Michigan State University
AgBioResearch

In Cooperation With
Michigan Potato
Industry Commission

Michigan Potato Research Report
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Dear Members of the Michigan Potato Industry,

The Michigan Potato Industry Commission remains steadfast in its commitment to advancing potato production through dedicated research efforts. Over the past year, the Commission has provided over $185,000 in direct funding to support research projects aimed at addressing critical challenges and opportunities in our industry. These projects have delivered significant insights into areas such as variety development, disease management, soil fertility, and storage innovations—ensuring that Michigan continues to lead as a competitive and respected force in the national potato industry.

The enclosed research report reflects the collective achievements of the 2024 potato research projects, carried out with the expertise and collaboration of Michigan State University AgBioResearch and Michigan State University Extension. We are proud to share these findings, which highlight our industry's resilience, innovation, and dedication to continuous improvement. We believe these research outcomes provide valuable tools and knowledge that can be directly applied to enhance your operations. Whether refining production techniques or improving resource efficiency, the insights from these projects aim to strengthen the profitability and sustainability of Michigan potato production.

This year's research accomplishments were made possible through the dedication of our researchers, industry partners, and suppliers, whose cooperation and support have been instrumental in overcoming challenges and seizing opportunities. As we navigate an ever-evolving landscape, we are inspired by the collaborative spirit within our industry and the shared commitment to a thriving future.

We invite you to explore this report and hope it serves as a resource for your continued success. Thank you for your ongoing contributions to Michigan's potato industry and for your commitment to excellence.

Sincerely,

Kelly Turner

Dr. Kelly Turner, Ed. D, CAE
Executive Director

2024 MICHIGAN POTATO RESEARCH REPORT

C. M. Long, Coordinator

INTRODUCTION AND ACKNOWLEDGMENTS

The 2024 Potato Research Report contains reports of the many potato research projects conducted by Michigan State University (MSU) potato researchers at several locations. The 2024 report is the 56th volume, which has been prepared annually since 1969. This volume includes research projects funded by the Potato Special Federal Grant, the Michigan Potato Industry Commission (MPIC), Project GREEEN and numerous other sources. The principal source of funding for each project has been noted in each report.

We wish to acknowledge the excellent cooperation of the Michigan potato industry and the MPIC for their continued support of the MSU potato research program. We also want to acknowledge the significant impact that the funds from the Potato Special Federal Grant have had on the scope and magnitude of potato related research in Michigan.

Many other contributions to MSU potato research have been made in the form of fertilizers, pesticides, seed, supplies and monetary grants. We also recognize the tremendous cooperation of individual producers who participate in the numerous on-farm projects. It is this dedicated support and cooperation that makes for a productive research program for the betterment of the Michigan potato industry.

We further acknowledge the professionalism of the MPIC Research Committee. The Michigan potato industry should be proud of the dedication of this committee and the keen interest they take in determining the needs and direction of Michigan's potato research.

Special thanks go to Mathew Klein for his management of the MSU Montcalm Research Center (MRC) and the many details which are a part of its operation. We also want to recognize Phabian Makokha, MSU for organizing and compiling this final draft.

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Montcalm Research Center Trials

Weather

Most trials were conducted at the Montcalm Research Center (MRC) in Montcalm County, MI, except for a few, such as the Potato Outreach Program on-farm variety trials, which were distributed across various potato-growing regions in Michigan. The weather data and fertility management program described herein pertains exclusively to trials conducted at MRC. Trials conducted at other locations may have experienced different weather conditions and fertility management practices.

Tables 1 and 2 summarize six months of temperature and rainfall data during the growing season over the past 15 years. No extreme temperature and rainfall patterns were observed in 2024. Table 3 highlights seven years of heat stress during the growing season, with minimal daytime heat stress and no night heat stress observed in 2024. The 13-year cumulative growing degree days data is presented in Table 4, with 2024 values falling within the range observed in previous years.

Field History, Tillage, and Field Management

Trials were conducted in Comden 3 field, previously planted with oats. Oat residue was disked in fall 2023 and sprayed in spring 2024. Potash was broadcast applied after deep chisel plowing, followed by vertical tillage for planting. The field was not fumigated with Vapam but Admire Pro® was applied in-furrow at planting. Soil samples for nutrient analysis were taken in April, with results shown in Table 5.

Potatoes were fertilized with 285 lbs/a N, 92 lbs/a P, 297 lbs/a K, 173 lbs/a Ca, 52 lbs/a Mg, 187 lbs/a S, 1.4 lbs/a B, 5 lbs/a Zn, and 0.8 lbs/a Mn. The application timings and quantities are summarized in Table 6.

Herbicides applied included Linex® 4L (24 oz/a) pre-emergence, Brawl® (16 oz/a) post-emergence in mid-May and mid-June, and Tricor DF® (1/3 lb/a) post-emergence in mid-June. Insecticide applications consisted of Delegate® (4 oz/a) in the first and second weeks of July. Fungicides included Luna Pro® (10 oz/a) in early July and Bravo® (16 oz/a) applied weekly from early July to late August, totaling seven applications.

Table 1. The 15-year summary of average maximum and minimum temperatures (°F) during the growing season at the Montcalm Research Center.

	April		May		June		July		August		September		Mean	
Year	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
2010	64	33	70	49	77	57	83	62	82	61	69	50	74	52
2011	53	33	68	48	77	56	85	62	79	58	70	48	72	51
2012	58	33	73	48	84	53	90	62	82	55	74	46	77	50
2013	51	33	73	48	77	55	81	58	80	54	73	48	73	49
2014	55	33	68	45	78	57	77	54	79	56	72	47	73	49
2015	58	33	71	48	76	54	80	56	77	57	77	54	72	49
2016	53	32	70	45	78	53	82	60	85	60	78	54	73	51
2017	61	39	67	44	78	55	81	58	77	54	77	50	74	50
2018	55	33	81	46	84	58	88	64	84	63	76	52	78	53
2019	55	35	65	45	75	54	84	69	80	55	73	54	72	52
2020	56	29	76	35	77	54	81	68	78	60	70	48	73	49
2021	58	35	69	41	80	58	81	58	85	59	76	50	75	50
2022	51	33	71	45	79	55	81	58	79	58	71	52	72	50
2023	59	36	72	42	80	52	80	58	77	56	74	52	74	49
2024	59	37	73	48	79	58	81	58	80	57	78	51	75	52
Mean	56	34	71	45	79	55	82	60	80	58	74	50	74	50

Table 2. The 15-year summary of precipitation (inches per month) recorded during the growing season at the Montcalm Research Center.

Year	April	May	June	July	August	September	Total
2010	1.59	3.68	3.21	2.14	2.63	1.88	15.13
2011	3.42	3.08	2.38	1.63	2.57	1.84	14.92
2012	2.35	0.98	0.99	3.63	3.31	0.76	12.02
2013	7.98	4.52	2.26	1.35	4.06	1.33	21.5
2014	4.24	5.51	3.25	3.71	1.78	2.35	20.84
2015	3.71	2.96	4.79	1.72	2.42	3.9	19.5
2016	2.25	2.77	1.33	3.42	5.35	3.05	18.17
2017	4.45	1.98	6.37	0.92	1.36	0.7	15.78
2018	2.04	5.51	3.64	1.19	7.73	2.65	22.76
2019	2.64	5.46	2.9	2.04	3.31	5.72	22.07
2020	3.49	4.75	1.4	4.07	2.21	3.12	19.04
2021	1.71	2.18	5.58	4.79	3.52	3.71	21.49
2022	3.44	2.67	1.59	3.37	6.56	2.19	19.82
2023	3.07	0.45	2.78	8.12	3.68	1.49	19.59
2024	2.36	2.89	2.76	5.75	3.12	1.15	18.03
Mean	3.25	3.29	3.02	3.19	3.57	2.39	18.71

Table 3. Seven-year heat stress summary from May – September 30, Montcalm Research Center, MI, 2024.

Year	Temperatures > 90ºF		Night (10pm-8am) Temperatures > 70ºF	
	Hours	Days	Hours	Days
2018	11	4	123	31
2019	0	0	104	20
2020	12	3	123	30
2021	0	0	168	35
2022	11	2	123	26
2023	0	0	47	18
2024	4	1	0	0
Mean	5	1	98	23

Table 4. Growing Degree Days from May 1 – September 30, Montcalm Research Center, MI, 2024

Year	May	June	July	August	September
2012	652	1177	2280	3153	3762
2013	637	1421	2334	3179	3798
2014	522	1340	2120	2977	3552
2015	604	1353	2230	3051	3789
2016	547	1318	2263	3274	4053
2017	480	1279	2202	2990	3695
2018	689	1487	2423	3373	4073
2019	457	1189	2179	3024	3731
2020	488	1298	2331	3241	3809
2021	494	1362	2276	3269	3956
2022	625	1434	2345	3240	3892
2023	531	1301	2196	3024	3707
2024	316	1039	1909	2822	3645
Mean	542	1308	2238	3124	3805

Table 5. Soil test analysis, Montcalm Research Center, MI, 2024

Soil pH	P	K	Ca	Mg	S	B	Zn	Mn
				lbs/a				
6.6	226	170	1,000	180	18	0.8	5.6	84

Table 6. Fertilizer analysis, application rates and timing, Montcalm Research Center, MI, 2024

Application*	Analysis	Rate	Nutrients ($N-P_2O_5-K_2O$-Ca/Mg/S/Zn)
Broadcast at plow down	0-0-22-11Mg-22S 0-0-0-21Ca-16S 10%B 0-0-62 0-0-0-18Zn-12S-4Mn-1B	475 lbs/A 500 lbs/A 12 lbs/A 310 lbs/A 20 lbs/A	0-0-105-52Mg-105S 0-0-0-105Ca-80S (pel. Gypsum) 1.2B 0-0-192 0-0-0-4Zn-2.4S-0.8Mn-0.2B
At-planting	28-0-0 10-34-0 0-0-0-9Zn	13 gpa 7 gpa 0.5 gpa	38-0-0 6-21-0 0.5Zn
At-cultivation	28-0-0 10-34-0 0-0-0-9Zn	40 gpa 20 gpa 0.5 gpa	118-0-0 21-71-0 0.5Zn
At-hilling	15.5-0-0-19Ca	360 lbs/A	56-0-0-68Ca
Late side dress (late varieties)	46-0-0	100 lbs/A	46-0-0
Additional Nitrogen Applications*	46-0-0	100 lbs/A	46-0-0

*Only applied when single daily rain total is over 3’’

Potato Outreach Program

Program Objectives

Our main objectives are to: 1) identify promising lines for further testing and evaluation, 2) conduct larger scale commercial agronomic and processing trials through multi-acre block plantings, and 3) use trial data to enhance commercialization of new varieties in the state of Michigan. The program also does research on key priorities of the Michigan Potato Industry Commission, focusing on improving potato production systems, particularly water and nutrient use efficiency and advancing genetic improvement through variety development. Current studies include in-row spacing and seed depth trials, 1,4-dimethylnaphthalene (1,4-DMN) tuber treatment evaluations, and bulk- and box-bin storage research. We share our results with growers, breeders, and processors across the country to facilitate the adoption and utilization of improved new varieties from breeding programs.

Evaluating agronomic and processing traits of new potato varieties and lines through on-farm trials.

Funding: Federal Grant, MPIC and Potatoes USA/SNAC
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Bernard M. Schroeter, Dave Douches, James DeDecker

Materials and Methods

We conducted 35 on-farm potato variety trials across 10 counties from April to October 2024, evaluating chipping and tablestock (reds/yellows and russets) potato varieties. Chipping varieties were evaluated at 4-L Farms (Kalamazoo), Black Gold Farms (St. Joseph), Hamptons Growers LLC (Bay), Lennard Ag Co. (St. Joseph), Main Farms LLC (Montcalm), Montcalm Research Center (Montcalm), Sandyland Farms (Montcalm), and Walther Farms (St. Joseph). The national potato USA Snacking, Nutrition, and Convenience (SNAC) study was conducted at Sandyland Farms. Tablestock trials were conducted at Elmaple Farms LLC (Kalkaska), 4-L Farms, Horkey Brothers (Monroe), Jenkins Potato Farm (Kalkaska), Lennard Ag Co., Kitchen Farms (Antrim), Styma Potato Farm (Presque Isle), Verbrigghe Potato Farms (Delta), and Walther Farms (Cass).

Our trials evaluated 56 chip-processing potato varieties (Table 1), with Atlantic, Bliss, Lamoka, Mackinaw, Manistee, and Snowden as checks. All trials, except the Walther Farms replicated trial, were established as non-replicated strips. The single strips measured 75 ft in length, except for the SNAC trial at Sandyland Farms, which measured 300 ft. All trials were planted on 2.8-ft bed widths with 10-inch in-row spacing. The Walther Farms replicated trial consisted of three-row plots, each 15-ft long and three replicates.

Trials were managed according to site-specific grower practices. A 23-ft section was harvested from the 75-ft strips, while three 23-ft sections were harvested from each 300-ft strip at Sandyland Farms to simulate replication. For the Walther Farms replicated trial, the center row (15 ft) was harvested. All trials were conducted for a full growing season, except for fresh market trials at Walther Farms, Black Gold Farms, and Lennard Ag Co., which were harvested from mid- to late August.

Seventy-nine tablestock varieties were evaluated, comprising 22 reds, 11 whites, one purple, 45 yellows, and 101 russets (Tables 2 and 3). The checks included red varieties (Red Norland and Dark Red Norland), white variety (Reba), yellow varieties (Colomba, Jelly, and Queen Anne), and russet varieties (Gold Rush, Reveille Russet, Russet Norkotah, Silverton Russet, and Vanguard). Tablestock trials followed a methodology like the chip-processing trials, with management practices tailored to local conditions. All tablestock trials were grown for a full season.

Data collected included vine vigor, vine maturity, tuber yield, size distribution, scab severity, pick outs, tuber flesh quality, specific gravity, chip quality traits (chipping varieties), flesh color (yellows), and skin traits (reds). Although the number of observations varied across locations, data were combined for multi-location analysis using SAS. Least square means were separated using Tukey's test at $P = 0.05$ to evaluate performance across sites.

Results

Site-specific variety performance results are available in the 2024 Farmer Packet on the MSU Potato Outreach Program website (https://www.canr.msu.edu/potatooutreach). Detailed results from the 2024 SNAC trial study are accessible on this site and at https://msupotato.medius.re. The combined summary of variety performance across sites is presented in Table 4 for chipping varieties and Table 5 for tablestock varieties. Several varieties outperformed the commercial check varieties across various parameters (Tables 1 and 2). Promising chip processing and tablestock varieties for further on-farm testing in 2025 are listed in Tables 4 and 5, respectively. Growers' preference for these varieties will depend on their performance at specific locations and market preferences by processors (chippers) and fresh market consumers for tablestock varieties. Growers should review both the combined statewide and site-specific farmer packet sheets. The statewide farmer packet highlights varieties' adaptability and stability across locations, while the site-specific farmer packet identifies varieties with strong local performance. Growers may benefit from consulting with a potato specialist to select the most suitable varieties for their sites.

Table 1: Statewide Chip Processing Trials: Summary Across 12 Locations, MI, 2024

Least Square Means

LINE	CWT/A		PERCENT OF TOTAL[1]					SP GR[2]	OTF CHIP SCORE[3]	RAW TUBER QUALITY[4] (%)				COMMON SCAB RATING[5]	SED SCORE[6]	VINE VIGOR[7]	VINE MATURITY[8]	COMMENTS
	US#1	TOTAL	US#1	Bs	As	OV	PO			HH	VD	IBS	BC					
MSDD372-07 LOW N[g]	694	811	87	13	86	0	1	1.092	1.2	2	2	2	0	0.3	0.1	2.0	4.0	Flat round tuber type, sticky stolons
MSDD376-4 LOW N[g]	589	667	90	9	89	0	2	1.083	1.2	2	22	2	0	0.3	0.2	2.0	3.5	Uniform blocky round to oval, sticky stolons, medium netted skin
MSGG409-3[abcdefgij]	566	636	88	11	88	0	1	1.083	1.1	2	6	7	0	0.6	0.2	1.6	3.3	Sticky stolons, sheep nose, severe skinning, blocky round uniform tubers, medium netted, nice general appearance
MSDD376-4[abcdefgij]	548	615	89	10	88	1	1	1.085	1.4	7	8	7	0	0.9	0.1	2.1	3.4	Large blocky flat round to oval tubers, medium to heavy dark netted, sticky stolons, severe skinning, deep apical eyes, misshapes, traces of heat sprouts, good general appearance
MSBB060-1[gj]	534	552	97	2	96	1	1	1.081	1.2	1	2	11	0	0.5	0.2	1.5	3.3	Large blocky round uniform tubers, severe sticky stolons, sheep nose, good general appearance
MSBB630-2 LOW N[g]	529	605	89	10	88	0	3	1.078	1.2	2	2	2	0	0.3	0.1	1.5	4.5	Round tubers, bright skin
ND13220C-3[acdefghij]	526	679	77	21	77	0	3	1.094	1.5	2	2	1	1	1.1	0.1	2.3	3.5	Large round blocky rough, pine cone eyes, light skin, not uniform tuber type, traces of heat sprouts and points, severe skinning, misshapes, sticky stolons
Mackinaw[abcdefij]	**524**	**588**	**89**	**11**	**89**	**0**	**1**	**1.087**	**1.1**	**1**	**2**	**0**	**0**	**0.6**	**0.1**	**1.8**	**3.2**	**Blocky flat round oval pear-shaped uniform, sheep nose, sticky stolons, slight skinning, light netted, traces of points**
Atlantic[bdi]	**518**	**563**	**93**	**5**	**91**	**1**	**2**	**1.089**	**1.0**	**35**	**4**	**15**	**6**	**1.5**	**0.1**	**2.4**	**2.8**	**Slight skinning, blocky tuber type**
NY174[acdefghij]	497	542	91	8	91	0	1	1.090	1.1	0	0	2	0	0.7	0.1	2.0	3.2	Large blocky round tubers, severe skinning, traces of pear shape, light netted, slight skinning, deep apical eyes, sticky stolons, sheep nose
AF6206-3[hj]	490	544	89	10	88	0	1	1.089	1.2	1	1	0	0	2.1	0.0	1.8	2.8	Large flat blocky round, medium netted, sticky stolons, slight skinning, traces of pear-shaping
W17AF6670-1[h]	487	546	89	11	88	0	0	1.081	1.2	1	2	0	0	1.0	0.0	1.9	3.0	Flat round, medium netted
Manistee[abcdefij]	**483**	**534**	**90**	**10**	**89**	**1**	**0**	**1.084**	**1.2**	**10**	**0**	**2**	**0**	**1.3**	**0.0**	**1.8**	**2.9**	**Large flat blocky round tubers, medium to heavy netted, deep apical eyes and stem end, sticky stolons, medium to severe skinning**
MSFF029-10[efgj]	479	560	85	14	85	0	1	1.089	1.2	2	3	11	0	1.2	0.2	1.7	3.0	Flat blocky round, medium to heavy netted, sticky stolons, medium skinning
NYU34-6[abcdefgij]	476	551	85	13	85	0	2	1.092	1.3	13	2	0	2	1.4	0.1	2.1	3.1	Flat blocky round, light skin appearance, traces of heat sprouts, traces of sticky stolons, traces of pear-shaping, poor general appearance for chip industry, not uniform tubers, growth cracks
MSDD244-05[acefgj]	464	515	89	9	88	1	2	1.082	1.2	4	1	1	0	0.4	0.0	1.7	3.1	Blocky round tubers, medium netted, sticky stolons, deep apical eyes, slight to moderate growth cracks, rough appearance, pear shapes
MSGG302-1[acdefgij]	460	493	93	5	89	4	2	1.085	1.3	4	8	1	1	0.7	0.2	1.8	3.3	Sticky stolons, deep apical eyes, growth cracks, knobs, large round oval blocky, medium netted, traces of heat sprouts, growth cracks, misshapes, deep eyes, severe skinning
Paige[j]	459	564	81	18	81	0	1	1.094	1.2	11	1	1	0	0.4	0.1	NA	3.1	Uniform flat round to oval tubers, pear-shaping
MSDD249-9[abcdefgij]	456	489	93	6	92	1	1	1.087	1.1	0	1	1	0	1.2	0.1	1.6	3.1	Large flat round blocky tubers, bright appearance, sheep nose, non uniform tubers, heart shaped tubers, sticky stolons, medium netted, slight skinning
Snowden[abcdefghij]	**453**	**517**	**86**	**13**	**86**	**0**	**1**	**1.084**	**1.1**	**2**	**6**	**0**	**0**	**1.2**	**0.1**	**1.9**	**2.9**	**Flat blocky round tubers, deep apical eyes, medium to severe skinning, light to medium netted, sticky stolons, sheep nose**
NY177[abcdefghij]	452	542	82	17	82	0	1	1.094	1.2	2	5	3	0	0.8	0.1	1.9	3.0	Large blocky flat round oval uniform tubers, traces of pear shape, light netted, medium to severe skinning, bright skin, deep apical eyes, traces of points, moderate black spot bruise, purple blush
MSFF038-3[abcdefgij]	450	504	89	9	88	1	2	1.083	1.4	10	3	0	0	1.0	0.1	1.7	2.9	Flat large blocky round, slight skinning, deeper apical eye, sheep nose, medium netted, traces of growth cracks
W17066-34[h]	449	504	88	12	87	0	1	1.089	1.2	3	2	0	0	0.7	0.1	1.9	3.0	Flat round oval
MSBB230-1[acefj]	443	506	87	12	87	0	2	1.087	1.2	1	1	0	0	1.2	0.3	2.0	3.1	Blocky round tubers, medium to heavy netted, traces of sticky stolons, deep apical eyes
F160032-6[abcdefij]	435	490	88	11	88	0	1	1.079	1.1	1	2	0	0	1.0	0.1	2.3	2.7	Blocky round uniform tubers, light netted, medium to light skin appearance, deep stem end eyes, slight skinning

