Yield	Can App	Can Color	Cooking Time
		dap[1]	dap[1]	(1-5)[2]	(1-5)[3]	inches	g/100 seeds	CWT[4]	(1-5)[5]	(1-5)[6]	min
B1904-3-1	B18504\BL1402-46-101	50	100	1.3	2.0	21.3	18.1	25.4	3.5	3.1	30
BL1726-6	B1402_46_101\LPA-02(06)	50	100	1.7	2.3	20.7	22.8	25.3	3.5	4.6	23
BL1810-2-1	LPA17-08\B1403-19	50	102	1.7	4.0	25.0	21.6	24.4	2.9	2.2	32
BL1726-2	B1402_46_101\LPA-02(06)	50	99	1.7	2.0	20.3	21.4	22.9	3.4	4.2	26
B1905-2-1	LPA17-08-1\BL1402-15	49	100	1.3	2.7	21.7	21.2	21.3	3.2	2.8	36
BL1803-1-1	B1402-15\LPA9(29)M	49	98	1.0	3.0	19.7	20.6	20.4	2.9	3.2	26
BL1802-7-1	B1403-19\LPA17-08	50	101	1.3	3.3	23.7	21.9	20.0	2.7	2.1	33
B-LPA17-32-3	LPA145\Zenith	50	98	2.0	2.7	20.7	18.0	19.9	3.2	3.2	145
BL1813-4-1	LPA9(29)M\BEL1303-9	52	101	1.7	3.3	20.0	18.9	19.5	2.8	3.2	83
B1904-3-2	B18504\BL1402-46-101	50	102	1.7	3.0	21.3	17.1	19.5	3.4	2.6	28
BL1814-6-1	LPA17-08\BEL1303-9	50	102	3.7	4.7	18.3	17.9	18.8	2.9	3.5	30
BL1726-1	B1402_46_101\LPA-02(06)	50	99	1.7	2.7	20.7	21.2	18.6	3.4	4.2	22
B-LPA17-34-2	LPA145\Zenith	49	98	1.7	3.3	18.7	18.3	18.3	3.2	2.4	99
BL1801-3-1	B1403-19\LPA9(29)M	50	98	1.3	3.3	19.3	22.2	18.3	2.1	2.3	18
BL1709-6	LPA-10(09)\B1402-4-99	50	99	1.0	3.0	22.7	21.0	16.7	2.7	3.9	45
BL1815-1-1	LPA9(29)M\BEL1291D	50	.	2.7	5.0	23.3	19.6	16.1	3.6	2.9	175
BL1801-2-1	B1403-19\LPA9(29)M	50	100	3.3	4.7	23.0	21.4	15.6	3.2	2.4	20
BL1727-2	B1402_46_101\Lpa-02(06)	50	99	1.0	3.0	18.3	21.0	15.4	3.5	4.1	33
BL1703-2	Zenith\BEL1291d	50	99	1.7	4.7	23.0	20.3	10.7	3.7	3.2	32
BL1812-6-1	LPA17-08\B1402-15	50	98	1.0	4.0	19.7	20.2	9.7	2.8	2.1	20
Adams	Check	50.0	98.0	1.3	2.3	21.0	19.7	22.0	2.6	2.5	22
Zenith		50.7	99.0	1.0	2.3	19.3	21.6	21.0	3.7	4.5	22

Zorro	Check	50.0	100.0	1.0	3.0	23.3	19.0	14.3	4.3	3.1	29
Eclipse	Check	49.3	98.0	1.0	2.0	20.3	20.3	18.7	2.7	3.1	34
Grand Mean		50.0	99.5	1.6	3.2	.	20.2	18.9	3.2	3.1	44
Check Mean		50.0	98.8	1.1	2.4	.	20.2	19.0	3.3	3.3	27
LSD		1.4	2.1	0.7	0.8	.	1.3	5.1	0.5	0.4	15
C.V.		2.1	1.5	33.4	17.3	.	4.7	19.6	8.7	7.2	20

[1]dap: days after planting

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

[3]Plant Desirability: Rating on a 1 to 5 scale where 1 is the most desirable agronomically and 5 is the least desirable.

[4]CWT: hundredweight per acre

[5]Can App: Canned bean appearance rating on a 1 to 5 scale where 1 is least desirable and 5 is most desirable

[6]Can Color: Canned bean color rating on a 1 to 5 scale where 1 is least intense black to brown and 5 is the most black.

Table 2. USDA-ARS 2022 Black Bean Preliminary Yield Trials at the Saginaw Valley Research Farm in Richville, Michigan

Genotype	**Pedigree**	**Flowering**	**Maturity**	**Lodging**	**Plant Desirability**	**Plant Height**	**Seed Wt.**	**Seed Yield**	**Cooking Time**
		dap[1]	**dap[1]**	**(1-5)[2]**	**(1-5)[3]**	**inches**	**g/100 seeds**	**CWT[4]**	**min**
B2003-6-1	B18208\BLPA17-36-2	50	101	3.5	3.5	19.5	20.7	29.0	41.0
B2002-4-3	BL1730-1\B18208	50	101	2.0	1.0	21.0	21.3	28.7	31.4
B2003-2-3	B18208\BLPA17-36-2	50	100	2.0	3.0	19.5	19.7	28.5	39.1
B2001-7-1	B18222\BEL1303-10	50	104	3.5	5.0	16.0	22.3	28.5	30.0
B2003-6-5	B18208\BLPA17-36-2	50	101	4.0	4.0	20.0	21.4	28.4	31.4

B2001-2-2	B18222\BEL1303-10	50	103	3.0	4.5	21.0	19.8	28.0	25.6
B2003-6-4	B18208\BLPA17-36-2	50	100	1.0	2.5	20.5	23.6	26.4	39.1
B2003-1-1	B18208\BLPA17-36-2	50	100	2.0	2.0	22.0	19.4	25.6	40.5
B2002-1-1	BL1730-1\B18208	50	98	1.0	2.5	22.0	21.1	25.3	39.1
B2002-5-1	BL1730-1\B18208	50	98	.	1.8	23.0	22.2	25.1	28.4
B2003-2-1	B18208\BLPA17-36-2	50	100	2.0	3.0	20.0	19.8	25.1	40.5
B2002-2-1	BL1730-1\B18208	52	103	2.0	3.0	24.0	20.7	25.0	21.7
B2002-1-2	BL1730-1\B18208	50	101	2.5	3.5	24.0	20.8	24.9	42.3
B2001-2-4	B18222\BEL1303-10	52	104	2.5	4.5	22.0	17.8	24.9	31.9
B2002-4-2	BL1730-1\B18208	50	103	1.5	1.5	23.0	18.5	24.6	22.0
B2002-6-2	BL1730-1\B18208	50	100	3.0	4.0	20.0	19.3	24.5	31.7
B2002-2-2	BL1730-1\B18208	48	101	1.0	2.0	24.5	20.0	24.1	22.3
B2002-2-3	BL1730-1\B18208	50	101	1.5	1.5	25.5	20.4	23.9	29.2
B2003-2-4	B18208\BLPA17-36-2	50	100	2.5	4.5	23.5	18.2	23.7	37.4
B2001-3-1	B18222\BEL1303-10	49	101	2.0	3.5	20.5	18.5	23.5	20.4
B2002-4-1	BL1730-1\B18208	54	101	1.5	2.0	21.5	19.3	23.3	25.1
B2001-6-1	B18222\BEL1303-10	50	103	3.0	4.0	21.5	22.1	23.3	24.0
B2001-7-3	B18222\BEL1303-10	49	103	2.0	3.5	16.5	20.4	23.2	46.3
B2002-1-3	BL1730-1\B18208	50	103	2.0	3.5	24.5	20.3	22.9	33.6
B2003-6-3	B18208\BLPA17-36-2	50	103	3.5	4.5	18.0	20.8	22.6	30.8
B2002-6-1	BL1730-1\B18208	50	101	3.0	3.5	20.0	21.9	22.5	34.0
B2003-2-10	B18208\BLPA17-36-2	50	103	4.0	4.5	19.0	18.5	22.1	23.2
B2003-7-1	B18208\BLPA17-36-2	55	101	3.0	4.0	24.5	21.2	21.9	29.0
B2001-6-2	B18222\BEL1303-10	50	103	2.5	3.5	22.0	21.4	21.7	40.7
B2003-2-6	B18208\BLPA17-36-2	50	104	3.0	4.0	23.0	19.4	21.7	36.0
B2001-2-3	B18222\BEL1303-10	50	100	2.5	4.5	19.0	19.7	21.3	23.3
B2003-8-3	B18208\BLPA17-36-2	50	100	2.5	3.5	24.0	21.2	21.0	32.3
B2001-2-1	B18222\BEL1303-10	52	104	3.0	4.5	20.5	18.8	21.0	25.4
B2003-5-1	B18208\BLPA17-36-2	50	101	2.0	4.0	19.0	20.5	20.7	22.9
B2002-6-3	BL1730-1\B18208	52	101	2.5	4.0	24.0	19.8	20.7	40.3
B2001-5-1	B18222\BEL1303-10	50	103	2.0	4.0	25.0	19.9	20.4	20.8
B2003-2-2	B18208\BLPA17-36-2	53	100	2.0	4.0	23.5	18.9	20.2	30.7

B2003-2-7	B18208\BLPA17-36-2	52	100	2.5	4.0	24.0	20.6	20.1	33.0
B2002-3-1	BL1730-1\B18208	54	104	2.5	5.0	24.5	17.2	20.0	30.0
B2003-2-5	B18208\BLPA17-36-2	50	103	2.5	4.0	21.5	17.6	19.6	26.4
B2001-7-2	B18222\BEL1303-10	49	104	3.5	5.0	21.5	21.4	19.4	37.0
B2003-4-2	B18208\BLPA17-36-2	49	98	1.0	3.0	22.5	19.7	19.2	23.4
B2002-10-1	BL1730-1\B18208	50	104	1.5	3.5	24.0	19.6	18.5	36.5
B2003-3-1	B18208\BLPA17-36-2	50	101	1.5	3.0	22.0	21.9	18.2	16.6
B2003-3-2	B18208\BLPA17-36-2	48	98	1.0	2.5	18.5	23.6	18.0	20.8
B2002-1-4	BL1730-1\B18208	50	104	2.5	4.0	20.0	19.3	17.8	34.0
B2003-8-2	B18208\BLPA17-36-2	49	98	1.5	4.0	19.0	18.9	17.0	159.1
B2003-6-2	B18208\BLPA17-36-2	49	101	2.0	4.0	23.5	20.3	16.8	32.1
B2003-4-1	B18208\BLPA17-36-2	48	100	1.0	2.0	21.5	19.1	16.2	24.9
B2003-2-9	B18208\BLPA17-36-2	52	104	3.5	5.0	20.5	18.4	15.4	30.9
B2001-1-2	B18222\BEL1303-10	50	101	2.6	2.8	20.5	20.5	15.1	47.3
B2001-1-1	B18222\BEL1303-10	50	104	3.0	4.5	18.5	22.8	14.9	37.5
B2003-2-8	B18208\BLPA17-36-2	49	98	1.0	4.0	21.5	15.6	7.9	58.5
Grand Mean		50.3	101.2	2.3	3.5	.	20.1	21.9	34.2
LSD		2.2	2.5	1.1	1.1	.	1.7	7.5	8.9
C.V.		2.6	1.5	29.1	18.6	.	5.0	20.5	15.5

[1]dap: days after planting

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

[3]Plant Desirability: Rating on a 1 to 5 scale where 1 is the most desirable agronomically and 5 is the least desirable.

[4]CWT: hundredweight per acre

Table 3. USDA-ARS 2022 Cranberry Bean Advanced Yield Trials at the Montcalm Research Farm in Entrican, Michigan and the Saginaw Valley Research Farm in Richville, MI

Genotype	Pedigree	Flowering	Maturity	Lodging	Plant Height	Seed Wt.	Seed Yield Irrigated	Seed Yield Dryland	Can App	Hardshell	Cooking Time
		dap[1]	dap[1]	(1-5)[2]	inches	g/100 seeds	CWT[3]	CWT[3]	(1-5)[4]	Percent[5]	min
CR1937-1-2	SR1227-038\PIC8	40	100	2.7	19.7	62.1	26.9	10.0	1.8	83	110.5
CR1804-2-2	ADP0562\ADP0517	41	100	3.7	17.5	52.4	21.8	8.0	3.9	0	52.9
CR1921-1-1	PIC3\PIC8	40	100	2.3	18.3	55.9	21.6	12.7	2.6	92	105.2
CR1937-1-3	SR1227-038\PIC8	40	100	2.0	16.0	60.6	20.8	10.3	1.7	85	104.0
CR1937-1-1	SR1227-038\PIC8	39	100	2.0	17.2	62.1	20.3	11.8	2.2	0	109.3
CR1921-2-1	PIC3\PIC8	41	100	3.3	20.8	61.1	19.8	11.6	2.7	0	106.3
CR1802-1-2	ADP0562\MICran	41	107	4.3	15.0	60.6	19.5	7.6	3.9	0	26.3
CR1941-1-1	SR1227-082\CR1402-1	43	100	4.7	19.0	59.4	18.3	10.0	3.8	75	106.0
CR1934-2-1	SR1227-038\CR1502-1	39	100	2.0	16.3	50.2	17.3	9.8	2.4	0	30.3
CR1801-2-2	ADP0562\Bellagio	40	100	1.7	12.8	57.8	17.2	8.8	3.3	0	39.6
CR1802-3-2	ADP0562\MICran	39	102	1.7	14.2	43.5	17.0	12.7	3.5	0	32.6
CR1921-3-1	PIC3\PIC8	40	100	2.7	15.0	58.2	15.3	8.4	4.1	88	130.9
CR1809-1-1	CR1504_12\CM433	40	104	2.0	16.5	50.3	15.0	10.5	1.8	0	22.3
CR1804-3-1	ADP0562\ADP0517	40	111	2.0	14.7	48.3	14.8	9.4	2.0	0	25.4
CR1801-2-1	ADP0562\Bellagio	40	104	2.3	21.5	54.5	14.5	9.4	3.6	0	43.6
CR1807-1-1	ADP0562\Snowdon	39	100	1.7	14.7	51.9	14.2	10.2	2.9	0	24.1
CR1921-2-2	PIC3\PIC8	40	107	3.0	16.8	60.4	11.9	13.6	3.6	92	100.2
CR1921-3-2	PIC3\PIC8	39	100	2.3	12.5	52.3	11.6	10.6	3.3	95	124.3
CR1934-1-1	SR1227-038\CR1502-1	40	107	2.3	18.3	32.9	11.6	5.1	4.4	3	26.7
CR1809-2-2	CR1504_12\CM433	39	107	2.3	13.5	56.5	10.6	4.1	3.4	0	34.5
CR1803-3-1	ADP0562\Etna	40	111	1.3	17.3	55.1	10.5	8.7	2.4	0	26.8
CR1809-2-1	CR1504_12\CM433	40	100	2.3	16.8	48.2	10.3	4.4	3.3	0	26.8

CR1806-1-1	ADP0562\ADP0168	41	106	1.7	14.8	50.7	10.2	5.5	2.4	0	25.9
CR1913-1-3	CR1512-2\PIC8	40	100	2.3	15.3	55.3	8.9	3.8	2.7	53	88.7
CR1801-6-1	ADP0562\Bellagio	40	107	1.7	15.7	58.1	8.0	4.8	2.6	0	32.0
CR1809-2-3	CR1504_12\CM433	40	111	2.0	15.7	49.6	7.9	3.4	2.4	0	24.4
CR1913-1-1	CR1512-2\PIC8	39	98	1.7	12.2	58.9	7.2	8.6	2.6	40	54.3
CR1902-3-1	14L1203B\CR1502-1	39	100	1.3	11.8	43.2	7.1	2.5	3.9	7	26.8
CR1703-1	ADP0562\14L1203C	39	97	1.0	10.8	53.5	5.2	1.8	3.2	0	38.6
14L1203B	.	39	100	1.3	10.7	57.5	4.9	2.1	3.4	0	34.6
CR1703-2	ADP0562\14L1203C	39	98	1.0	14.0	47.0	4.4	3.0	4.0	0	30.1
CR1916-1-1	CR1512-2\Wit-rood	39	97	1.3	10.3	47.3	3.8	4.4	3.9	77	107.9
Etna	Check	39	95	1.0	12.3	56.8	9.1	2.8	2.4	3	34.7
MI Cran	Check	42	111	5.0	17.2	59.2	16.9	9.9	4.9	0	40.9
Bellagio	Check	42	100	3.3	15.7	58.3	14.6	8.5	4.0	0	49.1
C19HR322ND	Check	39	98	2.0	17.3	57.0	9.3	.	3.5	0	32.9
Grand Mean		40	102	2.3	.	54.1	13.3	7.7	3.1		56.4
Check Mean		41	101	2.8	.	57.8	12.5	7.5	3.7		39.4
LSD		2	4	0.9	.	2.7	4.9	2.7	0.7		8.3
C.V.		3	3	29.8	.	3.7	27.2	26.2	13.7		8.7

[1]dap: days after planting

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

[3]CWT: hundredweight per acre

[4]Can App: Canned bean appearance rating on a 1 to 5 scale where 1 is least desirable and 5 is most desirable

[5]Hardshell: Percent of 30 beans that did not take up water after soaking in distilled water at room temperature for 12 hr

Table 4. USDA-ARS 2022 Cranberry Bean Preliminary Yield Trials at the Montcalm Research Farm in Entrican, Michigan and the Saginaw Valley Research Farm in Richville, MI

Genotype	Parents	Flowering[1]	Maturity[1]	Lodging[1]	Seed Wt.[1]	Seed Yield Irrigated[1]	Seed Yield dryland[2]	Hardshell[1]	Cooking time[1]
		Dap[3]	Dap[3]	(1-5)[4]	g/100 seeds	CWT[5]	CWT[5]	percent	min
CR2006-2-3	15C2\CO301RR	45	110	3	34.2	10.6	16.1	50.0	67.5
CR2001-1-2	CR1703-2\NE9-18-3	.	105	1.5	58.8	7.5	6.5	0	110.0
CR2007-3-1	15C2\NE-9-18-3	41.5	102.5	1	66.0	6.2	6.3	0	28.8
CR2001-1-3	CR1703-2\NE9-18-3	40	102.5	2	58.3	5.0	7.2	0	84.0
CR2007-1-1	15C2\NE-9-18-3	40	100	1	59.3	4.2	4.2	30.0	40.8
CR2004-1-3	15C2\CR1703-2	43	110	1	55.6	3.8	3.5	0	25.7
CR2005-1-2	CR1704-2\Racer	40	100	1	63.4	3.6	1.3	0	28.1
CR2005-2-1	CR1704-2\Racer	38	100	1	60.7	3.6	2.1	0	30.2
CR2007-2-1	15C2\NE-9-18-3	.	100	1	67.4	3.4	2.4	0	25.5
CR2005-2-2	CR1704-2\Racer	40	100	1	65.6	3.2	1.0	0	32.0
CR2005-1-1	CR1704-2\Racer	40	100	1.5	58.2	3.2	1.1	0	28.6
CR2001-2-1	CR1703-2\NE9-18-3	.	105	1	60.4	2.9	6.8	0	76.0
RR1910-2-2	CSU	41.5	100	1	28.7	2.8	3.2	0	22.7
CR2007-3-2	15C2\NE-9-18-3	43	105	1	66.9	2.7	4.1	0	30.3
CR2004-2-1	15C2\CR1703-2	.	100	2	55.3	2.6	.	0	32.3
CR2007-1-2	15C2\NE-9-18-3	.	107	1	64.3	2.3	2.7	0	29.3
CR2001-2-3	CR1703-2\NE9-18-3	40	100	1	54.0	2.3	1.8	0	35.6
CR2004-1-2	15C2\CR1703-2	40	105	1	56.8	2.0	4.1	0	31.7
CR2002-3-1	14L1203B\14C2	40	100	1	55.9	1.8	3.5	0	34.4
CR2002-7-4	14L1203B\14C2	40	105	2	57.4	1.8	.	.	.
CR2002-7-7	14L1203B\14C2	38	100	.	57.3	1.7	.	0	30.1
CR2004-1-1	15C2\CR1703-2	40	105	1	58.8	1.7	.	0	30.0
RR1910-2-1	CSU	.	.	.	32.2	1.7	7.1	.	.
CR2002-3-3	14L1203B\14C2	.	100	1	.	1.4	.	0	32.1
CR2008-2-1	14L203B\Racer	38	100	1	.	1.3	.	0	28.5

CR2008-6-1	14L203B\Racer	40	100	1	.	1.1	.	0	28.1
CR2008-5-1	14L203B\Racer	40	100	1	.	0.8	.	0	51.5
CR2001-1-1	CR1703-2\NE9-18-3	40	100	1	.	0.7	4.5	0	30.4
CR2007-1-3	15C2\NE-9-18-3	45	105	1	.	0.4	2.5	0	26.0
CR2001-2-2	CR1703-2\NE9-18-3	.	.	.	.	.	0.9	.	.
CR2002-3-2	14L1203B\14C2	.	.	.	.	.	1.3	.	.
CR2002-5-1	14L1203B\14C2	.	.	.	.	.	0.8	.	.
CR2006-1-1	15C2\CO301RR	.	.	.	.	.	6.0	.	.
CR2006-1-2	15C2\CO301RR	.	.	.	.	.	0.9	.	.
CR2006-1-3	15C2\CO301RR	.	.	.	.	.	3.9	.	.
CR2006-2-2	15C2\CO301RR	.	.	.	.	.	3.3	.	.
CR2008-4-1	14L203B\Racer	.	.	.	.	.	1.0	.	.
CR2008-5-2	14L203B\Racer	.	.	.	.	.	0.8	.	.
CR2008-7-3	14L203B\Racer	.	.	.	.	.	0.5	.	.
CR2008-7-4	14L203B\Racer	.	.	.	.	.	2.5	.	.
averages		41	102	1.2	56.3	3.0	3.6	3.0	38.9

[1]Measured at the Montcalm Research Farm trial location.

[2]Measured at the Saginaw Valley Research Farm trial location.

[3]dap: days after planting

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

[5]CWT: hundredweight per acre

Table 5. USDA-ARS 2022 Kidney Bean Advanced Yield Trials at the Montcalm Research Farm in Entrican, Michigan

Genotype	Pedigree	Flowering	Maturity	Lodging	Plant Desirability	Plant Height	Seed Wt.	Seed Yield	Can App	Cooking Time
		dap[1]	dap[1]	(1-5)[2]	(1-5)[3]	inches	g/100 seeds	CWT[4]	(1-5)[5]	min
DRK1601-1	ADP0778\1531JB	39	100	1.3	2.3	17.3	50.6	22.0	2.8	32.4
JC1803-1-1	UCD 0908\UCD 0701	40	106	2.0	4.0	17.7	58.0	21.6	1.0	31.8
WK1601-1	Y11405\ADP512	41	100	2.7	4.3	20.2	44.1	18.5	2.7	32.9
JC1803-6-1	UCD 0908\UCD 0701	39	100	3.0	4.3	15.2	48.3	18.2	2.9	49.4
DRK1601-3	ADP0778\1531JB	39	100	2.7	2.7	17.8	47.2	18.0	1.8	33.7
JC1803-3-1	UCD 0908\UCD 0701	42	104	3.0	3.3	19.7	52.7	16.8	3.1	40.3
JC1803-4-1	UCD 0908\UCD 0701	40	106	2.7	4.0	20.8	41.1	16.6	1.6	30.7
WK1601-2	Y11405\ADP512	38	102	2.3	3.7	16.7	53.3	16.5	3.1	43.2
LRK1701-2	K15901\TZ-37	39	107	2.7	4.7	18.7	42.9	16.2	2.6	28.3
WK1602-1	Snowdon\ADP521	40	109	1.7	4.3	17.3	53.4	15.4	3.7	26.1
WK1602-2	Snowdon\ADP521	38	104	1.3	3.0	18.0	53.4	15.3	2.4	26.0
LRK1701-3	K15901\TZ-37	.	102	3.7	4.7	20.8	44.8	14.8	1.3	29.2
K1910-1-1	SR1227-168\ADP0604	39	98	1.0	3.0	16.2	51.9	13.9	2.6	26.6
DRK1805-1-1	K16640\ADP0469	40	102	1.7	4.3	17.0	61.4	13.5	2.3	37.6
DRK1922-1	PIC19\Red Cedar	40	105	2.0	4.0	15.8	56.3	13.1	3.3	31.3
WK1802-4-1	ADP0587\Snowdon	39	103	1.0	2.7	15.0	55.2	13.0	1.8	36.0
WK1806-1-2	K16136\ADP0469	39	109	1.3	5.0	17.2	56.3	12.9	1.1	31.0
K1913-1	SR1227-168\PIC49	41	102	1.0	3.0	14.8	53.7	10.6	3.3	25.1
WK1806-1-1	K16136\ADP0469	37	97	1.0	2.0	13.0	57.0	9.4	1.3	28.3
K1910-1-2	SR1227-168\ADP0604	39	98	1.0	3.0	15.3	52.3	7.9	2.6	33.9
DRK1922-2-2	PIC19\Red Cedar	43	111	1.7	5.0	16.2	60.1	7.5	3.9	24.0
LRK1902-1	ADP0603\K15601	42	100	1.7	3.0	15.8	40.3	7.3	3.6	37.0
DRK1922-2-1	PIC19\Red Cedar	39	98	1.0	3.3	11.7	47.7	6.9	1.8	23.4
WK1805-2-2	ADP0781\Snowdon	39	95	1.0	4.0	15.2	43.6	5.1	2.6	25.7
K1902-1	SR1227-168\K16136	40	108	1.0	4.3	10.7	44.4	4.7	3.1	30.7

WK1804-7-1	ADP0106\Snowdon	38	110	2.3	4.3	17.8	49.4	3.8	3.2	29.8
Coho	LRK Check	39	106	1.7	3.7	16.0	49.5	20.4	2.0	27.7
Snowdon	WK Check	37	105	2.0	3.7	15.0	55.1	12.0	1.7	27.0
Cluoseau	LRK Check	37	100	1.3	2.7	.	57.5	17.6	3.6	28.0
Red Hawk	DRK Check	39	100	1.3	2.3	17.7	51.4	13.1	4.0	36.2
Dynasty	DRK Check	39	100	1.7	3.7	20.2	61.2	16.0	2.2	35.6
Montcalm	DRK Check	39	106	2.0	4.3	13.8	53.7	19.0	3.5	34.8
PinkPanther	LRK Check	37	100	1.7	3.3	15.7	62.5	15.7	3.0	39.5
Beluga	WK Check	41	104	2.0	4.0	17.8	55.2	13.4	1.8	40.1
NDWhitetail	WK Check	40	100	1.3	3.0	17.3	54.1	12.8	1.4	29.0
Grand Mean		39	103	1.8	3.6	.	52.1	13.8	2.6	32.3
Check Mean		39	102	1.6	3.4	.	55.6	15.6	2.6	34.0
LSD		2	4	0.9	1.0	.	2.7	5.7	1.0	5.9
C.V.		4	3	36.6	20.4	.	3.8	30.2	22.3	10.8

[1]dap: days after planting

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

[3]Plant Desirability: Rating on a 1 to 5 scale where 1 is the most desirable agronomically and 5 is the least desirable.

[4]CWT: hundredweight per acre

[5]Can App: Canned bean appearance rating on a 1 to 5 scale where 1 is least desirable and 5 is most desirable.

Table 6. USDA-ARS 2022 Kidney Bean Preliminary Yield Trials at the Montcalm Research Farm in Entrican, Michigan

Genotype	parents	Flowering	Maturity	Lodging	Seed Wt.	Seed Yield	Cooking Time
		dap[1]	dap[1]	(1-5)[2]	g/100 seeds	CWT[3]	min
K2007-4-1	Coho\LRK1701-2	42	103	3.0	51.0	15.9	38.2
LRK1935-1-5	PIC49 (16JD_PIC_65_4374_4_B)\SA118	42	110	2.2	52.6	14.5	37.0
K2002-1-1	Coho\DRK1601-5	44	105	2.0	57.6	13.1	37.2
LRK1911-1-1	ADP0604 \PIC46 (16MB_PIC_132_2)	45	107	1.0	58.9	12.2	29.4
K2006-4-1	DRK1701-2\WK1602-1	40	112	3.2	52.4	10.9	43.0
K2007-4-2	Coho\LRK1701-2	42	100	4.2	53.3	10.9	29.5
K2003-2-4	WK1602-1\Coho	40	100	4.0	45.8	10.7	33.6
K2007-4-3	Coho\LRK1701-2	40	107	3.0	54.7	10.5	29.3
K2002-3-3	Coho\DRK1601-5	44	110	1.2	51.8	10.3	29.4
LRK1935-1-2	PIC49 (16JD_PIC_65_4374_4_B)\SA118	43	105	1.5	53.9	10.0	30.8
K2009-5-1	DRK1601-3\Whitetail	39	103	2.2	48.3	9.2	40.1
K2009-3-1	DRK1601-3\Whitetail	40	103	2.2	48.4	9.2	26.5
K2009-7-1	DRK1601-3\Whitetail	43	110	1.2	56.6	9.0	27.3
K2007-1-3	Coho\LRK1701-2	39	105	1.2	61.6	8.8	39.7
K2007-2-3	Coho\LRK1701-2	42	105	1.2	51.4	8.8	38.4
K2009-1-1	DRK1601-3\Whitetail	40	112	1.2	56.0	8.7	23.3
K2009-6-1	DRK1601-3\Whitetail	42	103	2.2	50.3	8.7	37.5
K2003-2-2	WK1602-1\Coho	42	100	1.2	49.1	8.0	32.8
K2007-2-2	Coho\LRK1701-2	39	108	1.2	51.7	7.5	32.5
K2002-3-2	Coho\DRK1601-5	40	100	3.2	53.1	7.4	32.2
K2003-6-2	WK1602-1\Coho	40	100	3.2	55.6	7.4	.
WK1901-1-2	K16957\ND122386	40	100	1.2	47.0	7.4	26.1
K2002-2-3	Coho\DRK1601-5	39	100	1.5	51.1	7.1	29.7
K2010-3-1	Coho\WK1602-1	39	100	3.0	49.8	6.8	30.7
K1920-1-2	SR1227-168\ND122386	44	100	4.2	46.5	6.7	.
K1920-2-3	SR1227-168\ND122386	42	110	3.5	49.1	6.7	33.0
K2009-3-2	DRK1601-3\Whitetail	42	100	2.5	45.8	6.7	29.0

K2002-2-5	Coho\DRK1601-5	41	105	2.0	50.2	6.6	32.2
LRK1911-1-3	ADP0604 \PIC46 (16MB_PIC_132_2)	43	103	1.2	58.1	6.6	40.1
K2008-2-2	LRK1701-2\Whitetail	42	105	3.2	55.1	6.6	27.6
LRK1910-1-3	ADP0604 \K15601	39	110	1.5	48.6	6.5	34.4
K2003-7-3	WK1602-1\Coho	40	103	2.2	46.3	6.3	32.6
LRK1917-1-2	ADP0604\SA118	38	95	1.2	49.8	6.2	41.8
K2010-2-4	Coho\WK1602-1	40	105	3.0	46.4	6.2	26.0
LRK1935-1-3	PIC49 (16JD_PIC_65_4374_4_B)\SA118	40	107	3.2	58.7	6.0	28.2
K2003-6-1	WK1602-1\Coho	40	100	3.2	47.9	5.9	39.0
K2003-6-3	WK1602-1\Coho	38	98	1.5	47.9	5.9	34.4
K2010-2-5	Coho\WK1602-1	42	110	2.5	49.6	5.8	26.8
K2003-5-2	WK1602-1\Coho	43	112	2.2	50.7	5.5	42.0
K2002-2-2	Coho\DRK1601-5	39	100	2.2	49.0	5.4	34.2
K2010-2-1	Coho\WK1602-1	44	112	1.2	46.9	5.4	29.9
K2002-2-6	Coho\DRK1601-5	39	100	4.0	48.6	5.4	40.0
K2009-6-2	DRK1601-3\Whitetail	42	100	1.2	53.1	5.2	48.4
K2002-1-4	Coho\DRK1601-5	40	105	1.2	50.1	5.2	27.6
LRK1904-2-1	ADP0603\PIC49 (16JD_PIC_65_4374_4_B)	38	95	1.0	52.9	5.1	29.6
LRK1935-1-4	PIC49 (16JD_PIC_65_4374_4_B)\SA118	40	107	1.0	56.3	5.0	25.9
K2008-2-1	LRK1701-2\Whitetail	42	103	3.2	51.6	4.9	35.1
K2003-5-3	WK1602-1\Coho	42	107	3.2	50.6	4.6	.
K2003-7-6	WK1602-1\Coho	39	100	1.5	42.7	4.4	40.5
LRK1910-1-4	ADP0604 \K15601	39	107	1.2	54.4	4.4	38.4
K2002-3-1	Coho\DRK1601-5	39	103	2.2	48.2	4.3	27.5
K2008-3-1	LRK1701-2\Whitetail	43	110	1.2	52.0	4.3	32.5
K2002-2-7	Coho\DRK1601-5	43	98	1.5	46.4	4.1	49.5
WK1901-1-1	K16957\ND122386	40	103	3.2	49.7	4.1	23.4
LRK1907-1-1	ADP0603\PIC74 (16AR_PIC_066_3)	41	105	3.5	49.1	4.1	.
K2003-7-5	WK1602-1\Coho	42	112	3.5	46.3	4.0	38.2
LRK1911-1-2	ADP0604 \PIC46 (16MB_PIC_132_2)	38	95	1.2	55.9	4.0	44.3
K2009-3-5	DRK1601-3\Whitetail	39	95	3.2	53.3	3.9	36.1

K2001-1-2	Whitetail\WK1602-1	40	103	2.2	53.0	3.4	26.5
K2010-1-4	Coho\WK1602-1	39	103	1.2	52.5	3.4	28.9
K1902-2-2	SR1227-168\K16136	45	103	2.2	36.9	3.3	30.5
K1920-1-3	SR1227-168\ND122386	43	98	3.5	49.1	3.3	.
K2003-7-1	WK1602-1\Coho	39	109	4.2	45.7	3.2	38.8
K2002-2-4	Coho\DRK1601-5	40	108	1.5	51.2	2.6	34.5
LRK1910-1-1	ADP0604 \K15601	38	103	3.0	47.0	2.3	27.9
K2009-4-1	DRK1601-3\Whitetail	42	95	1.2	53.3	2.1	42.8
K1920-2-1	SR1227-168\ND122386	40	114	3.2	51.6	2.0	28.9
LRK1910-1-2	ADP0604 \K15601	39	110	1.2	53.3	1.9	37.5
LRK1915-1-1	ADP0604\PIC74 (16AR_PIC_066_3)	38	95	1.0	57.2	1.8	42.9
K2005-2-1	LRK1701-2\WK1602-1	42	100	1.2	49.9	1.7	.
K2003-2-1	WK1602-1\Coho	38	110	1.2	44.2	1.7	30.5
K2009-3-3	DRK1601-3\Whitetail	44	100	3.2	51.6	1.6	42.8
K2010-1-3	Coho\WK1602-1	39	98	2.0	50.2	1.6	42.6
K2009-3-4	DRK1601-3\Whitetail	40	98	1.5	52.0	1.4	.
K2003-4-1	WK1602-1\Coho	39	98	1.2	51.6	1.4	37.4
K2002-1-3	Coho\DRK1601-5	40	105	1.2	48.2	1.3	43.2
LRK1917-1-3	ADP0604\SA118	40	103	1.2		.	35.4
K1910-1-1	SR1227-168\ADP0604	41	100	3.2	37.0	.	63.3
K2006-3-1	DRK1701-2\WK1602-1	39	98	2.2		.	42.7
K2002-1-2	Coho\DRK1601-5	39	110	4.2		.	53.1
K1902-2-1	SR1227-168\K16136	45	114	1.2	.	.	.
K1920-1-1	SR1227-168\ND122386	43	114	1.2	.	.	.
K2002-2-1	Coho\DRK1601-5	43	110	1.0	.	.	.
K2003-5-1	WK1602-1\Coho	44	107	2.2	.	.	.
K2004-1-1	LRK1701-2\WK1601-2	43	107	3.0	.	.	.
K2007-1-2	Coho\LRK1701-2	40	114	3.2	.	.	.
K2007-1-4	Coho\LRK1701-2	42	107	1.2	.	.	.
K2010-1-2	Coho\WK1602-1	38	103	1.2	.	.	54.2
K2010-2-2	Coho\WK1602-1	43	114	2.2	.	.	.
K2010-2-3	Coho\WK1602-1	44	114	1.2	.	.	.

LRK1935-1-1	PIC49 (16JD_PIC_65_4374_4_B)\SA118	40	114	3.2	.	.	.
K2003-7-4	WK1602-1\Coho	40	114	1.5	.	.	.
Grand Mean		41	104	2.2	50.7	6.0	35.2
LSD		3	8	0.8	2.6	5.0	9.7
C.V.		4	4	21.5	3.1	53.4	16.3

[1]dap: days after planting

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

[3]CWT: hundredweight per acre

Table 7. USDA-ARS 2022 Yellow Bean Advanced Yield Trials at the Montcalm Research Farm in Entrican, Michigan and the Saginaw Valley Research Farm in Richville, MI

Genotype	Parents	Flowering[1]	Maturity[1]	Lodging[1]	Plant Height[1]	Seed Wt.[1]	Seed Yield Irrigated[1]	Seed Yield Dryland[2]	Can App[1]	Cooking Time [1]
		Dap[3]	Dap[3]	(1-5)[4]	inches	g/100 seeds	CWT[5]	CWT[5]	(1-5)[6]	min
Y1610-01	DYB-28-1\ADP-521	43	100	2.7	17.2	47.3	25.0	12.6	3.7	15.7
Y1803-5-3	ADP0781\mayacoba	45	108	2.3	16.0	46.0	23.8	16.5	3.0	21.1
RRY1803-1-1	ADP0512\Patron	40	102	1.7	14.7	43.9	23.8	13.0	2.7	26.7
CR1939-2-1	SR1227-038\W6-51279	40	109	1.7	17.8	41.7	21.8	4.2	2.0	26.1
Y1983-1-1	YBC228\YBC195	43	106	2.7	18.2	46.4	21.6	.	2.6	26.3
Y1802-9-1	ADP0781\Patron	39	102	2.3	16.0	41.1	21.0	13.4	3.2	24.5
Y1703-21	ADP0781\Y11405	36	102	1.0	16.0	46.6	20.4	10.1	2.0	25.6
Y1803-8-1	ADP0781\mayacoba	39	102	1.7	16.5	40.2	18.7	9.8	2.9	22.8
RRY1801-1-1	ADP0476\Patron	39	102	1.7	12.7	26.8	18.5	16.8	3.6	27.2
Y1608-14	Y11405\ADP521	38	97	1.7	14.2	40.5	16.7	6.9	1.3	22.6
Y1802-2-1	ADP0781\Patron	42	109	2.3	16.0	41.6	16.6	7.9	3.3	25.0
Y1934-2-3	YBC114\YBC122	38	100	1.0	18.5	50.4	16.4	.	1.7	23.8

Y1804-1-1	ADP0781\ADP0791	39	107	1.7	16.3	36.1	16.3	13.8	2.8	34.3
Y1702-22	ADP0781\Akaryose	38	105	1.0	12.2	36.3	15.6	10.3	1.5	16.1
Y1802-11-2	ADP0781\Patron	38	95	1.0	14.5	38.3	15.4	8.6	2.2	20.8
Y1608-07	Y11405\ADP521	39	107	1.3	15.5	38.6	13.8	8.2	2.3	22.7
Y1980-3-1	YBC200\YBC212	37	98	1.0	13.2	39.8	12.5	7.4	1.6	24.5
Y1923-1-2	YBC063\YBC211	37	98	1.0	10.5	46.4	11.9	.	1.7	36.9
Y1963-1-1	YBC190\YBC211	35	84	1.0	13.3	38.4	11.2	7.9	1.8	22.4
Y1802-11-1	ADP0781\Patron	39	98	1.3	14.7	36.0	11.0	6.0	3.5	25.5
Y1963-2-3	YBC190\YBC211	37	98	1.0	11.8	46.8	10.5	7.6	3.5	104.8
Y1983-2-1	YBC228\YBC195	37	104	1.3	13.3	46.9	10.5	3.5	3.9	21.6
Y1801-1-1	ADP0781\Snowdon	38	110	1.7	14.2	37.8	9.8	13.5	2.9	22.8
Y1960-1-1	YBC190\YBC196	39	100	1.0	12.3	40.8	9.6	10.0	1.2	24.1
Y1983-2-2	YBC228\YBC195	39	106	1.0	16.3	37.1	9.5	3.8	2.4	21.8
Y1963-2-1	YBC190\YBC211	37	90	1.3	13.8	44.5	9.1	6.5	2.8	67.3
Y1983-2-3	YBC228\YBC195	40	109	1.0	13.0	38.6	6.5	6.5	3.2	28.8
Y1904-1	YBC003\YBC196	37	95	1.0	11.0	37.6	4.6	.	2.8	32.0
Y1609-14	Y11405\ADP512	38	95	1.0	11.2	41.4	4.5	5.3	1.4	21.0
Y1951-1-1	YBC178\YBC195	37	97	1.0	10.7	36.6	3.1	6.0	2.6	22.3
Y1923-2-2	YBC063\YBC211	37	97	1.0	12.0	53.7	3.0	.	2.2	35.9
SVS-0863	Check	43	102	2.3	16.3	40.4	23.1	17.4	3.5	25.6
Y11405	Check	38	100	1.0	14.5	40.0	11.1	10.1	2.4	23.2
L11YL002	Check	37	91	1.0	10.7	39.4	3.1	6.9	.	26.2
Patron	Check	39	104	2.0	16.7	44.4	19.7	16.6	2.7	25.1
Yellowstone	Check	38	102	1.0	11.7	37.6	3.4	8.1	4.1	31.4
Averages		39	101	1	14	41	14	10	3	28

[1]Measured at the Montcalm Research Farm trial location.

[2]Measured at the Saginaw Valley Research Farm trial location.

[3]dap: days after planting

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

[5]CWT: hundredweight per acre

[6]Can App: Canned bean appearance rating on a 1 to 5 scale where 1 is least desirable and 5 is most desirable.

Table 8. USDA-ARS 2022 Yellow Bean Preliminary Yield Trials at the Montcalm Research Farm in Entrican, Michigan and the Saginaw Valley Research Farm in Richville, MI

Genotype	Pedigree	Flowering [1]	Maturity [1]	Lodging [1]	Plant Desirability [1]	Seed Wt. [1]	Seed Yield Irrigated[1]	Seed Yield dryland[2]	Cooking time irrigated[1]	Cooking time dryland[2]
		dap[3]	dap[3]	(1-5)[4]	(1-5)[5]	g/100 seeds	CWT[6]	CWT[6]	min	min
Y2004-2-5	Y1608-6\PIC86	39	103	1.0	2.5	57.0	14.2	6.0	24.1	30.8
Y2010-1-1	Bukoba\Y1703-22	39	107	1.0	4.0	56.7	10.0	15.9	21.0	22.2
Y2004-1-5	Y1608-6\PIC86	39	100	1.5	3.5	51.4	9.5	9.8	27.2	22.6
Y2002-2-5	Y1609-2\PIC86	40	107	2.5	4.0	62.0	8.6	13.4	19.4	21.3
A17157a-1	Y16503\STAYBRIGHT	38	110	4.0	4.0	54.8	6.6	7.8	.	23.7
Y2010-1-2	Bukoba\Y1703-22	40	100	1.0	3.0	53.9	6.5	10.9	18.4	22.9
Y2010-1-3	Bukoba\Y1703-22	38	103	1.0	2.5	56.2	6.3	10.5	20.0	24.1
OT2001-1-1	YBC200\Samurai	43	103	3.0	4.0	30.6	6.2	12.8	91.9	24.8
Y2002-1-3	Y1609-2\PIC86	41	108	1.0	3.5	50.6	6.1	11.3	21.9	22.7
A17159B-PS-2	Y16503\PI 151017	41	108	1.5	4.5	57.2	5.6	10.0	20.9	34.3
Y2010-1-4	Bukoba\Y1703-22	40	100	1.0	2.5	66.5	4.8	13.4	18.6	23.9
Y2007-1-2	YBC206\PIC86	40	112	1.0	4.5	55.5	4.4	6.5	.	23.8
Y2012-1-1	Y1612-1\PIC86	39	103	1.0	3.0	54.7	4.4	7.2	20.8	28.0
A17159B-PS-1	Y16503\PI 151016	39	108	2.5	4.5	45.1	3.6	9.8	25.2	.
Y2002-1-1	Y1609-2\PIC86	40	108	2.0	4.0	50.5	3.6	6.2	19.3	21.2
Y1979-2-2	YBC200\YBC211	37	95	1.0	4.0	62.5	2.9	5.4	21.6	31.6
Y1979-2-1	YBC200\YBC211	38	95	1.0	4.0	35.9	2.6	8.0	33.4	41.0
Y2004-2-2	Y1608-6\PIC86	39	114	2.5	5.0	64.5	2.6	9.6	.	28.6
Y2012-3-1	Y1612-1\PIC86	39	95	1.0	3.5	52.2	2.4	4.4	18.3	29.0
Y1904-1-3	YBC003\YBC196	38	95	1.0	4.0	44.8	2.2	10.4	33.6	29.0
Y2004-1-2	Y1608-6\PIC86	39	105	1.0	4.0	39.3	1.4	5.8	20.9	23.8

Y2004-2-3	Y1608-6\PIC86	39	103	1.5	3.0	56.3	1.1	7.3	20.0	34.4
Y2004-2-4	Y1608-6\PIC86	40	103	1.0	2.0	.	1.0	3.8	20.2	27.0
Y1904-1-2	YBC003\YBC196	39	95	1.0	4.5	.	.	6.5	.	35.6
Y2001-2-2	Y1608-14\PIC86	39	100	2.0	4.0	.	.	10.2	.	27.8
A17157a-2	Y16503\STAYBRIGHT	.	.	.	.	.	.	5.0	.	87.2
A17157B-Y-1	Y16503\STAYBRIGHT	.	.	.	.	.	.	12.0	.	23.9
A17157B-Y-2	Y16503\STAYBRIGHT	.	.	.	.	.	.	6.5	.	33.9
Y1904-1-1	YBC003\YBC196	39	95	1.0	4.0	.	.	11.3	.	35.9
Y1912-2-1	YBC045\YBC196	.	.	.	.	.	.	4.2	.	32.2
Y2001-2-1	Y1608-14\PIC86	40	103	1.0	4.5	.	.	11.5	.	25.4
Y2002-2-4	Y1609-2\PIC86	40	108	1.0	4.0	.	.	11.4	.	23.7
Y2004-1-4	Y1608-6\PIC86	39	114	2.0	5.0	.	.	14.6	.	22.8
Y2007-1-1	YBC206\PIC86	.	.	.	.	.	.	4.3	.	25.2
Y2007-1-3	YBC206\PIC86	.	114	2.0	5.0	.	.	9.6	.	28.3
Y2007-1-4	YBC206\PIC86	43	114	1.5	5.0	.	.	7.7	.	26.2
Y2007-1-5	YBC206\PIC86	.	.	.	.	.	.	5.2	.	21.7
Y2007-1-6	YBC206\PIC86	40	114	1.0	5.0	.	.	12.0	.	25.7
Y2007-1-7	YBC206\PIC86	40	114	1.0	5.0	.	.	14.7	.	27.4
Y2007-1-8	YBC206\PIC86	40	114	1.0	5.0	.	.	12.1	.	26.3
Y2008-1-1	Y1612-1\Y1703-21	40	108	1.5	5.0	.	.	.	.	.
Y2012-4-2	Y1612-1\PIC86	40	112	2.0	4.5	.	.	9.6	.	23.2
Grand Mean		39	105	1	4	53	5	9.1	.	28.6
LSD		.	.	.	.	.	.	3.6	.	6.9
C.V.		.	.	.	.	.	.	23.2	.	14.2

[1]Measured at the Montcalm Research Farm trial location

[2]Measured at the Saginaw Valley Research Farm trial location, [3]dap: days after planting

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

[5]Plant Desirability: Rating on a 1 to 5 scale where 1 is the most desirable agronomically and 5 is the least desirable.

[6]CWT: hundredweight per acre

Agronomic Biofortification of Commercial Black and Navy Beans with Foliar Applications of Fertilizers

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Introduction

Michigan is a leading producer of dry beans in the United States (U.S.) and demand for Michigan grown beans is high due to their superior seed quality. Domestically, Michigan beans are known for their excellent cooking, processing and canning qualities. Internationally, beans produced in the Great Lakes region are valued for their seed coat color and cooking quality. The nutritional content of Michigan dry beans is another quality aspect that can be explored further to add value to the crop.

Dry beans are a naturally rich source of trace minerals essential to human health, including iron, zinc and manganese. Dry beans are also a key target crop for the biofortification of iron using traditional breeding approaches. Publicly Available Specification (PAS) for high iron concentrations in beans have been established by international agencies including HarvestPlus® and the British Standards Institute (BSI) with three classes of enrichment to signify nutritional impact (**Table 1**; https://www.bsigroup.com/en-GB/standards/pas-234/). However, the biofortification of iron in dry beans depends on the growing conditions, agronomic practices and the processing conditions (i.e. heating, boiling) used to make them edible (**Table 1**). In addition, beans contain large amounts of bioactive compounds such as phytate and polyphenols, which can inhibit the absorption of iron from beans during digestion. Therefore, the iron content alone does not determine the nutritional impact of dry beans – biofortified beans must also provide more bioavailable iron in order to claim a health benefit over non-biofortified beans.

Table 1. Classification levels of iron content in iron enriched bean grain.[1]

Class	Iron content (µg/g)	Standard method of analysis (or equivalent)
Class I	≥ 94	AOAC 999.10 [N1]
Class II	83 – 93	
Class III	72 – 82	

[1]Classification of iron enriched bean shall be based on iron content limits in accordance with Table 1. Class I provides the highest nutrition impact when consumed as a whole bean minimally processed food. Iron enriched bean should be produced under optimal agricultural conditions and agronomic practices to achieve the highest iron content. Iron enriched bean shall be safely handled and properly cleaned to prevent mineral contamination (from soil and equipment) during analysis. Contamination might cause an elevated reading of iron during analysis and result in an inaccurate assessment of the iron content of iron enriched bean.

Agronomic biofortification describes the approach to optimize soil and environmental conditions for the enrichment of iron in staple food crops. Foliar application of trace minerals is one common practice of agronomic biofortification, especially used in wheat production for European nations with zinc deficient soil (Cakmak and Kutman 2017, *European Journal of Soil Science,* https://doi.org/10.1111/ejss.1237). The application of trace mineral fertilizer to leaf tissue allows minerals to translocate into the plant's biomass, which is later used as a resource for mineral distribution into developing seeds. Regions with trace mineral deficient soils rely on foliar fertilizer to maintain the nutrition value of their food crops. In the U.S. commercial application of foliar fertilizers on bean crops is used to ensure plant health and to increase the seed yield at harvest. Currently, there is little information on how these practices affect the trace mineral concentrations of dry beans when produced under ideal growing conditions, such as those found in Saginaw Valley, Michigan. Furthermore, if an increase in bean iron concentration is observed with foliar fertilizer, is it sufficient enough to improve the iron bioavailability of beans after cooking? Identification and validation of unique quality characteristics, such as enhanced iron content and improved iron bioavailability in different market classes of dry beans is essential for keeping pace with the growing demand for Michigan produced beans.

Black and navy beans are two of the most important dry bean market classes produced in Michigan. Often, the iron concentrations of black and navy beans grown in Michigan are too low to meet the enrichment standards set by international agencies (>72 µg/g). For this reason, a series of trials was established on four commercial farms in both 2021 and 2022 where black and navy varieties were treated with supplemental foliar fertilizers. The objective of this research was to determine if foliar fertilization increases the yield and is an effective strategy to increase the concentrations of iron, zinc and manganese in black and navy beans. In addition, iron bioavailability was measured using an in vitro digestion/Caco2 cell bioassay to determine if there is a nutritional impact with consuming beans treated with foliar fertilizer.