LINE	CWT/A		PERCENT OF TOTAL[1]					SP GR[2]	OTF CHIP SCORE[3]	RAW TUBER QUALITY[4] (%)				COMMON SCAB RATING[5]	SED SCORE[6]	VINE VIGOR[7]	VINE MATURITY[8]	COMMENTS
	US#1	TOTAL	US#1	Bs	As	OV	PO			HH	VD	IBS	BC					
AF6206-5[hj]	435	490	88	11	87	0	2	1.098	1.2	2	1	0	0	1.7	0.0	1.9	3.1	Growth cracks, sticky stolons, slight skinning, bottlenecks, flat round oval large blocky uniform tubers, medium netted
MSFF037-17[abcdefgij]	431	511	83	15	83	0	2	1.085	1.3	0	4	8	2	1.1	0.1	1.5	3.1	Severe sticky stolons, large blocky round flat tubers, points, growth cracks, heat sprouts, knobs, slight skinning, deep apical eyes, light netted
Bliss[acdefgij]	**425**	**487**	**87**	**12**	**86**	**1**	**1**	**1.083**	**1.2**	**0**	**1**	**0**	**0**	**0.5**	**0.0**	**1.7**	**2.9**	**Blocky round tubers, light netted, traces of sticky stolons, purple blush, traces of points**
MSBB058-1[abcdefghij]	425	484	87	12	84	3	1	1.090	1.2	0	0	1	0	0.8	0.0	1.8	3.0	Small blocky round tubers, moderate skinning, growth cracks, sticky stolons, medium netted, misshapes, deep stem end and apical eyes
Dundee[abcdefgij]	420	471	88	8	88	0	3	1.091	1.1	0	0	1	0	0.8	0.1	1.8	3.1	Large blocky round tubers, moderate skinning, medium to heavy netted, traces of soft rot, growth cracks, sticky stolons, alligator skin, moderate shatter bruise, heat sprouts
NC821-30[dfi]	415	470	88	10	88	0	2	1.091	1.1	52	0	5	0	1.1	0.2	1.6	2.8	Flat large blocky round, light skin appearance, medium netted, not uniform tubers, severe skinning
MSDD247-11[aefgj]	410	479	85	14	84	1	2	1.090	1.1	13	1	1	0	0.4	0.0	1.8	3.0	Medium to heavy netted, blocky round oval, growth cracks, knobby, sheep nose, good general appearance
MSDD244-15[efgj]	403	441	91	7	90	0	3	1.079	1.2	7	2	2	0	0.4	0.1	1.5	3.1	Misshapen, medium to heavy netted, deep stem end, deep apical eyes, flat round tuber type, sheep nose, heat knobs, sticky stolons
MSEE031-3[dgi]	396	440	91	8	91	0	1	1.082	1.3	9	5	2	0	0.8	0.1	1.9	3.1	Large blocky tubers, slight skinning, light to medium skin appearance, sheep nose, not uniform tuber type
B3403-6[bgij]	396	490	79	20	78	1	1	1.094	1.2	2	1	1	0	1.8	0.2	2.2	3.3	Flat round tubers, slight to moderate skinning, light to medium netted, traces of sticky stolons, uniform tubers
AF6671-10[gi]	394	436	91	9	91	0	1	1.087	0.9	1	1	2	5	0.6	0.1	1.9	2.3	Flat blocky round to oval tubers, severe skinning
AF5933-4[abcdefgij]	390	456	84	15	84	0	1	1.085	1.1	1	4	2	0	1.3	0.1	1.8	3.0	Round oval uniform tubers, traces of growth cracks, moderate to severe skinning, light netted skin
MSEE035-4[gj]	379	441	86	12	85	0	3	1.091	1.2	1	7	6	0	1.0	0.3	1.6	3.4	Light netted, large round blocky tubers, bottlenecks
Lamoka[acefhj]	**371**	**424**	**86**	**11**	**86**	**0**	**3**	**1.081**	**1.1**	**1**	**4**	**1**	**0**	**0.9**	**0.1**	**2.2**	**2.9**	**Flat blocky round oval, light netted, traces of misshapes, sheep nose, points, slight skinning**
MSAA076-6[abcdefgij]	368	445	83	15	83	0	2	1.086	1.3	0	1	18	1	0.9	0.1	1.9	3.1	Round tubers, light netted, deep apical eye, traces of heat sprouts, rough general appearance, moderate growth cracks, traces of rough tubers, sheep nose
MSGA24-02[g]	350	369	98	2	97	0	1	1.094	1.2	2	2	2	0	0.3	0.2	2.5	4.0	Blocky tubers, sticky stolons, medium skinning, poor periderm formation
MSDD247-07[aefgj]	342	394	87	12	87	0	2	1.096	1.2	5	1	7	6	1.1	0.0	2.1	3.1	Flat round to oval blocky tubers, medium to heavy netted skin
CMK2009-630-001[abcdefgij]	325	485	66	32	66	0	2	1.084	1.4	14	4	0	0	1.5	0.1	2.3	2.8	Round oval not uniform tubers, light yellow appearance, slight skinning, pear-shaping, light netted, knobs, heat sprouts, sticky stolons
AF6896-1[acefgj]	320	387	81	17	81	0	2	1.084	1.4	4	3	1	0	0.9	0.2	1.8	2.9	Round oval tubers, light to medium netted, sticky stolons
Petoskey[cdeij]	316	388	79	17	79	0	4	1.088	1.2	0	10	1	2	0.7	0.1	1.7	3.1	Blocky round to oval tubers, light to medium netted, traces of growth cracks, misshapes, moderate skinning, sticky stolons, traces of pear shaping, good general appearance
AC13126-1Wadg[abdefgij]	310	360	86	11	85	1	4	1.076	1.3	10	1	4	0	1.7	0.1	1.9	2.5	Blocky round tubers, misshapes, sticky stolons, deep apical eye, medium netted, apical sprouts, rough appearance, slight soft rot, not for chip industry
AC13125-5W[abdefgij]	308	376	82	17	82	0	2	1.069	1.2	6	1	1	2	1.5	0.2	1.7	2.4	Blocky round oval, light to medium netted skin, slight skinning, bright appearance, growth cracks, pear shaping
W17043-37[h]	305	383	76	23	75	0	1	1.084	1.2	3	2	0	0	1.4	0.0	1.9	2.5	Flat round tubers, heavy netted skin
MSEE016-10[abcdefgij]	301	379	79	19	79	0	2	1.086	1.2	1	1	3	0	0.8	0.1	1.6	3.0	Small round tubers, sticky stolons, light to moderate skinning, medium to heavy netted skin, deep apical eye, rough skin
AF6868-6[abcdefij]	289	394	70	25	71	0	5	1.079	1.8	6	12	2	0	1.3	0.3	2.3	2.9	Pink blush rough eyes, bright yellow appearance, severe heat sprouts, severe rots, not uniform tuber shape, oval to pointy, knobs, sticky stolons, deep apical eye, growth cracks

LINE	CWT/A		PERCENT OF TOTAL[1]					SP GR[2]	OTF CHIP SCORE[3]	RAW TUBER QUALITY[4] (%)				COMMON SCAB RATING[5]	SED SCORE[6]	VINE VIGOR[7]	VINE MATURITY[8]	COMMENTS
	US#1	TOTAL	US#1	Bs	As	OV	PO			HH	VD	IBS	BC					
Kal. 91. 03[g]	276	311	89	11	88	0	1	1.084	1.2	2	2	2	0	0.3	0.1	1.5	4.0	Blocky round, medium netted
MI-4[abcdefij]	271	467	58	41	58	0	2	1.085	1.3	17	1	0	0	1.6	0.0	2.1	3.1	Golden yellow skin appearance, round oval to oblong tubers, sticky stolons, misshapes, bottlenecks, knobs, heat sprouts, light netted, slight to moderate skinning
Sinatra[abcdefgij]	266	407	63	34	63	0	3	1.085	1.1	0	1	2	0	1.1	0.1	2.0	3.2	Small round oval tubers, traces of pear-shaping, light skin appearance, slight skinning, traces of misshapes, sticky stolons, traces of heat sprouts
MSBB230-1 Low N[g]	263	370	65	34	64	0	2	1.080	1.2	2	2	2	0	0.8	0.1	3.0	3.5	Small round tubers
Elevate[g]	243	343	64	36	63	0	1	1.078	1.2	2	2	2	0	1.8	0.1	2.5	4.0	Small round tuber type, slight skinning
LSMEAN	**418**	**489**	**84**	**14**	**84**	**0**	**2**	**1.086**	**1.2**	**5**	**3**	**3**	**1**	**1.0**	**0.1**	**1.9**	**3.1**	

2024 Chip Variety Trial Sites
[a]4-L Farms, Storage Trial
[b]Black Gold Farms, Fresh Trial
[c]Hampton Potato Growers, Storage Trial
[d]Lennard Ag. Co., Fresh Trial
[e]Lennard Ag. Co., Storage Trial
[f]Main Farms, Storage Trial
[g]Montcalm Research Center Box Bin Trial
[h]Sandyland Farms SNAC Replicated Storage Trial
[i]Walther Farms, Fresh Trial
[j]Walther Farms, Replicated Storage Trial

[1]SIZE
Bs: < 1 7/8"
As: 1 7/8" - 3 1/4"
OV: > 3 1/4"
PO: Pickouts
% of total: Values rounded to the nearest whole number

[2]SPECIFIC GRAVITY
Total solids

[3]OUT OF THE FIELD CHIP COLOR SCORE
(SNAC Scale)
Ratings: 1 - 5
1: Excellent
5: Poor

[4]RAW TUBER QUALITY
(percent of tubers out of 10)
HH: Hollow Heart
VD: Vascular Discoloration
IBS: Internal Brown Spot
BC: Brown Center

[5]COMMON SCAB RATING
0.0: Complete absence of surface or pitted lesions
1.0: Presence of surface lesions
2.0: Pitted lesions on tubers, though coverage is low
3.0: Pitted lesions common on tubers
4.0: Pitted lesions severe on tubers
5.0: More than 50% of tuber surface area covered in pitted lesions

[6]SED (STEM END DEFECT) SCORE
0: No stem end defect
1: Trace stem end defect
2: Slight stem end defect
3: Moderate stem end defect
4: Severe stem end defect
5: Extreme stem end defect

[7]VINE VIGOR RATING
Date: Variable
Rating 1-5
1: Slow emergence
5: Early emergence (vigorous vines, some flowering)

[8]VINE MATURITY RATING
Date: Variable
Rating 1-5
1: Early (vines completely dead)
5: Late (vigorous vines, some flowering)

Table 2. Statewide Tablestock (Non-Russet) Variety Trials: Summary Across Nine Locations, MI, 2024

Least Square Means

	LINE	CWT/A		PERCENT OF TOTAL[1]					SP GR[2]	RAW TUBER QUALITY[4] (%)				COMMON SCAB RATING[5]	VINE VIGOR[7]	VINE MATURITY[8]	YELLOW FLESH		RED SKIN				COMMENTS
		US#1	TOTAL	US#1	Bs	As	OV	PO		HH	VD	IBS	BC				WAXINESS[7]	FLESH COLOR[8]	WAXINESS[7]	SKIN COLOR[9]	UNIFORMITY[10]	SILVER SCURF[11]	
Purple	BNC917-2[abcdeh]	361	415	87	11	87	0	2	1.073	0	4	0	0	1.3	1.9	2.8			3.2	4.2	4.1	2.3	Blocky oval to oblong, 4.0 rating for silver scurf, pine cone eyes, moderate skinning, pink eyes, knobby, prominent eyes, kind of crappy, 1.5 powdery scab, nice skin color, netted skin, alligator skin, slight black scurf
Red	MSGG127-3R[abcdeh]	507	546	90	9	90	1	0	1.082	0	2	0	0	1.1	2.1	3.8			2.8	3.0	3.3	0.6	Uniform round tuber type, moderate to severe skinning, deep apical eyes, black scurf, misshapen pick outs, 3.5 on powdery scab, minimal rough appearance, uniform tuber type, sticky stolons, growth cracks
	Red Norland[f]	**486**	**520**	**96**	**4**	**96**	**0**	**0**	**1.061**	**0**	**3**	**0**	**0**	**0.4**	**2.7**	**1.4**			**3.0**	**3.0**	**3.0**	**1.3**	**Severe silver scurf, round oval blocky tuber type**
	Cerata KWS[abcdeh]	463	526	88	9	88	0	3	1.071	0	2	0	0	0.9	2.0	3.5			3.1	3.1	3.6	1.0	Blocky round to oval, uniform skin appearance, not uniform tuber type, ok general appearance, 3.0 rating for sliver scurf, alligator skins, black scurf, severe sticky stolons, growth cracks, pear shapes, powdery scab of 2.5
	MSGG137-1R[abcdehi]	451	521	86	12	84	1	2	1.081	0	2	0	9	0.7	2.3	3.3			2.9	2.9	3.0	0.7	Large blocky round tuber type, moderate to severe skinning, sticky stolons, deep eyes, moderate skinning, growth cracks and knobs in pick outs, 2 on powdery scab, pear shapes with some points, moderate silver scurf, rough general appearance
	RP07-095[g]	426	530	74	17	74	0	10	1.062	0	1	0	10	0.2	1.6	3.0			3.0	3.1	3.0	0.5	Growth cracks, flat round to oval
	NDAF113484B-1R[abcdefhi]	407	442	92	7	92	0	1	1.063	0	4	0	0	0.4	1.9	2.8			3.2	3.5	3.8	1.5	Blocky round to oval, uniform, OK general appearance, moderate skinning, 4.0 rating for silver scurf, stem end hips,, moderate skinning, knobs, black scurf, misshapen, pine cone eyes, rough
	AC11596-1R[h]	398	477	83	14	83	0	3	1.063	0	2	0	0	0.6	2.2	3.0			3.0	4.0	3.9	1.2	Oval to oblong, traces of skinning, ok general appearance, some points, traces of black scurf
	Dark Red Norland[abcdefhi]	**365**	**418**	**88**	**9**	**88**	**0**	**3**	**1.065**	**0**	**1**	**0**	**0**	**0.6**	**2.5**	**2.8**			**2.9**	**3.0**	**2.5**	**1.2**	**Oval to oblong, 3.5 on silver scurf, rough general appearance, slight to moderate skinning, non uniform skin, 1.5 powdery scab, slight black scurf, pine cone eyes**
	HZA 13-1486[abcdefh]	355	455	78	20	78	1	1	1.075	0	3	0	0	1.0	2.4	3.2			3.1	3.8	3.7	1.1	Moderate skinning, small round to oval tuber type, sticky stolons, 2.5 silver scurf, black scurf , 4.5 on powdery scab, DROP, slight skinning
	BNC981-1[e]	346	347	90	6	90	0	4	1.079	0	3	0	0	0.4	1.2	2.4			3.0	3.0	3.5	0.8	Large blocky round to oval
	Rediva[gh]	345	490	66	29	66	0	6	1.089	0	2	7	0	0.7	1.7	3.6			2.8	3.0	3.2	1.3	Rough appearance, non uniform, poor general appearance, flat round to oval Small round to oval tuber type, traces of misshapes, sticky stolons
	MSII417-02[g]	329	375	81	19	81	0	1	1.069	0	1	0	0	0.7	1.6	3.0			3.0	3.1	3.0	1.5	Non uniform tuber type, blocky
	MSII415-01[g]	312	356	81	20	81	0	0	1.065	0	1	0	0	0.7	1.6	3.0			3.0	4.1	4.0	0.5	Severe skinning, round tuber type, sticky stolons
	MSGG135-1R[abcdehi]	305	483	61	37	61	0	1	1.084	0	8	0	0	0.7	2.3	3.7			2.9	2.9	3.1	0.7	Sticky stolons, severe skinning, moderate silver scurf, black scurf, traces of points, 3 on powdery scab, poor general appearance, deep eyes
	COTX15083-1R[gi]	304	356	82	17	82	0	1	1.066	0	2	0	0	0.3	1.7	3.0			3.0	4.1	4.0	1.8	Blocky round, nice general appearance, moderate skinning, severe silver scurf, uniform round tuber type, DROP
	TC19094-1R[g]	258	302	79	21	79	0	0	1.075	0	1	0	0	0.2	1.6	3.0			3.0	3.1	4.0	0.5	Blocky round tuber type, slight deep eye, slight skinning, DROP
	MSII418-12[g]	252	301	78	22	78	0	1	1.074	0	1	0	0	0.2	1.6	3.0			3.0	4.1	4.0	0.5	Smaller round tuber type, DROP
	COTX050169-1R[eg]	234	298	65	33	65	0	2	1.063	0	2	0	0	0.3	1.4	3.2			3.0	3.6	4.0	1.4	Small round uniform tuber type, pink eye, moderate sliver scurf, sticky stolons, moderate skinning, non uniform
	TX17802-5R[g]	232	326	66	33	66	0	2	1.071	0	1	0	0	0.2	1.6	3.0			3.0	4.1	4.0	2.0	Non uniform tuber type, moderate skinning, some chimeral eyes, DROP
	MSII432-03[g]	113	200	54	43	54	0	5	1.067	0	1	0	0	0.2	1.6	3.0			3.0	3.1	3.0	0.5	Flat round tuber, non uniform, DROP
	BNC839-5[abcdh]	107	132	83	9	81	2	8	1.070	0	0	0	2	0.9	1.4	3.0			3.3	4.0	4.3	1.1	Round oval blocky, 3.5 rating for silver scurf, sticky stolons, black scurf, misshapen and points, uniform color and tubers, 1 on powdery scab, rough tubers, low yield, sticky stolons, slight skinning
	ND14324B-7R[g]	35	88	45	55	45	0	1	1.055	0	1	0	0	0.2	1.6	4.0			3.0	3.1	3.0	0.5	Very small tuber, rough
	MEAN	**320**	**386**	**78**	**20**	**77**	**0**	**2**	**1.071**	**0**	**2**	**0**	**1**	**0.5**	**1.9**	**3.1**			**3.0**	**3.4**	**3.5**	**1.0**	
White	Cleo[h]	533	603	93	7	92	0	0	1.067	0	4	30	0	0.8	2.0	3.0	3.0	0.8					Blocky round to oval, non uniform type
	MSFF031-6[abcdefhi]	499	546	89	10	89	1	1	1.072	0	2	0	0	0.9	2.1	3.1	3.0	1.0					Large round to oval, deep apical eyes, light netted skin, light skin appearance, 3.5 on powdery scab, moderate silver scurf, growth cracks
	Sifra[abcdeh]	486	603	79	19	78	0	2	1.076	0	1	0	0	1.2	1.9	4.1	2.9	1.1					Blocky round to oval, light to medium netted, sticky stolons, growth cracks, traces of knobs, not uniform, 2 on powdery scab, bright appearance, pear shaped tubers, misshapes, black scurf
	Reba[abcdefi]	**417**	**458**	**88**	**8**	**88**	**0**	**3**	**1.072**	**0**	**0**	**0**	**3**	**0.8**	**2.1**	**3.0**	**2.4**	**0.9**					**Blocky rough appearance, deep eyes, sticky stolons, deep apical eyes, rough general appearance, sheep nose, 1 on powdery scab, light to medium netted skin**
	Noya[abcdefh]	399	473	81	13	81	0	5	1.079	6	0	0	0	1.3	1.7	3.9	3.1	1.5					Misshapen tubers, growth cracks, sticky stolons, bright appearance, knobs, oval to oblong tuber type, pear shapes, light netted, 2.5 on powdery scab, points, non uniform, slight black scurf, ok general appearance
	Alliston[bd]	368	388	92	8	91	0	1	1.078	1	2	0	1	0.8	2.5	2.6	3.0	1.0					Flat blocky round to oval, light netted, non uniform 1 powdery scab, flat oval to oblong, medium netted
	Foxy[gh]	363	465	76	20	76	0	4	1.074	0	3	0	0	1.5	1.9	3.6	3.0	0.9					Rough non uniform tuber type, round tuber type, light to medium netted, points, pear shaping, ok to poor general appearance
	Caledonia Pearl[abcdeh]	350	522	67	29	66	0	4	1.065	0	5	2	2	1.0	2.2	2.8	2.9	1.6					Flat round to oval, misshapen, knobs, growth cracks, light skin appearance, non uniform, heat sprouts, slightly netted, slight silver scurf, OK general appearance, points
	Superior[bdi]	334	366	89	7	89	0	3	1.075	0	2	0	0	0.3	2.5	2.7	3.0	1.0					Round blocky tuber, deep eyes, pine cone eyes, rough general appearance, non uniform skin type, heavy netted
	AF6735-2[g]	316	387	82	13	77	5	6	1.067	0	3	10	0	0.8	2.0	3.0	3.0	0.8					Flat blocky round to oval, growth, light netted skin, DROP
	Marta[abcdeh]	217	423	52	42	52	0	6	1.069	0	0	0	0	1.1	1.6	3.4	3.1	3.0					Oblong to long tuber type, points, light netted, some pear shapes, bright skin appearance, pine coning eyes, knobby, small tuber type, deep apical eyes, 2 on powdery scab, rough general appearance, growth cracks, DROP, moderate black scurf, not uniform skin
	MEAN	**389**	**476**	**81**	**16**	**80**	**1**	**3**	**1.072**	**1**	**2**	**4**	**1**	**1.0**	**2.1**	**3.2**	**2.9**	**1.2**					