Materials and Methods

Plant Material, Growing Conditions and Foliar Fertilizer Treatments

Two black bean varieties (Black Beard and Zenith) and one navy bean variety (Merlin) were selected for testing. Varieties were chosen to represent both commercial standards for processing quality, as well as new varieties that commercial dry bean growers have adopted based on agronomic traits. All three varieties were planted at four separate locations in Michigan in 2021 and 2022. These locations will be referred to by their county: Bay, Huron, Sanilac and Tuscola. Trials were planted within fields of commercial production. All locations are in the traditional dry bean production region of Michigan comprised of the Thumb and Saginaw Valley. Dry beans were seeded at 130,000 seeds per acre in a plot size of 6.6' x 20'. This plot size consist of 4-row plots at 20-inch row spacing. Trial design was a randomized complete block design with four replications at all locations. Planting dates for all locations and both years were within the first two weeks of June. Fertilizer treatments differed slightly by year. In 2021 three quarts of a custom blended fertilizer product was applied at all timings and locations. The custom blended fertilizer treatments consisted of: 32 fluid ounces per acre of 'Max-in Mn®'+ 32 fluid ounces 'Max-in Zn®'+ 32 fluid ounces 'Max-in Fe®'. Results from field season 2021 indicated that zinc and manganese concentrations in all three varieties were not affected by foliar treatments, therefore, in 2022 fertilizer blends were simplified and only included 32 fluid ounces 'Max-in Fe®'. In both years two foliar applications were made: Application A- V2 growth stage & Application B- R1 growth stage. All applications were made with a CO_2 powered backpack research sprayer calibrated to 22 gallons per acre at 60 PSI utilizing water as a carrier for fertilizer treatments. Seed was direct harvested from both market classes utilizing a Wintersteiger Quantum combine in September of both years. Moisture adjusted yield was taken on cleaned seed from each plot and used to calculate yield per acre in pounds at 18% moisture.

Storage Conditions, Sample Preparation and Cooking

For each variety, 100 g of beans were placed into opaque paper bags and stored under ambient conditions (20-22 °C, 50-60% relative humidity) at standard atmospheric pressure for six months. Bean samples were then shipped to Ithaca, New York for analysis and place into a moisture controlled refrigerator (4ºC; 40% RH) for three weeks before analysis. At this time, subsets of 100 randomly selected seed from each field replicate were evaluated for mineral analysis. Bean samples were washed 3x in distilled water prior to air drying at room temperature overnight. Washed seed were then place into 50 mL polyethene centrifuge tubes before freezing at -80°C for 16 hours. Frozen samples were freeze-dried (Genesis 12EL, VirTis Research Equip., Gardiner, NY, USA) then milled into a fine powder with a stainless-steel Kinematica Polymix® analytical hammer mill (PX-MFC 90D, Bohemia, NY, USA) fitted with a 0.5 mm sieve. Powdered samples were stored in sealed polyethene containers at room temperature until mineral analysis.

Bean samples from each field replicate were cooked in distilled water under standardized cooking conditions using a Mattson pin drop device (Wang & Daun, 2005 *J Sci Food Agric* 85:1631-1635). Prior to cooking, thirty bean seed were soaked in 120 mL distilled water for 12 hours. Twenty-five beans were then positioned onto twenty-five well Mattson cookers (Michigan State University Machine Shop, East Lansing, MI, USA), which were fitted into 4 L stainless steel beakers containing 1.8 L of boiling distilled water heated on a Max Burton 6400 induction stove. Fully cooked beans correspond to number of minutes required for 20 of the cooker's 25 piercing rods (80%) to pass completely through each bean under a boiling temperature of 100°C Once a standardized cooking time of 80% is reached, the Mattson device is immediately removed from the boiling water and beans were allowed to cool for 10 minutes prior to freezing at -80°C in 50 mL polyethene centrifuge tubes. Average cooking times for the three varieties ranged from 28-35 minutes. Frozen samples were freeze-dried and then milled into a fine powder with an analytical hammer mill fitted with a 0.5 mm sieve. Powdered samples were stored in sealed polyethene containers at room temperature until iron bioavailability measurements were conducted using an in vitro digestion/Caco2 bioassay.

Mineral Analysis

For mineral analysis, 0.5 g of powdered sample from raw beans was predigested in boro-silicate glass tubes with 3 mL of a concentrated ultrapure nitric acid and perchloric acid mixture (60:40 v/v) for 16 h at room temperature. Samples were then placed in a digestion block (Martin Machine) and heated incrementally over 4 h to a temperature of 120ºC with refluxing. After incubating at 120ºC for 2 h, 2 mL of concentrated ultrapure nitric acid was subsequently added to each sample before raising the digestion block temperature to 145ºC for an additional 2 h. The temperature of the digestion block was then raised to 190ºC and maintained to evaporate any remaining liquid. Digested samples were resuspended in 20 mL of ultrapure water prior to analysis using ICP-AES (inductively coupled plasma atomic emission spectrometry; Thermo iCAP 6500 Series, Thermo Scientific) with quality control standards (High Purity Standards) following every 10 samples.

Yttrium purchased from High Purity Standards (10M67–1) was used as an internal standard. All samples were digested and measured with 0.50 μg/mL of Yttrium (final concentration) to ensure batch-to-batch accuracy and to correct for matrix inference during digestion. All samples were assessed for possible iron contamination from soil with aluminum (Al) concentrations. None were found to have Al concentrations over 5 µg/g (dry weight), which is the concentration indicative of possible iron contamination.

Caco2 Cell Bioassay for Iron Bioavailability

An established *in vitro* digestion/Caco2 cell culture model of the human intestinal epithelial barrier was used to assess the iron bioavailability of each cooked, lyophilized and milled bean sample according to the methods described in Glahn, 2022 (Glahn, 2022 *JoVE*, 182:e63859).

Statistical Analysis

Statistical analysis of yield and yield data was conducted in R utilizing analysis of variance procedure (ANOVA). Main effects and interactions were tested for at $\alpha \leq 0.05$, when insignificant data were pooled over insignificant factors. For the purpose of this report all yield data were combine over locations and kept separate for years due to differing fertilizer treatments. For mineral concentrations and iron bioavailability measurements, statistical analyses and mean separations were determined with GraphPad Prism9 (GraphPad Software, La Jolla, CA, USA) using the command for the analysis of variance. The normality of residuals for each parameter was evaluated using the Kolmogorov-Smirnov test. Equality of variance for each parameter was determined using the Bartlett's test. Measured parameters were found to have a normal distribution and equal variance, and were, therefore, acceptable for ANOVA without additional data transformation steps. Variety and location was designated as a fixed effect and replication as a random effect followed by a Tukey-Kramer *post-hoc* test. Graphs illustrating the iron bioavailability of black and navy beans were developed in GraphPad Prism9. Differences with p values ≤ 0.05 were considered statistically significant.

Results and Discussion

Yields of Black and Navy Beans after Foliar Fertilizer Treatments

Table 2 contains year results for all varieties tested - with and without fertilizer treatments for 2021 and 2022. The results in **Table 2** show that foliar fertilizer had no significant effect on the yields of black beans in both 2021 and 2022. In contrast, a significant ($\alpha < 0.05$) increase in seed yield was measured in the navy bean Merlin in 2021 (**Table 2**), indicating a potential plant health benefit to this market class with the application of all three trace minerals (iron, zinc and manganese fertilizer). Overall, the yield and first pass quality was near average for all county locations in both years of testing. With the exception of Merlin produced in 2021, the application of foliar fertilizer does not appear to increase bean yields in these selected production regions. However, it is important to note that the application of foliar fertilizer had no negative affect on yield in both the black and navy beans produced in Michigan.

Iron Concentrations of Black and Navy Beans Produced in Michigan

The results in **Table 3** show the iron concentrations of black and navy beans with and without foliar fertilizer from the four production regions in Michigan. There was a significant ($p \leq 0.05$)

location effect with higher iron concentrations being detected in all three varieties produced in Sanilac and Bay counties (**Table 3**). The navy bean Merlin had significantly ($p \leq 0.05$) higher iron concentrations than either black bean across the four commercial environments (70 – 87 µg/g), with iron values ranging within the Class II and Class III enrichment standards for bean iron biofortification (**Table 1**). Merlin is not considered a biofortified bean variety, however, it would be classified as an iron enriched bean grain when produced in the Saginaw Valley regions of Michigan. This is an example of how agronomic biofortification can be achieved in selected varieties. Further research is warranted to discover if other navy bean varieties can be enriched with iron using the standard agronomic practices of Michigan's commercial framers.

Foliar Fertilizer Increases Bean Iron Concentrations, But is Variety and Location Specific
Foliar application of fertilizer significantly ($p \leq 0.05$) increased the iron concentrations of Black Beard and Merlin, but not Zenith (**Table 3**). These results reveal that the benefits of foliar fertilizer may be variety specific and might not be ideal for all varieties across all the market classes produced in Michigan. Also, the Tuscola location is interesting because the response to foliar treatment in Black Beard and Merlin was not as robust when compared to the other three locations (**Table 3**). The impact of foliar fertilizer on bean iron concentrations was greatest in Black Beard, increasing raw seed iron concentrations by 7 – 10 µg/g, which was enough to classify them as Class III iron enriched beans. Iron concentrations in navy beans only increased 3 – 7 µg/g with foliar fertilizer, but was enough to boost them from a Class III to a Class II iron enriched bean when produced in Huron and Bay counties. Interestingly, the iron concentrations in raw Zenith bean seed were significantly lower when treated with foliar fertilizer in Bay County (**Table 3**). Certain varieties might not respond well to foliar applications of fertilizer, as the spray tends to damage leaf tissue on some varieties more than others. This observation reveals that small scale testing of varieties to foliar fertilizer may be necessary before using it in large scale commercial production.

Black and Navy Beans Treated with Foliar Fertilizer Have More Bioavailable Iron
Figure 1 illustrates the iron bioavailability of cooked black and navy beans treated with and without foliar fertilizer. Iron bioavailability is measured as Caco2 cell ferritin formation after being exposed to a digest of cooked bean sample. Increases in ferritin protein production are proportional to increases in iron uptake from Caco2 cells (Glahn, 2022 JoVE, 182:e63859), and ferritin values ranged from 1 -7 ng ferritin / mg total cell protein across the two bean varieties produced in Sanilac, Huron and Bay counties. The iron bioavailability of Merlin was significantly ($p \leq 0.05$) higher than Black Beard (**Figure 1**). Generally navy beans have higher iron bioavailability than black beans due to the high concentrations of condensed tannins and anthocyanins in the seed coats of black beans, which act as inhibitors of iron absorption during digestion. The results in **Figure 1** show that in each of counties where foliar fertilizer increased the iron concentrations of black and navy beans, an increase in iron bioavailability was also observed among the cooked bean samples. These results demonstrate that increases in bean iron concentrations due to foliar fertilizer have a positive nutritional impact on the delivery of iron from black and navy beans after cooking. More research is warranted to better understand if this nutritional benefit from foliar treated dry beans can be applied to other popular markets classes of beans produced in Michigan, such a small red, pink and kidney.

Foliar Fertilizer Does Not Increase the Zinc and Manganese Concentrations of Black and Navy Beans Produced in Michigan

The results in **Table 4** and **Table 5** show the zinc and manganese concentrations of black and navy beans with and without foliar fertilizer from the four production regions of Michigan. There was a significant ($p \leq 0.05$) location effect with the highest zinc concentrations being measured in all three bean varieties produced in Huron and Bay counties (**Table 4**), and the highest manganese concentrations being detected in all three bean varieties produced in Bay County (**Table 5**). The zinc and manganese concentrations of black and navy beans did not significantly increase when plants were treated with foliar fertilizer (**Tables 4-5**). In fact, the manganese concentrations in black beans were negatively affected by foliar treatments (**Table 5**). These results show that foliar applications of zinc and manganese do not improve the zinc and manganese concentrations of black and navy beans, and may not be beneficial to farmers who want to increase their bean yields (**Table 2**).

Conclusions

As demand for Michigan grown dry beans continues to rise, more research is needed to ensure that the trace mineral content and iron bioavailability of newly adopted varieties in each of the major market classes is comparable, if not superior to current market standards. Michigan has ideal growing conditions to produce high iron beans, however, the response to agronomic biofortification varies with variety and location. Navy beans are a promising market class to explore for the commercialization of foliar fertilizer because Merlin demonstrated significant increases in yield, iron content and iron bioavailability after treatment in field season 2021. This study demonstrates that foliar application of iron fertilizer can improve the iron nutrition of black and navy beans by enhancing iron concentrations and iron bioavailability of certain varieties after cooking. Determining how foliar fertilizer effects the iron nutrition of other market classes, such as pinto, pink or kidney is the next step in evaluating the potential nutritional benefits of consuming Michigan grown dry beans.

Tables and Figures

Table 2. Average yields of black and navy beans treated for two years with foliar fertilizer across four production regions (Tuscola, Sanilac, Huron and Bay) in Michigan.

	2021	2022
Entry	**Yield (Lbs./A)[AB]**	**Yield (Lbs./A)**
Black Beard	3154 a	3141 a
Black Beard + Fertilizer	3181 a	3175 a
Zenith	3234 a	2449 c
Zenith + Fertilizer	3045 ab	2499 bc
Merlin	2565 c	2548 bc
Merlin + Fertilizer	2823 b	2846 ab

[A] Dry bean yield in pounds per acre adjusted to 18% moisture.
[B] Means followed by the same letter are not significantly different ($\alpha < 0.05$)

Table 3. Iron concentrations (µg/g) of black and navy beans treated with foliar fertilizer in four production regions of Michigan.[1]

	Black Beard (black)		Zenith (black)		Merlin (navy)	
Location	**Control**	**+Fertilizer**	**Control**	**+Fertilizer**	**Control**	**+Fertilizer**
Tuscola	62.9 a	64.5 b	63.7ab	60.9 a	77.4 a	80.8 b
Sanilac	64.6 a	75.3 a*	62.2 b	61.6 a	80.1 a	87.9 a*
Huron	56.8 b	63.7 b*	56.7 c	56.6 b	70.2 b	76.3 b*
Bay	65.0 a	72.8 a*	66.2 a	60.7 a**	80.7 a	87.1 a*

[1]Values are means ± standard deviations of four field replicates from field season 2021 (n = 4). Iron concentrations are measured in raw, lyophilized and milled beans (dry weight). * Significantly ($p \leq 0.05$) higher iron concentrations when compared to the same variety grown under control conditions. ** Significantly ($p \leq 0.05$) lower iron concentrations when compared to the same variety grown under control conditions.

Table 4. Zinc concentrations (µg/g) of black and navy beans treated with foliar fertilizer in four production regions of Michigan.[1]

	Black Beard (black)		Zenith (black)		Merlin (navy)	
Location	**Control**	**+Fertilizer**	**Control**	**+Fertilizer**	**Control**	**+Fertilizer**
Tuscola	26.7 b	27.1 b	23.8 c	25.1 c	27.1 b	27.9 c
Sanilac	26.2 b	27.7 b	25.6 b	24.9 c	27.9 b	29.7 b
Huron	31.6 a	29.7 a	28.3 a	27.9 b	30.9 a	32.7 ab
Bay	31.4 a	29.5 a	29.2 a	29.5 a	31.4 a	34.4 a

[1]Values are means ± standard deviations of four field replicates from field season 2021 (n = 4). There was no significant effect of foliar treatment on the concentrations of zinc among the four production regions. Zinc concentrations are measured in raw, lyophilized and milled beans (dry weight).

Table 5. Manganese concentrations (µg/g) of black and navy beans treated with foliar fertilizer in four production regions of Michigan.[1]

	Black Beard (black)		Zenith (black)		Merlin (navy)	
Location	**Control**	**+Fertilizer**	**Control**	**+Fertilizer**	**Control**	**+Fertilizer**
Tuscola	14.3 b	13.8 b	13.5 a	12.9 b	15.0 b	15.9 a
Sanilac	14.0 b	13.4 b	12.7 b	12.7 b	14.3 c	14.4 b
Huron	16.3 a	13.1 b**	12.7 b	11.3 c**	14.0 c	14.7 b
Bay	15.7 a	14.6 a**	13.9 a	13.9 a	17.1 a	15.9 a

[1]Values are means ± standard deviations of four field replicates (n = 4). ** Significantly ($p \leq 0.05$) lower manganese concentrations when compared to the same variety grown under control conditions. Manganese concentrations are measured in raw, lyophilized and milled beans (dry weight).

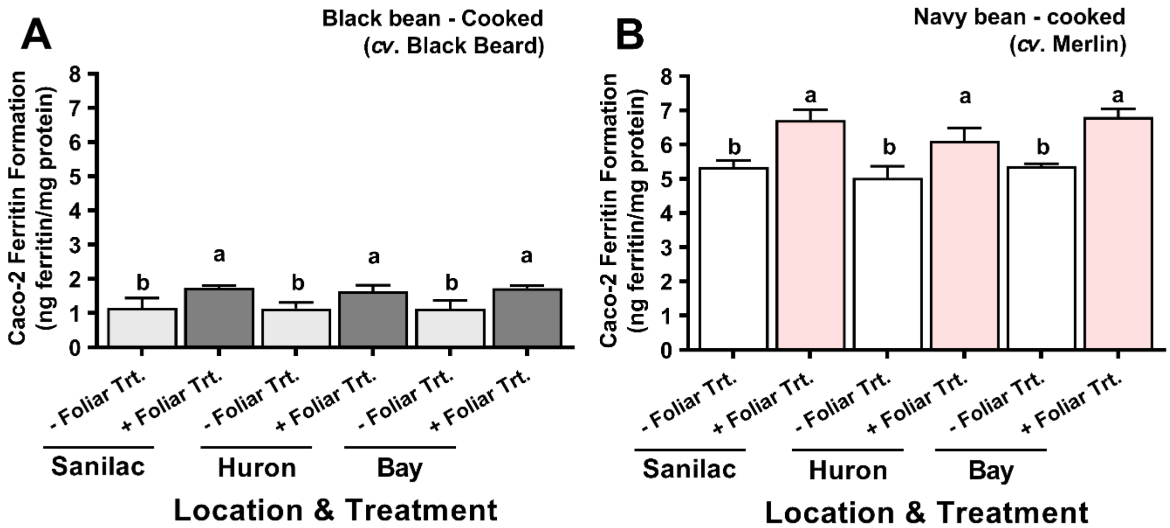

Figure 1. Comparing the iron bioavailability between black and navy beans under control conditions (-Foliar Trt) or after two treatments of foliar fertilizer (+Foliar Trt.) at three production sites in Michigan. Values are means ± SD of four field replicates for each treatment at each location. Values sharing the same superscript are not significantly ($p \leq 0.05$) different.). Iron bioavailability is measured as Caco-2 cell ferritin formation (ng ferritin / mg total cell protein) after exposure to an *in vitro* digestion of cooked, drained, lyophilized and milled beans (dry weight).

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Utilizing Boron to Improve Cercospora Leaf Spot Management

Jaime Willbur, Chris Bloomingdale, Daniel Bublitz, 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 29, 2022 (Harvest 9/23/22)	**N Rates**: 150 lb./A
Soil Type: Clay loam; 2.8% OM; 6.2 pH; 22 ppm P (Olsen P); 178 ppm K	**Population**: 4 in. spacing
Variety: C-G932NT	**Replicated**: 4 replications

Table 1. Field trial treatments evaluating a high rate of foliar boron on sugarbeet yield, quality, and resistance to *C. beticola*.

Treatment	Product Rate† and Timing‡
Non-treated Check	No Fungicide, No Foliar Boron
Grower Standard	Manzate Max (1.6 qt) ABCDE + Inspire XT (7 fl oz) BE + Super Tin (8 fl oz) C + Propulse (13.6 fl oz) D + Topsin (20 fl oz) D
Foliar Boron (FBH)	SprayBor (0.7 lb) ABCDE
Grower Standard + Foliar Boron High (FBH)	SprayBor (0.7 lb) ABCDE + Manzate Max (1.6 qt) ABCDE + Inspire XT (7 fl oz) BE + Super Tin (8 fl oz) C + Propulse (13.6 fl oz) D + Topsin (20 fl oz) D

†All rates, unless otherwise specified, are listed as a measure of product per acre.
‡Application letters code for the following dates: A=Jul 8, B=Jul 19, C=Aug 2, D=Aug 16, E=Aug 30. MasterLock 0.25% V/V was added to all treatments.

Table 2. Sugarbeet yield, recoverable sugar per ton (RWST), and sugar % in 2022.

Treatment	Tons/A	RWST†	% Sugar
Non-treated Check	15.3	210 ab	14.6 ab
Grower Standard	24.1	222 a	15.3 a
Foliar Boron High (FBH)	17.2	204 b	14.3 b
Grower Standard + FBH	21.3	221 a	15.3 a
Pr > F	NS	= 0.05	< 0.05

†Values followed by the same lowercase letter are not significantly different at (α=0.05).

Table 3. Gross grower payment and profitability analysis.

Treatment	Gross Grower Payment ($/A)
Non-treated Check	813
Grower Standard	1,354
Foliar Boron High (FBH)	888
Grower Standard + FBH	1,191

‡Gross grower payment and net economic returns based upon harvest date adjustment factor for tonnage and RWST on 9/23/2022 and $0.18 per pound of sugar payment.

Table 4. Final area under the disease progress curve (AUDPC) in 2022.

Treatment	Final CLS Severity Sept. 8	AUDPC†, ‡
Non-treated Check	7.9	200 a
Grower Standard	1.9	35 b
Foliar Boron High (FBH)	8.3	173 a
Grower Standard + FBH	1.8	47 b
Pr > F	-	<0.0001

†Values followed by the same lowercase letter are not significantly different at (α=0.05).

‡ AUDPC calculated from disease severity ratings recorded every 10-14 days post infection beginning July 26. Ratings were assigned using the KWS scale based on infected 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%.

Summary: Trial quality was fair. Trial was established to evaluate the efficacy of foliar-applied boron for managing Cercospora leaf spot (CLS) in sugarbeet. Boron-containing compounds may have fungistatic properties as recent work has found reduced *in vitro* fungal growth and decreased disease severity in the field. All treatments received 90 lbs N A^{-1} as pre-plant urea. Sidedress N was 60 lbs N A^{-1} as UAN applied at the 4-6 leaf stage on June 2. Treatments initiated on July 8 and continued every 10-14 days through August 30. Applications were made using a CO_2 powered backpack sprayer equipped with four TJ 8004XR nozzles (30-in spacing), calibrated at 15 gal A^{-1}. Inoculation of *C. beticola* ($1x10^3$ spores mL^{-1}) was applied at 15 gal/A using a tractor mounted sprayer on July 12. Disease ratings were collected bi-weekly starting July 26 and continued until September 8. Significant CLS pressure was observed uniformly throughout this study. The grower standard fungicide program resulted in significantly lower AUDPC ($P < 0.0001$), and greater RWST and percent sugar ($P < 0.05$), than the non-treated control. Five applications of foliar boron at 0.7 lb A^{-1} did not significantly reduce CLS severity or improve sugar beet yield or quality.

Sugarbeet Yield Response to Input-Intensive Management

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Location: Saginaw Valley Research & Extension Center	**Tillage: Conventional, 30-in. row**
Planting Date: 11 May 2022 (Harvest 24 Oct 2022)	**Treatments:** see Table 1
Pre-plant soil: 7.8 pH, 2.1% OM, 15 CEC, 30 ppm P (Bray equiv.), 152ppm K	**Population**: 4 in. spacing
Variety: C-G049	**Replications:** 4

Summary: Trial quality was good. Trial conducted to investigate the influence of more intensive early- and mid-season fertilizer management strategies on sugarbeet yield, sugar %, nutrient tissue response, and plant growth. Treatments were arranged in a randomized complete block design with four replications. Treatments represented stepwise increases in management intensity from 1) a baseline of 160 lbs N acre^{-1} (Standard N, SN), 2) SN + in-furrow P, 3) SN + PPI Lime, 4) SN + SD ATS, 5) SN + Foliar B, 6) SN + Liquid K_2O, 7) SN + late-applied N, 8) All treatment combinations SN + in-furrow P + PPI Lime + SD ATS + Foliar B + Liquid K_2O + Late N, and 9) nontreated check (Table 1). See Table 1 for specific products used, quantity applied, application placements, and application timings.

Growing season (May-Oct) precipitation was down 18.4% from the 30-yr mean during 2022. May 2022 cumulative rainfall was 51% below average resulting in some saltation from in-furrow applications and reduced emergence with ammonium polyphosphate (10-34-0) [SN + in-furrow P and intensive] (Table 2). Despite 10-34-0 application rates within recommended thresholds, results highlight risks with in-furrow nutrient applications which include uncertainty regarding immediate climate conditions soon after application which in this case were extremely dry.

Preventative fungicide applications for Cercospora leaf spot combined with decreased precipitation, decreased soil moisture, and lower relative humidity during the growing season reduced the favorable environment for foliar disease. All fertilizer treatments yielded above the Michigan average of 37 tons A^{-1} except for the SN + in-furrow P treatment (33.29 tons A^{-1}) (Table 3). For the SN + in-furrow P treatment, recoverable white sugar per ton (RWST) was 17.4% lower than the SN treatment leading to reduced potential profitability. Aside from the standard N treatment, the application of other nutrient sources did not increase the recoverable white sugar per acre (RWSA) or impact sugar quality during the 2022 growing season (Table 3).

Table 1. Sugarbeet treatment design and application timing, Richville, MI, 2022.

Treatment Name	**Fertilizer applied**	**Fertilizer grade**	**Amount (A^{-1})**	**Placement**	**Timing†**
Standard N (SN)	**UAN**	**28-0-0**	**13.3 gal**	**2x2**	**Planting**
	UAN	**28-0-0**	**40 gal**	**Side-dress**	**2-4 LF**
SN + in-furrow P	Ammonium polyphosphate	10-34-0	5 gal	In-furrow	Planting
SN + PPI Lime	Agricultural lime	32% Ca	2 tons	Broadcast	Pre-planting
SN + SD ATS	UAN	28-0-0	13.3 gal	2x2	Planting
	UAN	28-0-0	37.5 gal	Side-dress	2-4 LF
	ATS	12-0-0-26S	5.6 gal	Side-dress	2-4 LF
SN + Foliar B	Sodium pentaborate	14% B	0.5 lb	Foliar	Weekly in July
SN + Liquid K_2O	K_2O Liquid	0-0-28	30.8 gal	Band	Early July
SN + Late N	UAN	28-0-0	26.7 gal	Side-dress	2-4 LF
	UAN	28-0-0	13.3 gal	Side-dress	2WASD
Intensive (all treatments)	Agricultural lime	32% Ca	2 tons	Broadcast	Pre-planting
	UAN	28-0-0	13.3 gal	2x2	Planting
	liquid ammonium phosphate	10-34-0	5 gal	In-furrow	Planting
	UAN	28-0-0	24.2 gal	Side-dress	2-4 LF
	ATS	12-0-0-26S	5.6 gal	Side-dress	2-4 LF
	UAN	28-0-0	13.3 gal	Side-dress	2WASD
	Sodium pentaborate	14% B	0.5 lb	Foliar	4x in July
	K_2O Liquid	0-0-28	30.8 gal	Band	Early July
Nontreated check	No fertilizer added		NA	NA	NA

† **Application Dates**: Pre-planting and Planting – 11 May 2022; 2-4 leaf stage (sidedress)– 01 June 2022; Late N– 14 June 2022; Liquid K_2O – 05 July 2022; Foliar B sprays – 08, 14, 19, 26 July 2022.

Table 2. Influence of early and mid-season fertilizer on percent sugarbeet stand count (emergence and pre-harvest), Richville, MI, 2022. †

Treatment	Emergence ‡	Pre-harvest	Change
	—%	—%	—%
Standard N (SN)	71 a	71	-
SN + in-furrow P	51 b	57	6
SN + PPI Lime	72 a	70	(2)
SN + SD ATS	71 a	70	(1)
SN + Foliar B	71 a	70	(1)
SN + Liquid K_2O	72 a	71	(1)
SN + Late N	71 a	67	(4)
Intensive (all treatments)	60 b	64	4
p-value	***0.0024***	**0.17**	**NA**
Nontreated check	**73**	**73**	**-**

† Treatments were compared at 0.10 probability level, Tukey's HSD. Values followed by the same lowercase letter are not significantly different.
‡ CG-049 variety average emergence = 61.5% Source: 2021 Variety Results. https://www.michigansugar.com/wp-content/uploads/2021/12/2021-Variety-Trial-Results-Book.pdf

Table 3. Early and mid-season fertilizer effects on sugarbeet root yield, recoverable sugar (RSWT and RSWA), sucrose concentration, and purity, Richville, MI, 2022. †

	Root Yield ‡	Recoverable Sugar		Sucrose	Purity
Treatment	**-T A^{-1}-**	**—RWSA—**	**—RWST—**	—%	—%
Standard N (SN)	40.20 a	296.80	11,890.95 ab	22.44	95.76
SN + in-furrow P	33.29 b	295.06	9,816.01 b	22.29	95.80
SN + PPI Lime	41.97 a	293.17	12,282.47 ab	22.18	95.95
SN + SD ATS	40.98 a	300.16	12,306.13 a	22.70	95.88
SN + Foliar B	38.40 a	298.60	11,467.52 ab	22.52	95.74
SN + Liquid K_2O	39.24 a	300.11	11,797.13 ab	22.62	95.88
SN + Late N	39.27 a	301.38	11,817.85 ab	22.78	95.85
Intensive (all treatments)	38.52 a	291.20	11,221.15 ab	22.09	95.86
p-value	***<.0001***	***0.63***	***0.02***	***0.63***	***0.79***
Nontreated check	**24.61**	**295.17**	**7,236.45**	**22.29**	**95.72**

† Treatments were compared at 0.10 probability level, Tukey's HSD. Values followed by the same lowercase letter are not significantly different.
‡ Michigan 2021 average sugarbeet yield = 37 tons A^{-1}
https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=MICHIGAN

Sugarbeet Varietal Response to Fertilizer Strategy and Harvest Timing

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Location: Saginaw Valley Research and Extension Center	**Tillage**: Conv., 30-in. row
Planting Date: May 11, 2022 (Harvest 8/30/22 & 10/24/22)	**Trt's**: See below
Soil Type: Clay loam; 2.4% OM; 7.9 pH; 26 ppm P (Bray equiv.), 151 ppm K	**Population**: 4 in. spacing
Variety: C-G675 & C-G919	**Replicated**: 4 replications

Table 1. Overview of fertilizer rate, timing, and methods of application.

Treatment	Rate	Timing	Method
1. 28-0-0	60 lb. A	Planting	2x2†
2. 28-0-0 28-0-0	60 lb. A 100 lb. A	Planting 4 Leaf (June 1)	2x2 Side dress
3. 28-0-0 0-0-28*	60 lb. A 100 lb. A	Planting 20 Leaf (June 22)	2x2 Banded next to row
4. 28-0-0 28-0-0 0-0-28	60 lb. A 100 lb. A 100 lb. A	Planting 4 Leaf (June 1) 20 Leaf (June 22)	2x2 Side dress Banded next to row

† Two inches below and two inches to the side of the seed.

Summary: Trial quality was good. Trial conducted to determine whether a higher tonnage/higher sugar variety as compared to a more defensive, disease resistant variety respond differently to specific fertilizer management strategies and early vs. conventional harvest intervals. Altering management decisions such as variety, harvest timing, fertilizer management, and interactions amongst these factors may help provide insight into producing the same or more sugar with less overall tonnage. The study was blocked by two harvest timings (early - 8/30/22 and conventional - 10/24/22), and two varieties (C-G675, a more aggressive, high tonnage/sugar variety C-G919, a more defensive variety with average tonnage/sugar but good resistance to Cercospora and Rhizoctonia). All treatments received 60 lbs. N/A at planting applied 2x2. Fertilizer strategies consisted of only 60 lbs. N/A applied 2x2 at-plant, 60 lbs. N/A applied 2x2 and 100 lbs. N/A sidedress coulter inject at 4 leaf stage, 60 lbs. N/A applied 2x2 and 100 lbs. K_2O/A (0-0-28) surface applied next to row at canopy closure (~20 leaf stage), and 60 lbs. N/A applied 2x2 along with 100 lbs. N/A sidedress coulter inject at 4 leaf stage and 100 lbs. K_2O/A

(0-0-28) surface applied next to row at canopy closure (~20 leaf stage). Nitrogen source was 28% UAN for both starter and sidedress N applications. Liquid potash (0-0-28) was used for mid-season K_2O applications. Canopy coverage was measured every two weeks until full canopy. Normalized Difference Vegetation Index (NDVI, i.e., greenness) and Fractional Green Canopy Cover via SPAD were measured at 6-8LF and 12-14LF.

Due to no more than 4 days between any rainfall event during March and April 2022, planting was delayed until 11 May. Sidedress N applications occurred 1 June while liquid K_2O was applied 22 June. At the 12-14 leaf growth stage, C-675 had a significantly higher NDVI reading and also greater percent canopy cover by 20-leaf than C-919 (data not shown). Fertilizer strategies consisting of both N timings (i.e., 2x2+SD N) had greater canopy coverage than those without (i.e., 2x2+K and 'All') on July 20. Due to known yield and quality differences from harvest timing, post-harvest statistics were sliced by harvest timing. No interactions between variety and fertilizer strategy occurred during early harvest (30 August). However, C-G675 produced 3.1 T A^{-1} and 647 lb. RWSA more than C-G919, respectively (Table 2). A full season N-rate produced on average 3.1 tons A^{-1} more than starter 2x2 N only, regardless of the addition of liquid K_2O. Further N-rate evaluation of early harvest sugar beet is necessary as 60 lb. A^{-1} (2x2) was not enough to maximize yields in 2022 but the 160 lb. A^{-1} (2x2+SD) rate may not have fully been utilized prior to harvesting.

Interactions between variety and fertilizer strategy occurred during regular harvest timing (24 October) on yield and RWSA (Tables 4, 5). C-G919 yield and RWSA were maximized by having both N applications while liquid K_2O did not influence yield (Table 5). C-G675 achieved maximum yield and RWSA within all treatments except '2x2+liquid K' where the in-season liquid K_2O may have decreased yield without the addition of sidedress N. Drier weather conditions later in the season may have decreased N loss opportunities or resulted in poor use of sidedress N resulting in the lower applied N rate maximizing yield and RWSA. C-G675 responded better to decreased applied N rates in a full season application than C-G919. Across varieties in early harvest 2022, tonnage responded to a full-season N rate but RWSA, RWST, % sugar, and profitability did not implying that 60 lbs N/A was sufficient for early harvest when compared to the full rate of 160 lb N/A. The more defensive variety (C-G919) did respond to the full N rate in 2022 with greater yield, RWSA, and profitability.

Table 2. Sugarbeet early harvest 2022 yield, recoverable sugar per acre (RWSA), recoverable sugar per ton (RWST), sugar %, and clear juice purity (CLP).

Early Harvest					
Treatment	**Tons**	**RWSA**	**RWST**	**Sugar**	**CJP**
Variety	—Tons—	—lbs—	—lbs—	—%—	—%—
C-G675	29.92 a*	7371 a	246.5 a	17.02 a	94.67 a
C-G919	26.80 b	6724 b	250.7 a	16.79 a	94.79 a
P > F	**0.002**	**0.06**	**ns†**	**ns**	**ns**
Fertilizer					
2x2 N Only	26.82 b	6694 a	248.8 ab	16.91 ab	94.60 a
2x2 + Sidedress N	30.20 a	7480 a	247.6 ab	16.82 ab	94.77 a
2x2 + Liquid K	26.82 b	6846 a	255.7 a	17.34 a	94.81 a
All	29.61 a	7169 a	242.2 b	16.56 b	94.74 a
P > F	**<0.001**	**ns**	**0.09**	**0.07**	**ns**
675 CHECK ††	23.37	5864	251.4	17.08	95.07
919 CHECK	20.35	5192	255.1	17.27	94.54

*Values followed by the same lowercase letter in the same column are not significantly different at α = 0.10. Values represent actual field data without early delivery program compensation factors.

† ns = not significantly different at α = 0.10.

†† CHECK plots were not statistically analyzed with all other plot factors.

Table 3. Sugarbeet regular harvest 2022 yield, recoverable sugar per acre (RWSA), recoverable sugar per ton (RWST), sugar %, and clear juice purity (CLP).

Regular Harvest					
Treatment	**Yield**	**RWSA**	**RWST**	**Sugar**	**CJP**
Variety	—Tons—	—lbs—	—lbs—	—%—	—%—
C-G675	†	†	311.0 a*	20.21 a	95.80 a
C-G919			305.0 a	19.96 a	95.80 a
P > F			**ns‡**	**ns**	**ns**
Fertilizer					
2x2 N Only			307.6 ab	20.05 ab	95.83 a
2x2 + Sidedress N			307.9 ab	20.08 ab	95.70 a
2x2 + Liquid K			314.8 a	20.50 a	95.80 a
All			301.6 b	19.70 b	95.84 a
P > F			**0.07**	**0.05**	**ns**
675 CHECK δ	31.92	9797	307.5	20.07	96.03
919 CHECK	23.46	7049	302.1	19.73	95.79

*Values followed by the same lowercase letter in the same column are not significantly different at α = 0.10.

† See below for interactions of variety and fertilizer strategy on RWSA and yield.

‡ ns = not significantly different at α = 0.10.

δ CHECK plots were not statistically analyzed with all other plot factors.

Table 4. Interaction between sugarbeet variety and fertilizer strategy on yield at regular harvest timing.

	Variety		
Fertilizer	**C-G675**	**C-G919**	***P > F***
	Tons A^{-1}		
2x2 N Only	40.14 a†A‡	29.99 bB	**<0.001**
2x2 + Sidedress N	41.41 aA	40.23 aA	**0.40**
2x2 + Liquid K	35.75 aB	29.62 bB	**0.03**
All	41.63 aA	41.13 aA	**0.85**
P > F	**0.09**	**<0.001**	

†Values followed by the same lowercase letter in the row are not significantly different at $\alpha = 0.10$.
‡Values followed by the same uppercase letter in the same column are not significantly different at $\alpha = 0.10$.

Table 5. Interaction between sugarbeet variety and fertilizer strategy on recoverable white sugar per acre at regular harvest timing.

	Variety		
Fertilizer	**C-G675**	**C-G919**	***P > F***
	Lbs. A^{-1}		
2x2 N Only	12,562 a†AB‡	9,071 bB	**<0.001**
2x2 + Sidedress N	12,786 aA	12,356 aA	**0.56**
2x2 + Liquid K	11,401 aB	9,212 bB	**0.007**
All	12,636 aAB	12,337 aA	**0.68**
P > F	**0.22**	**<0.001**	

†Values followed by the same lowercase letter in the row are not significantly different at $\alpha = 0.10$.
‡Values followed by the same uppercase letter in the same column are not significantly different at $\alpha = 0.10$.

Table 6. Early harvest main effects of sugarbeet variety and fertilizer strategy on 2022 gross grower payment and profitability analysis less trucking and or fertilizer costs.

Early Harvest			
Treatment	**Gross Grower Payment**	**Net Economic Return Less Trucking Cost ‡**	**Net Economic Return Less Fertilizer Costs and Trucking**
Variety	— $/A —	— $/A —	— $/A —
C-G675	2,515 a*	2,356 a	1,935 a
C-G919	2,294 b	2,152 b	1,730 b
P > F	**0.06**	**0.07**	**0.07**
Fertilizer			
2x2 N Only	2,284 a	2,142 a	2,067 a
2x2 + Sidedress N	2,252 a	2,392 a	2,172 a
2x2 + Liquid K	2,336 a	2,193 a	1,569 b
All	2,446 a	2,289 a	1,522 b
P > F	**nsδ**	**ns**	**<0.001**
675 CHECK †	1,413	1,325	1,325
919 CHECK	1,251	1,175	1,175

* Values followed by the same lowercase letter are not significantly different at α = 0.10.
† CHECK was not statistically analyzed with all other plot factors
‡ Trucking figured at $3.75/T
δ ns = not significant at α = 0.10.
Gross grower payment and net economic returns based upon harvest date adjustment factor for tonnage and RWST on 8/30/2022 and $0.18 per pound of sugar payment.

Table 7. Regular harvest interaction between variety and fertilizer strategy on gross grower payment.

	Variety		
Fertilizer	**C-G675**	**C-G919**	***P > F***
	$/A^{-1}		
2x2 N Only	3,026 a†A‡	2,185 bB	**<0.001**
2x2 + Sidedress N	3,080 aA	2,977 aA	**0.55**
2x2 + Liquid K	2,747 aA	2,219 bB	**0.007**
All	3,044 aA	2,972 aA	**0.68**
P > F	**0.23**	**<0.001**	

†Values followed by the same lowercase letter in the row are not significantly different at α = 0.10.
‡Values followed by the same uppercase letter in the same column are not significantly different at α = 0.10.

Table 8. Regular harvest interaction between variety and fertilizer strategy on grower payment less trucking expense ($3.75/T) of regular harvest timing.

	Variety		
Fertilizer	**C-G675**	**C-G919**	***P > F***
	——— $/A^{-1} ———		
2x2 N Only	2,876a†AB‡	2,073 bB	**<0.001**
2x2 + Sidedress N	2,925 aA	2,826 aA	**0.55**
2x2 + Liquid K	2,613 aB	2,108 bB	**0.007**
All	2,888 aAB	2,818 aA	**0.68**
P > F	**0.24**	**<0.001**	

†Values followed by the same lowercase letter in the row are not significantly different at α = 0.10.

‡Values followed by the same uppercase letter in the same column are not significantly different at α = 0.10.

Table 9. Regular harvest interaction between variety and fertilizer strategy on grower payment less trucking expense ($3.75/T), fertilizer costs, and application costs of regular harvest timing.

	Variety		
Fertilizer	**C-G675**	**C-G919**	***P > F***
	——— $/A^{-1} ———		
2x2 N Only	2,801a†A‡	1,998 bB	**<0.001**
2x2 + Sidedress N	2,705 aA	2,606 aA	**0.55**
2x2 + Liquid K	1,989 aB	1,484 bC	**0.007**
All	2,422 aB	2,051 aB	**0.68**
P > F	**<0.001**	**<0.001**	

†Values followed by the same lowercase letter in the row are not significantly different at α = 0.10.

‡Values followed by the same uppercase letter in the same column are not significantly different at α = 0.10.

PCR-based fungicide resistance screening in *Cercospora beticola* populations in Michigan, 2021-22

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Background:

There are multiple fungicide groups that are commonly used and registered for Cercospora leaf spot (CLS) management in sugar beet including methyl benzimidazole carbamates (MBC or benzimidazole, FRAC group 1), quinone outside inhibitors (QoI or strobilurins, FRAC group 11), demethylation inhibitors (DMI or triazoles, FRAC group 3), organo-tins (FRAC group 30), and multi-site contact activity (FRAC group M03) fungicide classes. Reduced sensitivity to QoI, MBC, DMI, and organo-tin fungicides has been detected in *C. beticola* populations in Michigan (Weiland and Halloin 2001, Kirk et al. 2012, Bolton et al. 2012a, Rosenzweig et al. 2015, Rosenzweig et al. 2020). Because of the fluctuating levels of resistant isolates, continuous monitoring is necessary for prompt identification and proactive management of shifts in *C. beticola* sensitivities. PCR-based methods to detect mutations associated with fungicide resistance could provide timely and field specific guidance to improve CLS management, but they must provide information that is reliable and relevant to field efficacy of the compounds.

Methods:

CLS-symptomatic leaf samples were collected from mid-July through the end of October. Twenty-nine and thirty field locations were sampled in 2021 and 2022, respectively, across nine counties in east-central Michigan. Approximately eight lesions from 8-15 leaves were collected at each timepoint from each field site and mono-conidial isolates were obtained from each lesion.

Testing was conducted using polymerase chain reaction restriction fragment length polymorphism (PCR-RFLP) assays to detect point mutations in the *C. beticola* genome associated with fungicide resistance. QoI resistance was determined using the G143A point mutation present in the fungal mitochondrial cytochrome b gene of *C. beticola* isolates previously characterized to be resistant to pyraclostrobin, with EC50 values >100 ppm (Rosenzweig et al. 2015). MBC resistance was determined using the E198A point mutation present in the beta-tubulin gene of *C. beticola* isolates previously characterized to be resistant to benzimidazole, with EC50 values ≥ 60 ppm (Rosenzweig et al. 2015). DMI resistance was associated with the Glu169 (GAA to GAG) mutation present in the C-14 alpha-demethylase gene of *C. beticola* isolates characterized to be highly resistant to epoxiconazole, with EC50 values of 65-115 ppm (Nikou et al. 2009).

These rapid PCR-RFLP techniques were compared to current *in vitro* fungicide sensitivity testing methods. The effective concentrations required to inhibit mycelial growth by 50% (EC50) were determined through spiral gradient plating with each active ingredient of interest (Förster et al. 2004; Torres-Londoño et al. 2016; Rosenzweig et al. 2020). Isolates were tested for sensitivity to the QoI pyraclostrobin, the MBC thiophanate-methyl, the DMIs difenoconazole, tetraconazole, prothioconazole, fenbuconazole, and mefentrifluconazole, and the organotin, triphenyltin hydroxide.

Results:

<u>*Objective 1*</u> **-** Evaluate rapid testing as a tool to monitor *C. beticola* sensitivity to critical fungicide groups.

Results for the three PCR-RFLP assays were successfully obtained from 399 isolates in 2021 and 498 isolates in 2022. Of these, 63 isolates collected in 2021 were tested for in vitro fungicide sensitivity and compared with the PCR-RFLP results. The benzimidazole PCR marker predicted resistance to thiophanate-methyl with 100% accuracy. All the tested isolates contained the genetic mutation associated with QoI resistance. However, the pyraclostrobin EC50 values measured by spiral plating ranged from

0.79 ppm (lower limit of assay) to 88.37 ppm (upper limit). Resistance to triazoles is a complex trait controlled by multiple genes (Rangel et al. 2020). The mutation used in this study successfully predicted levels of insensitivity (> 1 µg/ml; Bolton et al. 2012b) for certain triazole fungicides (difenoconazole; Figure 1A) but not for others (tetraconazole; Figure 1B). This study will continue to explore other mutations associated with DMI resistance to tetraconazole (Spanner et al. 2021) and evaluate the mutations' ability to predict fungicide sensitivity.

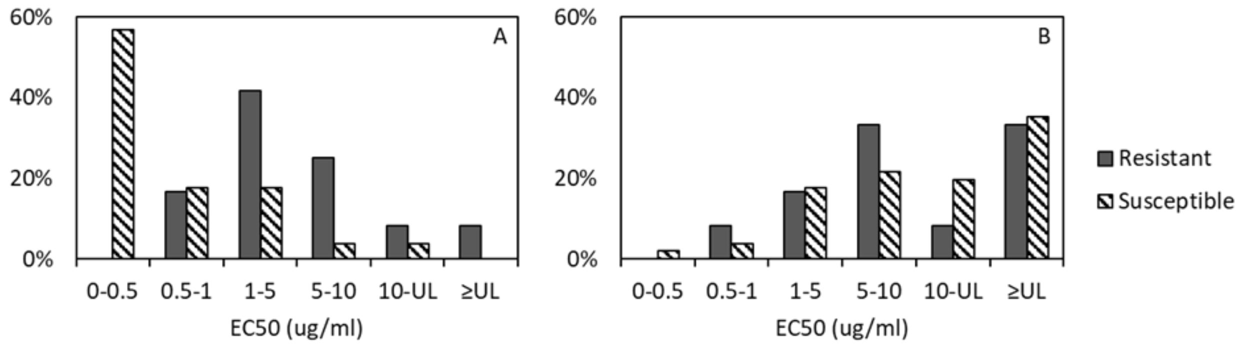

Figure 1. Isolate frequency distribution of *in vitro* fungicide sensitivity to (A) difenoconazole and (B) tetraconazole for *C. beticola* containing the mutation associated with high resistance (Resistant, N = 12; gray bars) and absence of the mutation meaning moderate resistant/susceptible (Susceptible, N = 51; striped bars) isolates (Nikou et al. 2009). The upper limit (UL) was 17.6 ppm for difenoconazole and 17.7 ppm for tetraconazole.

<u>*Objective 2*</u> - Monitor levels of resistance to critical fungicide groups across Michigan growing regions.

Some isolates with reduced sensitivity were identified for every active ingredient tested. Resistance to DMI fungicides varied by active ingredient; isolates of *C. beticola* exhibited the highest level of resistance to prothioconazole, followed by tetraconazole (Figure 2). High frequencies of resistance to pyraclostrobin were observed across Michigan (Figure 3). Some reduced sensitivity to triphenyltin hydroxide was observed for isolates tested in this study. However, the degree of resistance was lower than that of other fungicide classes with no isolates having EC50 values >10ppm (Figure 3). Resistance to low doses of organotin fungicides is being observed in North Dakota and Minnesota as well (Secor et al. 2019). Tables 1&2 show the percentage of isolates with reduced sensitivity for each of the field locations sampled. These frequencies are associated with *in vitro* EC50 values > 1 µg/ml active ingredient (Secor et al. 2010, Bolton et al. 2012b). While these values do not correspond directly to field-level resistance, regions with high frequencies of resistant isolates may be more likely to experience reduced efficacies with corresponding fungicide groups.

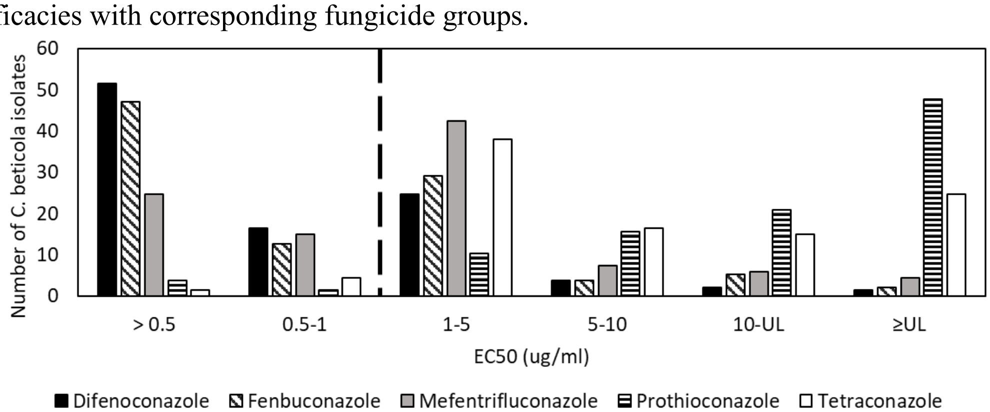

Figure 2. Isolate frequency distribution of in vitro fungicide sensitivity to difenoconazole (black), fenbuconazole (diagonal stripes), mefentrifluconazole (gray), prothioconazole (horizontal stripes), and tetraconazole (white) for *C. beticola* isolates. The dashed line represents a resistance threshold of 1 ppm (Bolton et al. 2012b). All isolates to the right of the dashed line are considered to have some resistance. The upper limit (UL) was 17.6 ppm for difenoconazole, 17.9 ppm for fenbuconazole, 17.6 ppm for mefentrifluconazole, 17.8 ppm for prothioconazole, and 17.7 ppm for tetraconazole.

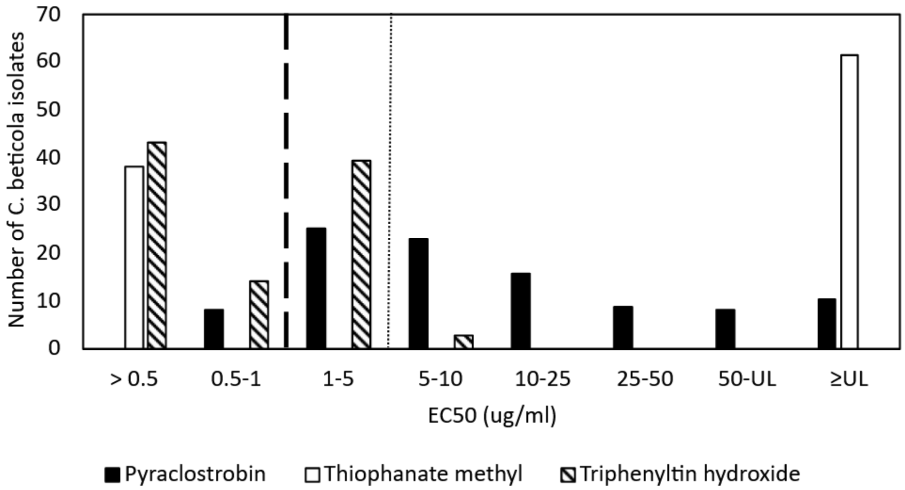

Figure 3. Isolate frequency distribution of *in vitro* fungicide sensitivity to a QoI, pyraclostrobin (black), an MBC, thiophanate methyl (white), and an organo-tin, triphenyltin hydroxide (diagonal stripes) for *C. beticola*. The dashed line represents a resistance threshold of 1 ppm used for pyraclostrobin and triphenyltin hydroxide. The dotted line represents a resistance threshold of 5 ppm used for thiophanate methyl (Secor et al. 2010). All isolates to the right of the corresponding threshold are considered resistant. The upper limit (UL) was 88.4 ppm for pyraclostrobin, 89.3 ppm for thiophanate methyl, and 17.8 ppm triphenyltin hydroxide.