	LINE	CWT/A		PERCENT OF TOTAL[1]					SP GR[2]	RAW TUBER QUALITY[4] (%)				COMMON SCAB RATING[5]	VINE VIGOR[7]	VINE MATURITY[8]	YELLOW FLESH		RED SKIN				COMMENTS
		US#1	TOTAL	US#1	Bs	As	OV	PO		HH	VD	IBS	BC				WAXINESS[7]	FLESH COLOR[8]	WAXINESS[7]	SKIN COLOR[9]	UNIFORMITY[10]	SILVER SCURF[11]	
	Chas (05 6556.1)[abcdefhi]	627	714	87	8	86	1	5	1.056	0	1	0	0	0.9	2.0	2.9	3.2	1.7					Bright appearance, knobs, sticky stolons, growth cracks, misshapen, round flat, bright appearance, 1 for powdery scab, medium netted
	MSII344-05[g]	588	667	93	4	92	0	4	1.069	0	3	0	0	0.8	2.0	2.5	3.0	2.8					Oval to oblong, lenticel scarring, some misshapen tubers, pointed, DROP
	MSII320-04[g]	573	626	97	3	97	0	0	1.060	0	3	0	0	0.3	2.5	3.0	3.0	2.8					Blocky round to oval, growth cracks, moderate black dot, slight apical eye
	MSII344-02[g]	545	665	85	13	84	0	3	1.064	0	4	20	0	2.3	2.0	3.0	3.0	2.8					Non uniform tuber, oval to oblong, lenticel scarring, DROP
	MSII323-04[g]	545	582	100	0	92	8	1	1.065	10	3	0	0	1.3	2.5	2.5	3.0	2.8					Blocky oval to oblong, medium netted, DROP
	MSII308-05[g]	541	618	90	10	90	0	0	1.067	0	3	0	0	0.8	2.5	3.0	3.0	2.8					Flat round to oval, non uniform, DROP
	MSII323-06[g]	533	614	91	4	90	0	6	1.060	0	3	0	0	0.8	2.0	3.0	3.0	2.8					Rough general appearance, blocky oval to oblong, growth cracks, moderate rhizoctonia, deep apical eyes, DROP
	MSGG039-11Y[abcdefhi]	488	546	87	10	87	0	3	1.077	0	5	0	1	0.7	2.0	3.1	3.1	2.6					Knobs, sticky stolons, blocky round to oval, bright appearance, sticky stolons, bright appearance, 4.5 powdery scab, uniform tuber type, traces of knobs, moderate black scurf, light to medium netted, slight black scurf
	Georgina[abcdeh]	486	570	85	7	85	0	8	1.066	0	4	0	0	1.1	2.3	3.2	3.5	3.8					Bright, blocky round to oblong, not uniform, knobs, bottlenecks, traces of growth cracks, pointed tubers, pear shaped, black scurf, 3.5 powdery scab, DROP due to powdery scab, light netted, rough not uniform tuber type
	MSII320-03[g]	458	512	94	6	94	0	0	1.067	0	3	0	0	0.3	2.5	2.5	3.0	2.8					oval to oblong, poor gen appearance, DROP
	Colomba[abcdefgh]	**455**	**539**	**84**	**12**	**83**	**1**	**3**	**1.057**	**0**	**6**	**0**	**0**	**0.4**	**2.5**	**2.5**	**3.4**	**2.9**					**Round oval large blocky, heat sprouts, misshapes, bright appearance, non uniform tuber, traces of growth cracks, light netting, deeper eyes, slight silver scurf, severe black dot, deep apical eye, rough**
	CO18054-4Y[g]	451	493	97	0	97	0	3	1.080	0	3	0	0	0.3	2.0	3.0	3.0	3.8					Blocky round, traces of points
	Allison[abcdeh]	451	568	78	18	78	0	4	1.077	7	3	0	0	0.8	2.3	3.9	2.9	1.0					Oblong to long, light buff netted, knobs, bright skin, alligator hide, non-uniform, rough general appearance, sticky stolons, 3 powdery scab rating, traces of points
	Jelly[abcdefghi]	**448**	**516**	**86**	**6**	**86**	**0**	**8**	**1.080**	**0**	**10**	**0**	**5**	**0.4**	**1.9**	**3.8**	**2.8**	**3.6**					**Golden yellow appearance, sticky stolons, round oval, points, large, blocky, golden yellow appearance, knobs, light to medium netted, rough general appearance, slight to moderate black scurf**
	Decibelabcdeh	434	568	74	22	74	0	4	1.068	0	0	0	0	1.3	2.1	3.4	3.1	2.4					Round oval uniform tuber type, bright general appearance, pear shapes and points, light netted, golden yellow appearance, points, bottlenecking, knobby stem ends, traces of black scurf
	RP582-98[g]	434	497	91	9	91	0	0	1.064	0	3	0	0	0.8	2.0	3.0	3.0	4.8					Round flat, medium netted, uniform tubers, OK gen appearance
	T10g	432	499	90	10	90	0	0	1.053	0	3	0	0	1.3	2.0	3.0	3.0	2.8					Small round tuber type, slight netted
	W13103-2Y[abcdefh]	419	475	87	10	87	0	3	1.065	0	2	0	0	1.2	2.0	3.0	3.3	3.7					Moderate tuber rots, round oval tubers, blocky, heat sprouts, light netted, growth cracks,
	Gaya[bcdi]	410	468	86	9	86	0	5	1.073	5	0	0	0	1.4	1.6	4.1	2.5	3.6					Round oval blocky, black scurf, golden yellow, non uniform, growth cracks, sticky stolons, misshapes, heat sprouts, light to medium netted, deep apical eyes
	MSGG039-08Y[abcdefhi]	404	557	71	23	71	0	5	1.073	0	4	0	0	1.2	2.2	3.4	2.9	2.8					Flat oval to oblong, light to medium netted, pointed, pear shape, misshapen pick outs, 1 on
	Acoustic[abcdegh]	399	488	82	14	81	0	4	1.067	1	8	0	0	1.2	1.8	3.0	3.1	2.6					Round oval pear shape, not uniform tuber type, sticky stolons, bright general appearance, misshapen, moderate silver scurf, points
	Montana[abcdeh]	398	515	76	20	76	0	3	1.066	0	3	0	0	1.0	2.1	3.6	3.8	4.8					Knobs, oblong to long large tubers, bright appearance, non uniform, black scurf, points, nice general appearance, traces of growth cracks, light netted, traces of black scurf, growth cracks
Yellow	Camelia[abcdeh]	391	463	84	11	84	0	5	1.066	0	7	0	0	1.2	1.9	3.0	3.0	4.1					Blocky round to oval, not uniform tuber type, light netted, deep apical eyes, bright skin, black scurf, rough general appearance, some points, misshapen, 1.5 powdery scab, knobby, pear-like shapes
	IPB8343-5W/Y[abcdehi]	388	507	73	26	72	0	2	1.075	0	0	0	0	0.6	2.4	3.0	3.0	3.0					Large blocky round to oval, light netted, sticky stolons, bright appearance, round uniform tubers, severe alligator skin, deeper surface and apical eyes, pointed, pear shapes
	Christel[abcdeh]	386	506	76	16	76	0	7	1.065	0	2	1	0	0.5	2.6	3.0	3.5	4.1					Round oval pear shape, golden yellow, minor traces of point, light general appearance, knobs, 2 on powdery scab, medium netted, misshapes
	Tyson[abcdeh]	385	466	83	8	82	1	8	1.076	0	5	0	0	0.9	2.0	3.1	3.0	2.8					Round oval large, misshapes, knobs, not uniform tuber type, alligator skin, bright appearance, growth cracks, heat sprouts, points, 1 on powdery scab, good appearance, sheep nose, sticky stolons, points
	W15240-2Y[abcdeh]	380	473	79	20	78	0	2	1.065	0	4	5	0	1.2	1.8	2.9	3.3	3.0					Blocky round to oval, light netted, pointed, bright appearance, black scurf, points, 3 powdery scab, flat oval, pear shape, some points, bright appearance
	Sensation[abcdefh]	380	444	83	13	84	0	3	1.064	0	14	1	0	1.0	1.5	3.2	3.2	3.3					Blocky, oval to oblong, bright appearance, not uniform tuber type, pear shaped, bright skin, black scurf, pointed ends light netted
	IPB8343-8W/Y[abcdehi]	375	450	83	14	83	0	4	1.077	0	0	0	0	0.8	2.6	2.7	3.3	3.4					Round oval not uniform tuber type, deep apical eyes, traces of pine cone eyes, bright appearance, points, heat sprouting, lots of misshapes, golden yellow appearance, pear shape, slight points, light netted, moderate black scurf
	Bernice[abcdeh]	371	447	81	15	81	0	4	1.062	0	0	0	0	1.1	2.2	2.8	3.0	3.5					Blocky pear shapes, round to oval, not uniform, traces growth cracks,
	Vanilla[abcdeh]	346	460	75	23	75	0	2	1.073	0	3	0	0	0.9	2.3	3.0	3.1	2.7					Round oval uniform tuber type, golden yellow appearance, bright appearance, uniform, black
	Gala[abcdeh]	321	429	72	26	72	0	1	1.065	0	0	0	0	0.9	2.3	3.0	3.5	4.4					Oval to round, pointed, light netted, traces of heat sprouts, uniform, bright appearance, pear shaped, bright appearance
	IPB8343-2W/Y[abcdehi]	320	413	76	23	76	0	2	1.069	0	0	8	0	1.2	2.5	2.7	3.2	3.1					Blocky round tuber type, deeper eyes, sticky stolons, bright appearance, black scurf, points, golden appearance, uniform tuber type, moderate silver scurf, rough general appearance, light to medium netted
	Natalia[abcdeh]	300	404	73	21	73	0	5	1.055	0	13	0	0	0.9	2.4	2.7	3.2	2.6					Oblong to long tuber type, light bright skin type, pointed tubers, pear shaped, black scurf, slight tuber rot, 3 on powdery scab, points, light netted, misshapen, growth cracks
	Queen Anne[abcdeh]	**299**	**448**	**66**	**32**	**66**	**0**	**2**	**1.063**	**0**	**3**	**0**	**0**	**1.2**	**1.6**	**2.9**	**3.5**	**4.3**					**Oblong to long tubers, bright appearance, traces of rots, pointed, 2 on powdery scab, light netted, moderate silver scurf, traces of black scurf**
	Constance[abcdeh]	299	376	78	20	78	0	2	1.073	0	1	1	0	0.5	2.0	3.0	3.2	3.2					Round oval, oblong to blocky, golden yellow appearance, light netted, 1.5 on powdery scab,
	Sound[abcdeh]	274	510	50	43	50	0	7	1.072	0	3	0	0	1.0	2.3	3.1	3.1	2.8					Oblong to long, light skin, flat tuber type, knobs, pointed tubers, alligator skin, bright skin,
	CO16154-2Y[abcdefh]	269	320	85	7	83	1	8	1.085	16	1	1	0	1.5	1.6	2.9	2.7	4.4					Knobs, growth cracks, rough tuber type, round oval, yellow skin, points, non uniform size, medium netted, growth cracks, traces of black scurf, poor general appearance
	ATX13134-3W/Y[beh]	268	316	80	19	80	0	1	1.074	0	2	0	0	1.0	2.0	3.0	2.9	1.0					Small round tubers, light netted, sticky stolons, traces of knobs, slight deep eyes
	CO16279-5Y[abcdegh]	243	310	78	18	78	0	4	1.085	2	3	3	2	0.9	2.0	3.0	3.0	4.8					Round oval, yellow skin, deep apical eyes, pear shaped, bright skin, black scurf, misshapen pick outs, medium netted, buff skin, not uniform, points
	Yukon Gold[cdi]	243	336	66	31	65	0	3	1.081	8	3	1	0	0.4	1.8	2.9	2.0	1.8					Round oval blocky, black scurf, bright appearance 2.5 on powdery scab, rough tuber type Flat round to oval, light pink eyes
	Rock[abcdegh]	229	396	58	41	58	0	2	1.084	0	0	1	0	0.8	2.0	3.2	3.1	3.0					Round oval, sticky stolons, golden yellow appearance, nice skin appearance, light to medium netted, pointed tubers, ok to poor general appearance
	T12[g]	217	359	46	25	45	0	29	1.070	0	3	10	0	0.3	2.0	3.0	3.0	3.8					Flat round to oblong, non uniform, points and knobs, DROP
	CO16212-1Y[g]	180	265	46	54	46	0	0	1.076	0	3	0	0	0.8	2.0	3.0	3.0	4.8					Small round tuber, DROP
	Jule[abcdeh]	156	429	35	63	35	0	2	1.070	0	4	0	0	0.6	2.2	3.5	3.0	4.6					Oval to oblong, pointed, bottlenecking, bright appearance, points, alligator skin, light to medium netted, 1 on powdery, oval to oblong, pear shapes and points, light netted, uniform tuber type, knobs
	MEAN	**390**	**485**	**79**	**18**	**78**	**0**	**4**	**1.069**	**1**	**3**	**1**	**0**	**0.9**	**2.1**	**3.0**	**3.1**	**3.2**					

2024 Russet Variety Trial Sites

[a]4-L Farms, Inc.,
[b]Horkey Brothers Farm
[c]Jenkins Potato Farm
[d]Kitchen Farms, Inc.,
[e]Styma Potato Farm
[f]Verbrigghe Potato Farms
[g]Walther Farms Cass City EGS
[h]Walther Farms Cass City Replicated
[i]Walther Farms Cass City Strip

[1]SIZE

Non-russet tablestock
Bs: < 1 7/8"
As: 1 7/8" - 3 1/4"
OV: > 3 1/4"
PO: Pickouts
% of total: Values rounded to the nearest whole number

[2]SPECIFIC GRAVITY

Total solids

[3]RAW TUBER QUALITY

(percent of tubers out of 10)
HH: Hollow Heart
VD: Vascular Discoloration
IBS: Internal Brown Spot
BC: Brown Center

[4]COMMON SCAB RATING

0.0: Complete absence of surface or pitted lesions
1.0: Presence of surface lesions
2.0: Pitted lesions on tubers, though coverage is low
3.0: Pitted lesions common on tubers
4.0: Pitted lesions severe on tubers
5.0: More than 50% of tuber surface area covered in pitted lesions

[5]VINE VIGOR RATING

Date: Variable
Rating 1-5
1: Slow emergence
5: Early emergence

[6]VINE MATURITY RATING

Date: Variable
Rating 1-5
1: Early (vines completely dead)
5: Late (vigorous vines, some flowering)

[7]WAXINESS RATING

1: Heavy netting, buff
5: Waxy, smooth

[8]FLESH COLOR

1: White
5: Dark yellow

[9]SKIN COLOR

1: Light pink
5: Dark red

[10]UNIFORMITY OF SKIN COLOR

1: Highly variable, non-uniform
5: Highly uniform, color throughout

[11]SILVER SCURF

0: No incidence of silver scurf
5: High incidence of silver scurf

Table 3: Statewide Table Russet Variety Trials: Summary Across 12 Locations, MI, 2024
Least Square Means