Summary

- The PCR-RFLP rapid detection technique was accurate at predicting MBC resistance and can be deployed for screening isolates in future years. However, the genetic tests used in this study were not sufficient for accurately predicting QoI or DMI *in vitro* sensitivity for *C. beticola* isolates.
- Reduced sensitivity was observed for all active ingredients tested, but resistance was particularly widespread for the DMIs prothioconazole and tetraconazole as well as the QoI pyraclostrobin.

Future Directions

Isolates collected in 2022 will be tested using the spiral gradient method and compared to 2021 resistance levels to assess shifts in *C. beticola* populations. A subset of fields were sampled multiple times over the growing season and seasonal changes in resistance will be tracked and compared to the fungicide programs used. Fungicide sensitivities for *Alternaria alternata* isolates collected from similar Michigan sugar beet field locations will also be determined.

Additional mutations associated with DMI resistance will be tested for their ability to predict isolate sensitivity. Newer qPCR techniques (Shrestha et al. 2020) will also be investigated for rapid screening optimization. Collection and screening of symptomatic leaf samples will be repeated in 2023.

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Table 1. Frequencies of *C. beticola* resistance to five triazole active ingredients detected using in vitro sensitivity testing in 2021

Date	Field Location	County	No. Samples	% Resistant[a]				
				Difeno-conazole	Fenbu-conazole	Mefentriflu-conazole	Prothio-conazole	Tetra-conazole
14-Jul	Munger	Bay	4	50.0	0.0	75.0	100.0	100.0
15-Jul	Auburn	Bay	4	25.0	0.0	75.0	100.0	100.0
15-Jul	Auburn	Bay	4	25.0	0.0	75.0	100.0	100.0
22-Jul	Brown City	Sanilac	3	66.7	0.0	66.7	66.7	100.0
27-Jul	Ashley	Gratiot	5	0.0	0.0	60.0	80.0	80.0
16-Aug	Auburn	Bay	3	66.7	33.3	100.0	100.0	100.0
16-Aug	Freeland	Saginaw	3	33.3	33.3	0.0	100.0	100.0
17-Aug	Caseville	Huron	4	0.0	50.0	25.0	100.0	100.0
25-Aug	Akron	Tuscola	3	0.0	100.0	0.0	100.0	100.0
25-Aug	Gilford	Tuscola	5	0.0	80.0	40.0	100.0	100.0
1-Sep	Ruth	Huron	4	75.0	0.0	100.0	100.0	100.0
1-Sep	Freeland	Saginaw	5	20.0	40.0	40.0	100.0	100.0
7-Sep	Crump	Bay	6	50.0	50.0	50.0	100.0	100.0
7-Sep	Cass City	Tuscola	5	40.0	80.0	40.0	100.0	100.0
13-Sep	Gladwin	Gladwin	5	60.0	20.0	80.0	100.0	100.0
15-Sep	Midland	Midland	5	20.0	20.0	40.0	80.0	100.0
16-Sep	Standish	Arenac	4	50.0	25.0	100.0	100.0	100.0
16-Sep	Auburn	Bay	5	60.0	60.0	100.0	100.0	100.0
17-Sep	Au Gres	Arenac	3	33.3	33.3	66.7	100.0	100.0
17-Sep	Pinconning	Bay	3	0.0	0.0	33.3	33.3	33.3
18-Sep	Brown City	Sanilac	4	50.0	50.0	100.0	100.0	75.0
18-Sep	Croswell	Sanilac	3	0.0	66.7	0.0	66.7	66.7
22-Sep	Freeland/Saginaw	Saginaw	4	50.0	50.0	50.0	100.0	100.0
24-Sep	Beaverton	Gladwin	5	80.0	60.0	100.0	100.0	100.0
3-Oct	Munger	Bay	4	0.0	0.0	75.0	100.0	100.0
18-Oct	Sandusky	Sanilac	5	0.0	100.0	20.0	100.0	100.0
21-Oct	Freeland	Saginaw	5	40.0	60.0	40.0	80.0	80.0
23-Oct	Caseville	Huron	6	33.3	50.0	66.7	100.0	83.3
24-Oct	Breckenridge	Gratiot	5	40.0	60.0	40.0	80.0	80.0
Total	**29 Locations**	**9 Counties**	**124**	**33.4**	**38.7**	**57.2**	**92.6**	**93.0**

[a]Isolates with EC50 values ≥1µg/ml were considered resistant (Bolton et al. 2012b). While regions with high frequencies of resistant isolates are at greater risk for reduced efficacy of fungicides with these active ingredients, resistance rates are based on laboratory testing only and are not a direct measure of in-field control provided by these products.

Table 2. Frequencies of *C. beticola* resistance to QoI, MBC and organotin active ingredients detected using in vitro sensitivity testing in 2021

Date	Field Location	County	No. Samples	% Resistant[a]		
				Pyraclostrobin	Thiophanate methyl	Triphenyltin hydroxide
14-Jul	Munger	Bay	4	100.0	0.0	0.0
15-Jul	Auburn	Bay	4	50.0	50.0	25.0
15-Jul	Auburn	Bay	4	50.0	75.0	0.0
22-Jul	Brown City	Sanilac	3	100.0	0.0	0.0
27-Jul	Ashley	Gratiot	5	100.0	20.0	0.0
16-Aug	Auburn	Bay	3	100.0	0.0	33.3
16-Aug	Freeland	Saginaw	3	66.7	66.7	0.0
17-Aug	Caseville	Huron	4	75.0	100.0	75.0
25-Aug	Akron	Tuscola	3	100.0	100.0	33.3
25-Aug	Gilford	Tuscola	5	80.0	100.0	20.0
1-Sep	Ruth	Huron	4	100.0	50.0	50.0
1-Sep	Freeland	Saginaw	5	100.0	80.0	80.0
7-Sep	Crump	Bay	6	100.0	100.0	83.3
7-Sep	Cass City	Tuscola	5	100.0	60.0	40.0
13-Sep	Gladwin	Gladwin	5	100.0	60.0	60.0
15-Sep	Midland	Midland	5	100.0	60.0	40.0
16-Sep	Standish	Arenac	4	75.0	100.0	0.0
16-Sep	Auburn	Bay	5	100.0	80.0	80.0
17-Sep	Au Gres	Arenac	3	100.0	33.3	0.0
17-Sep	Pinconning	Bay	3	100.0	0.0	100.0
18-Sep	Brown City	Sanilac	4	100.0	25.0	25.0
18-Sep	Croswell	Sanilac	3	100.0	66.7	66.7
22-Sep	Freeland/Saginaw	Saginaw	4	75.0	75.0	25.0
24-Sep	Beaverton	Gladwin	5	100.0	80.0	80.0
3-Oct	Munger	Bay	4	100.0	100.0	0.0
18-Oct	Sandusky	Sanilac	5	100.0	80.0	100.0
21-Oct	Freeland	Saginaw	5	80.0	20.0	40.0
23-Oct	Caseville	Huron	6	100.0	66.7	33.3
24-Oct	Breckenridge	Gratiot	5	80.0	60.0	80.0
Total	**29 Locations**	**9 Counties**	**124**	**90.7**	**58.9**	**40.3**

[a]Isolates with EC50 values ≥1µg/ml for pyraclostrobin and triphenyltin hydroxide and ≥5µg/ml for thiophanate methyl were considered resistant (Secor et al. 2010, Bolton et al. 2012b). While regions with high frequencies of resistant isolates are at greater risk for reduced efficacy of fungicides with these active ingredients, resistance rates are based on laboratory testing only and are not a direct measure of in-field control provided by these products.

Evaluation of Cercospora leaf spot and postharvest rot pathogen impacts on sugarbeet storage, 2021-22

Carly Hendershot[1], Chris Bloomingdale[1], Holly Corder[1], Tom Goodwill[2], Sarah Ruth[1], Randy Beaudry[1], Linda E. Hanson[1,2], and Jaime F. Willbur[1]; [1]Michigan State University; [2]USDA-ARS

Objective 1: Evaluate the impacts of variety and Cercospora leaf spot (CLS) field infection on rate of storage rot symptom development. CLS was rated on the KWS scale of 0 (disease-free) to 10 (>50% necrotic). Beets were harvested by hand and stored at 7 °C in plastic bags with wood shavings. Healthy-appearing beets of each variety were removed from storage, washed, and cut into approximately 3-cm thick sections. Root sections were inoculated with a known storage rot pathogen or with a sterile potato dextrose agar (PDA) plug as a control. There were four replications of each variety x pathogen combination. Based on common pathogens from 2019-21 MSC pile samples, *Penicillium vulpinum*, *Botrytis cinerea*, and *Fusarium graminearum* were chosen for storage trials (REACh, 2020). Inoculated beets were incubated for 24 hours before removal of agar plugs, and after one week at ambient temperature, the lesion length and depth were measured.

Trial 1: CLS infection impact on susceptibility of sugarbeet to three postharvest diseases

Location: Saginaw (SVREC)	**Treatments:** Non-treated (high CLS), grower standard (low CLS)
Planting Date: May 6th, 2021	**Variety:** C-G932NT
Harvest: October 11th, 2021	**Inoculated:** July 12th, 2021
"High CLS" average rating: 10	**"Low CLS" average rating:** 4.75

Summary: There was no evidence that CLS levels in the field affect rate of rot development for *Botrytis cinerea, Fusarium graminearum*, or *Penicillium vulpinum*. There were no significant differences between storage rot development in beets with high and low CLS levels at any timepoint in 2020 or 2021 ($P > 0.05$, Figure 1).

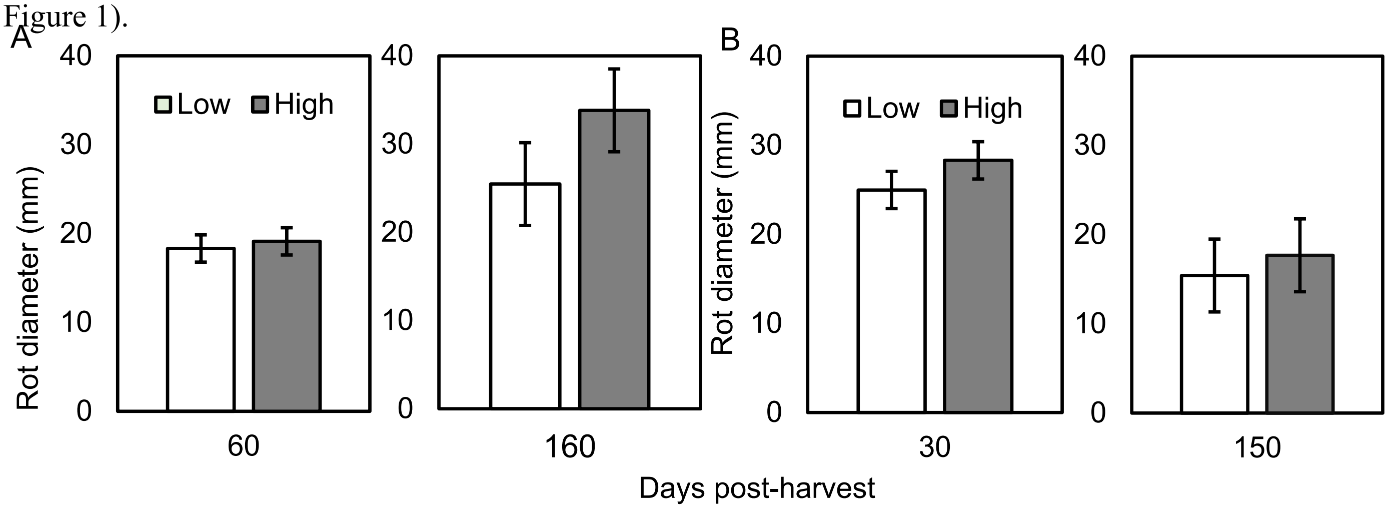

Figure 1. Mean diameter of necrotic tissue on beet slices with low and high CLS in the field after one week incubation. There was no significant difference between CLS levels in rate of rot development at any timepoint ($P > 0.05$) in 2020 (A) or 2021 (B). Observations were similar regardless of storage pathogen used, thus means across all pathogens are shown. Bars indicate 32 and 24 replicate roots for 2020 and 2021, respectively, and error bars indicate standard error. First and last timepoints shown of 3 timepoints in 2020 and 4 total timepoints in 2021.

Trial 2: CLS inoculation and variety impacts on susceptibility of sugarbeet to three postharvest diseases

Location: Saginaw (SVREC)	**Treatments:** Inoculated (high CLS), non-inoculated (low CLS)
Planting Date: May 6th, 2021	**Varieties:** F1042, EL50/2, C-G932NT, HIL-9865
Harvest: November 5th, 2021	**Inoculated:** July 12th, 2021
"High CLS" average rating: 6.58	**"Low CLS" average rating:** 3.79

Summary: There were no significant differences between rot susceptibility in beets with high or low CLS in the field at any timepoint among the four varieties ($P > 0.05$, data not shown). There were significant varietal differences in lesion development across the three pathogens at all storage timepoints ($P < 0.05$, Figure 2). There were also significant differences ($P<0.05$) in rate of rot development among varieties in 2020 (data not shown).

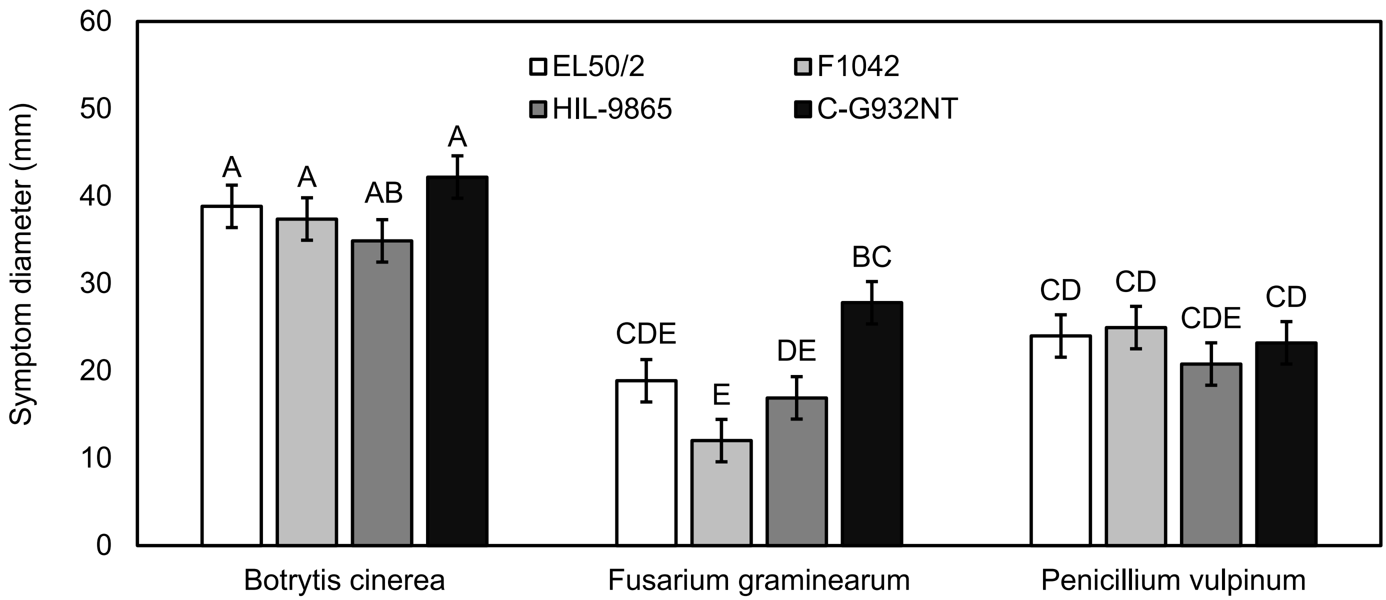

Figure 2: Comparison of mean diameter of necrotic tissue on beet slices among three storage pathogens, inoculated on roots originating from Trial 2, after one week incubation. Graph showing results from the 60-days postharvest timepoint tested in 2021. Bars indicate 8 replicate roots and error bars indicate standard error.

Objective 2: Investigate the effect of CLS infection and postharvest rot on beet respiration rate in storage. Roots of C-G932NT with high and low CLS levels (collected from Trial 1 described above) were inoculated at the crown by removing a plug of beet tissue, inserting a plug of *B. cinerea, F. graminearum*, *P. vulpinum* or PDA control, replacing the beet plug, and sealing with petroleum jelly. Respiration was measured weekly for two months.

Summary: Across three storage pathogens and a single beet variety, there was no difference in rate of respiration per kilogram of beet weight between beets classified as having high and low CLS in the field ($P > 0.05$, data not shown), consistent with work from K. Fugate (Fugate et al. 2022). Differences were observed in respiration rate among varieties. In addition, beets inoculated with *B. cinerea* had a significantly increased respiration rate compared to other storage pathogens by the end of the storage season ($P < 0.05$, Figure 3); this was not related to in-season CLS levels ($P > 0.05$).

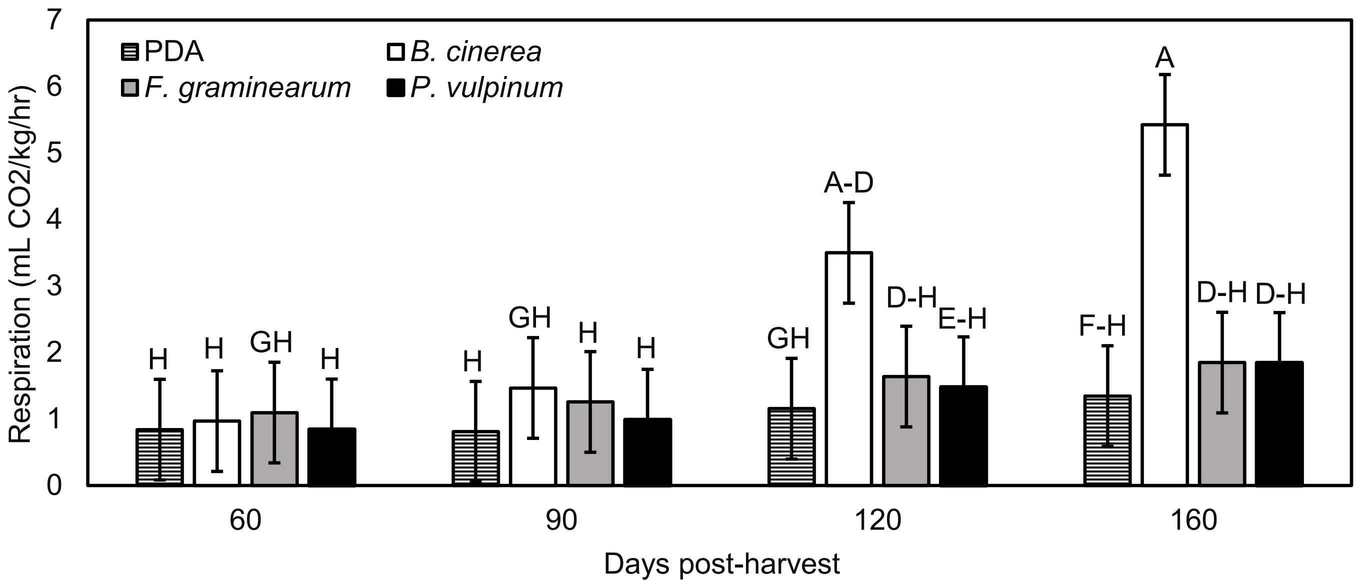

Figure 3. Comparison of mean respiration rate of beets inoculated with three storage pathogens or PDA control. Roots originated from Trial 1 in 2021. Bars indicate 6 replicate chambers and error bars indicate standard error.

Summary

- There is no evidence that CLS in the field causes an increase in rate of rot development or respiration in intact beets.
- There is variation among varieties in storage rot responses to different pathogens.
- One of the storage rots showed evidence of increasing respiration, we are repeating this experiment.
- We will continue to investigate the effects of CLS on storage pathology and beet storability.

Acknowledgements: This work is supported by the Michigan Sugar Company, USDA-ARS, Beet Sugar Development Foundation, and Project GREEEN. We also thank Dennis Bischer, Corey Guza, Amanda Harden, and Michigan Sugar Company agronomists for their assistance in obtaining beet root samples.

Inoculum reduction strategies tested in the field for improved management of Cercospora leaf spot on sugar beets, 2021-22

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Background: This research aims to identify, develop, and deploy novel, long-term CLS management strategies. Observations of *C. beticola* survival over the winter, early-season inoculum and spore presence, and disease pressure overtime have helped us to identify opportunities for further improvement in CLS management. End-of-season management strategies were assessed to reduce *C. beticola* inoculum levels and CLS disease pressure in the field.

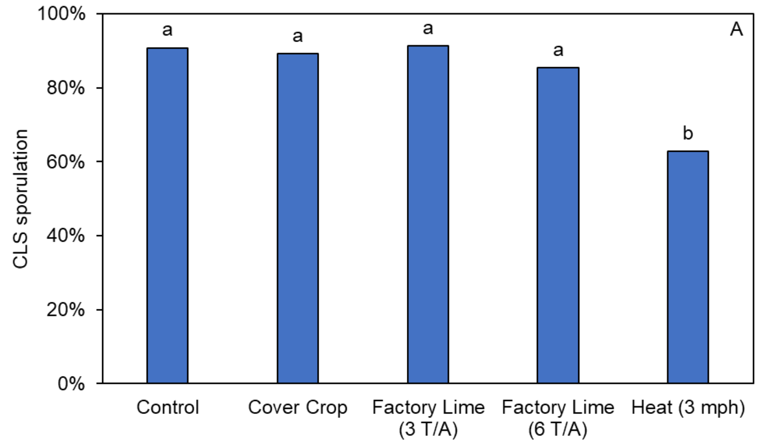
Location: Saginaw (SVREC)	**Treatments:** described below
Planting Date: May 7, 2022	**Variety:** C-G932NT (Inoculated July 12, 2021)
Harvest: September 23, 2022	**Replicates:** 4

Methods: From 2021-22, experiments were conducted to evaluate the following fall treatments: **1)** nontreated control, **2)** Wheeler rye cover crop at 67 kg/ha planted immediately post-harvest, **3)** factory lime at 3 and **4)** 6 tons/acre applied immediately post-harvest, and **5)** propane-fueled heat treatment at 3 mph prior to defoliation. In 2021, treatments were applied to 10 x 60 ft plots, surrounded by a 10-ft buffer of soybean followed by winter wheat, and replicated four times in a randomized complete block design. Leaf samples were collected from each plot at harvest before topping and evaluated 0-, 35-, 70-, and 168-days post-harvest (DPH) to assess *C. beticola* survival over the winter, determined using the percentage of lesion sporulation and isolation frequency from treated leaves. Leaf degradation over time was also evaluated.

In 2022, highly susceptible sentinel beets (germplasm F1042) and bi-weekly CLS ratings in re-planted plots were used to assess the efficacy of inoculum reduction strategies. Yield and sugar data were collected to assess the long-term efficacy of inoculum reduction strategies. Statistical analyses (mixed model ANOVA) were conducted in SAS v. 9.4 and evaluated at the α=0.05 significance level. Fisher's protected Least Significance Difference was used for mean comparisons.

Summary: In 2021 (following treatment application), significant reductions in percent lesion sporulation were detected for 3 mph heat treated at-harvest ($P < 0.0001$, Fig. 1A) samples (N=160 leaves and 200 lesions per timepoint). No differences were detected in sporulation for 35-, 70-, and 168-DPH or isolation frequencies of *C. beticola* from leaf samples evaluated at-harvest, 35-, 70-, and 168-DPH. Additionally, no differences were observed in percent sugar or RWST following fall treatments. Significant differences in percent leaf degradation, calculated using initial leaf weight at-harvest and final weight post-harvest, were detected in 70-DPH ($P < 0.05$, Fig. 1B) leaf samples. In 2022 (the year following treatment application), significant differences were seen in number of lesions on sentinel beets. Numerical reductions in sentinel beet CLS lesions were seen in Week 1 (May 17-24), Week 2 (May 24-31), and Week 4 (June 15-22) in the cover crop treated plots and Week 1 and 2 for the 3-mph heat treated plots compared to the non-treated control (Fig. 2A, N = 60 beets per timepoint). Area under the disease progress curve (AUDPC) values were significantly different among treatments ($P < 0.001$, Fig. 2B & C); the cover crop and 3 mph heat treatment resulted in significantly lower CLS than the non-treated control. Results from experiments suggest the use of a foliar heat treatment at 3 mph and a rye cover crop treatment at-harvest could have some potential to significantly reduce CLS disease pressure the following year.

Acknowledgements: This work is supported by the Michigan Sugar Company, USDA-ARS, Project GREEEN, Sugarbeet Advancement, and the USDA National Institute of Food and Agriculture, Hatch project 1020281.



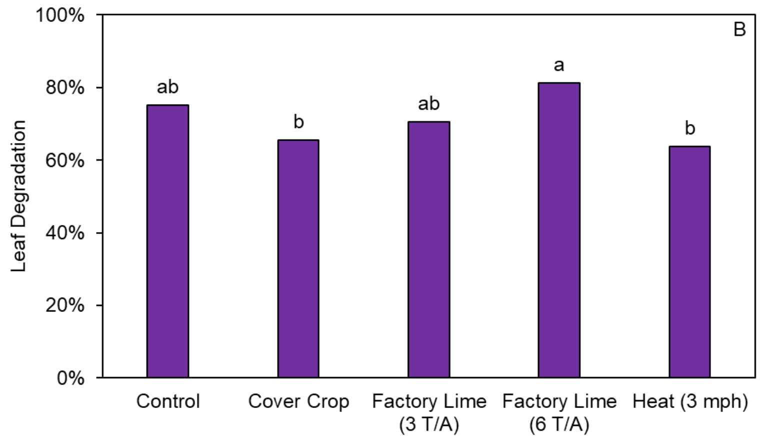


Figure 1. A) *90-day post-harvest lesion sporulation and* ***B)*** *leaf degradation following fall treatments applied in 2020. Leaf samples were weighed at initial and final collection from each treated plot, then placed in a moist chamber for three days. Then CLS lesions were assessed by observing characteristic C. beticola sporulation under a stereomicroscope (X7-X30 magnification). Means of bars with the same letters were not different based on Fisher's protected LSD at α=0.05.*

The 3-mph heat treatment significantly reduced sporulation over the winter. Leaf degradation for all treatments were not different from the control.