LINE	CWT/A		PERCENT OF TOTAL[1]					SP GR[2]	RAW TUBER QUALITY[3] (%)				COMMON SCAB RATING[4]	VINE VIGOR[5]	VINE MATURITY[6]	COMMENTS
	US#1	TOTAL	US#1	Bs	As	OV	PO		HH	VD	IBS	BC				
MN19AF6945-003[j]	726	783	91	6	50	40	3	1.075	0	0	6	0	2.5	2.6	2.8	Round to oval tuber type, knobs and heat sprouts, soft rot, light russet
W19039-6Rus[k]	589	653	86	12	64	22	1	1.082	0	2	4	0	0.6	2.8	3.1	Oblong to long, medium russeting, misshapen, consistent skin and tuber type
A16051-3[j]	577	702	81	12	65	16	7	1.075	10	0	0	0	2.0	2.6	2.8	Severe rots, bottlenecking, slight growth cracks, heat sprouts, not uniform tuber type, DROP
A15254-5[j]	538	658	81	10	75	5	9	1.079	0	0	46	0	1.0	1.6	2.8	Bottlenecking, long tuber type, misshapen, DROP
A18243-1[j]	534	663	80	14	77	2	7	1.077	0	0	0	0	2.0	3.1	2.8	Medium russet skin, smaller oval to oblong, bottlenecking, heat sprouting
A08433-4STO[abcdefghi]	512	589	87	8	81	6	4	1.085	20	2	3	0	0.7	2.4	4.1	Large oblong to long to blocky, light russeting, sticky stolons, traces of knobs, misshapen appearance, 2.0 rating for silver scurf, points
A18084-1sto[j]	511	638	79	13	14	65	8	1.079	0	0	0	0	2.5	2.6	2.8	Misshapen tubers, smaller size tuber profile, not uniform tuber type, medium russet skin
AF6384-2[abdefgi]	498	573	85	11	75	10	4	1.082	14	2	2	0	1.0	2.5	3.4	Large oblong to long, light to medium russeting, traces of knobs, traces of rots, pink eye disorder, OK general appearance Oblong to long tuber type
Campagna[egi]	495	604	82	13	80	2	5	1.073	12	3	2	0	0.5	2.4	3.4	Uniform medium russeting, good general appearance, large oblong to long tuber type, pine cone eyes, knobs, misshapen, alligator skin, some nice skin and shaped tubers
A12305-2[abcdefgi]	495	580	85	5	78	7	10	1.079	5	1	2	0	1.5	2.4	3.6	Misshapen, large oblong to long wavy tuber type, slightly rough, not uniform, light to medium russeting, knobs, black scurf, pine cone eyes, Oduor and severe rots, growth cracks, moderate skinning, sticky stolons, points, apical growth cracks, misshapen, poor tuber shape tubular-like, skinny tubers, DROP
Russet Norkotah[abcdefghij]	**487**	**575**	**84**	**10**	**77**	**7**	**6**	**1.074**	**18**	**8**	**2**	**0**	**1.0**	**2.5**	**3.0**	**Large blocky, oblong to long tuber type, medium to heavy russeting, knobs, rough general appearance, misshapen, moderate pink eyes, non uniform skin, prominent eyes, pointed ends**
Silverton Russet[abcdefghik]	**487**	**549**	**88**	**8**	**79**	**9**	**4**	**1.076**	**10**	**1**	**6**	**0**	**0.4**	**2.8**	**3.3**	**Nice tuber type and appearance, light to medium russet, oblong to long block, growth cracks, nice general appearance, alligator skin, black scurf, misshapen, points**
A18077-11TE[j]	482	690	70	14	66	4	16	1.091	0	0	0	0	0.5	3.1	3.8	Heavy russeting, traces of misshapes, bottlenecking, slight points, would test again
COA17105-1[j]	482	642	75	6	66	8	20	1.078	0	0	0	0	2.0	2.6	2.8	Light russet skin, elongated tubers, misshapen tubers, DROP
A15094-13[j]	478	655	73	13	72	0	14	1.077	20	0	0	0	2.5	2.1	2.8	Light russet skin, misshapen tubers, bottlenecking, heat sprouting, DROP
A12327-5VR[abcdefghi]	474	546	86	8	75	10	6	1.078	10	2	3	0	0.3	2.5	3.4	Blocky oblong to long, knobs, very large tuber type, medium to heavy dark russeting, ok general appearance, traces of growth cracks, pine cone eyes, traces of sticky stolons, alligator skin, black scurf, rough tuber appearance, growth cracks, bottlenecks, misshapen, skinning. DROP
A15077-9TE[j]	470	509	90	6	51	39	4	1.090	30	0	0	0	0.0	2.1	2.8	Large blocky tuber type, slight growth cracks, sticky stolons, interesting selection see again
A18224-2[j]	467	512	89	9	53	36	2	1.087	0	40	6	0	2.5	3.1	2.8	Blocky oblong , light russet skin type
AOR15166-2[abcdefgi]	467	516	89	8	82	7	3	1.092	0	3	2	0	0.7	2.4	3.2	Oblong to long, medium russeting, sticky stolons, nice appearance, misshapen pick outs, uniform tuber type
MI-3[bcdefghi]	465	599	77	18	74	3	5	1.075	15	0	2	0	1.8	2.6	2.8	Oblong to long tuber type, pointed stem end, golden appearance, not uniform tuber type, light bright skin type, golden yellow, points, knobs, black scurf, misshapen
OR18H019-2[j]	459	630	73	12	58	14	15	1.087	10	20	0	0	2.0	2.1	3.3	Secondary growth, knobs and misshapen, growth cracks, medium russeting, heat sprouts, DROP
A18035-13[j]	458	636	72	17	66	5	12	1.082	0	20	0	0	1.0	2.1	2.8	Medium russet tuber type, heat sprouts, misshapen tubers, slight knobs, variable tuber type
AOR15227-2[abcdefgi]	451	542	81	9	75	7	9	1.091	10	4	2	0	1.4	2.5	3.4	Severe knobs, medium russeting, misshapen tubers, oblong to long blocky, non uniform, pine cone eyes, rough appearance, not uniform, ugly, moderate skinning, OK general appearance, sticky stolons, tubular-like tubers, DROP
AOR16066-5[acfgj]	450	542	83	11	76	6	7	1.072	1	2	5	0	1.7	2.0	2.7	Large oblong to long, light to medium russeting, not uniform, knobs, misshapen, DROP
Reveille Russet[abcdefghi]	**441**	**513**	**86**	**7**	**75**	**10**	**7**	**1.071**	**0**	**0**	**1**	**0**	**0.4**	**1.9**	**3.1**	**Large oblong to long, medium to dark russeting, slight skinning, misshapen, non uniform, black scurf, alligator skin, growth cracks, knobs, consistent skin**

LINE	CWT/A		PERCENT OF TOTAL[1]					SP GR[2]	RAW TUBER QUALITY[3] (%)				COMMON SCAB RATING[4]	VINE VIGOR[5]	VINE MATURITY[6]	COMMENTS
	US#1	TOTAL	US#1	Bs	As	OV	PO		HH	VD	IBS	BC				
AF6340-6[acdefgik]	439	528	82	16	79	3	3	1.067	1	6	2	0	1.2	2.6	2.8	Oblong to long tubular, alligator skin, light to medium russeting, black scurf, severe silver scurf, OK appearance, non uniform tuber type, nice shape, skinning, poor shape, bad appearance
AF6314-12[acdefgik]	438	511	85	9	78	7	6	1.083	10	2	23	0	1.1	2.2	3.5	Large oblong blocky, light to medium to heavy russeting, non uniform, black
AAF15169-3[acdefgik]	435	528	80	14	75	4	6	1.085	4	1	1	0	1.4	2.8	3.0	Large oblong to long blocky, light to medium russeting, black scurf, slight rots, not uniform skin, severe silver scurf, Knobs, growth cracks, misshapen, rough general appearance, deep apical eyes, moderate skinning, 4.0 rating on powdery scab, long tubular tubers, pine cone eyes, tubular, prominent eyes,
AF6377-10[abcdefgik]	431	477	89	7	74	15	4	1.074	15	1	1	1	0.2	1.7	3.1	Growth cracks, medium to dark russeting, large blocky tuber type, moderate skinning, black scurf, good general appearance, growth cracks, slight sheep nose, nice skin, slight alligator skin, sticky stolons
Peribonka[gi]	428	498	86	8	78	8	7	1.081	12	2	1	0	0.5	2.5	2.5	Medium russeting, rough general appearance, non uniform, large long tubers, light to medium russeting, slight growth cracks, traces of misshapen tubers, nice tubers, consistent shape
W19037-11Rus[fk]	425	545	76	21	74	2	3	1.077	0	1	1	0	0.8	2.7	2.5	Light to medium russeting, flat oblong long, not uniform, growth cracks, sheep no
AF5736-16[abcdefghik]	423	484	87	10	79	7	3	1.091	10	4	1	0	0.6	2.0	3.8	Oblong to long, light to medium russeting, good general appearance, black scurf, misshapen, pick outs, growth cracks, sticky stolons, smaller tubers
AAF15180-3[egik]	420	505	81	14	73	8	5	1.084	3	3	15	0	1.0	2.1	3.4	Consistent light skin, tubular, prominent eyes, some bottlenecks
A18476-3adg[j]	416	461	88	11	82	5	2	1.080	0	10	0	0	0.0	1.6	2.8	Light russet skin, good general appearance, test again
MN19AOR16061-007[abcdgik]	412	509	73	23	71	2	4	1.079	0	1	10	0	0.6	2.6	3.4	Oblong to long, dark russeting, slight skinning, black scurf, points, growth cracks, good general appearance, nice skin, smaller tubers, nice shape but small tubers, uniform
A18215-3[j]	408	779	54	15	53	1	31	1.084	0	0	0	0	0.5	2.6	2.8	Bottlenecking, long tuber type, DROP
A18503-2sto[j]	408	501	80	7	60	20	13	1.093	0	0	0	0	1.0	2.1	3.3	misshapen bottlenecking, medium heavy russeting, growth cracks
AFA5661-8[acdefgi]	405	462	87	8	82	6	5	1.086	0	13	2	0	1.2	2.0	3.5	Light russeting, sticky stolons, oblong to long tuber type, black scurf, pine cone eyes, not uniform tubers, traces of points, rough tubers, nice general appearance growth cracks, misshapen, poor skin (inconsistent), apical skin cracks, deeper eyes, DROP
AF6855-4[abdefgik]	403	471	82	15	77	5	4	1.087	14	1	2	0	1.7	2.5	3.2	Oblong to long, traces of skinning, medium to heavy russeting, traces of heat sprouts, blocky tuber type, black scurf, slight skinning, poor appearance, DROP
MN18W17091-015[j]	401	612	66	8	43	23	26	1.074	0	10	0	0	2.0	2.6	2.8	Long tubular pointed ends, misshapen tubers, apical growth cracks, DROP
TX20076-1RU[gk]	392	507	79	10	71	8	11	1.067	4	8	9	0	0.6	2.5	3.8	Blocky oblong tuber type, nice general appearance, medium russet skin, severe growth cracks, secondary growths, misshapen
Vanguard[acdefgh]	**389**	**469**	**81**	**15**	**77**	**4**	**4**	**1.068**	**1**	**2**	**5**	**0**	**0.6**	**2.2**	**2.6**	**Light to dark russeting, growth cracks, oblong to long tuber type, misshapen, non uniform russeting, knobs, misshapes in pick outs, nice general appearance, nice type and skin**
AF6377-12[abcdefghik]	386	459	82	14	74	7	4	1.081	11	4	7	2	0.6	2.1	3.0	Blocky oblong to long large tuber type, dark russeting, traces of growth cracks, growth cracks, black scurf, prominent eyes, nice general appearance, slight alligator skin
AF7001-5[abcdefghik]	382	469	78	15	75	3	7	1.085	6	0	1	1	0.8	1.9	3.2	Large oblong to long, light russeting, traces of pine cone eyes, misshapen, black scurf, pine cone eyes, uniform, nice appearance
AF6749-3[acdefgik]	380	490	77	17	74	3	6	1.085	6	3	2	0	0.6	2.3	3.1	Oval to oblong tuber type, mishappen, growth cracks, knobs, medium russet skin Round oval blocky, pine coning eyes, slightly misshapen, rough general appearance, prominent eyes, uniform type, sticky stolons, traces of points, nice tuber type, slight skinning
A15175-1[j]	378	530	71	20	70	1	8	1.082	0	0	0	0	1.5	2.1	2.8	Light russet skin, tubular tuber type, not uniform
AAF10596-1[abcdefgik]	376	466	80	15	74	6	5	1.088	3	2	4	0	2.0	2.4	2.9	Light to medium russeting, oblong to long tuber type, sticky stolons, black scurf,
AOR11908-2[cdefgj]	368	460	80	10	75	5	10	1.071	18	5	1	2	0.5	2.5	2.8	Long to oblong, misshapen, black scurf, medium to heavy russeting, knobs, nice skin, points and knobs, pine cone eyes, prominent eyes, non uniform tubers
AOR16118-1[cdfgj]	368	453	81	15	75	6	5	1.089	37	4	1	0	0.9	2.3	3.0	Blocky, light russeting, pine coning, rough appearance, black scurf, severe
W13008-1Rus[abcdefghi]	362	438	80	16	75	4	4	1.077	7	2	4	1	0.8	2.6	3.1	Large block tuber type, growth cracks, alligator skin, sticky stolons, medium to light russeting, nice general appearance, misshapen, pointed ends, non uniform tuber type, flaky skin, points

LINE	CWT/A		PERCENT OF TOTAL[1]					SP GR[2]	RAW TUBER QUALITY[3] (%)				COMMON SCAB RATING[4]	VINE VIGOR[5]	VINE MATURITY[6]	COMMENTS
	US#1	TOTAL	US#1	Bs	As	OV	PO		HH	VD	IBS	BC				
AF6750-3[abcdefgik]	361	438	81	11	75	6	8	1.076	0	0	1	0	0.4	2.1	3.2	Oblong to long tubular, medium to heavy russeting, black scurf, misshapen appearance, prominent eyes, prominent eyes, pine cone eyes, points, knobs, nice general appearance, pear-sharpen tubers
Goldrush[bdegh]	**360**	**450**	**79**	**13**	**75**	**4**	**8**	**1.068**	**12**	**0**	**1**	**0**	**0.2**	**2.5**	**2.9**	**Slight skinning, pine cone eyes, tubular, black scurf, medium to heavy russeting , heavy russeting, non uniform tuber type, blocky oval to oblong, good general appearance**
MN19TX18206-002[j]	350	564	63	37	63	0	0	1.083	0	20	0	0	3.0	1.6	3.8	Round to oblong, golden appearance, 90 percent heat sprouts , misshapen tubers, small tuber type, DROP
AF5762-8[acdefghik]	349	416	81	13	76	5	6	1.089	22	7	5	0	0.4	2.1	3.5	Medium to heavy russeting, large long to oblong, traces of pine cone eyes,
CO13003-1RU[abcdefgi]	348	450	77	17	74	4	6	1.071	10	0	3	6	0.5	2.4	3.0	Blocky oblong to long, medium to heavy russet skin, moderate skinning, slight growth cracks, black scurf, ok general appearance, misshapen tubers, alligator skin, consistent small tuber type and skin, greening, sprouting
NDAF1791-6[k]	341	466	73	17	63	9	10	1.089	20	2	0	0	2.6	2.3	3.1	
A15084-4[j]	338	417	79	12	74	5	8	1.086	10	0	26	10	2.5	2.1	2.8	Knobs, misshapen, medium russet skin type, traces of growth cracks
AOR18053-7[j]	336	441	75	19	75	0	6	1.085	0	0	0	0	1.5	2.1	2.8	Sticky stolons, tubular tuber type, medium russet, DROP
AOR16071-6[bcij]	333	444	76	17	70	6	7	1.080	3	2	6	0	2.3	2.5	3.0	Oblong to long tuber type, light skin appearance, pointed, misshapen, pointed, lots of greening, smooth tablestock type, apical growth cracks, light skin, doesn't look like a russet DROP
COTX10080-2RU[bcdefgi]	330	405	78	18	74	4	4	1.072	3	0	2	0	0.6	2.2	3.3	Medium tuber rots, oblong to long tuber type, medium to heavy russeting, traces of alligator skin, black scurf, pointed, growth cracks, bottlenecking, misshapen, nice skin
A13091-5[bdfgij]	328	389	82	15	78	3	4	1.083	4	8	0	0	0.8	2.2	3.0	Small nice appearance tubers, variable skin finish, tubular shape
W19039-3Rus[abcdefgk]	326	391	83	12	73	9	5	1.068	0	3	1	0	1.0	2.4	2.4	Light russet skin type, blocky oblong to long tuber type, misshapen pine cone, ok general appearance, tubular-like, large rough tubers, moderate stem end rot, traces of rots Misshapen, very poor tuber type, DROP
Meister[acdefgi]	326	506	63	31	60	4	5	1.086	0	2	3	0	2.0	3.2	3.1	Oblong to long, light skin type, bottlenecking, points, light skin appearance, black scurf, points, misshapen, non uniform, shiny tablestock skin, smooth skin, no russeting, growth cracks
W19034-30Rusk	319	522	62	27	62	0	11	1.078	0	2	0	0	1.1	2.8	2.6	Misshapen, pointed, bottlenecks
A18057-2TE[j]	316	429	73	20	73	0	7	1.079	0	0	0	0	2.0	2.1	2.8	Smaller tuber type, oblong to long, light russet, slight growth cracks
OR18002-2[fgj]	313	383	80	13	71	10	7	1.079	3	1	0	0	0.4	2.1	2.8	Oblong to long tuber type, mishappen, medium russeting Large blocky tuber type, not uniform skin type Flat oblong to long, medium dark russeting, rough general appearance
AOR15152-2[j]	310	447	69	11	63	7	19	1.089	30	10	0	0	2.0	1.6	2.8	Bottlenecking, medium russeting, misshapen tubers, tubular tuber type
A15028-2TE[j]	309	390	78	12	78	0	10	1.077	0	0	0	0	1.0	1.6	3.8	Medium russeting, oblong to long, ok shape, traces of knobs
MN18W17091-005[j]	304	476	65	9	45	20	27	1.074	10	0	0	0	1.5	2.1	2.8	Misshapen, tubular, light to medium russet skin, pointed ends, DROP
T 08[j]	300	425	71	18	71	0	11	1.074	0	0	0	0	2.0	2.1	2.8	Smaller oblong to long, misshapen, slight growth cracks, medium buff skin type
MN18W17076-001[j]	286	337	82	15	77	5	3	1.082	0	0	0	0	0.0	1.6	2.8	Dark russet skin type, not uniform skin and tuber type
Umatilla Rus[etf]	281	477	60	30	55	6	10	1.075	20	1	8	10	1.0	2.0	2.9	Medium russet, long tubular, rough gen appearance
A13072-7[dfgij]	280	321	86	7	80	6	7	1.079	29	6	2	0	0.8	2.2	3.1	Round oval to blocky, medium russeting, black scurf, not uniform, misshapen tubers, some uniform good appearance, variable skin finish, smaller tuber size, traces of growth cracks
A15102-11[j]	277	439	64	28	64	0	8	1.085	0	0	16	0	2.5	2.6	2.8	Oblong to long tuber type, misshapen, light russeting, DROP
AOR18511-1[j]	274	336	79	11	70	9	9	1.090	50	0	0	0	1.0	1.6	2.8	Heat sprouts, oblong blocky, knobs, light to medium russet
PSS11357-21[abcdefghij]	271	338	79	15	75	4	6	1.084	1	2	1	0	0.5	2.2	3.9	Large oblong to long tubular tuber type, pointed, light to medium russet skin, knobs, black scurf, not uniform, rough appearance, poor tuber shape,
CO15016-1Rusto[abcdefgik]	270	422	64	28	62	3	7	1.073	14	0	3	0	0.6	2.3	2.9	Nice skin, misshapen, points, growth cracks, bottlenecks, heat knobs, dark russet skin, oblong to long, light skinning, black scurf, pine coning, nice bright medium russet
AF6465-7[abcdefgi]	265	370	70	26	65	5	4	1.077	6	3	7	2	0.6	2.2	2.8	Medium to heavy russeting, oblong to long tuber type, not uniform russeting black scurf Dark russet, large uniform tubers, moderate skinning, misshapen pick outs, OK general appearance, rough, deeper eyes, slight skinning
A11887-5adg[j]	265	427	63	13	56	8	24	1.071	0	0	16	0	1.5	1.6	2.8	Misshapen tuber type, long tuber type, DROP
MN19AOR17020-009[b]	265	368	71	19	67	4	11	1.080	10	1	8	0	1.0	1.8	3.7	Misshapen, light to medium russeting, blocky tuber type Light skin, prominent eyes,