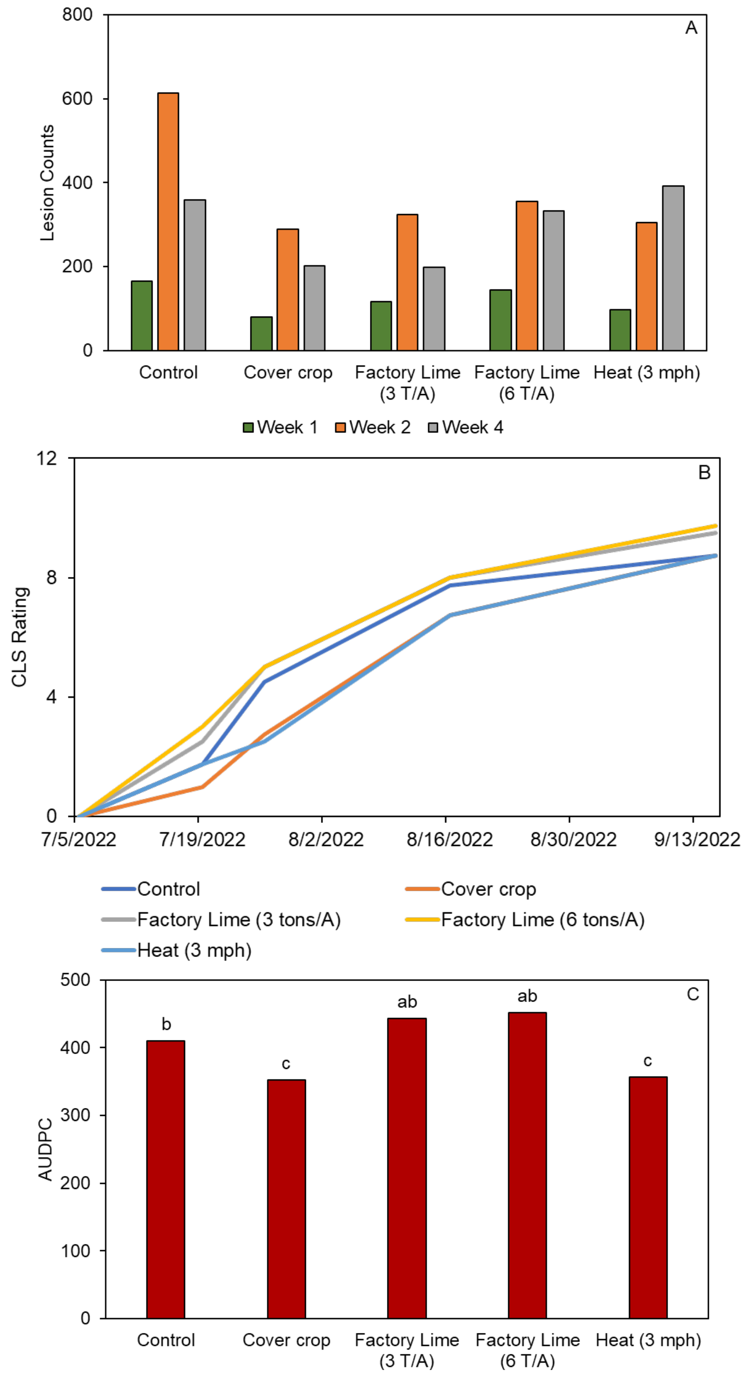


***Figure 2.** Early-season inoculum and subsequent CLS observations in 2021 following end-of-season treatments applied in 2020. **A)** Spot counts were collected from four sentinel beets placed in the center of each treated plot, left for seven days, and quantified after 21 days. **B)** Progression of mean CLS severity ratings collected 7 July to 15 Sept. **C)** Area under the disease progress curve (AUDPC) generated from biweekly CLS ratings (0-10 scale). Means of bars with the same letters were not different based on Fisher's protected LSD at α=0.05.*

Decreased lesion counts were observed from mid-May to late June for the cover crop treatment. The cover crop and heat treatment reduced AUDPC and CLS ratings from late July to mid-August.

Cercospora beticola risk model and in-field validation for Cercospora leaf spot on sugar beets, 2021-22

Alexandra Hernandez[1], Chris Bloomingdale[1], Cheryl Trueman[3], Linda E. Hanson[1,2], and Jaime F. Willbur[1]; [1]Michigan State University; [2]United States Department of Agriculture – Agricultural Research Service; [3]Syngenta Canada

Methods: Aerial spores were collected in sugarbeet fields using a Burkard spore trap in Michigan from 2019, 2020, 2021 and 2022 and from Ontario, Canada 2019, 2020, and 2021 early in the season (May to July). Environmental factors were monitored using on-site or local MSU Enviroweather stations and evaluated for correlations to spore abundance. Stepwise regression analyses were conducted to assess the accuracy of the model variables separately and together.

A preliminary model was created in 2021 to predict elevated spore numbers with a threshold of 35 spores. Correlated weather predictors were identified, and logistic modeling was used to predict elevated spore counts ($R^2 = 0.18$, $P < 0.0001$). The model predicted whether daily spore abundance was 35 or more spores (Spore35) based on number of hours with leaf wetness greater than or equal to 25% from 11AM to 10AM (DurLW), average daily air temperature in Celsius from 11AM to 10AM (AvgTemp), and maximum daily wind speed in km/h (MaxWS). The following model equation was used to predict risk for elevated aerial spores.

Spore35 = 0.1132*DurLW + 0.1285*AvgTemp + 0.0369*MaxWS - 5.0814

A validation study was conducted in 2022 to test the ability of this model to assist in fungicide application timing and improved management. The field treatments were in a randomized complete block design with three treatments applied to both CLS susceptible and resistant sugarbeet variety.

Location: Frankenmuth (Saginaw Valley Research and Extension Center)	**Treatment Timings:** see table
Planting Dates: April 29, 2022 (Harvest September 23)	**Pesticides:** see table
Soil Type: Loam	**O.M.:** 5.0 **pH:** 7.5
Replicates: 4	**Variety:** C-G021 and C-G932NT

Table 1. Model validation treatment programs tested in 2022. After initiation, subsequent spray timings followed a 14-day interval for the susceptible (C-G932NT) and 28-day interval for the resistant variety (C-G021).

Trt	Variety	Program	Initiation Criteria [a]	Actual Initiation Date	No. App.	App. Interval	AUDPC [b]		Yield (T/A)
1	C-G021	Non-treated control	-	-	-	-	31.6	c	17.5
2	C-G021	Grower standard [c]	55 DSV	7/12/22	3	28-day	14.0	c	17.3
3	C-G021	Model Spore35	70% + DSV 3 or 4	7/8/22	3	28-day	27.6	c	20.0
4	C-G932NT	Non-treated control	-	-	-	-	264.1	a	15.3
5	C-G932NT	Grower standard	50 DSV	7/8/22	5	14-day	135.5	b	15.7
6	C-G932NT	Model Spore35	70% + DSV 3 or 4	7/8/22	5	14-day	102.5	b	14.1
				P-value			< 0.001		NS

[a] Model Spore35 was implemented to trigger at a 70% likelihood threshold for the presence of 35 or more *C. beticola* spores paired with a BEETcast DSV value of 3 or 4 on the same day.
[b] Grower standard program as follows for the susceptible variety: Manzate Max (1.6 qt) ACDFG; Inspire XT (7 fl oz) CF; Super Tin (8 fl oz) D; and resistant variety: Manzate Max (1.6 qt) ADG and BEH; Inspire XT (7 fl oz) DE; Super Tin (8 fl oz) GH. Application letters code for the following dates: A=8 Jul, B=12 Jul, C=19 July, D=2 Aug, E=9 Aug, F=16 Aug, G=30 Aug, and H=6 Sept.
[c] Area under the disease progress curve was calculated using disease severity scores (0-10 scale) collected Jul 26 through Aug 15.
[d] Column values followed by the same letter were not significantly different based on Fisher's Protected LSD (α=0.05).

Summary: The treatments in this study did not result in significant differences in yield. The model prediction spray timings triggered at the same time as the susceptible standard control treatment. Therefore, no significant differences in AUDPC were observed between the model-based spray timing and the grower standard control for the susceptible variety. Both the model-based, and the grower standard fungicide treatments resulted in significantly lower CLS pressure than the non-treated control. No significant difference in AUDPC was detected between treatments on the resistant variety. The addition of a resistant cultivar may not be necessary to test early-season risk models in future experiments.

Aerial spores were collected mid-May through mid-July of 2022 at SVREC in Frankenmuth, Michigan. The current model predicted correctly 73% of days where *C. beticola*-like conidia observed surpassed the 35-spore threshold on a small subset of 15 days monitored (final analyses in progress). Spore observations from 2022 and alternative modeling techniques will be used to further refine the risk models of interest, and final models will be validated in 2023.

Acknowledgements: This work is supported by the Michigan Sugar Company, USDA-ARS, Project GREEEN, and the USDA National Institute of Food and Agriculture, Hatch project 1020281.

SUGAR BEET (*Beta vulgaris* 'SX-2283')
Rhizoctonia root and crown rot; *Rhizoctonia solani*

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Evaluation of in-furrow and banded fungicide applications to manage Rhizoctonia root and crown rot of sugar beet in Michigan, 2022.

A field trial was established at the Saginaw Valley Research and Extension Center in Frankenmuth, MI to evaluate the efficacy of experimental and commercially available fungicides at managing *Rhizoctonia solani* in sugar beets. Sugar beet variety SX-2283 was planted at a rate of 50,000 seed/A on 17 May. A randomized complete block design, with four replicates, was used. Plot dimensions were four rows wide (30-in row spacing) by 30 ft long. In-furrow treatments were applied at planting, using a tractor mounted CO_2-powered backpack sprayer (TJ2502E nozzles) and applying fungicides at a volume of 0.60 gal/1,000 row-ft (32 psi). Plots were inoculated with *R. solani* (anastomosis group 2-2)-infested barley on 23 Jun. Inoculum was deposited atop rows at a rate of 1.25 g/row-ft. Banded applications were made 30 Jun, when plants were at the 6-8 leaf stage. Treatments were applied with a CO_2-powered backpack sprayer in an 8-in. band at 15 gal/A (TJ4001E; 19 psi). Asymptomatic and symptomatic plant counts were collected throughout the summer to assess stand establishment and disease progression. The center two rows of plots were harvested 15 Sep. Weights were collected to estimate yield and a target of ten beets from each row were arbitrarily selected to rate disease (0-7 scale). The severity scale is based on the area of root infected: 0=0%, 1=0-2.5%, 2=2.5-5%, 3=5-25%, 4=25-50%, 5=50-75%, 6=95% (only tip not rotten), 7=100% (plant dead). Disease incidence and severity were combined into a single disease index (DX) to assess disease pressure among treatments. The disease index was calculated by multiplying the Rhizoctonia root rot incidence from the total rated roots (0-100%) by the mean symptomatic root severity divided by seven. A generalized linear mixed model procedure was used to conduct the ANOVA and mean separations at an $\alpha=0.05$ significance level (SAS version 9.4).

Significant differences in the percent stand loss were observed among tested programs ($P < 0.0001$). All programs had lower rates of stand loss, ranging from 0 to 35.2%, than the inoculated control (program 1), which had 59.4% loss. Stand reduction in programs 3, 7, 8, 9, and 10 did not differ from the non-inoculated control (program 2). Disease index values also differed significantly among fungicide programs ($P < 0.0001$). Programs 3, 8, 9, and 10 all had significantly lower disease indices than the inoculated control. Yield estimates also were significantly different among programs ($P < 0.01$). Fungicide programs 3 and 5-10 had estimated values ranging between 11.4 and 22.3 t/A and were significantly greater than the inoculated control, with 3.4 t/A.

No.	Treatment, Rate[z]	Application Type[y]	Stand Loss (%)[x,w]	Root Disease Index (%)[v]	Yield (t/A)
1	Inoculated Control[u]	-	59.4 a	68.2 ab	3.4 d
2	Non-inoculated Control[u]	-	0.7 d	1.2 d	13.0 bc
3	Quadris, 13.9 fl oz Quadris, 13.9 fl oz	In-Furrow Banded	0.0 d	14.9 d	17.8 ab
4	Experimental, 24 fl oz	In-Furrow	25.1 bc	59.0 a-c	9.1 cd
5	Experimental, 32 fl oz	In-Furrow	35.2 b	76.2 a	11.4 bc
6	Experimental, 48 fl oz	In-Furrow	22.2 bc	52.8 bc	12.5 bc
7	Experimental, 32 fl oz Experimental, 32 fl oz	In-Furrow Banded	2.7 d	47.3 bc	18.4 ab
8	Experimental, 32 fl oz	Banded	12.1 cd	38.3 c	14.7 bc
9	Quadris, 13.9 fl oz Elatus, 7.1 fl oz	In-Furrow Banded	0.6 d	7.5 d	22.3 a
10	Elatus 7.1 fl oz	Banded	2.2 d	12.3 d	17.9 ab

[z] All rates are listed as measure of a product per acre.

[y] In-furrow treatments were applied at planting (17 May), banded applications were applied at the 6-8 leaf stage (30 Jun).

[x] Stand loss percentages calculated from initial stand counts collected 23 Jun and final dead beet counts collected 15 Sep.

[w] Column values followed by the same letter were not significantly different based on Fisher's Protected LSD (α=0.05).

[v] Disease index was calculated by multiplying the Rhizoctonia root rot incidence (0-100%) by the mean symptomatic root severity (1-7) and dividing by 7.

[u] Non-treated control.

SUGAR BEET (*Beta vulgaris* 'SX-1278N')
Cercospora Leaf Spot; *Cercospora beticola*

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Evaluation of foliar fungicides to manage Cercospora leaf spot of sugar beet in Michigan, 2022.

A field trial was established at the Saginaw Valley Research and Extension Center in Frankenmuth, MI to evaluate the efficacy of fungicides at managing Cercospora leaf spot (CLS) in sugar beets. The trial was planted 29 Apr at a rate of 50,000 seed/A using 30-in row spacing. A randomized complete block design was used, with four replicates, and plots were four rows wide and 35 ft long. Liquid *C. beticola* inoculum ($1x10^3$ conidia/mL) was applied at 15 gal/A using a tractor mounted sprayer on 12 Jul. Five foliar applications were made for all programs (A, B, C, D, and E) on 8 Jul, 19 Jul, 2 Aug, 16 Aug, and 30 Aug. Foliar applications were made using a CO_2-powered backpack sprayer equipped with four TJ8004XR nozzles (30-in spacing), calibrated at 20 gal/A (32 psi). Disease ratings were collected through the summer; plots were assigned a severity using the following scale based on infected 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%. The ratings were used to calculate area under the disease progress curve (AUDPC) for CLS severity. The center two rows of the plots were harvested on 23 Sep to estimate yield in t/A. After weights were collected, subsamples from each plot were sent to Michigan Sugar Company (Bay City, MI) to determine percent sugar and pounds of recoverable white sugar per ton (RWST). A generalized linear mixed model procedure was used to conduct the ANOVA and mean separations at the α=0.05 significance level (SAS version 9.4).

Significant CLS pressure was observed uniformly throughout this study; all fungicide programs had significantly lower AUDPCs than the non-treated control ($P < 0.0001$). AUDPCs for fungicide programs ranged between 38.0 and 72.5, while the control program had a AUDPC of 177.8. No differences were observed among estimated yields ($P > 0.05$), however, all programs had numerically greater yields (13.9-20.1 t/A) than the control (11.2 t/A). All fungicide programs had significantly greater sugar content than the control ($P < 0.0001$) and all programs resulted in significantly greater RWST than the control ($P < 0.0001$).

No.	Treatment, Rate[z], and Timing[y]	AUDPC[x, w]		Yield (t/A)	Sugar (%)		RWST[v]	
1	Non-treated Control	177.8	a	11.2	14.9	c	215.9	d
2	Manzate Max (1.6 qt) ABCDE; Inspire XT (7 fl oz) BD; Super Tin (8 fl oz) C	53.5	cd	16.9	17.0	ab	251.8	a-c
3	Manzate Max (1.6 qt) ACE; Propulse (13.7 fl oz) BD; Super Tin (8 fl oz) C	38.0	d	20.1	16.9	ab	250.4	a-c
4	Manzate Max (1.6 qt) ACE; Proline (5.7 fl oz) BD; Super Tin (8 fl oz) C	45.5	d	15.7	16.7	ab	246.9	a-c
5	Manzate Max (1.6 qt) ACE; Delaro (11 fl oz) B; Super Tin (8 fl oz) C; Proline (1.7 fl oz) D	46.0	d	19.7	17.0	ab	253.1	a-c
6	Manzate Max (1.6 qt) AE; Delaro (11 fl oz) B; Luna Privilege (2 fl oz) C; Proline (1.7 fl oz) D	67.3	bc	15.2	16.6	ab	243.4	bc
7	Badge (2 pt) ABCDE; Domark (6.9 fl oz) B; Super Tin (8 fl oz) C; Inspire XT (7 fl oz) D	72.5	b	18.9	17.2	a	254.9	ab
8	Manzate Max (1.6 qt) ABCDE; Domark (6.9 fl oz) B; Super Tin (8 fl oz) C; Inspire XT (7 fl oz) D	44.5	d	15.9	17.0	ab	252.3	a-c
9	Badge (2 pt) ABCDE; Exp[u] (1.5 pt) A; Domark (6.9 fl oz) B; Super Tin (8 fl oz) C; Inspire XT (7 fl oz) D	54.8	b-d	13.9	16.7	ab	245.8	a-c
10	Manzate Max (1.6 qt) ABCDE; Domark (6.9 fl oz) B; Super Tin (8 fl oz) C; Exp (1.5 pt) C; Inspire XT (7 fl oz) D	46.0	d	15.2	16.5	b	242.7	c
11	Manzate Max (1.6 qt) ABCDE; Domark (6.9 fl oz) B; Super Tin (8 fl oz) C; Inspire XT (7 fl oz) D; Exp (1.5 pt) E	44.5	d	16.4	16.7	ab	246.6	a-c
12	Manzate Max (1.6 qt) ABCDE; Exp (1.5 pt) ACE; Domark (6.9 fl oz) B; Super Tin (8 fl oz) C	45.0	d	15.2	17.2	a	256.3	a

[z] 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.

[y] Application letters code for the following dates: A=8 Jul, B=19 Jul, C=2 Aug, D=16 Aug, and E=30 Aug.

[x] Area under the disease progress curve was calculated using disease severity scores (0-10 scale) collected Jul 26, Aug 11, Aug 23, and Sep 8.

[w] Column values followed by the same letter were not significantly different based on Fisher's Protected LSD (α=0.05).

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

[u] Exp=Experimental compound

SUGAR BEET (*Beta vulgaris* 'SX-2283')
Cercospora Leaf Spot; *Cercospora beticola*

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Evaluation of banded and foliar compounds to manage Cercospora leaf spot of sugar beet in Michigan, 2022.

A field trial was established at the Saginaw Valley Research and Extension Center in Frankenmuth, MI with the objective of evaluating the efficacy of banded and foliar applications at managing Cercospora leaf spot (CLS) in sugar beets. Variety SX-2283 was planted on 29 Apr at 50,000 seed/A. Research plots were four rows wide (30-in. row spacing) by 35 ft long. The trial was inoculated with liquid *C. beticola* inoculum ($1x10^3$ conidia/mL) on 12 Jul using a tractor mounted sprayer (15 gal/A). Two banded applications (α and β) were made 13 Jun and 27 Jun. A CO_2-powered backpack sprayer was used to apply products in an 8-in. band at 15 gal/A (TJ4001E; 19 psi). Five foliar applications (A, B, C, D, and E) were made 8 Jul, 19 Jul, 2 Aug, 16 Aug, and 30 Aug. Foliar applications were made using a CO_2-powered backpack sprayer equipped with four TJ8004XR nozzles (30-in spacing), calibrated at 20 gal/A (32 psi). Disease ratings were collected through the summer; plots were assigned a severity using the following scale based on infected 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%. The ratings were used to calculate area under the disease progress curve for disease severity (AUDPC). The center two rows of the plots were harvested on 23 Sep to estimate yield in t/A. After weights were collected, subsamples from each plot were sent to Michigan Sugar Company (Bay City, MI) to determine percent sugar and pounds of recoverable white sugar per ton (RWST). A generalized linear mixed model procedure was used to conduct the ANOVA and mean separations at the α=0.05 significance level (SAS version 9.4).

Tested programs had AUDPCs ranging from 44.3 to 142.3, compared to the control with an AUDPC value of 165.5. All programs, except for 7, had significantly lower AUDPCs than the non-treated control ($P < 0.0001$). No differences were observed among yields ($P > 0.05$); however, significant differences were observed among sugar content ($P < 0.05$) and RWST ($P < 0.05$). The greatest sugar content was observed from programs 2, 3, and 5, which ranged between 15.4 and 16.3%; the greatest RWST was observed from programs 2, 3, and 5.

No.	Treatment, Rate[z], and Timing[y]	AUDPC[x, w]		Yield (t/A)	Sugar (%)		RWST[v]	
1	Non-treated Control	165.5	a	9.2	14.6	c	210.0	c
2	Manzate Max (1.6 qt) ABCDE; Inspire XT (7 fl oz) BD	48.8	c	12.6	15.8	ab	231.0	ab
3	Manzate Max (1.6 qt) ABCDE; LifeGard (4.5 oz/100 gal) ACE; Inspire XT (7 fl oz) BD	44.3	c	15.2	16.3	a	238.9	a
4	LifeGard (4.5 oz/100 gal) AC; Manzate Max (1.6 qt) BDE; Inspire XT (7 fl oz) BD	88.0	b	8.2	15.2	bc	220.4	bc
5	LifeGard (4.5 oz/100 gal) ABCDE; Mankocide (4.3 lb) ABCDE	52.8	c	13.7	15.4	a-c	223.1	a-c
6	Sunergist (6.4 fl oz/100 gal) αβA	102.3	b	9.3	14.6	c	209.3	c
7	Sunergist+Chitosan (6.4 fl oz/100 gal) αβA	142.3	a	9.1	14.6	c	208.6	c
8	Sunergist (6.4 fl oz/100 gal) αβAB	105.0	b	13.2	14.9	bc	217.2	bc
9	Sunergist (6.4 fl oz/100 gal) αβAB; Proline (5.7 fl oz) B	102.5	b	14.0	15.0	bc	216.2	bc

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

[y] Banded application letters code for the following dates: α=13 Jun and β=27 Jun. Foliar application letters code for the following dates: A=8 Jul, B=19 Jul, C=2 Aug, D=16 Aug, and E=30 Aug.

[x] Area under the disease progress curve was calculated using disease severity scores (0-10 scale) collected Jul 26, Aug 11, Aug 23, and Sep 8.

[w] Column values followed by the same letter were not significantly different based on Fisher's Protected LSD (α=0.05).

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

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan State University AgBioResearch

Sugarbeet tolerance to postemergence applications of Ultra Blazer

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

Location: Richville (SVREC)	**Application timings**: 2 lf beets (May 19), 6 lf beets (June 1), 10 lf beets (June 16)
Planting Date: April 20, 2022	**Herbicides:** see treatments
Soil Type: Sandy clay loam	**O.M.:** 2.5 **pH:** 7.4
Replicated: 4 times	**Variety:** Crystal G049RR

Table 1. Sugarbeet tolerance to POST applications of Ultra Blazer (acifluorfen) applied at various sugarbeet stages and with various mixtures, 7 d after the 6- and 10-lf application and in late-August.

Herbicide treatments[a]	**Timing**	**Injury (June 8)**	**Injury (June 23)**	**Injury (August 25)**	**Yield**	**RWSA**
		— % —	— % —	— % —	– ton/A –	– lb/A –
Roundup PowerMax 3 (30/20/20 fl oz)	2-, 6-, 10 lf	0	0	0	28.7	6749
Ultra Blazer (8/8 fl oz)	6-, 10 lf	24*[b]	30*	0	23.1*	5238*
Ultra Blazer (16/16 fl oz)	6-, 10 lf	24*	25*	0	23.4*	5490*
Ultra Blazer (16 fl oz)	6 lf	34*	18*	0	25.8	6052
Ultra Blazer (16 fl oz)	10 lf	0	18*	0	26.8	6098
Ultra Blazer (16 fl oz) + Dual Magnum (1.33 pt)	6 lf	63*	40*	0	22.9*	5197*
Ultra Blazer (16 fl oz) + Warrant (3 pt)	6 lf	14*	8*	0	26.1	6046
Ultra Blazer (16 fl oz) + Outlook (16 fl oz)	6 lf	38*	14*	0	25.0	5690*
Ultra Blazer (16 fl oz) + Ethofumesate (32 pt)	6 lf	28*	6*	0	26.4	6195
Stinger (2 fl oz) fb. Ultra Blazer (16 fl oz) + Stinger (4 fl oz)	2-, 6 lf	34*	8*	0	24.0*	5670*
Stinger (2 fl oz) fb. Stinger (4 fl oz)	2-, 6 lf	8*	4	0	27.5	6373
LSD$_{0.05}$[c]		*7.4*	*5.8*	*0*	*4.4*	*969*

[a] Roundup PowerMax 3 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] Injury, yield and RWSA data with asterisks (*) are significantly different than the Roundup PowerMax 3 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 waterhemp in sugarbeet. Ultra Blazer (aciflurofen) is a Group 14 herbicide that has activity on pigweed species. Over the past five years we have conducted research evaluating sugarbeet safety to POST applications of Ultra Blazer. Ultra Blazer injury to sugarbeet consists of leaf speckling/bronzing. The greatest injury from Ultra Blazer was when Ultra Blazer was tank-mixed with Dual Magnum. This treatment along with two applications of Ultra Blazer at 8 or 16 fl oz/A, tank-mixtures with Outlook or Stinger resulted in significant yield and/or RWSA reductions. Other tank-mixtures with/or Ultra Blazer alone at the 6- or 10-lf stage also resulted in injury, however sugarbeet was able to recover without reductions in yield. This research helps support Michigan's 2022 Section 18 registration that allowed for Ultra Blazer applications on sugarbeets at the 6-leaf stage or larger at a 16 fl oz/A rate.