LINE	CWT/A		PERCENT OF TOTAL[1]					SP GR[2]	RAW TUBER QUALITY[3] (%)				COMMON SCAB RATING[4]	VINE VIGOR[5]	VINE MATURITY[6]	COMMENTS
	US#1	TOTAL	US#1	Bs	As	OV	PO		HH	VD	IBS	BC				
AOR13064-2[acdefgi]	258	357	69	24	63	6	7	1.086	18	2	5	0	0.8	2.6	3.6	Traces of black scurf, medium russeting, oblong to long tuber type, points, ok general appearance, pointed, non uniform,, pink to purplish blush to skin, rough general appearance, apical skin cracks, inconsistent skin finish, some nice type tubers, DROP
AOR15194-2[j]	247	369	67	16	65	2	17	1.080	0	0	6	0	2.0	2.1	2.8	Oblong to long tuber type, misshapen
NDAF13242B-3[k]	245	339	74	20	74	0	6	1.079	0	2	0	0	2.6	2.3	3.1	Very poor tuber type and appearance, DROP
CO16238-4RU[abcdefgijk]	244	348	69	27	67	1	4	1.075	1	1	8	0	0.5	2.0	2.9	Medium russeting, oblong to long, good general appearance, sticky stolons, small and knobby not uniform tuber type, slight alligator skin, bottlenecking, knobs, misshapen, pointed, tubular-like, slight skin cracks, DROP
T 05[j]	217	413	55	33	55	0	13	1.069	0	30	0	0	3.5	1.6	2.8	Bright smooth skin, bottlenecking , misshapen tubers, DROP
AFA6346-2[j]	210	537	43	15	43	0	42	1.082	0	0	0	0	2.5	2.1	2.8	Misshapen, knobs bottlenecking, DROP
A16018-4TE[j]	178	392	49	8	39	10	43	1.082	0	0	26	0	0.5	1.1	2.8	Not uniform tuber type, misshapen tuber type, DROP
MN18CO16154-009[j]	178	276	65	29	66	0	6	1.090	0	0	36	0	1.0	2.6	2.8	Oval to oblong, golden appearance, heat sprouting
MN19AOR16059-001[j]	170	253	68	12	57	11	20	1.079	0	0	16	0	0.5	2.1	1.8	Not uniform russeting, knobs, points
A18085-9[j]	169	347	52	28	52	0	19	1.074	0	0	0	0	0.5	2.1	2.8	Light russet skin, tubular, pointed ends, knobs
CO15070-4RU[abcdefgjk]	147	295	50	45	48	2	6	1.072	0	4	1	0	0.3	2.5	2.8	Slender tubular tuber type, purple skin blush, medium to dark russeting, knobs, pointed ends, misshapen, uniform, general appearance, good general appearance, great skin appearance
T 01[j]	146	420	40	46	40	0	14	1.079	0	0	0	0	2.5	2.1	2.8	Tubular, bottlenecks, points, heat sprouts, DROP
NDAF1791-1[k]	140	386	45	15	45	0	41	1.101	0	2	0	0	0.1	1.8	3.1	Oblong to long tuber type, heat stress, knobs and pine cone eyes, DROP
A18682-8sto[j]	126	147	80	13	76	5	7	1.089	10	0	0	0	1.5	2.1	2.3	Not uniform, medium russet skin type
A17053-1ZC[j]	125	154	77	11	53	24	11	1.090	10	10	26	0	1.0	2.1	2.8	Slight knobs, medium russet skin type, slight heat sprouts, bottlenecking
COTX19072-2Ru[k]	119	197	70	26	70	0	4	1.073	0	42	0	0	3.1	1.8	1.1	Light skin, poor tubular appearance, DROP
MN19CO17074-003[j]	113	130	80	19	73	6	1	1.077	0	0	0	0	1.5	2.6	1.8	Round white to oval uniform, bright appearance
TX20118-1RuRe[k]	109	396	37	13	26	11	50	1.068	0	22	24	0	1.6	2.8	2.6	Severe herbicide injury, DROP
COTX17304-1RU[gk]	106	237	45	53	43	2	2	1.076	3	2	0	0	2.1	2.0	1.1	Smaller oblong to long tuber type, medium russet skin, poor yield, nice dark uniform russet skin
COTX19136-1Ru[k]	99	228	57	42	57	0	1	1.075	0	2	0	0	1.6	1.3	1.1	Misshapen tubers, variable skin type
Russet Burbank[f]	66	269	27	64	22	6	8	1.073	0	1	0	0	1.0	2.5	2.9	Small, tubular, not uniform, knobby
MEAN	**350**	**464**	**74**	**17**	**67**	**7**	**9**	**1.080**	**6**	**4**	**4**	**0**	**1.2**	**2.2**	**3.0**	

2024 Table Russet Variety Trial Sites
[a]4-L Farms, Inc.,
[b]Elmaple Farms LLC
[c]Horkey Brothers Farm
[d]Jenkins Potato Farm
[e]Kitchen Farms, Inc.,
[f]Lennard Ag Co.
[g]Styma Potato Farm
[h]Verbrigghe Potato Farms
[i]Walther Farms Cass City NFPT
[j]Walther Farms Cass City Replicated
[k]Walther Farms Strip

[1]SIZE
Bs: < 4 oz
As: 4 - 10 oz
OV: > 10 oz
PO: Pickouts
% of total: Values rounded to the nearest whole number

[2]SPECIFIC GRAVITY
Total solids

[3]RAW TUBER QUALITY
(percent of tubers out of 10)
HH: Hollow Heart
VD: Vascular Discoloration
IBS: Internal Brown Spot
BC: Brown Center

[4]COMMON SCAB RATING
0.0: Complete absence of surface or pitted lesions
1.0: Presence of surface lesions
2.0: Pitted lesions on tubers, though coverage is low
3.0: Pitted lesions common on tubers
4.0: Pitted lesions severe on tubers
5.0: More than 50% of tuber surface area covered in pitted lesions

[5]VINE VIGOR RATING
Rating 1-5
1: Slow emergence
5: Early emergence (vigorous vine, some flowering)

[6]VINE MATURITY RATING
Rating 1-5
1: Early (vines completely dead)
5: Late (vigorous vines, some flowering)

Table 4: Chipping lines selected for further on-farm testing in 2025 growing season

Lines		
AF5933-4	MSEE016-10	NY174
AF6671-10	MSEE031-3	NY177
B3403-6	MSEE035-4	Paige
F160032-6	MSFF029-10	W17066-34
Kal 91.03	MSFF037-17	W17AF6670-1
MSBB058-1	MSFF038-3	
MSBB230-1	MSGA24-02	
MSDD244-05	MSGG302-1	
MSDD247-07	MSGG409-3	
MSDD247-11	NC821-30	
MSDD249-9	ND13220C-3	

Table 5: Tablestock lines selected for further on-farm testing in 2025 growing season

Reds	Whites	Yellows	Russet lines	
AC11596-1R	Cleo	Acoustic	A08433-4STO	W19037-11Rus
BNC981-1	MSFF031-6	Christel	A12327-5VR	
Cerata KWS	Noya	Constance	A13091-5	
COTX050169-1R		IPB8343-2W/Y	A18057-2TE	
MSGG127-3R		IPB8343-8W/Y	A18077-11TE	
MSGG135-1R		IPB9343-5W/Y	AAF10596-1	
MSGG137-1R		Jelly	AF6377-10	
		Montana	AF6377-12	
		MSGG039-11Y	AF6384-2	
		W13103-2Y	AF7001-5	
		W15240-2Y	AOR15166-2	
		RP582-98	Campagna	

Field performance of 1,4-dimethylnaphthalene (DMN) treated seed potatoes

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Introduction

1,4-dimethylnaphthalene (DMN) is a known sprout inhibiter for enhancing dormancy in commercially stored potatoes. Dormant potato tubers treated with DMN exhibit increased expression of genes associated with stress response (Campbell et al., 2012; Campbell and D'Annibale, 2016; Campbell et al., 2020). Of particular interest are those associated with drought, water, and heat stress response. When such stresses are moderately experienced by plants, they induce related gene expression changes which are hypothesized to prime, or prepare, the plant for a future stress event. Previous research has supported this hypothesis, specifically in the response of various crops to heat (Wang et al., 2016; Zhou et al., 2020; Liu et al., 2022) and water stresses (Sun et al., 2010; Nawaz et al., 2013; Chakma et al., 2021). As one of the top ranked crops in terms of production and consumption, there is growing interest in improving potato plant stress response to increasing climate stressors such as heat and drought. This study evaluated the effect of 1,4-DMN on potato field performance at Michigan State University's Montcalm Research Center and Pennsylvania State University's Erie Research Site.

Materials and Methods

Certified seed tubers of two chip-processing potato varieties, Mackinaw and Snowden, were treated with 10 ppm 1,4-DMN or left untreated (control) and evaluated in a two-way factorial study. Mackinaw, a recently released variety with disease resistance and heat stress tolerance, was compared to Snowden, an industry standard. The trials followed a randomized complete block design with six replications at two locations: MSU Montcalm Research Center (Lakeview, MI) and PSU Erie Research site (Erie, PA). Identical protocols and experimental designs were used at both sites. All seed tubers, cut at MSU, were treated four weeks before planting by the Potato Outreach Program at MSU and another lot shipped to PSU for planting. Seed potato tubers were planted in three row plots of 15-ft long with an in-row spacing of 10 inches and 34-inch-wide rows.

Once during the growing season, prior to the first flower opening, three plants from border rows of each plot were destructively sampled and the fresh and dry root biomass was determined from the three-plant composite sample. Before row closure, the number of plants and total stems in the middle row of each plot were recorded.

At two time points (flowering and prior to senescence/vine kill), leaves in each plot of the center row were harvested for gene expression utilizing Illumina RNA sequencing analysis. Leaves of approximately the same maturity were collected from three plants within each plot (one leaf per plant), flash frozen with liquid nitrogen, and transported on dry ice to PSU for extraction and sequencing. At harvest, the center rows of yield plots were harvested, and tubers were graded using Kerian Sizer® at MSU, while PSU hand graded their tubers. Data on tuber yield was measured on tuber weight based on size categories (As, Bs, and oversize tubers), tuber count of each size profile, specific gravity, and internal defect evaluation of ten large tubers for hollow heart, vascular discoloration, internal brown spot, and brown center.

Three composite samples of 40 A-size tubers in good physical condition from the six replicates were collected. One sample from each of the 24 plots was chipped the following day by Techmark, Inc. (https://www.techmark-inc.com) for the MSU site to determine SFA color, sucrose and glucose concentrations, total chip defects. The other two sets of 40 tuber samples from each of the 24 plots were stored at the Montcalm Research Center and evaluated in January and April for chip quality traits.

Results

Montcalm Research Center trial site, Michigan

The application of 1,4-DMN had no significant effect on any measured in-season growth traits (Table 1). Variety influenced stem count and above-ground dry biomass at 109 days after planting (DAP), while the interaction between 1,4-DMN and variety significantly affected stem count and below-ground dry biomass at the same time point (Table 1). Snowden had the twice stem count per acre compared to Mackinaw (Table 2).

1,4-DMN Mackinaw treated seed had a 20% reduction in stem count relative to the control, whereas 1,4-DMN Snowden treatments increased stem count by 46%, suggesting that 1,4-DMN application may require variety-specific optimization (Table 3).

These results further indicate that Mackinaw produced 34% more dry above-ground biomass than Snowden (Table 4). Additionally, the non-treated Mackinaw demonstrated significantly higher dry below-ground biomass than other treatments 109 (DAP) as shown in Table 5.

Table 1. In-season data on stand and stem count, above and below ground biomass for potatoes grown from DMN treated and non-treated seed potatoes, Montcalm, MI, 2024.

Source of Variation	Stand count	Stem count	Vine vigor	Vine maturity	Dry above ground biomass (Days after planting)		Dry below ground biomass
					58 DAP	109 DAP	109 DAP
DMN	0.78	0.26	0.87	0.99	0.68	0.09	0.22
Variety (V)	0.34	<.0001	0.66	0.96	0.12	<.0001	0.05
DMN × V	0.15	<.0001	0.87	0.99	0.65	0.30	0.02

Table 2. Means for stem count of two potato varieties, Montcalm Research Center, MI, 2024.

Variety	Stem count/acre
Mackinaw	46,334 b
Snowden	105,620 a

Table 3. Means for stem count of two potato varieties grown from treated and non-treated DMN seed potatoes, Montcalm Research Center, MI, 2024.

Variety	DMN rate (ppm)	
	0	10
	Stem count/acre	
Mackinaw	51,931	41,340
Snowden	88,488	126,069
LSD		

Table 4. Means for dry above ground biomass (109 DAP) of two potato varieties grown at Montcalm Research Center, MI, 2024.

Variety	Dry above ground biomass 109 DAP
	cwt/acre
Mackinaw	47 a
Snowden	31 b

Table 5. Means for below ground biomass (109 DAP) of two potato varieties grown from treated and non-treated DMN seed potatoes, Montcalm Research Center, MI, 2024.

Variety	DMN rate (ppm)	
	0	10
	cwt/acre	
Mackinaw	125	101
Snowden	96	104
LSD	18	

The application of 1,4-DMN significantly affected most tuber yield attributes, while variety influenced just over half of the traits, with no interaction effects between 1,4-DMN and variety observed (Table 6).

Seed treatment with 1,4-DMN reduced total yield (11% less), US#1 yield (21% less), and %A size tuber yield (9% less), compared to untreated seed. However, %B size tubers, A-count, and B-count tubers per acre increased by 9%, 11%, and 38%, respectively (Table 7).

Mackinaw produced 9% higher A-size tuber yield but 8% lower B-size yield, 15% fewer A-size tubers, and 42% fewer B-size tubers than Snowden (Table 8), likely due to its lower stem count compared to Snowden.

Table 6. *P* values for measured traits of potatoes grown from DMN treated and non-treated at Montcalm Research Center, MI, 2024.

Source of variation	Total yield	US#1	Tuber (%) A	Tuber (%) B	Tuber (%) PO	Tuber count A	Tuber count B	Scab
DMN	0.02	<.0001	0.0002	0.0003	0.51	0.05	0.005	0.82
Variety (V)	0.27	0.25	0.0004	0.0005	0.33	0.004	<.0001	0.95
V × DMN	0.27	0.53	0.43	0.43	0.82	0.90	0.19	0.65

Table 7. Means for total and US#1 yield, % A and B tuber yield, and B tuber count for potatoes grown from DMN and control treatments, Montcalm Research Center, MI, 2024.

DMN rate	Total yield	US#1	Tubers/acre A	Tubers/acre B	Tuber count A	Tuber count B
ppm	-------cwt/acre-------		--------%------		------------Count/acre----------	
0	305 a	247 a	81 a	19 b	82,338 b	43,390 b
10	272 b	196 b	72 b	28 a	91,563 a	59,872 a

Table 8. Means for % A and B tuber yield, and B tuber count for two potato varieties grown from DMN and control treatments, Montcalm Research Center, MI, 2024.

Variety	Tubers/acre A	Tubers/acre B	Tuber count A	Tuber count B
	--------------%------------		------------Count/acre----------	
Mackinaw	81 a	19 b	79,690 b	38,009 b
Snowden	72 b	27 a	94,210 a	65,225 a

Erie Research site, Pennsylvania

Treatment of seed potatoes with 1,4-dimethylnaphthalene (1,4-DMN) had no effect on fresh above- or below-ground biomass. Variety significantly influenced most fresh biomass parameters, while the interaction between 1,4-DMN and variety affected only pre-bloom above-ground biomass (Table 9).

Snowden had 5 times greater pre-bloom above-ground biomass, 1.5 times greater pre-bloom below-ground biomass, and 1.4 times greater pre-kill fresh below-ground biomass than Mackinaw (Table 10). No differences were observed in pre-bloom fresh above-ground biomass within varieties across 1,4-DMN rates (Table 11). However, Snowden consistently demonstrated higher pre-bloom fresh above-ground biomass than Mackinaw in all other pairwise comparisons (Table 11).

Table 9. *P* values for days to emergence and blooming, pre-bloom fresh above ground biomass and below ground biomass, and pre-vine kill fresh above ground biomass and below ground biomass for two potato varieties grown from DMN treated and non-treated seed, Erie, PA, 2024.

Source of variation	Pre-bloom fresh above ground biomass	Pre-bloom fresh below ground biomass	Pre-vine kill fresh above ground biomass	Pre-vine kill fresh below ground biomass
DMN	0.44	0.82	0.39	0.98
Variety (V)	<.0001	0.001	0.05	0.02
DMN × V	0.02	0.63	0.85	0.46

Table 10. Pre-bloom fresh above ground biomass, pre-bloom fresh below ground biomass, and pre-vine kill fresh below ground biomass for two potato varieties, Erie, PA, 2024.

Variety	Pre-bloom fresh above-ground biomass	Pre-bloom fresh below-ground biomass	Pre-vine kill fresh below-ground biomass
	cwt/acre		
Mackinaw	15 b	39 b	158 b
Snowden	68 a	57 a	227 a

Table 11. Pre-bloom above-ground fresh biomass for two varieties at Erie, PA, 2024.

Variety	DMN rate (ppm)	
	0	20
	cwt/acre	
Mackinaw	20	12
Snowden	60	88

Tuber yield and related attributes were unaffected by 1,4-DMN seed application, except for B-size tuber count. Variety significantly influenced over 50% of the measured parameters, while the interaction between 1,4-DMN and variety was not significant for any parameter (Table 12). Snowden produced approximately twice total and US#1 yield, A-size tuber count, and 1.5 times B-size tuber count compared to Mackinaw (Table 13). The 1,4-DMN treatments increased B-size tuber count by 1.3 times compared to the control (Table 14).

Table 12. *P* values for total and US#1 yield, % A, B, and over-size tuber yield, and tuber count for potatoes grown from DMN treated and non-treated seed at Erie, PA, 2024.

Source of Variation	Tuber yield					Tuber count	
	Total	US#1	%A	%B	%Over-size	A-size	B-size
DMN	0.89	0.47	0.48	0.32	0.19	0.92	0.01
Variety (V)	0.0003	0.002	0.11	0.08	0.43	0.0001	0.001
DMN × V	0.42	0.77	0.57	0.88	0.15	0.17	0.07

Table 13. Total and US#1 tuber yield, A- and B-size tuber count for two potato varieties grown at Erie, PA, 2024.

	Tuber yield		Tuber count	
Variety	Total	US#1	A-size	B-size
	cwt/acre		Count/acre	
Mackinaw	100 b	66 b	43,304 a	56,458 b
Snowden	185 a	132 a	81,142 b	84,473 a

Table 14. B-size tuber count of two DMN rates at Erie, PA, 2024.

DMN rate (ppm)	B-size tuber count/acre
0	60,985 b
10	79,946 a

Summary findings

At Montcalm Research Center, MI, 1,4-DMN seed treatment had no significant effect on in-season growth traits. However, its interaction with variety significantly influenced stem count and dry below-ground biomass, favoring increased stem count in Snowden and higher below-ground biomass in Mackinaw without 1,4-DMN. At Erie research site, PA, 1,4-DMN interaction with variety significantly affected pre-bloom fresh above-ground biomass, favoring Snowden. For tuber yield traits, 1,4-DMN application only significantly increased B-size tuber count.

The application of 1,4-DMN to seed had no significant effect on internal tuber qualities, including internal brown spot, hollow heart, vascular discoloration, and brown center, in both trials.

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Improving the economic sustainability of Michigan potato producers by determining the optimal in-row seed spacing and seed piece depth for two commercial chip processing varieties Bliss and Mackinaw.

Funding: MPIC

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Introduction

Introducing new potato varieties better adapted to local climates is a key strategy for improving sustainability in production systems. However, even with the release of climate-resilient cultivars, best practices for each variety are often unknown. It typically takes 5 to 7 years of large-scale commercial production to identify these practices. Bliss and Mackinaw, recently introduced to the national chip-processing industry, have limited known agronomic best practices. This study seeks to accelerate the development of best practices for these varieties, enabling producers to implement them within 1 to 2 years rather than 5 to 7 years of trial and error. This research will enhance the marketable yield, improve tuber quality, and optimize resource use, thereby advancing both economic and environmental sustainability in potato production in the Great Lakes region.

Specific objectives

Optimize in-row seed spacing and planting depth for the newly released commercial chip processing potato varieties, Bliss and Mackinaw, to enhance yield and processing quality.

Materials and Methods

The trial was conducted at Montcalm Research Center, Montcalm County, on sandy loam soil in 2024. Two newly released commercial chip potato varieties (Bliss and Mackinaw) and an industry variety (Lamoka) were evaluated. Certified seed potatoes were cut to approximately 2.5 oz, treated with CruiserMaxx Vibrance®, and stored at 50°F for 7 days to suberize. The trial was conducted using a randomized complete block design with four replicates of each treatment.

Seed depths were 3-, 5-, and 7-inches, and seed spacings were 7-, 9-, 11-, and 13-inches. Trial plots consisted of three rows, 15 feet long and 2.8 feet wide. To simulate commercial field conditions, two Red Norland seed potatoes were planted at the beginning and end of each middle row to provide competition to end plants and ensure clear plot separation during harvest.