Weed control in sugarbeet with Rinskor

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

Location: Richville (SVREC)	**Application timings**: (A) Cotyledon-2 lf weeds (May 13); (B) + 10 days (May 25)
Planting Date: April 20, 2022	**Herbicides:** see treatments
Soil Type: Sandy clay loam	**O.M.:** 2.5 **pH:** 7.4
Replicated: 4 times	**Variety:** Crystal G049RR

Table 1. Sugarbeet tolerance and common lambsquarters control with Loyant (Rinskor), at the 2nd herbicide application (B), 14 and 51 d after the last herbicide application.

		Injury			**c. lambsquarters**		
Herbicide treatments[a]	**Timing**	**@ B**	**14 DA-B**	**51 DA-B**	**@ B**	**14 DA-B**	**51 DA-B**
		— % —	— % —	— % —	— % —	— % —	— % —
Roundup PowerMax 3 (25 fl oz)	A & B	0	0	0	96	100	96
Loyant (0.274 fl oz)	A & B	15*[b]	23*	3	70*	94*	78*
Loyant (0.41 fl oz)	A & B	16*	23*	10*	86*	96*	76*
Loyant (0.547 fl oz)	A & B	20*	24*	17*	85*	94*	88
Loyant (0.274 fl oz) + Etho (6 fl oz) + RUP 3 (25 fl oz)	A & B	20*	18*	6	100	100	94
Loyant (0.41 fl oz) + Etho (6 fl oz) + RUP 3 (25 fl oz)	A & B	26*	25*	20*	100	100	97
Loyant (0.547 fl oz) + Etho (6 fl oz) + RUP 3 (25 fl oz)	A & B	20*	23*	26*	100	100	98
Loyant (0.274 fl oz) + Dual (1 pt) + Etho (6 fl oz) + RUP 3 (25 fl oz)	A & B	23*	26*	3	100	100	100
Loyant (0.41 fl oz) + Dual (1 pt) + Etho (6 fl oz) + RUP 3 (25 fl oz)	A & B	33*	29*	13*	100	100	100
Loyant (0.547 fl oz) + Dual (1 pt) + Etho (6 fl oz) + RUP 3 (25 fl oz)	A & B	33*	25*	20*	100	100	100
Stinger HL (1.2/2.4 fl oz) + Dual (1 pt) + RUP 3 (25 fl oz)	A & B	3	15*	0	89	98	93
$LSD_{0.05}$[c]		*5.9*	*6.4*	*7.8*	*8.1*	*2.8*	*8.9*

[a] AMSOL at 2.5% v/v was included with all treatments with Roundup PowerMax 3, Destiny HC at 0.5% v/v was included with all Loyant treatments. Etho = Ethofumesate, RUP 3 = Roundup PowerMax 3, Dual = Dual Magnum.
[b] Injury and common lambsquarters control data with asterisks (*) are different than the Roundup PowerMax 3 alone control.
[c] Means within a column greater than least significant difference (LSD) value are different from each other.

Summary: Rinskor (florpyrauxifen) is a new arylpicolinate Group 4 herbicide. Currently, this active is sold as Loyant in rice and has been used in sugarbeet in Europe. The goal of this research was to examine sugarbeet safety and weed control at various rates and tank-mixtures. Sugarbeet injury from Loyant consisted of typical growth regulator injury, fused and elongated leaves. All rates of Loyant resulted in sugarbeet injury and at the higher rates lasted throughout most of the season. Additionally, two applications of Loyant alone resulted in lower common lambsquarters than two applications of Roundup PowerMax alone until 51 DA-B. We expect to continue to examine this herbicide and determine if there is a fit for weed control in Michigan sugarbeet production.

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan State University AgBioResearch

Sugarbeet tolerance with Rinskor

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

Location: Richville (SVREC)	**Application timings**: (A) 2 lf beets (May 19); (B) + 10 days (June 1)
Planting Date: April 20, 2022	**Herbicides:** see treatments
Soil Type: Sandy clay loam	**O.M.:** 2.5 **pH:** 7.4
Replicated: 4 times	**Variety:** Crystal G049RR

Table 1. Sugarbeet tolerance with Loyant (Rinskor) under weed-free conditions at the 2nd application, and 15 and 51 d after the last application.

Herbicide treatments[a]	Timing	Injury @ B	Injury 15 DA-B	Injury 44 DA-B	Yield	RWSA
		— % —	— % —	— % —	– ton/A –	– lb/A –
Weed-free	A & B	0	0	0	30.5	7250
Loyant (0.274 fl oz)	A & B	13*[b]	19*	11*	23.3*	5363*
Loyant (0.547 fl oz)	A & B	19*	23*	23*	23.4*	5251*
Loyant (1.095 fl oz)	A & B	21*	29*	34*	22.7*	5018*
Loyant (0.274 fl oz) + Dual (1 pt) + Etho (6 fl oz) + RUP 3 (25 fl oz)	A & B	24*	25*	11*	25.9	6209
Loyant (0.547 fl oz) + Dual (1 pt) + Etho (6 fl oz) + RUP 3 (25 fl oz)	A & B	30*	32*	26*	22.0*	5126*
Loyant (1.095 fl oz) + Dual (1 pt) + Etho (6 fl oz) + RUP 3 (25 fl oz)	A & B	30*	36*	38*	20.2*	4564*
Stinger HL (1.2/2.4 fl oz) + Dual (1 pt) + RUP 3 (25 fl oz)	A & B	19*	6*	1	29.5	6849
Loyant (0.274 fl oz) + Dual (1 pt) + RUP 3 (25 fl oz)	A & B	21*	24*	13*	26.9	6265
Loyant (0.547 fl oz) + Dual (1 pt) + RUP 3 (25 fl oz)	A & B	26*	31*	25*	24.7*	5538*
LSD$_{0.05}$[c]		*6*	*5.6*	*7.1*	*5.41*	*1051*

[a] AMSOL at 2.5% v/v was included with all treatments with Roundup PowerMax 3, Destiny HC at 0.5% v/v was included with all Loyant treatments. Etho = Ethofumesate, RUP 3 = Roundup PowerMax 3, Dual = Dual Magnum.

[b] Injury, yield and RWSA data with asterisks (*) are significantly different than the weed-free control.

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

Summary: Rinskor (florpyrauxifen) is a new arylpicolinate Group 4 herbicide. Currently, this active is sold as Loyant in rice and has been used in sugarbeet in Europe. The goal of this research was to examine sugarbeet tolerance at various rates and tank-mixtures. Sugarbeet injury from Loyant consisted of typical growth regulator injury, fused and elongated leaves. All rates of Loyant resulted in significant sugarbeet injury. Loyant applications also resulted in lower yields and recoverable white sugar per acre with the exception of Loyant at 0.274 fl oz per acre tank-mixed with Dual + Roundup or Dual + Ethofumesate + Roundup. Even though applications of Stinger + Dual + Roundup caused some injury; this injury did not last throughout the season and sugarbeet yield and RWSA was similar to the weed-free control. We expect to continue to examine Loyant and determine if there is a fit for weed control in Michigan sugarbeet production.

Adama Copper Roundup

SVREC - Richville, MI - 2022

Trial Quality: Fair
Variety: BTS - 1703
Planted: April 22
Harvested: October 11
Plots: 6 rows X 38 ft, 4 reps
Row Spacing: 22 in.

Soil Info: Clay Loam
% OM: 2.4 **pH:** 7.3 **CEC:** 13.2
P: High **K:** Medium
Mn: High **B:** Medium
Added N: 120 lbs. PPI + 35 lbs. 2X2
Previous Crop: Wheat

Rhizoc Level: Low
Cerc Control: Good
Problems: Variable Stand
Seeding Rate: 4.1 in.
Rainfall: 13.46 in.
Beets/100 ft: 139

Application: JD 3520 tractor mounted plot sprayer, compressed air, 15.3 gpa
Monosem 6-row Agronomy Planter, compressed air, 30 psi, 9 gpa - IF, 3.5" band

No.	Treatment*	Rate/A	Applic Timing***	Injury 0-10 5-Aug	Net $/A	RWSA	RWST	T/A	% SUC	% CJP
3	EBDC**	1.6 qt	A	**0.0**	**$2,447**	**11044**	309	**35.6**	20.2	**96.4**
	Copper**	2 pt	B							
	EBDC** + Provysol	2 lb + 5 fl oz	C							
	Copper**	2 pt	D							
1	EBDC**	1.6 qt	A	**0.0**	**$2,327**	**10467**	299	**35.0**	20.0	95.1
	Mastercop	1.5 pt	B							
	EBDC** + Provysol	2 lb + 5 fl oz	C							
	Mastercop	1.5 pt	D							
5	EBDC**	1.6 qt	A	**0.5**	**$2,275**	**10253**	305	**33.6**	19.9	**96.5**
	Mastercop	2 pt	B							
	EBDC** + Provysol	2 lb + 5 fl oz	C							
	Mastercop	2 pt	D							
2	EBDC**	1.6 qt	A	**0.9**	**$2,287**	**10329**	305	**33.8**	20.1	**95.9**
	Mastercop + Roundup PowerMAX + AMS	1.5 pt + 24 fl oz + 17 lbs/100 gal	B							
	EBDC** + Provysol	2 lb + 5 fl oz	C							
	Mastercop + Roundup PowerMAX + AMS	1.5 pt + 24 fl oz + 17 lbs/100 gal	D							
6	EBDC**	1.6 qt	A	1.8	**$2,147**	**9736**	300	**32.5**	19.9	**95.6**
	Mastercop + Roundup PowerMAX + AMS	2 pt + 24 fl oz + 17 lbs/100 gal	B							
	EBDC** + Provysol	2 lb + 5 fl oz	C							
	Mastercop + Roundup PowerMAX + AMS	2 pt + 24 fl oz + 17 lbs/100 gal	D							
4	EBDC**	1.6 qt	A	3.6	$1,796	8275	297	27.7	19.8	95.4
	Copper** + Roundup PowerMAX + AMS	2 pt + 24 fl oz + 17 lbs/100 gal	B							
	EBDC** + Provysol	2 lb + 5 fl oz	C							
	Copper** + Roundup PowerMAX + AMS	2 pt + 24 fl oz + 17 lbs/100 gal	D							
	Average			1.1	$2,213	10017	303	33.1	20.0	95.8
	LSD 5%			1.3	379.7	1634.4	n.s.	5.0	n.s.	0.9
	CV%			76.1	11.4	10.8	2.7	10.1	2.1	0.6

*All treatments included MasterLock @ 6.4 fl oz

****EBDC =** Manzate/Manzate Pro-stick **Copper =** Badge

*****Application Dates: A - 6/24, B - 7/5, C - 7/20, D - 8/5**

Comments: This trial had stand issues due to soil crusting after planting. Many of the treatments were able to be evaluated for injury. The study was designed to evaluate injury with Mastercop copper mixed with Roundup PowerMAX plus AMS compared to Badge mixed with Roundup PowerMax plus AMS at different rates. While injury was lower with Mastercop vs Badge injury still occurred. Michigan Sugar Company does not recommend mixing Copper fungicides and glyphosate products with AMS at this time.

$/A: Payment calculated using early delivery adjustment where necessary, and a per pound payment of $.18 minus fungicide and application cost.

Bold: Results are not statistically different from top-ranking treatment in each column.

Bayer Movento
SVREC - Richville, MI - 2022

Trial Quality: Good
Variety: BTS-1703
Planted: April 22
Harvested: October 11
Plots: 6 rows X 38 ft, 5 reps
Row Spacing: 22 in.

Soil Info: Clay Loam
% OM: 2.4 **pH:** 7.3 **CEC:** 13.2
P: High **K:** Medium
Mn: High **B:** Medium
Added N: 120 lbs. PPI + 35 lbs. 2X2
Prev Crop: Wheat

Rhizoc Level: Low
Cerc Control: Good
Problems: None
Seeding Rate: 4.1 in.
Rainfall: 13.46 in.
Beets/100 ft: 133

Application: JD 3520 tractor mounted plot sprayer, compressed air, 30 psi, 15.3 gpa - Foliar 7" band
Monosem 6-row Agronomy planter, compressed air, 30 psi, 9 gpa - IF, 3.5" band

No.	Treatment	Rate/A	Applic Date	Dead Beets/ 100 ft	Net $/A	RWSA	RWST	T/A	% SUC	% CJP
3	Mustang Maxx Destiny	4 oz .25% v/v	31-May	0.4	**$2,987**	**12976**	312	41.7	20.4	**96.2**
	Mustang Maxx Destiny	4 oz .25% v/v	8-Jun							
1	Untreated Check			0.6	$2,789	12008	305	39.4	20.0	**96.1**
2	Movento Destiny	9 oz .25% v/v	31-May	0.6	$2,668	12169	308	39.5	20.3	95.8
	Movento Destiny	9 oz .25% v/v	8-Jun							
	Average			0.6	$2,815	12,384	308	40.2	20.2	96.0
	LSD 5%			n.s	169.6	729.9	n.s	n.s	n.s	0.2
	CV%			171.4	3.5	3.4	2.0	4.5	2.0	0.1

Comments: Movento was tested to examine the effect of insects on yield. Insect pressure was low at this location.

$/A: Payment calculated using early delivery adjustment where necessary, and a per pound payment of $.18 minus fungicide and application cost.

Bold: Results are not statistically different from top-ranking treatment in each column.

Cercospora Nursery
Average of 2 years, 2021 & 2022

Trial Quality: Good
Locations:
2021 - Blumfield East, SVREC
2022 - Blumfield East, SVREC
Inoculation: Trials were Inoculated

Plot Size:
Blumfield East 2021/2022 - 2 Rows x 25 ft., 6 reps
SVREC 2021- 2 Rows x 20 ft., 6 reps

Variety	Avg of 2 Years CLS Rate 0-9	2021 CLS Rate 0-9	2022 CLS Rate 0-9
BTS-1941	1.8	1.9	1.7
C-G021	1.8	2.0	1.7
BTS-1065	2.0	2.1	2.0
C-G049	2.1	2.2	2.0
BTS-1183	2.2	2.2	2.1
C-G151	2.2	2.4	2.0
BTS-1122	2.2	2.5	2.0
HIL-2401NT	3.4	3.5	3.3
BTS-1703	3.4	3.5	3.4
MA-813NT	3.6	3.4	3.8
MA-709	3.7	3.7	3.7
Resistant Check	3.7	3.7	3.8
SX-2201	3.8	4.2	3.4
SX-2294	3.8	4.0	3.7
C-G174NT	3.9	3.9	3.9
HIL-2361	4.0	4.2	3.9
SX-2297	4.1	4.3	3.9
HIL-2403	4.1	4.1	4.0
SX-2295	4.1	4.2	4.0
HIL-2238NT	4.1	4.1	4.0
C-G675	4.1	4.3	3.9
C-G139	4.1	4.2	3.9
MA-933NT	4.2	4.2	4.2
BTS-1606N	4.3	4.5	4.0
HIL-9865	4.3	4.3	4.3
C-G752NT	4.5	4.8	4.1
C-G932NT	4.6	4.9	4.3
HIL-2332NT	4.7	4.8	4.6
BTS-197N	4.7	4.9	4.6
SX-2296N	4.7	5.0	4.5
Susceptible Check	5.1	6.0	4.2
Average	3.65	3.80	3.50

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: Disease pressure was slightly lower and slower to progress in 2022 than 2021. Differences in varietal tolerances were still easily observed. Trials are rated every 2-3 days once susceptible varieties reach economic impact (rating of 3) and are rated until either burn down or until regrowth complicates ratings.

Plant Health Trial DPH
SVREC - Richville, MI - 2022

Trial Quality: Very Good
Variety: C-G675
Planted: April 22
Harvested: October 11
Plots: 6 rows X 38 ft, 4 reps
Row Spacing: 22 in.

Soil Info: Clay Loam
% OM: 2.4 **pH:** 7.3 **CEC:** 13.2
P: High **K:** Medium
Mn: High **B:** Medium
Added N: 120 lbs. PPI
Previous Crop: Wheat

Rhizoc Level: Low
Cerc Control: Good
Problems: None
Seeding Rate: 4.1 in.
Rainfall: 13.46 in.
Beets/100 ft: 182

Application: JD 3520 tractor mounted plot sprayer, compressed air, 15.3 gpa - Foliar 7" band
Monosem 6-row Agronomy Planter, compressed air, 30 psi, 9 gpa - IF, 3.5' band

No.	Treatment	Rate/A	Applic Timing	Applic Method	Vigor* 0-10 21-Jun	Net $/A	RWSA	RWST	T/A	% SUC	% CJP	Beets/100 ft 6-May	Beets/100 ft 16-May
3	UAN 28% 10-34-0 Thio-Sul	8 gal 6 gal 4 gal	At Plant	2X2	7.5	$2,746	12342	**313**	39.5	**20.4**	96.4	95	184
	Azteroid Mustang Maxx SP-1	6.3 fl oz 4 fl oz 3 gal	At Plant	In-Furr									
2	UAN 28% 10-34-0 Thio-Sul	8 gal 6 gal 4 gal	At Plant	2X2	7.5	$2,627	11765	304	38.7	20.0	96.1	96	179
	Azteroid Mustang Maxx SP-1	6.3 fl oz 4 fl oz 2 gal	At Plant	In-Furr									
1	UAN 28% 10-34-0 Thio-Sul	8 gal 6 gal 4 gal	At Plant	2X2	7.3	$2,799	12049	**311**	38.8	**20.2**	96.6	99	181
	Azteroid Mustang Maxx	6.3 fl oz 4 fl oz	At Plant	In-Furr									
4	UAN 28% 10-34-0 Thio-Sul	8 gal 6 gal 4 gal	At Plant	2X2	7.3	$2,685	12146	**316**	38.4	**20.6**	96.4	105	184
	Azteroid Mustang Maxx SP-1	6.3 fl oz 4 fl oz 4 gal	At Plant	In-Furr									
Average					7.4	$2,714	12076	311	38.9	20.3	96.4	98.9	181.9
LSD 5%					n.s.	n.s.	n.s.	7.6	n.s.	0.5	n.s.	n.s.	n.s.
CV%					6.9	8.6	8.3	2.0	9.0	2.0	0.5	12.5	8.1

*__Vigor__ 0 to 10 ratings, 10 is the best

Comments: This trial was designed to test DPH products, SP-1 for yield improvements and crop safety when applied in-furrow. Stand loss was not observed with SP-1.

$/A: Payment calculated using early delivery adjustment where necessary, and a per pound payment of $.18 minus fertilizer and application cost.

Bold: Results are not statistically different from top-ranking treatment in each column.

Official Variety Trial

SVREC, Richville - 2022

Trial Quality: Very Good
Planted: April 22
Harvested: October 27
Plots: 2 Rows x 38 ft., 8 reps
Row Width: 22 in.
Seeding Rate: 1.9 in. thinned to 170 beets/100'

Soil Info: Clay Loam
Prev Crop: Wheat
Added N: 120 lbs. PPI, 35 lbs 2x2

Disease Pressure:
Cerc: Low
Rhizoc: Low
Rainfall: 16.78 in.

Variety	$/A	RWSA	RWST		Yield		Sugar		CJP		Emergence	
			lb/T	Rank	T/A	Rank	%	Rank	%	Rank	%	Rank
C-G151	**$2,813**	**15629**	**338**	**7**	**46.2**	**2**	**21.7**	**7**	**97.0**	**4**	**51.6**	**3**
BTS-1122	**$2,812**	**15621**	**337**	**8**	**46.4**	**1**	21.6	10	**97.1**	**1**	**54.7**	**1**
C-G049	**$2,663**	**14795**	324	25	**45.7**	**3**	21.1	26	96.5	23	50.2	5
BTS-1183	$2,612	14512	329	20	**44.2**	**4**	21.2	22	**96.8**	**16**	42.9	19
BTS-1065	$2,561	14230	334	11	42.6	6	21.5	12	**96.9**	**12**	**51.0**	**4**
SX-2201	$2,562	14229	**338**	**6**	42.1	12	**21.8**	**6**	**96.9**	**10**	31.5	29
C-G174NT	$2,549	14158	332	15	42.6	7	21.4	18	**97.0**	**7**	43.5	17
BTS-1703	$2,534	14079	333	12	42.3	11	21.5	13	**96.8**	**14**	**54.3**	**2**
HIL-9865	$2,529	14049	331	16	42.4	8	21.3	20	**97.0**	**6**	45.3	12
C-G675	$2,527	14037	331	17	42.4	9	21.4	17	**96.8**	**15**	46.3	9
BTS-1941	$2,509	13936	317	27	**43.9**	**5**	20.7	27	96.2	27	**50.1**	**7**
C-G139	$2,498	13880	**344**	**1**	40.4	17	**22.1**	**1**	**97.0**	**5**	41.1	21
SX-2296N	$2,479	13774	**340**	**4**	40.5	16	**21.9**	**3**	**96.9**	**13**	40.2	24
HIL-2332NT	$2,447	13595	**342**	**2**	39.7	21	**21.9**	**2**	**97.1**	**3**	44.9	14
BTS-197N	$2,436	13531	326	23	41.6	13	21.3	19	96.2	28	45.3	13
MA-933NT	$2,435	13528	336	10	40.3	18	**21.7**	**8**	96.7	21	40.8	22
C-G932NT	$2,411	13397	331	18	40.5	15	21.4	15	96.7	20	45.6	11
SX-2294	$2,407	13372	333	14	40.2	19	21.4	14	**96.9**	**11**	38.1	27
HIL-2238NT	$2,405	13360	316	29	42.3	10	20.7	28	96.1	29	42.7	20
C-G021	$2,390	13278	327	22	40.7	14	21.1	23	96.7	18	44.1	15
HIL-2361	$2,388	13265	**339**	**5**	39.2	24	**21.8**	**5**	**96.9**	**9**	43.8	16
C-G752NT	$2,371	13172	329	21	40.1	20	21.2	21	96.7	17	**50.2**	**6**
SX-2297	$2,354	13076	**341**	**3**	38.3	25	**21.9**	**4**	**97.1**	**2**	37.3	28
HIL-2403	$2,312	12842	**336**	**9**	38.2	27	**21.6**	**9**	**96.9**	**8**	46.1	10
MA-709	$2,294	12742	324	24	39.3	23	21.1	24	96.5	24	43.4	18
SX-2295	$2,291	12728	333	13	38.2	26	21.5	11	96.7	19	39.2	26
BTS-1606N	$2,254	12525	317	28	39.6	22	20.6	29	96.4	25	47.4	8
HIL-2401NT	$2,208	12269	323	26	38.1	28	21.1	25	96.3	26	40.8	23
MA-813NT	$2,101	11672	330	19	35.3	29	21.4	16	96.6	22	39.8	25
Average	$2,453.5	13630.4	331		41.2		21.40		96.74		44.56	
LSD 5%	166.6	925.7	8.1		2.8		0.5		0.3		6.7	
CV %	6.9	6.9	2.5		7.0		2.2		0.3		15.3	

See Cercospora Fungicide Application Page 48 for applications

$/A: Payment calculated using early delivery adjustment where necessary, and a per pound payment of $0.18.

Bold: Results are not statistically different from top-ranking variety in each column.

Comments: This location was planted in late April and had some of the most favorable growing conditions of all locations, although still receiving less than average rainfall. Slightly weaker emergence required thinning this trial to a 170 beet/100' equivalent to achieve consistent spacing. Excellent plant health throughout the season and levels of disease resulted in excellent root yield and sugar content in this trial harvested in late October.

Plant to Stand
SVREC, Richville - 2022

Trial Quality: Very Good
Planted: April 22
Harvested: Oct 11
Plots: 6 Rows x 38 ft., 6 reps
Row Width: 22 in.
Seeding Rate: 4.5 in.

Soil Info: Clay Loam
Prev Crop: Wheat
Added N: 120 lbs. PPI, 35 lbs. 2x2

Disease Pressure:
Cerc: Low
Rhizoc: Low
Rainfall: 15.42 in.

Variety	$/A	RWSA	RWST		Yield		Sugar		CJP		B/100 ft.	
			lb/T	Rank	T/A	Rank	%	Rank	%	Rank	Act.	Rank
BTS-1065	**$2,204**	**12246**	318	9	**38.4**	**2**	20.6	12	**96.7**	**1**	**159.2**	**5**
C-G049	**$2,125**	**11804**	306	18	**38.6**	**1**	20.2	19	**95.9**	**14**	**160.8**	**3**
SX-2296N	**$2,101**	**11674**	**328**	**1**	35.6	6	**21.2**	**1**	**96.6**	**3**	143.1	11
C-G021	**$2,046**	**11369**	318	11	35.8	5	20.7	11	**96.4**	**8**	**159.8**	**4**
BTS-1941	$2,018	11211	302	21	**37.2**	**3**	20.1	20	95.4	21	**152.4**	**6**
HIL-2332NT	$1,981	11007	**327**	**2**	33.6	11	**21.2**	**2**	**96.7**	**2**	137.4	15
BTS-1606N	$1,971	10952	306	19	35.8	4	20.2	18	95.8	18	**151.1**	**8**
SX-2201	$1,969	10940	318	10	34.4	9	**20.9**	**7**	95.9	16	91.8	21
HIL-9865	$1,956	10866	315	13	34.4	8	20.5	14	**96.4**	**6**	138.5	14
C-G675	$1,939	10774	**320**	**6**	33.7	10	**21.0**	**6**	**96.1**	**13**	145.7	10
SX-2295	$1,927	10707	**324**	**5**	33.1	12	**21.1**	**5**	**96.4**	**7**	118.0	17
SX-2294	$1,919	10664	**325**	**4**	32.9	13	**21.2**	**3**	**96.3**	**9**	108.9	20
HIL-2361	$1,916	10645	**326**	**3**	32.7	14	**21.1**	**4**	**96.5**	**5**	126.1	16
HIL-2238NT	$1,891	10506	304	20	34.6	7	20.1	21	95.9	17	146.3	9
SX-2297	$1,876	10424	**320**	**7**	32.6	15	20.8	9	**96.5**	**4**	114.8	19
C-G752NT	$1,848	10268	317	12	32.4	17	20.7	10	**96.2**	**11**	**160.8**	**2**
BTS-1703	$1,842	10233	318	8	32.1	18	20.8	8	**96.2**	**10**	**166.2**	**1**
MA-709	$1,822	10124	311	16	32.5	16	20.5	15	95.8	19	139.2	13
MA-813NT	$1,788	9931	312	15	31.9	19	20.4	17	**96.2**	**12**	118.0	18
C-G932NT	$1,784	9914	312	14	31.8	20	20.5	16	95.9	15	**152.0**	**7**
BTS-197N	$1,674	9297	311	17	29.9	21	20.5	13	95.7	20	140.1	12
Average	$1,933.3	10740.8	316		34.0		20.68		96.17		11.50	
LSD 5%	158.0	877.7	9.2		2.6		0.4		0.8		18.4	
CV %	7.1	7.1	2.5		6.6		1.7		0.7		11.5	

See Cercospora Fungicide Application Page 48 for applications

$/A: Payment calculated using early delivery adjustment where necessary, and a per pound payment of $0.18.