Fertility management was uniform across all treatments and using the standard Montcalm Research Center potato fertility management practices. Irrigation was applied as needed through an overhead pivot irrigation system at approximately 0.75 inches of water every 5 days as needed to supplement natural rainfall.

Data was collected on plant emergence, stand and stem counts on the center row. A plot vigor rating (June) and maturity rating (September) was collected for each plot prior to vine desiccation. Season long thermal unit base GDD_{40} accumulation was measured from planting to harvest including relative humidity, soil, and air temperature. Soil moisture and temperature at each of the seed piece depths were collected at four observational plots using data loggers.

At harvest, total and marketable yield were determined along with tuber number in each size tuber size profile (A's, B's, Pick outs and Oversize). Greening observed on tubers was considered as a pick out. Specific gravity and tuber internal raw quality was evaluated for presence of hollow heart, vascular discoloration, brown center, and heat necrosis from the largest ten oversize tubers in each plot. Chip quality samples were collected as a composite sample across replicates to evaluate chip quality. Data were analyzed using SAS and means separated using Tukey at $P<0.05$. An economic analysis was performed to assess the profitability of treatments.

Results

Variety and seed spacing significantly influenced total yield, US#1 yield, %B, %A1, %A2, and % pickouts (Table 1). Interaction of variety and seed spacing was significant only for %A1 yield, while variety and planting depth interaction was significant for total and US#1 yield. Seed spacing and planting depth interaction significantly affected % pickouts. The three-way interaction of variety, seed spacing, and planting depth significantly affected total yield and % A1 yield. Planting depth alone did not significantly affect most measured traits, except for specific gravity. However, its interaction with variety and seed spacing significantly influenced total and US#1 yield, percentage of A1 and pickout tuber yield, as well as A1 and pickout tuber counts.

Table 1. Analysis of variance for tuber yield of three potato varieties, seed spacings and planting depths at Montcalm Research Center, MI, 2024.

Source of variation	US#1	Total	%B	%A1	%A2	%OV	% Pickouts
Variety (V)	<.0001	<.0001	<.0001	<.0001	<.0001	0.39	<.0001
Seed Spacing (SS)	0.001	<.0001	<.0001	<.0001	<.0001	0.41	0.005
Planting depth (D)	0.57	0.77	0.65	0.14	0.24	0.38	0.13
V × SS	0.37	0.64	0.09	0.01	0.22	0.45	0.39
V × D	0.002	0.003	0.07	0.06	0.42	0.43	0.11
SS × D	0.45	0.69	0.56	0.90	0.75	0.47	0.01
V × SS × D	0.06	0.05	0.26	0.02	0.29	0.49	0.31

The check variety Lamoka produced 14 to 15% lower total yield, and 9 to 15% lower US#1 yield compared to the newly released varieties Bliss and Mackinaw, demonstrating the potential of the new germplasm (Table 2). Based on tuber size distribution, Bliss produced 3 to 6% higher B size tuber yield compared to the other varieties, while Mackinaw produced the highest A1 size tuber yield outyielding others by 3 to 11% (Table 3). Lamoka produced the highest A2 size tuber yield, with a 12% increase, and the highest pickouts, by 2 to 3%, compared to the other varieties.

Table 2. Least squares mean total and US#1 yield for three potato varieties grown at Montcalm Research Center, MI, 2024.

Variety	Total yield	US#1 yield
	---------------------------------cwt/a	---------------------------------------
Bliss	403	339
Lamoka	348	306
Mackinaw	408	358
LSD (*P*≤0.05)	16	17

Table 3. Least squares mean for % B, A1, A2, and pickouts for three potato varieties at Montcalm Research Center, MI, 2024.

	Tuber yield			
Variety	B	A1	A2	Pickouts
	---	%---		
Bliss	13	72	12	3
Lamoka	7	64	24	5
Mackinaw	10	75	12	2
LSD (*P*≤0.05)	1	2	2	1

Variety and seed spacing independently influenced tuber counts across most size profiles, while the interaction between variety and planting depth significantly affected tuber numbers only in the A1 size and pickout categories (Table 4).

Table 4. Analysis of variance for tuber number of potato varieties planted at different depths and seed spacings at Montcalm Research Center, MI, 2024.

Source of variation	Tuber Count				
	B	A1	A2	Pickouts	Specific gravity
Variety (V)	<.0001	<.0001	0.0004	0.004	<.0001
Seed Spacing (SS)	<.0001	<.0001	<.0001	0.4	0.32
Planting depth (D)	0.62	0.15	0.27	0.09	0.0002
V × SS	0.97	0.63	0.18	0.06	0.71
V × D	0.62	0.002	0.38	0.002	0.20
SS × D	0.21	0.86	0.2	0.95	0.79
V × SS × D	0.25	0.05	0.47	0.59	0.74

Bliss produced higher counts of B size (42 to 124% more), and A1 (13 to 75% more) tubers among the three varieties. Lamoka yielded higher A2 size (24 to 33% more), while Bliss had higher (1 to 55% more) tuber counts of pickouts compared to other varieties (Table 5).

Table 5. Least squares mean tuber count for three potato varieties at Montcalm Research Center, MI, 2024.

Variety	Tuber count			
	B	A1	A2	Pickouts
	--------------------------------Number/acre--------------------------------			
Bliss	40,565	114,791	10,164	3,883
Lamoka	18,092	65,416	12,653	3,836
Mackinaw	28,559	101,950	9,478	2,511
LSD (P≤0.05)	2441[1]	5,346[4]	1,609[6]	974[8]
	3065[2]	5,383[5]	1,620[7]	977[9]
	3597[3]			1183[10]

[1]Compares Lamoka and Mackinaw
[2]Compares Bliss and Lamoka
[3]Compares Bliss and Mackinaw
[4]Compares Lamoka and Mackinaw
[5]Compares Bliss to Lamoka, and Bliss to Mackinaw
[6]Compares Bliss and Mackinaw
[7]Compares Bliss and Lamoka, Lamoka and Mackinaw
[8]Compares Lamoka and Mackinaw
[9]Compares Bliss and Mackinaw
[10]Compares Bliss and Lamoka

Within the three planting depths, Lamoka produced 13% lower total yield at the 3-inch depth and 14 to 22% lower yield at the 5-inch depth compared to other varieties. Bliss demonstrated a 9 to 18% higher yield at the 7-inch depth. No consistent trend in total yield response to planting depth was observed, with most variety-by-planting depth interactions being non-significant. However, Mackinaw showed a significant response, producing 13% higher total yield at the 5-inch depth compared to 7-inch planting depth (Table 6).

Mackinaw produced 17% higher US#1 yield compared to Lamoka at the 3-inch depth and 16 to 30% higher than both Bliss and Lamoka at the 5-inch depth (Table 7). The interaction between variety and planting depth showed no significant differences in US#1 yield across depths, except for Mackinaw, which produced 13% more US#1 yield at the 5-inch depth compared to 7-inch depth.

Table 6: Least squares mean total yield for the interaction between three potato varieties and three planting depths at Montcalm Research Center, MI, 2024.

		Planting depth (inches)	
	3	5	7
Variety		Total yield (cwt/a)	
Bliss	403	395	419
Lamoka	350	338	355
Mackinaw	404	435	384
LSD ($P \leq 0.05$)[1]	29		
LSD ($P \leq 0.05$)[2]	28		
LSD ($P \leq 0.05$)[3]	27		

[1]Comapares Bliss 3 and Lamoka 3, Bliss 3 and Mackinaw 7, Lamoka 3 and Mackinaw 7, Bliss 3 and Lamoka 7, Lamoka 3 and Lamoka 7, Lamoka 7 and Mackinaw 7, Bliss 3 and Bliss 5, Bliss 3 and Lamoka 5, Bliss 3 and Mackinaw 5, Bliss 5 and Lamoka 3, Bliss 5 and Mackinaw 7, Lamoka 3 and Lamoka 5, Lamoka 3 and Mackinaw 5, Lamoka 5 and Mackinaw 7, Mackinaw 5 and Mackinaw 7

[2]Compares Bliss 3 and Bliss 7 Bliss 3 and Mackinaw 3 Bliss 7 and Lamoka 3 Bliss 7 and Mackinaw 7 Lamoka 3 and Mackinaw 3 Mackinaw 3 and Mackinaw 7 Bliss 5 and Lamoka 7 Lamoka 5 and Lamoka 7 Lamoka 7 and Mackinaw 5 Bliss 5 and Lamoka 5 Bliss 5 and Mackinaw 5 Lamoka 5 and Mackinaw 5 Bliss 7 and Lamoka 7 Lamoka 7 and Mackinaw 3 Bliss 5 and Bliss 7 Bliss 5 and Mackinaw 3 Bliss 7 and Lamoka 5 Bliss 7 and Mackinaw 5 Lamoka 5 and Mackinaw 3 Mackinaw 3 and Mackinaw 5

[3]Compares Bliss 7 and Mackinaw 3

Table 7: Least squares mean US#1 yield for the interaction between three potato varieties and three planting depths at Montcalm Research Center, MI, 2024.

		Planting depth (inches)	
	3	5	7
Variety		US#1yield (cwt/a)	
Bliss	328	332	356
Lamoka	304	297	316
Mackinaw	356	385	333
LSD ($P \leq 0.05$)[1]	30		
LSD ($P \leq 0.05$)[2]	29		
LSD ($P \leq 0.05$)[3]	28		

[1]Comapres Bliss 3 and Lamoka 3, Bliss 3 and Mackinaw 7, and Lamoka 3 and Mackinaw 7

[2]Compares Bliss 3 and Lamoka 7, Lamoka 3 and Lamoka 7, Lamoka 7 and Mackinaw 7, Bliss 3 and Bliss 5, Bliss 3 and Lamoka 5, Bliss 3 and Mackinaw 5, Bliss 5 and Lamoka 3, Bliss 5 and Mackinaw 7, Lamoka 3 and Lamoka 5, Lamoka 3 and Mackinaw 5, Lamoka 5 and Mackinaw 7, Mackinaw 5 and Mackinaw 7, Bliss 3 and Bliss 7, Bliss 3 and Mackinaw 3, Bliss 7 and Lamoka 3, Bliss 7 and Mackinaw 7, Lamoka 3 and Mackinaw 3, Mackinaw 3 and Mackinaw 7, Bliss 5 and Lamoka 7, Lamoka 5 and Lamoka 7, Lamoka 7 and Mackinaw 5, Bliss 5 and Lamoka 5, Bliss 5 and Mackinaw 5, Lamoka 5 and Mackinaw 5

[3]Compares Bliss 7 and Lamoka 7, Lamoka 7 and Mackinaw 3, Bliss 5 and Bliss 7, Bliss 5 and Mackinaw 3, Bliss 7 and Lamoka 5, Bliss 7 and Mackinaw 5, Lamoka 5 and Mackinaw 3, Mackinaw 3 and Mackinaw 5, Bliss 7 and Mackinaw 3

A negative relationship was observed between seed spacing and total yield, with a 7 to 19% reduction in yield as seed spacing increased from 7 to 13 inches. All pairwise comparisons were significant, except for the 11 and 13-inch seed spacings, which did not differ significantly. Similar results were observed for US#1 yield. The 7-inch seed spacing produced 8% and 11% higher US#1 yield compared to the 11-inch and 13-inch spacings, respectively, while the 9-inch seed spacing yielded 9% more US#1 yield than the 13-inch spacing (Table 8).

Table 8. Least squares mean for total, and US#1 yield for four seed spacings at Montcalm Research Center, MI, 2024.

Seed spacing	Total yield	US#1 yield
in	---------------------------------cwt/a	---------------------------------------
7	424	352
9	398	344
11	368	325
13	355	316
LSD ($P \leq 0.05$)	19	19

Tuber size distribution varied across seed spacings with narrow seed spacings demonstrating higher B and A1 size tuber yield compared to wider seed spacings. For instance, 7-inch seed spacing produced more B size tuber yield by 4 to 6% compared to other spacings. The A1 size tuber yield was lower by 4% (11-inch) and 6% (13-inch) compared to 7-inch spacing. The wider 13-inch seed spacing produced 3 to 12% more A2 size tuber yield than other spacings and more pickouts (2% more) than 7-inch seed spacing (Table 9).

Table 9. Least squares mean for % B-size, %A1, %A2, and % Pickouts for four seed spacings at Montcalm Research Center, MI, 2024.

	Tuber yield			
Seed spacing	B	A1	A2	Pickouts
inches	%			
7	15	73	10	2
9	11	73	13	3
11	8	69	19	3
13	7	67	22	4
LSD (*P*≤0.05)	2	3	3	1

The response of A1 size tuber yield to the interaction between variety and seed spacing was observed (Table 10). At 7-inch seed spacing, Lamoka produced 7% less A1 size tuber yield than Mackinaw. Further, Lamoka yielded 8 and 10% less yield at 9-inch, 6 and 13% less yield at 11-inch, and 14 and 15% less yield at 13-inch seed spacings compared to Bliss and Mackinaw in that order. Lamoka planted at 7-inch seed spacing produced more A1 size tuber yield than 13-inch (11% more), while Lamoka at 9-inch yielded 9% more than 13-inch seed spacing. The yield of A1 size tuber yield for Bliss and Mackinaw across seed spacings did not differ significantly.

Table 10. Least squares mean % A1 size tuber yield for the interaction between three potato varieties and four seed spacings at Montcalm Research Center, MI, 2024.

	Seed spacing (inches)			
Variety	7	9	11	13
	%			
Bliss	73	75	69	72
Lamoka	69	67	63	58
Mackinaw	76	77	76	73
LSD (*P*≤0.05)[1]	5			
LSD (*P*≤0.05)[2]	4			

[1]Compare Lamoka 7 and Lamoka 11, Lamoka 7 and Mackinaw 13, Lamoka 11 and Mackinaw 13
[2]Compare all other pairwise comparisons

The % pickouts differed significantly due to variety-by-seed spacing interaction. Lamoka demonstrated 2% more pickouts at 7- and 9-inch, and 4% more at 13-inch seed spacing compared to Bliss and Mackinaw. At 11-inch spacing, Bliss and Lamoka produced 3 and 2% more pickouts than Mackinaw in that order (Table 11).

Table 11. Least squares mean % pickouts tuber yield for the interaction between three varieties and four seed spacings at Montcalm Research Center, MI, 2024.

Variety	Seed spacing (inches)			
	7	9	11	13
inches	---%---------------------------------------			
Bliss	2	2	5	3
Lamoka	4	4	4	7
Mackinaw	2	2	2	3
LSD (P≤0.05)[1]	1			

[1]Compares within and across all interactions

Closer seed spacings increased the counts of B and A1 size tubers, with B tuber counts increasing by 38 to 161% and A1 tuber counts by 11 to 46% at 7-inch spacing compared to wider spacings. On the contrary, wider seed spacings increased A2 tuber counts, with the 13-inch spacing producing 6 to 69% more A2 tubers than closer spacings (Table 12).

Table 12. Least squares mean for B, A1, and A2 tuber counts for four seed spacings at Montcalm Research Center, MI, 2024.

Seed spacing	Tuber count		
	B	A1	A2
inches	------------------------------------count/acre---------------------------------		
7	45,951	112,878	7,673
9	33,287	101,555	10,136
11	21,452	84,434	12,260
13	17,612	77,341	12,990
LSD (P≤0.05)	2,360[1]	6,162[7]	
	3,042[2]	6,185[8]	
	3,286[3]	6,196[9]	
	3,837[4]	6,207[10]	
	4,081[5]	6,219[11]	
	4,763[6]	6,241[12]	

[1]Compares 11- and 13-inch seed spacings
[2]Compares 9- and 13-inch seed spacings
[3]Compares 9- and 11-inch seed spacings
[4]Compares 7- and 13-inch seed spacings
[5]Compares 7- and 11-inch seed spacings
[6]Compares 7- and 9-inch seed spacings

Lamoka produced fewer tuber counts at 3- and 5-inch planting depths compared to Bliss and Mackinaw. At the deepest 7-inch depth, Bliss had 30 to 72% higher tuber counts than Lamoka and Mackinaw. While tuber counts for Bliss and Lamoka did not differ significantly across planting depths, Mackinaw produced 14 to 19% more tubers at 7-inch depth compared to 3- and 5-inch depths (Table 13).

Table 13. Least squares mean A1 tuber counts for variety-by-planting depth interaction for three potato varieties and three planting depths, Montcalm Research Center, MI, 2024.

	Planting depth (inches)		
	3	5	7
Variety	Tuber number/acre		
Bliss	113,107	114,345	116,920
Lamoka	62,884	65,404	67,958
Mackinaw	104,557	111,014	90,280
LSDs (*P*≤0.05)[1]	9,286[1]		
	9,399[2]		
	9,474[3]		
	9,093[4]		
	9,209[5]		
	9,171[6]		
	9,585[7]		
	9,474[8]		

[1]Compare Bliss 3 and Lamoka 3, Mackinaw 3, or Bliss 5, Lamoka 5, or Mackinaw 5.
[2]Compare Bliss 3 and Lamoka 5, Mackinaw 5, Bliss 5 and Lamoka 3, or Mackinaw 3, Bliss 7 and Lamoka 3, Mackinaw 3, and Lamoka 7, Mackinaw 5.
[3]Compare Lamoka 3 and Bliss 3 or Mackinaw 7, Lamoka 7 and Mackinaw 7.
[4]Compare Bliss 5 and Mackinaw 7, Lamoka 5 and Mackinaw 5, Lamoka 7 and Mackinaw 7.
[5]Compare Bliss 5 and Lamoka 5, Mackinaw 5, Lamoka 7 and Mackinaw 3 or 5.
[6]Compare Bliss 7 and Lamoka 7, Mackinaw 5.
[7]Compare Bliss 3 and Lamoka 7, Mackinaw 7, Bliss 7 and Lamoka 3, and Mackinaw 7.
[8]Compare Lamoka 3 and Mackinaw 7.

Lamoka produced 49–98% more pickout tubers at the shallow 3-inch seed depth compared to Bliss and Mackinaw, likely due to its 50% higher A2-sized tuber yield, which may have led to increased surface exposure and greening. However, greened tubers were not separately counted and were categorized as pickouts. Deeper seed depths reduced pickouts for Lamoka, while a 5-inch seed depth appeared optimal for Mackinaw. Bliss demonstrated a consistent trend in response to seed depth (Table 14).

Table 14. Least squares mean pickouts count for variety-by-planting depth interaction for three potato varieties and three planting depths, Montcalm Research Center, MI, 2024.

	Planting depth (inches)		
	3	5	7
Variety	Tuber number/acre		
Bliss	3,856	4,095	3,707
Lamoka	5,764	4,114	2,381
Mackinaw	2,918	1,596	3,400
LSDs (*P*≤0.05)	1,407[1]		
	1,402[2]		
	1,372[3]		
	2,065[4]		
	1,291[5]		
	1,852[6]		

[1]Lamoka 5 and Mackinaw 5
[2]Bliss 5 and Mackinaw 5
[3]Bliss 3 and Mackinaw 5
[4]Lamoka 3 and Lamoka 7
[5]Bliss 7 and Mackinaw 5
[6]Lamoka 3 and Mackinaw 5

Mackinaw demonstrated higher specific gravity by 0.37 to 0.65% higher compared to Bliss and Lamoka (Table 15). Deeper planted potatoes at 5 and 7-inch depths had higher specific gravity by 0.18% than shallow planted potatoes at 3-inches.

Table 15: Least squares mean for specific gravity of three potato varieties and three planting depths at Montcalm, MI, 2024.

Variety	Specific gravity	Planting depth (inches)	Specific gravity
Bliss	1.084	3	1.084
Lamoka	1.081	5	1.084
Mackinaw	1.088	7	1.086
LSD ($P \leq 0.05$)	0.001	LSD ($P \leq 0.05$)	0.001

Conclusions and Recommendations

Variety had no independent effect on total or US#1 yield. Closer seed spacings (7 and 9 inches) increased most tuber yield traits, except for the percentage of oversize tubers and specific gravity. While seed depth alone did not significantly affect measured parameters, it interacted with variety (enhancing US#1 yield) and seed spacing (increasing tuber pickouts), emphasizing the need to optimize seed depth for specific cultivars. Additionally, a deeper seed depth (7 inches) improved specific gravity.

These initial findings are promising, and further data is needed to refine our understanding of optimal management practices for these varieties. Optimizing seed spacing and planting depth will improve grower income, enhance processing efficiency, reduce cull rates, and increase overall processor productivity, contributing to the competitiveness and sustainability of the Michigan potato industry.

Variety Storage Studies in Box and Bulk Bins, 2023-2024

Chris M. Long, Phabian Makokha, Trina VanAtta, Azamat Sardarbekov, Mathew Klein, Ian Smith, Bernard M. Schroeter

Box Bin Study

Objectives

The study evaluated new chip processing lines, and/or varieties (which I will be referring to as entries) from public and private breeding programs for processing quality after storage. We evaluated their response to CIPC (Isopropyl N-(3-chlorophenyl) carbamate) + Octanol treatment as reflected in glucose and sucrose levels and total defects.

Materials and methods

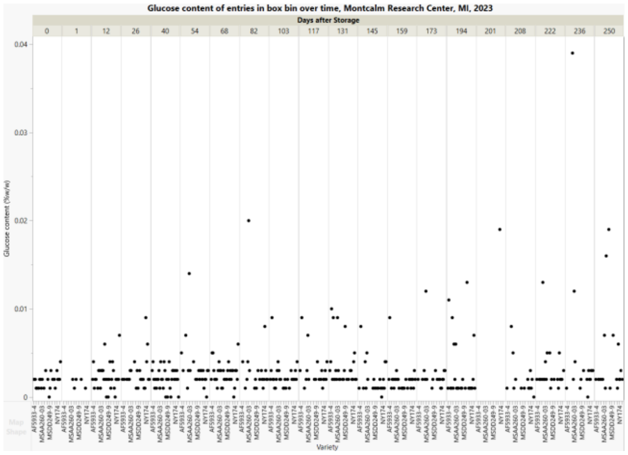
Field trials

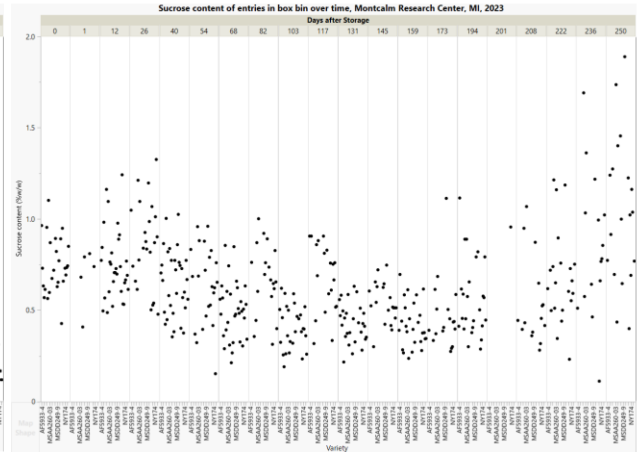
Thirty-one entries were evaluated against the check variety Snowden. Seed potatoes (hundredweight) were planted in a single 34-inch-wide row with 10-inch in-row spacing on May 20, 2023, at the MSU Montcalm Research Center, Entrican, MI. Fertilization included 284 lbs N, 92 lbs P, and 299 lbs K. Crops were vine-killed 110 days post-planting and harvested 23 days later. Field growth attributes and yield data are available in 2023 farmer packet at https://www.canr.msu.edu/potatooutreach. Nine 20-lb tuber samples were collected from selected full-row varieties for weight loss and pressure bruise evaluation. Tubers were graded to exclude B size and pickouts, ensuring only those in good physical condition were stored.

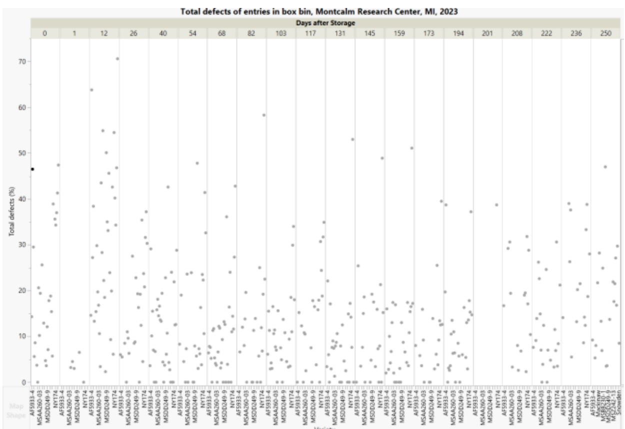
Box Bin Storage

The storage season started October 4, 2023, to June 5, 2024. Ten cwt tubers per entry were placed in box bins stacked in Bin 7. The box design facilitated airflow through forklift holes and potatoes, with air reconditioned and recirculated via a plenum system. Each box had a sampling door facing the center aisle for bi-weekly or monthly tuber sampling. Storage temperature averaged 54.0°F, and the bin was treated with DMN and CIPC on November 4, 2023, and March 14, 2024. Sampling began October 4, 2023, with 40 tubers per box randomly selected for sucrose, glucose, chip color, and defect analysis at Techmark, Inc.

Results







Bulk Bin Study

Objectives

To evaluate the effects of 1,4-dimethylnaphthalene, and CIPC (Isopropyl N-(3-chlorophenyl) carbamate) + Octanol treatment on storability of Bliss to inform further variety assessment.

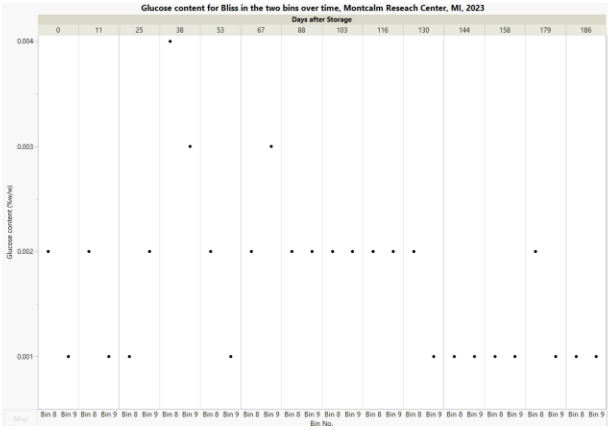
Materials and Methods

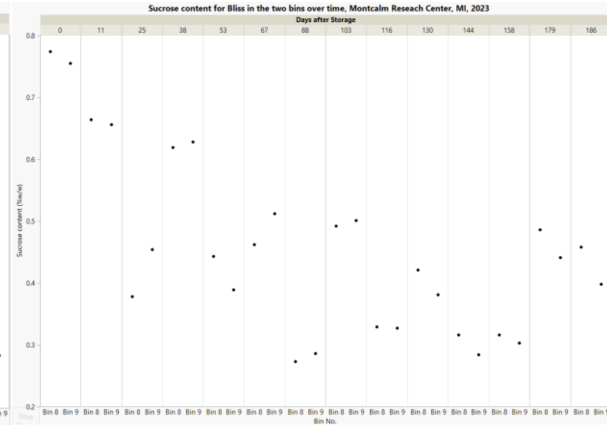
The potato variety Bliss was planted at Sandyland Farms in Montcalm County, MI, under the MPIC-paid field contract for delivery to the demonstration storage. During bulking, nine 20–25 lb. tuber samples per entry were collected, with three samples placed at depths of 3, 8, and 14 feet from the storage floor within the bulk pile. Bins were filled on October 13, 2023 (bin 8) and October 13, 2023 (bin 9). Bulk bin 8 was treated with CIPC + Octanol on November 9, 2023, and February 6, 2024. Bulk bin 9 received 20 ppm 1,4-DMN on October 17, 2023, followed by CIPC + Octanol treatments on November 9, 2023, and February 6, 2024. Eight 20 - 25 lb. tuber samples in mesh bags for the SNAC trial were placed on top of the pile in bin 8 for monthly evaluation of sugar, sucrose, and defects.

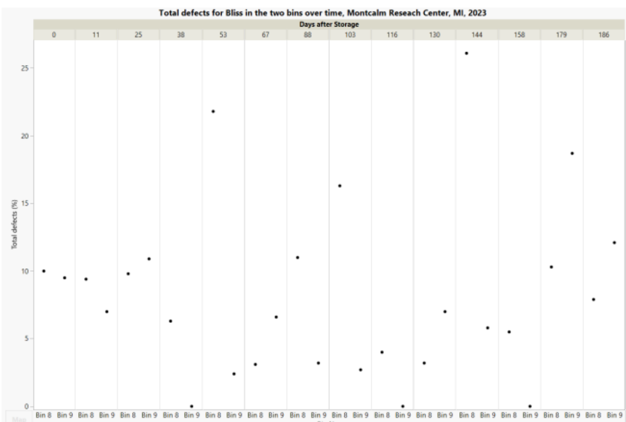
Sugar monitoring began on the day tubers were loaded into storage, with biweekly sampling. Forty tubers were collected from the sample door of each bin every two weeks and sent to Techmark, Inc. for sucrose, glucose, chip color, and defect analysis.

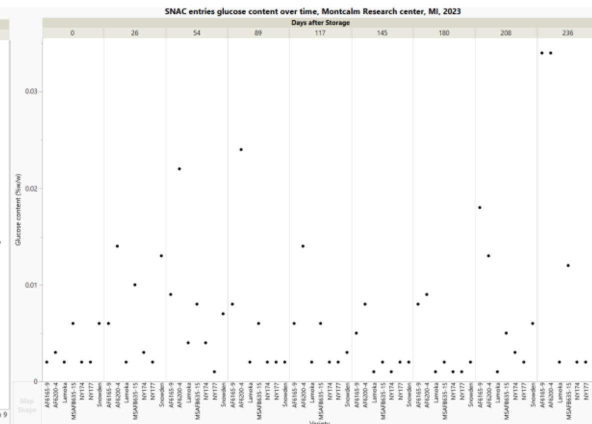
Pressure bruise samples were evaluated 3 - 5 days after bin unloading. A random set of 25 tubers per bag was visually inspected for pressure bruising, with discoloration of flat spots assessed by removing skin with a knife. A visual rating determined the presence or absence of flesh blackening. Percent weight loss was calculated for each tuber sample upon removal from storage.

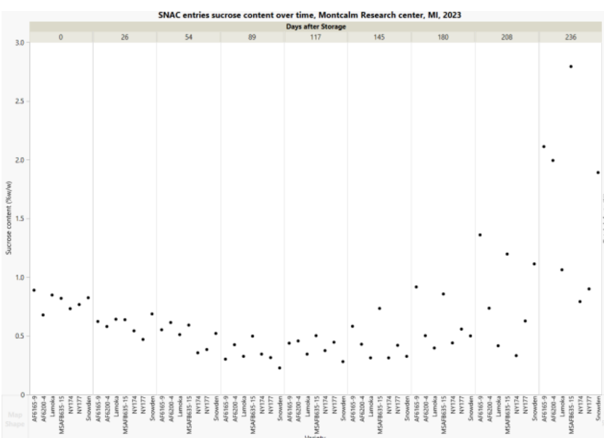
Results

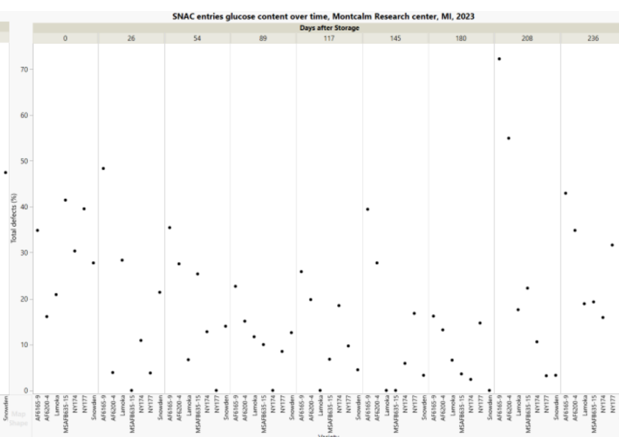












Additional results are available at msupotato.medius.re.

2024 MSU POTATO BREEDING AND GENETICS RESEARCH REPORT
January 2025

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Cooperators: Jaime Willbur and Chris Long

INTRODUCTION

At Michigan State University, we have been dedicated to developing improved potato varieties for the chip-processing and tablestock markets since 1988. The program is one of four integrated breeding programs in the North Central region supported through the USDA/NIFA Potato Special Grant. At MSU, we conduct a comprehensive multi-disciplinary program for potato breeding and variety development that incorporates plant pathology, entomology, biotechnology and genomics to meet the Michigan industry needs. Our program integrates traditional and biotechnological approaches to breed for disease and insect resistance that is positioned to respond to scientific and technology opportunities that emerge. We are also developing and applying more efficient methods to breed improved potato varieties at the tetraploid and diploid level.

In Michigan, the primary market requires that we focus on developing high yielding round white potatoes with excellent chip-processing from the field and/or storage. In addition, there is also a need for table varieties (russet, red, yellow, and round white). We conduct variety trials of advanced selections and field experiments at MSU research locations (Montcalm Research Center, Lake City Research Center and MSU Agronomy Farm), we ship seed to other states and Canadian provinces for variety trials, and we cooperate with Chris Long on grower trials throughout Michigan. The broad testing is crucial in determining the commercial potential of the lines. Through conventional crosses in the greenhouse, we develop new genetic combinations in the breeding program, and screen and identify exotic germplasm that will enhance the varietal breeding efforts. With each cycle of crossing and selection we are seeing directed improvement towards improved varieties (e.g. combining chip-processing, scab resistance, PVY resistance, late blight resistance and higher specific gravity). We continue to see the increase in scab, late blight and PVY resistance in the breeding material and selections. We need to continue to combine these traits in long-term storage chip-processing lines with earlier maturity. We are benefiting from the SolCAP SNP array DNA marker technology as we can now query 32,000 SNPs. We have markers linked to specific resistance genes for virus, late blight, golden nematode and also vine maturity in the cultivated potato lines and then breed them into elite germplasm. The SNPs also allow us to accurately fingerprint the varieties (DNA fingerprinting database with 5,000 entries). In addition, our program has been utilizing genetic engineering as a tool to introduce new genes to improve varieties and advanced germplasm for traits such as tuber size profile, insect resistance, late blight and PVY resistance, lower reducing sugar, lower blackspot bruising, higher yield and specific gravity and drought resistance. In 2025, we will continue to test our engineered potatoes for late blight resistance, drought tolerance and invertase silencing. Furthermore, PotatoesUSA is supporting national early generation trials through the National Chip Processing Trial (NCPT) which will feed lines into the SNAC trials and also Fast Track lines into commercial testing (NexGen testing). This national cooperative testing is the key to determining the commercial potential of our advanced lines. This has led to the release of Saginaw Chipper, Manistee, Huron Chipper, Mackinaw, Petoskey and now Dundee. In the table markets, Blackberry and MSV093-1Y (Bonafide) were released. We also have had funding to develop genome editing technologies that may not be classified as regulated through a USDA/BRAG grant. This technology can be used to introduce lower sugars, bruising and asparagine as well several other traits in the future. We also had a USDA/AFRI diploid breeding grant to develop some foundational diploid breeding germplasm (Potato 2.0). We are also screening for new sources of late blight resistance through a USDA/AFRI grant. We have a USDA/SCRI grant to support the breeding of Colorado potato beetle resistant potatoes. In 2015, we were awarded the USAID grant to generate late blight resistance potatoes for Bangladesh and Indonesia and now includes Nigeria and Kenya. This Feed the Future project brings us into cutting edge GM work with Simplot and the International Potato Center (CIP). This project has been extended another 5 years beginning in 2021. We feel that these in-house capacities (both conventional and biotechnological) put us in a unique position to respond to and focus on the most promising directions for variety development and effectively integrate advanced technologies with the breeding of improved chip-processing and tablestock potatoes.

The breeding goals at MSU are based on current and future needs of the Michigan potato industry. Traits of importance include yield potential, size profile, disease resistance (scab, late blight, early die, and PVY), insect (Colorado potato beetle) resistance, chipping (out-of-the-field, storage, and extended cold storage) and bruise resistance, storability, along with shape, internal quality, and appearance. We are also focusing on earlier maturing lines, looking for lines that do not have harvest hangover and assessing chipping lines to make sure blackspot bruising is not an issue. If these goals can be met, we will be able to reduce production input costs, keep potato production profitable as well as reduce the reliance on chemical inputs such as insecticides, fungicides, and sprout inhibitors, and improve overall agronomic performance through new potato varieties.

Varietal Development

Breeding

The MSU potato breeding and genetics program is actively producing new germplasm and advanced seedlings that are improved for long-term storage chipping, and resistance to scab, late blight, and Colorado potato beetle. For the 2024 field season, progeny from about 250 crosses were planted and evaluated. Of those, the majority were crosses to select for round whites (chip-processing and tablestock), with the remainder to select for yellow flesh, red skin, and specialty market classes. During the 2024 harvest, about 600 selections in a field with high levels of scab were made from the 25,000 seedlings produced. Most of these first-year selections are segregating for PVY resistance. All second, third or fourth-year potential chip-processing selections will be tested in January and April 2025 directly out of 45°F (7.2°C) storage. Mackinaw, Lamoka, Manistee and

Snowden are chip-processed as check cultivars. Selections have been identified at each stage of the selection cycle that have desirable agronomic characteristics and chip-processing potential. At the 12-hill and 30-hill evaluation state, about 200 and 60 selections were made, respectively; based on chip quality, specific gravity, scab resistance, late blight resistance and DNA markers for PVY resistance. Most of our advanced selections now have PVY resistance. Selection in the early generation stages has been enhanced by the incorporation of the scab and late blight (US-23) evaluations of the early generation material. We are pushing our early generation selections from the 30-hill stage into tissue culture to minimize PVY issues in our breeding and seed stock. We use a cryotherapy method as well as the traditional methods that was developed in our lab to remove viruses. This technique predictably and quickly removes virus from tissue culture stocks. Our results show that we can remove both PVY and PVS from lines, but PVS can still be difficult to remove in certain lines if the titer is high. Over 1,200 different varieties and breeding lines are maintained in tissue culture for the breeding and genetics program.

Chip-Processing

Over 80% of the single hill selections have a chip-processing parent in their pedigree. We prioritize scab resistance and PVY resistance in our chip-processing selections. Our most promising advanced chip-processing lines are MSBB058-1 (scab resistant), MSDD244-05, MSDD247-07 and MSDD247-11 all combine high specific gravity, earlier maturity and lower blackspot bruising as well as scab and PVY resistance. We have some newer lines to consider such as from the FF and GG generations. With a successful late blight trial in 2023 and 2024, we were able to confirm resistance in some of our advanced selections. We are using the NCPT trials to identify promising new selections more effectively. Manistee and Mackinaw were licensed to Canada. Saginaw Chipper and Mackinaw are in Australia and South Korea. Blackberry has a niche chip-processing market in Michigan.