Bold: Results are not statistically different from top-ranking variety in each column.

Comments: This Plant to Stand trial was planted in late April and experienced difficulties during emergence. Some slight crusting was observed and varietal differences can be observed in the data. Overall root and sugar yields were very good even though stands were lower than desired. This location was on the high end of precipitation received, especially during the months of August and September. Disease control in this trial was good.

Rhizoctonia Nursery

Average of 2 years, 2021 & 2022

Trial Quality: Good
Location: 2021 - SVREC, 2022 - 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 %
SX-2297	**4.30**	**35.0**
HIL-2403	**4.51**	**41.3**
HIL-2361	**4.52**	**40.0**
Resistant Check	**4.58**	**42.5**
HIL-2332NT	**4.59**	**41.3**
MA-933NT	**4.64**	**43.8**
SX-2295	**4.83**	**48.8**
BTS-197N	**4.92**	**50.0**
BTS-1183	4.94	51.3
C-G049	4.95	51.3
HIL-9865	5.03	53.8
BTS-1703	5.07	53.8
C-G021	5.12	55.0
SX-2296N	5.14	56.3
C-G151	5.16	56.3
MA-709	5.17	56.3
C-G675	5.19	57.5
BTS-1606N	5.19	57.5
HIL-2401NT	5.20	57.5
C-G932NT	5.21	57.5
C-G174NT	5.27	60.0
BTS-1941	5.34	61.3
SX-2201	5.34	61.3
C-G752NT	5.37	62.5
MA-813NT	5.47	65.0
C-G139	5.55	66.3
BTS-1122	5.57	66.1
Susceptible Check	5.61	67.5
HIL-2238NT	5.64	68.8
SX-2294	5.70	69.6
BTS-1065	5.77	72.5
Average	5.13	55.71
LSD 5%	0.6	16.0
CV %	6.2	14.1

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

***Rating System:**

0 = No Infection
1 = less than 2% rotted roots
2 = less than 5% rotted roots
3 = 5 to 25% rotted roots
4 = 26 to 50% rotted roots
5 = 51 to 75% rotted 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 for all six replications.

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan State University AgBioResearch

Project: Optimizing planting decisions for improved yield and profitability in Michigan soybeans
Objective: Evaluate the role of seed priming and planting methods on soybean development and yield

Manni Singh and Patrick Copeland, Michigan State University

Location:	SVREC	**Seed rate:**	**130,000** seeds/A
Planting Date:	May 20, 2022	**Variety:**	**Steine 12EB32**
Replicated:	4 times	**Tillage:**	Conventional

Table 1. Effect of planting method on soybean plant stand and final yield.

Treatments	**Spring Population[a]**	**Fall Population**	**Yield**
	— plants/A —	— plants/A —	— bu/A —
Precision Planting	126,380 a	108,464 a	54.3 b
Broadcast Incorporation	73,834 b	85,813 b	60.4 a

[a] Means within a column followed by a different letter are significantly different (α = 0.10) from each other.

Summary: The past few growing seasons have brought many weather-related challenges and opportunities to soybean growers. Variability in spring rainfall has led to a wide range of planting dates implemented by growers. Results from recent planting date studies in Michigan have shown that planting in mid-May consistently resulted in greater soybean yield and was no different from earlier-planted soybeans *unless* other management decision (e.g., variety maturity selection) were changed. However, information is lacking on how various soybean management practices should be adjusted based on planting date. Such information would benefit growers by maximizing the benefits of early-season soybean planting while mitigating losses from delayed planting. One management decision that might be beneficial in dealing with early planting windows with adverse weather conditions is the use of high-speed planting technologies. Michigan growers have shown interest in broadcast incorporation as a technique for planting winter wheat, and it has shown promise in soybean production elsewhere, possibly due to timely planting and reduced inter-plant competition compared to the clumped pattern observed in row crops (high density within the row with low density between rows). However, there are concerns about optimal seed placement in this technique, especially non-ideal seeding depth and seed-to-soil contact. The goal of this project is to develop management strategies that can lead to increased farm profitability by evaluating the impact of planting methods and seed placement on soybean development and yield. The project compares various planting methods under early planting, including precision planter in 15-inch rows, seed drill in 7.5-inch row, and broadcast incorporation. Data collection included stand counts, spatial uniformity, yield components, and yield. So far, this experiment has been conducted across 3 site years. One site year (East Lansing 2021) showed no difference in yield between any of the planting methods. Another site year (East Lansing, 2022) showed an 11% yield penalty in drill compared to precision planter but no difference between precision planter and broadcast incorporation. SVREC 2022 included only precision planter and broadcast incorporation. At this location, broadcast incorporation outyielded precision planter by 11%. Overall, these results show that less precise planting technologies do not negatively impact soybean yield. More site-years are needed to validate these findings.

Impact of soil-applied herbicides on early planted soybean

Matthew Goddard, Christy Sprague, and Brian Stiles, Michigan State University

Location:	Richville (SVREC)	**Tillage:**	Conventional
Replicated:	4-times	**Row width:**	30-inch
Planting Date:	April 22, 2022 May 20, 2022	**PRE application date:**	April 22, 2022 May 20, 2022
Variety:	Pioneer P24T35E	**POST application date:**	June 24, 2022 July 7, 2022

Table 1: Soybean injury by preemergence herbicide, application timing and planting time. Rating 5 and 8 weeks after planting (early/normal) at the time of POST herbicide application.

	Soybean Injury			
	Early Planting		**Planting Timing**	
Herbicide treatment	**PRE**	**DPRE**	**Early**	**Normal**
	— % —		— % —	
Metribuzin (8 oz)	0 b	0 b	0 d	0 d
Valor (2.5 oz)	12 a	15 a	12 a	2 cd
Dual II Magnum (2 pt)	3 b	11 a	3 c	2 cd
Zidua SC (4 fl oz)	3 b	3 b	3 c	0 d
Sharpen+Metribuzin+Zidua SC (1 fl oz+6oz+4 fl oz)	-	-	0 d	1 cd
Metribuzin + Valor (6 oz+2oz)	-	-	6 b	0 d
Untreated	0 b	0 b	0 d	0 d

**Numbers with the same letters are not statistically different from each other. (α=0.05)*

Table 2: Soybean yield by preemergence herbicide, application timing and planting time in bushels/acre.

	Soybean Yield			
	Early Planting		**Planting Timing**	
Herbicide treatment[1]	**PRE**	**DPRE**	**Early**	**Normal**
	— bu/A —		— bu/A —	
Metribuzin	59	58	58	54
Valor	59	61	59	55
Dual II Magnum	58	59	58	52
Zidua SC	61	57	61	57
Sharpen + Metribuzin + Zidua SC	-	-	60	55
Metribuzin + Valor	-	-	54	54
Weed-free	55	55	55	55
Untreated	52	51	52	51

[1]Herbicides rates are indicated in Table 1.

**Differences in yield between treatments were not statistically significant.*

Summary: Spring weather patterns continue to decrease the number of days that are fit to conduct field operations. Due to this pattern, we wanted to examine the effects of early season conditions on commonly used preemergence herbicides in soybean. The objective of the study was: 1) compare PRE and delayed PRE (DPRE) herbicide application in early planted soybean, and 2) examine weed control and crop safety of several PRE herbicides versus normal planted soybean. All Preemergence applications were followed by a POST application of Enlist One + Roundup PowerMax + AMS at ~4-inch weeds. When the normal planting was initiated, the early planted soybean was at the VC growth stage. Early planted soybean actually had higher stand when compared to the normal planting and only the Metribuzin + Valor treatment showed stand reduction (9%). At the time of POST application, injury for the early planting was still apparent with Valor (12%) and Valor + Metribuzin (6%). All PRE treatments provided similar reductions in weed biomass at POST. However, weed biomass was 77% lower when soybean planting was delayed 4 weeks (early versus normal planting). Yield was not impacted by any of the factors present. In terms of the delayed PRE (DPRE) and PRE comparison in the early planted soybean, there was an 8% stand reduction in the DPRE compared to the PRE application. Soybean injury 14 DAE was the highest from Valor, regardless of application timing (25-29%). Both applications of Dual II Magnum also had significant injury with ratings of 7 and 16%, the highest being in the DPRE. At the time of POST herbicide application, the DPRE of Dual II Magnum and both application timings of Valor showed injury above 10%. Weed biomass was reduced best by Metribuzin and Valor and the applications of Zidua SC and Dual II Magnum had mild weed escapes. The POST application provided good weed control in all treatments prior to harvest. Soybean yield on average was 55 bu/A, but there was no significant difference in yield between application timing or herbicide. We will continue to test the safety and efficacy of preemergence herbicides in early planted soybean in the coming year with replicates of this study.

2022 Bean & Beet Diagnostic Day

Coordinators: Scott Bales, Daniel Bublitz, Tom Wenzel, and Jaime Willbur

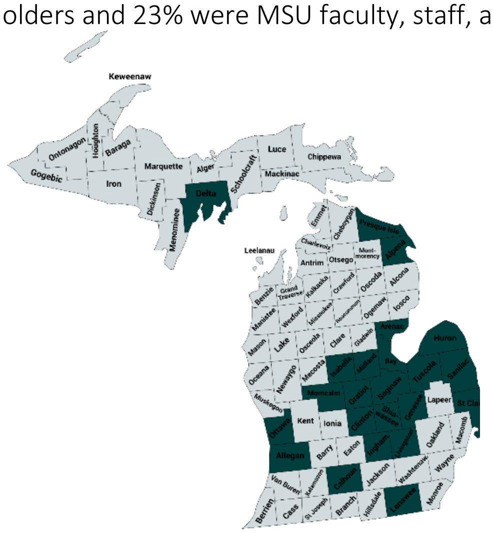
MSU ANR Event Services Coordinators: Renae Siler and Shelby Warner

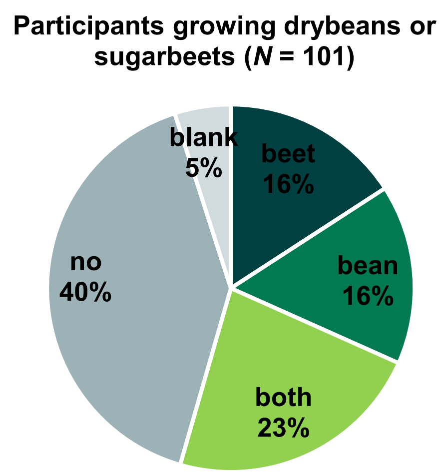
Session Leaders: Martin Chilvers, Chris Difonzo, Linda Hanson, Marisol Quintanilla, Christy Sprague, Kurt Steinke (MSU Extension); Erin Hill and Angela Tenney (MSU Plant and Pest Diagnostics); Dennis Bischer and Corey Guza (Michigan Sugar Company)

SVREC Management: Paul Horny, Dennis Fleishmann, and Holly Corder

Purpose: Michigan is the second largest edible dry bean and fourth largest sugar beet producer in the United States. Combined, pests and diseases cost Michigan bean and beet producers estimated annual losses of tens of millions of dollars. Effective management of these issues requires early and accurate diagnosis of the diseases and pathogens present in the field. The 2023 Bean & Beet Diagnostic Day was developed to 1) help the industry better understand and identify the pests and diseases impacting dry bean and sugar beet production, 2) provide a comprehensive diagnostic training in bean and beet diagnostics, which are often included in the same rotation, and 3) connect these industries with Michigan State University Extension resources, specialists, and educators. Deployed August 23, 2022.

Attendance: 147 total attendees representing 23 counties in Michigan (77% attendees were industry stakeholders and 23% were MSU faculty, staff, and student researchers)





Grower survey respondents (N = 51) represented at least 12,000 bean acres and 10,135 beet acres. Agribusiness survey respondents (N = 29) reported to advise between 65 to 155,000 acres (see table).

More than 80% advised greater than 1,000 acres.

%	acres
3	<100
14	100-1,000
17	1,000-10,000
48	10,000-20,000
7	20,000-100,000
10	>100,000

Topics and Activities:

- **Dry bean insects:** Show-and-tell highlights, including live specimens of various insect pests as well as discussion of scouting and damage assessment methods.
- **Herbicide injury**: Demonstration plots in sugar beet and dry bean. Interactive participant identification quiz and review of modes of action with common injury symptoms.
- **Nitrogen fertility in beets:** Demonstration plots of nitrogen programs highlighting in- and end-of-season management related to sugar and yield outcomes.
- **Weed ID:** A brief introduction to important plant structures and the resources available to assist in weed identification, including the use of smartphone apps.
- **Nematode ID:** Interactive workshop to see and learn the basics of identifying beet cyst nematodes through hand lens and microscopes.
- **Beet diseases:** Hands-on exercises using symptomatic beet plots and collected samples to detect, diagnose, and submit samples for major seedling, root, and foliar beet diseases of the region.
- **Bean diseases:** Show-and-tell with diseased samples to recognize common bacterial and fungal diseases. Also included brief discussion of management and other resources.

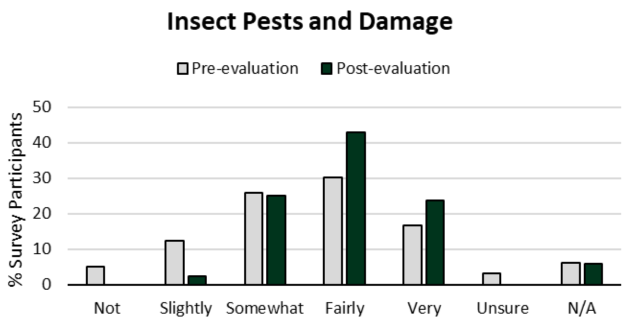
Dry bean insect show-and-tell session led by Chris Difonzo and Scott Bales.

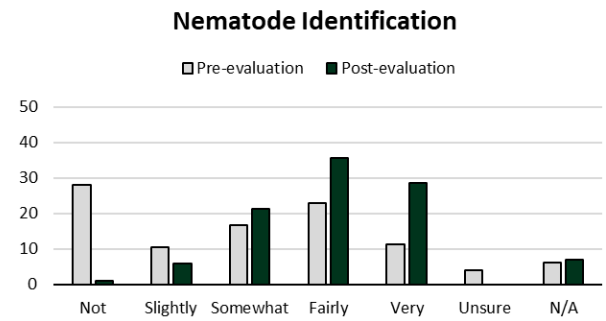
Sugar beet herbicide injury demonstration led by Christy Sprague and Dennis Bischer.

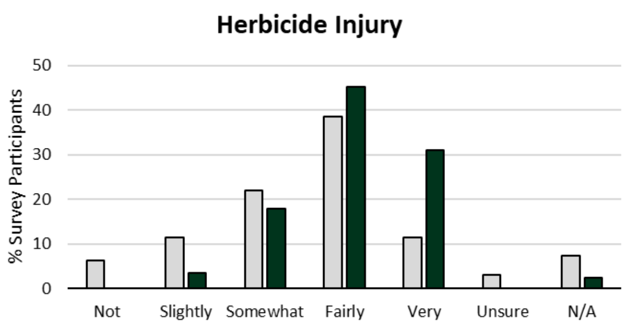
Sugar beet nitrogen program demonstrations led by Kurt Steinke, Corey Guza, and graduate students Storm Soat and Lane Suplito.

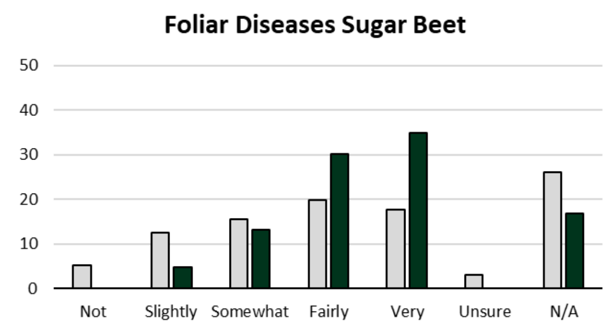
Sugar beet seedling and foliar disease demonstrations led by Linda Hanson and Jaime Willbur.

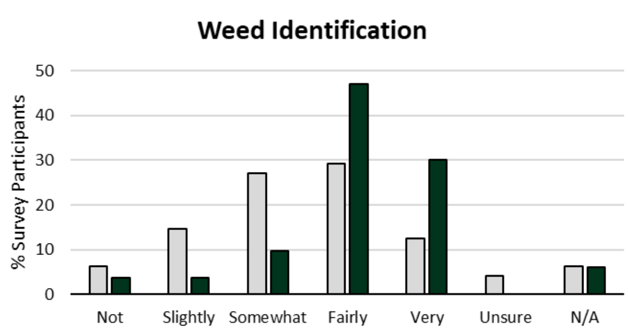
Pre- and Post-Evaluation Survey Results: Participants responded to an online pre- (grey, *N* = 96) and post- (green, *N* = 85) evaluation survey administered to assess confidence levels surrounding each topic.

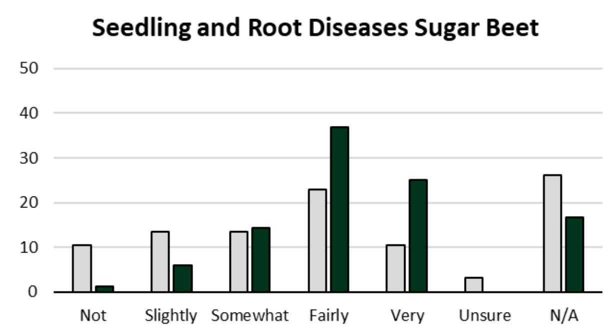


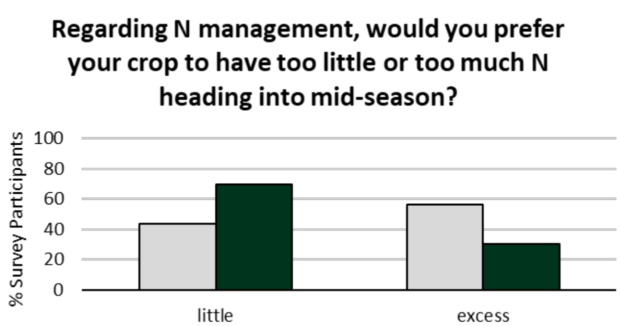


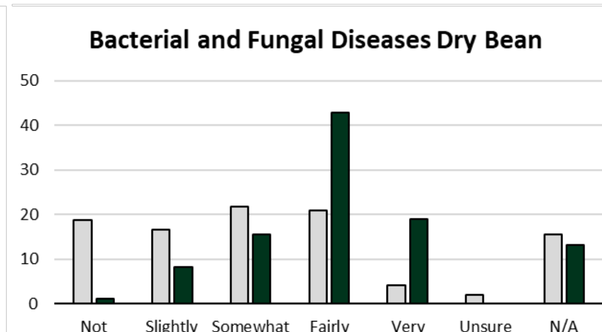




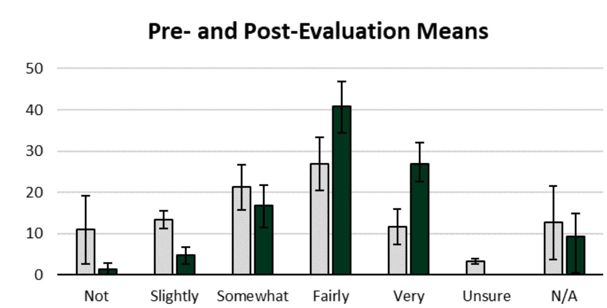




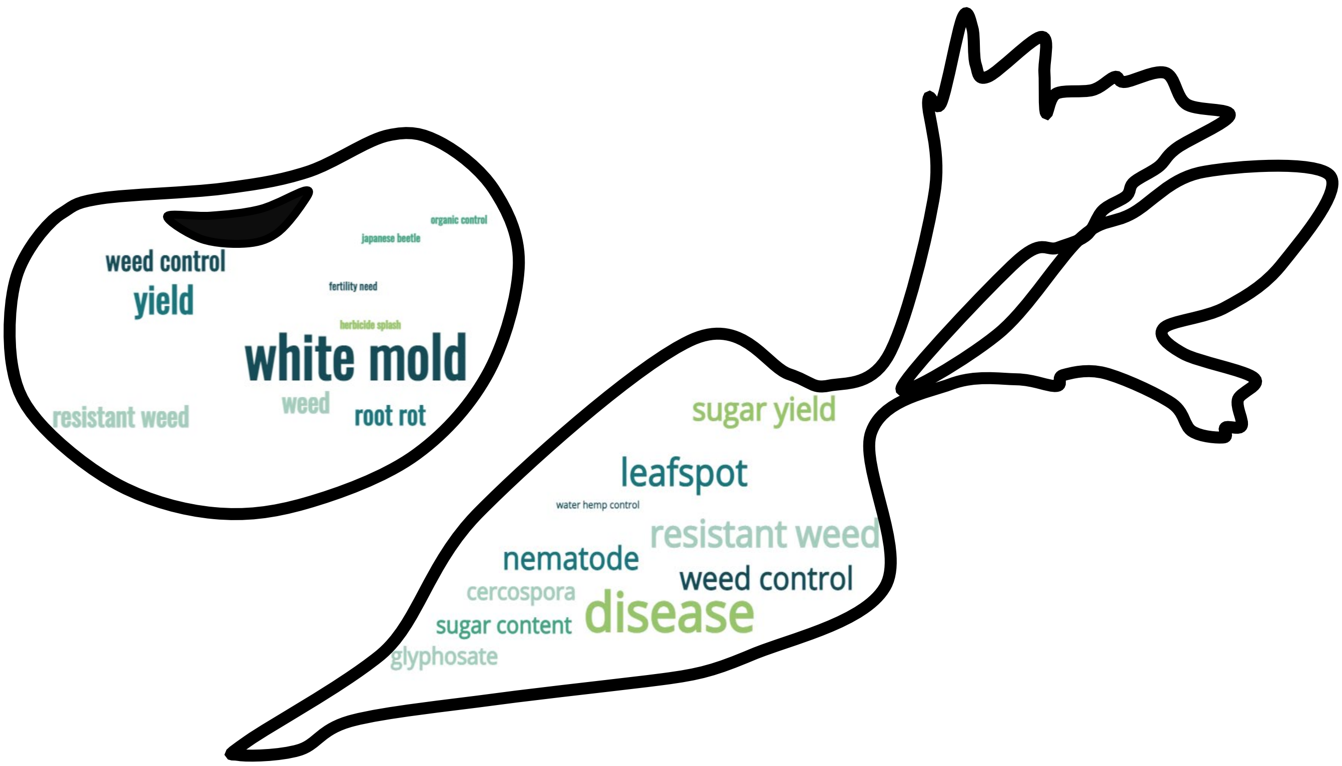




Across all topics, participant confidence increased in the "fairly" and "very" categories by more than 10% following the event (mean frequencies shown at right). Corresponding decreases were noted in all "not" and "slightly" categories. In the nitrogen management question, post-evaluation responses shifted toward the target answer "little" rather than "excess" as were the slight majority beforehand.



Content Relevance: Online survey participants were given the opportunity to comment on their "most important agronomy concern for sugar beet and/or bean crops". These responses (*N* = 57) were used to generate the figures below illustrating the significant concerns for the bean (left) and beet (right) industries. To summarize, white mold, yield, resistant weeds, and root rots were the top dry bean concerns; diseases, leaf spots, resistant weeds, sugar yield, and nematodes were the top sugar beet concerns. We were glad to see that the activities presented aligned well with industry concerns. This information will also be used to direct future extension programming efforts.



Concluding Remarks: The 2022 Bean & Beet Diagnostic Day was the first co-coordinated event delivering interactive diagnostic activities to these combined industries. The event was well attended by dry bean and sugar beet industry stakeholders, according to registration numbers and regions represented. The event content was well aligned with grower concerns and helped to increase attendee confidence in across all topics. Attendee participation was further noted to be higher than in a typical field day and comments from stakeholders following the event were positive. The coordinators feel that periodic integration of the diagnostic day event into dry bean and sugar beet extension programming is beneficial to educate participants, especially those new to the industry, in the diagnosis and management of current and emerging pest, disease, and agronomic concerns.

Event Details and Full Agenda

August 23, 2022
9 a.m. - 3 p.m.
Saginaw Valley Research and Extension Center
3775 S. Reese Rd., Frankenmuth, MI 48734

8:30-9:00 AM	Registration, Check-In, and Refreshments
9:00-11:20 AM	Morning Tours
Session 1 (40 min)	Dry Bean Insects - Identification of common dry bean insects and damage. (Chris Difonzo & Scott Bales)
Session 2 (40 min)	Herbicide Injury - Diagnosing herbicide injury in dry bean and sugar beet. (Christy Sprague & Dennis Bischer)
Session 3 (40 min)	Nutrient and Fertility Concerns - Discussions of nitrogen management. (Kurt Steinke & Corey Guza)
11:30AM-12:30PM	Lunch Provided by Norm's Catering
12:40-3:00 PM	Afternoon Tours
Session 1 (40 min)	Weed ID When You're in a Hurry! - A brief introduction to the resources available to assist in weed identification. 20 minutes. (Erin Hill & Angela Tenney) Beet Cyst Nematode ID - Learn the basics of nematode identification and key characteristics of sugar beet cyst nematodes. 20 minutes. (Marisol Quintanilla)
Session 2 (40 min)	Spot the Spot, and Root out the Rot! - Learn to detect and diagnose major seedling, root, and foliar beet diseases of the region. (Linda Hanson & Jaime Willbur)
Session 3 (40 min)	Bean Diseases - Learn how to recognize and manage common bacterial and fungal diseases and discuss Sporecaster app. (Marty Chilvers, Scott Bales, Jill Check, Madison Whyte, Molly Irvin)
3:00-3:30 PM	Concluding Remarks & Ice Cream Social - Cream & Sugar Ice Cream Company

Acknowledgements: We thank the Michigan dry bean and sugar beet industries for supporting and participating in this event. Funding support provided by MSU Project GREEEN Extension. This work was further collaboratively organized and supported by the MSU AgBioResearch and Extension programs, MSU ANR Event Services, Michigan Sugar Company, Michigan Dry Bean Commission, and USDA-ARS.