Tablestock

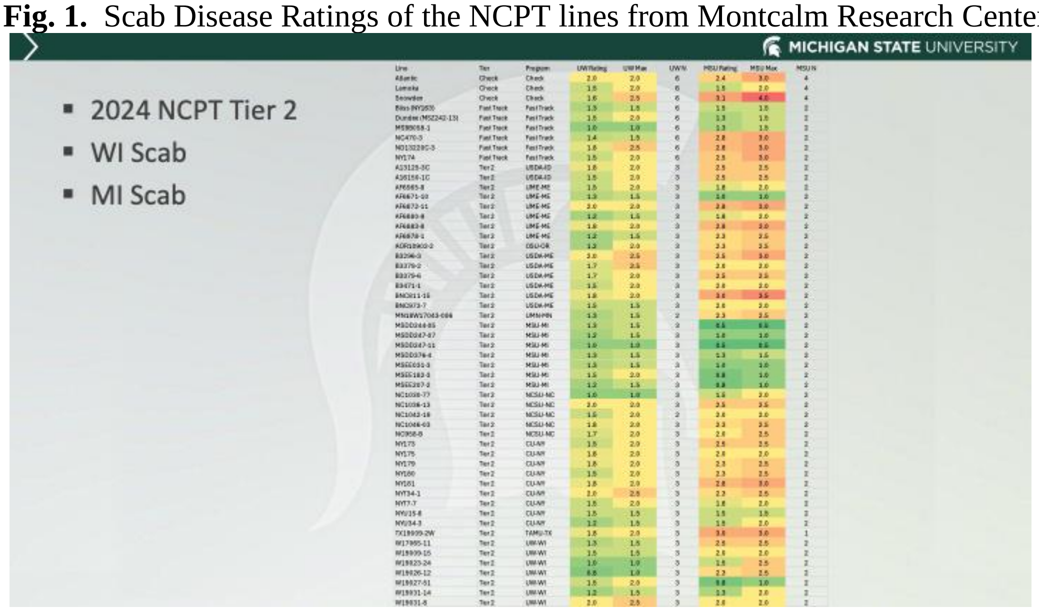
Efforts have been made to identify lines with good appearance with an attractive skin finish, low internal defects, good cooking quality, high marketable yield and resistance to scab, late blight and PVY. Our current tablestock development goals now are to continue to improve the frequency of scab and PVY resistant lines, incorporate resistance to late blight along with marketable maturity and excellent tuber quality, and select more red-skinned and yellow-fleshed lines. We have also been selecting some pigmented skin and tuber flesh lines that fit some specialty markets. We have interest from some western specialty potato growers to test and commercial these lines. From our breeding efforts we have identified mostly round white lines, but we also have several yellow-fleshed and red-skinned lines, as well as some purple skin selections that carry many of the characteristics mentioned above. PVY resistance is incorporated into these different table market classes. Some of the tablestock lines were tested in on-farm trials in 2024, while others were tested under replicated conditions at the Montcalm Research Center. Promising tablestock lines include MSGG135-1R which is scab and PVY resistant. We are excited about MSFF031-6 as a scab and PVY resistant round white and MSGG039-11Y as a PVY resistant yellow table line. We are working with Chris Long to select a new cohort of red-skinned and yellow-fleshed potato lines. Jacqueline Lee (late blight resistant) was licensed to Australia and is being grown in Central America for its late blight resistance. Raspberry, Blackberry, MSQ558-2RR (Ruby Rose) and our PVY resistant Red Marker #2 (Spartan Red) potato are being marketed in the specialty markets. Blackberry is also being chip-processed by the Great Lakes Chip Co. in Traverse City, MI. Higher antioxidants are found in Blackberry and we tested in 2024.

Disease and Insect Resistance Breeding

Scab: In 2024, we had evaluated scab resistance at a highly infected site at the Montcalm Research Center. The Montcalm Research Center site gave us very good scab infection levels as well as previous years. The susceptible checks of Snowden and Atlantic were highly infected with pitted scab. Promising resistant selections will be summarized in the variety report. If you examine the variety trials at Montcalm Research Center in the variety report, you will notice that many of the lines are scab resistant. We need to continue in this direction of many selections with scab resistance so we can find the great scab resistant chipper as well as table yellows and reds. The high level of scab infection at the on-farm site with a history of scab infection and MRC has significantly helped with our discrimination of resistance and susceptibility of our lines. The MRC scab site was used for assessing scab susceptibility in our advanced breeding lines and early generation material. All susceptible check plots (Snowden and Atlantic) were scored as susceptible.

Based upon scab trial, scab resistance is very strong in the breeding program. We lead the nation in scab resistant lines. This is evident in the NCPT (Figure 1). The scab nursery data is also incorporated into the early generation selection evaluation process at Lake City. We are seeing that this expanded effort is leading to more scab resistant lines advancing through the breeding program. In the past three years, almost all the advanced selections in the breeding program have moderate to high levels of scab resistance. Many highly scab resistant lines (score < 1.0) coming from this effort are summarized in the variety report.

Fig. 1. Scab Disease Ratings of the NCPT lines from Montcalm Research Center Trials



Late Blight: Our specific objective is to breed improved cultivars for the industry that have foliar and tuber resistance to late blight using a combination of conventional breeding, marker-assisted strategies, and transgenic approaches. Through conventional breeding approaches, the MSU potato breeding and genetics program has developed a series of late blight resistant advanced breeding lines and cultivars that have diverse sources of resistance to late blight. In 2024 we conducted late blight trials at the MSU campus. We inoculated with the US23 genotype and obtained high levels of infection in the susceptible border plants. The infection progressed and we were able to confirm late blight resistance for Mackinaw, Huron Chipper and numerous breeding lines. The late blight trial results are summarized in the variety report.

PVY: We are using PCR-based DNA markers to select potatoes resistant to PVY. The gene is located on Chromosome 11. Each year since 2013 we are making new crosses, making selections, and expanding the germplasm base that has PVY resistance. In the past year we tested over 600 progeny for the PVY resistance marker. The marker positive selections were evaluated at Lake City Research Center. With the development of molecular markers for potato breeding, marker-assisted selection has been incorporated into our routine breeding practice and greatly facilitate the selection process. At times we are using DNA markers to also screen for PVX resistance, PLRV resistance, late blight resistance and Golden nematode resistance. DNA markers allow for a prioritization of the space in the field, and for earlier, more informed decisions in variety selection. The advanced selections from the breeding program were evaluated in a field PVY trial on campus in 2024. The results validated the lines carrying the markers for PVY resistance. I want to note that we also determined that Blackberry had PVY resistance! Currently 69% of the selections in the breeding program have PVY resistance with the majority (over 90%) of the advanced breeding lines having PVY resistance.

MSU Lines with Commercial Tracking

Petoskey (MSV030-4)

Parentage: Beacon Chipper x MSG227-2
Developers: Michigan State University and the MSU AgBioResearch.
Plant Variety Protection: To Be Applied For.

Strengths: Petoskey is a chip-processing potato with resistance to common scab (*Streptomyces scabies*). This variety has high specific gravity and yield potential, with attractive, uniformly round tubers. Petoskey has a medium vine and a mid-season maturity and has demonstrated excellent long-term storage chip-processing quality. MSV030-4 has performed well in Michigan and multiple locations in the PotatoesUSA National Chip Processing Trials (NCPT) and national SFA (SNaC) trials.

Incentives for production: Excellent chip-processing quality out of the field and long-term chip quality with high specific gravity and resistance to common scab, and a good size profile of uniform, round tubers.

Morphological Characteristics:
Plant: Medium height vine, semi-erect with a balance between stems and foliage visible, and flowers.
Tubers: Uniform, smooth, round tubers with lightly netted, tan colored skin. Tubers have a white flesh with a low incidence of internal defects.

Agronomic Characteristics:
Vine Maturity: Mid-full season maturity.
Tubers: Smooth, round tubers with lightly netted, tan colored skin and white flesh.
Yield: Above average yield under irrigated conditions, with uniform tubers.
Specific Gravity: Averages higher than Atlantic and Snowden.
Culinary Quality: Chip-processes from short and long-term storage.
Diseases: Resistant to common scab (*Streptomyces scabies*).

Huron Chipper (MSW485-2)

Parentage: MSQ070-1 x MSR156-7
Developers: Michigan State University and the MSU AgBioResearch.
Plant Variety Protection: To Be Applied For.

Strengths: MSW485-2 is a chip-processing potato with resistance to and late blight (*Phytophthora infestans*), and stronger tolerance to common scab (*Streptomyces scabies*) than Atlantic. This variety has high yield and good specific gravity, with attractive, uniformly round tubers. MSW485-2 has a strong vine and a mid-season maturity and has demonstrated excellent long-term storage chip-processing quality. MSW485-2 has performed well in multiple locations in the PotatoesUSA National Chip Processing Trials (NCPT) and national SFA (SNaC) trials.

Incentives for production: Excellent chip-processing quality out of the field and long-term chip quality with resistance to late blight and a good size profile.

Morphological Characteristics:
Plant: Medium height vine, semi-erect with a balance between stems and foliage visible, and flowers.
Tubers: Uniform, smooth, round tubers with lightly netted, tan colored skin. Tubers have a white flesh with a low incidence of internal defects.
Agronomic Characteristics:

Vine Maturity: Mid-season maturity.
Tubers: Smooth, round tubers with lightly netted, tan colored skin and a white flesh.
Yield: Above average yield under irrigated conditions, with uniform tubers.
Specific Gravity: Averages similar to above Atlantic and Snowden.
Culinary Quality: Chip-processes from short to long-term storage.
Diseases: Resistant to late blight (*Phytophthora infestans*) and tolerant to common scab (*Streptomyces scabies*).

Blackberry (MSZ109-10PP)

Parentage: COMN07-W112BG1 x MSU200-5PP
Developers: Michigan State University and the MSU AgBioResearch
Plant Variety Protection: To Be Applied For.

Strengths: Blackberry is a tablestock variety with unique purple skin and a deep purple flesh. The tubers have an attractive, uniform, round shape and a purple flesh with common scab resistance and low incidence of internal defects. Yield can be high under irrigated conditions. Blackberry will also chip-process out of the field.

Incentives for production: The unique purple skin and purple flesh of the tubers of Blackberry offer a unique potato that could lend itself to the specialty variety market, such as gourmet restaurants and food stores, as well as farm and road-side markets. The primary market for this clone will be farm market and direct retail sale growers, and home gardeners. This variety is also used as a gourmet chip processing variety.

Morphological Characteristics:
Plant: Full-sized vine, semi-erect with a balance between stems and foliage visible, and flowers.
Tubers: Round tubers with a smooth skin and unique purple skin and purple flesh color. Tubers have a deep purple flesh with a low incidence of internal defects.

Agronomic Characteristics:
Maturity: Mid-season.
Tubers: Round tubers with unique purple skin and deep purple flesh.
Yield: Above average yield.
Specific Gravity: Averages 1.065 in Michigan.
Culinary Quality: Gourmet specialty with deep purple flesh and also chip-processes.
Diseases: Good common scab resistance.

Dundee (MSZ242-13)

Parentage: MSR169-8Y x MSU383-A
Developers: Michigan State University and the MSU AgBioResearch.
Plant Variety Protection: To Be Applied For.

Strengths: Dundee is a chip-processing potato with resistance to common scab (*Streptomyces scabies*) and has demonstrated excellent long-term storage chip-processing quality. This variety has high specific gravity and average yield potential, with attractive, uniformly round tubers. Dundee has a medium vine and a mid-full season maturity. Dundee has performed well in Michigan and multiple locations in the Potatoes USA National Chip Processing Trials (NCPT) and national, multi-state SNAC trials.

Incentives for production: Excellent chip-processing quality out of the field and long-term chip quality with high specific gravity and resistance to common scab, and a good size profile of uniform, round tubers.

Morphological Characteristics:
Plant: Medium height vine, semi-erect with a balance between stems and foliage visible.
Tubers: Uniform, smooth, round tubers with lightly netted, tan colored skin. Tubers have a white flesh with a low incidence of internal defects.

Agronomic Characteristics:
Vine Maturity: Mid-full season maturity.
Tubers: Smooth, round tubers with lightly netted, tan colored skin and white flesh.
Yield: Average yield under irrigated conditions, with uniform tubers.
Specific Gravity: Averages higher than Atlantic and Snowden.
Culinary Quality: Chip-processes from short and long-term storage.
Diseases: Resistant to common scab (*Streptomyces scabies*).

Colorado Potato Beetle: *Solanum chacoense*-derived and other new sources of resistance

Our goal is to provide durable Colorado potato beetle management in an integrated, sustainable manner. With this research we should be able to move towards developing resistant diploid parental lines for commercial breeding purposes. Our current objective is to evaluate the transmission of *S. chacoense* host plant resistance in a set of diverse cultivated diploid clones.

We made crosses with the best CPB resistant inbred line ‘431”. Using inbred 431 will more likely transmit resistance to a greater percentage of the progeny because the genes related to insect resistance are more likely fixed from inbreeding. Selfing will recover the homozygous condition of recessive loci contributing to beetle resistance. In 2023 and 2024 we made selections in the families for tuber appearance on the survivors at the end of the season. We will run detached leaf bioassays in the winter to screen the selfed progeny for resistance. Further crosses will be made with the resistant lines so we can further adapt the beetle resistant germplasm.

We also have four hybrids between our diploid germplasm and other wild potato species with non-leptine-based resistance were identified to have an extremely high level of resistance to Colorado potato beetle. Two of the lines were hybrids that are 50% cultivated diploid germplasm. These lines we tested attracted the beetles (both large larvae and adults) but after a small amount of feeding, the beetles dropped from the plant and died. These lines offer opportunities to pyramid the resistance mechanisms as we move forward with our breeding for Colorado potato beetle resistance.

Figure 2. Colorado potato beetle defoliation at Montcalm Research Center Nursery. Please note that the whole range was planted to Atlantic border rows.

Dihaploid Potato Production at Michigan State University

The benefits of developing a richer germplasm of dihaploid potatoes brings the industry ever closer to the expansive changes that would come with diploid potatoes. Our goal is to develop a broad-based dihaploid germplasm that is the foundation of diploid potato breeding focused on variety development. We started by crossing currently established MSU tetraploid germplasm with a known haploid inducer, *S. phureja* IVP 101. Parent lines were selected based on traits such as high yield, disease resistance, and good chip quality, among others. Confirmed dihaploids are crossed with diploid self-compatible lines to access the dihaploid traits and introgress self-compatibility. From the crosses produced in the past 10 years from these dihaploid crosses with over 70 breeding lines or varieties, over 1,200 progeny have been confirmed as diploid. These dihaploids (diploids derived from tetraploid varieties) are the foundation of our diploid breeding program for round white potatoes for the chip and table markets. We have also now selected some russet dihaploids and red dihaploids and well as more chippers, table and yellows. Right now, we have over 300 good female-fertile dihaploids that are forming the core of our varietal diploid breeding program. We cross these dihaploids to our best diploid germplasm as a means to bring their traits into the diploid breeding program.

Diploid Breeding

The diploid genetic material represent material from South American potato species and other countries around the world that are potential sources of resistance to Colorado potato beetle, late blight, potato early die, and ability to cold-chip process. We are now placing more emphasis on the diploid breeding effort because of the advantages the breeding system brings when we introduce the ability to self-pollinate a line. Features of diploid breeding include 1) a simpler genetic system than current breeding methods, 2) tremendous genetic diversity for economic traits, 3) minimal crossing barriers to cultivated potato, 4) the ability to reduce genetic load (or poor combinations) through selfing and 5) the ability to create true breeding lines like wheat, soybeans and dry beans. We are also using some inbred lines of *S. chacoense* that have fertility and vigor (also a source of *Verticillium* wilt resistance to initiate our efforts to develop inbred lines with our own diploid germplasm. Through 10 years of crossing and selecting we have bred diploid breeding lines that yield and size as well as tetraploid potato varieties. From 2021-24, we yield tested about over 260 breeding lines. In 2021 over 30 lines were equal or better than Lamoka and Atlantic in yield. In 2022 we saw similar results with over 100 lines equal or better than the Atlantic check. 2023-24 data validate the results from the past years so we are confident that we can develop potato varieties with this new breeding approach. We are also identifying more lines will excellent tuber appearance (Figure 3)

Figure 3. Diploid selections: harvesting the diploid trial at Montcalm Research Center and tuber samples of new third year selections from Lake City.

Integration of Genetic Engineering with Potato Breeding

MSU conducts genetic engineering research to introgress and test economically important traits into potato. We have a USAID-funded project to create and commercialize 3-R-gene potato varieties in Bangladesh, Indonesia, and Africa. This a partnership with Simplot Plant Sciences. Simplot has created some of the plants for the target countries. Agronomic and late blight trials in Bangladesh, Indonesia, Nigeria and Kenya (Figure 4) demonstrate their resistance to late blight and yield well under late blight pressure.

Figure 4. Field Trials in Bangladesh in 2024

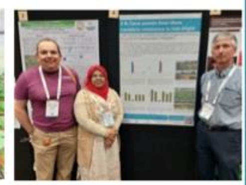
Workstream 1: 3 R-gene LBR potato field trials – **CFTs Completed Activities**

Bangladesh

- ML-CFT 1 – yield data analyzed (t/ha)

	Gazipur	Rangpur	Mushiganj	Chittagong
DIA-MSU-UB015	16.3	26.7	7.2	24.4
Dia-MSU-UB255	15.7	20.4	5.7	19.6
Diamant	16.1	24.5	3.9	18.9


- **No significant differences in yield between transgenic and non-transgenic lines.**
- Greenhouse seed multiplication
- Presented a paper at the World Potato Congress
- Submitted application to conduct ML-CFT @ 6 locations (2 new locations)
  - Pending approval

We have also generated lines with the genes for water use efficiency. The XERICO gene is showing the most promise. From 2018 to 2023, we conducted trials at MRC with Ranger Russet events. These results are indicating that we are not seeing a yield reduction from the XERICO gene and the XERICO events also had a higher specific gravity than Ranger Russet. In 2024 we were able to get USDA approval to grow these lines without regulation. We are now transforming varieties important to Michigan to raise the specific gravity. Lastly, we have generated and selected a Kalkaska invertase silencing line (Kal91.03) that has resistance to accumulating reducing sugars in cold (40°F) storage. We tested the agronomic characteristics of Kal91.03 from 2016-2023. The initial results are suggesting that the invertase silencing line has good tuber type, size, and similar specific gravity. This suggests that we can correct sugar issues in a chip processing lines with this genetic engineering strategy. We also obtained USDA approval to grow this line without regulation. We are also targeting Michigan varieties for invertase silencing to increase their chip processing quality and long-term storability.

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2024 POTATO VARIETY EVALUATIONS

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INTRODUCTION

Each year, the MSU potato breeding and genetics team conducts a series of variety trials to assess advanced potato selections from the Michigan State University and other potato breeding programs at the Montcalm Research Center (MRC). In 2024, we tested over 200 varieties and breeding lines in the replicated variety trials, 132 lines in the North Central Regional trial plus over 180 lines in the National Chip Processing Trial (NCPT). The variety evaluation also includes disease testing in the scab nursery (Montcalm Research Center) and foliar late blight evaluation (MSU Campus Plant Pathology Farm). The objectives of the evaluations are to identify superior varieties for fresh or chip-processing markets (chip, round white/yellow table, specialty/red and russet). The varieties were compared in groups according to market class, tuber type, skin color, and to the advancement in selection. Each season, total and marketable yields, specific gravity, tuber appearance, incidence of external and internal defects, chip color (from the field as well as from 45°F (7.2°C) storage at 3 and 6 months), along with susceptibilities to common scab, late blight (foliar and tuber), and blackspot bruising are determined.

We would like to acknowledge the collaborative effort of the Michigan Potato Industry and research colleagues Matthew Klein and the MSU Potato Breeding Team (along with the graduate students) for helping to get the field research done.

PROCEDURE

The field variety trials were conducted at the Montcalm Research Center in Entrican, MI. A randomized complete block design was used. The plots were 23 feet (7 m) long and spacing between plants was 10 inches (25.4 cm). Inter-row spacing was 34 inches (86.4 cm). Supplemental irrigation was applied as needed. Nutrient, weed, disease and insect management were similar to recommendations used by the commercial operations in Montcalm County. The field experiments were conducted on a sandy loam soil that has been out of potato production for 4 years. Oats were grown in 2023 on this ground. There was no serious damage from insects, diseases or weeds.

The most advanced selections were tested in the Advanced chip and Tablestock trials, representing selections at a stage after the preliminary trials. The other field trials were the Preliminary (chip-processors and tablestock), Preliminary Pigmented, the North Central Regional, NCPT and the early observational trials.

2024 was the fourteenth year of the National Chip Processing Trial (NCPT). The purpose of the trial is to evaluate early generation breeding lines from the US public breeding programs for their use in chip-processing. The NCPT has 10 trial locations (Northern sites: NY, MI, WI, ND, OR and Southern: NC, FL, CA, TX) in addition to a scab trial Wisconsin. The North Central trial was reformatted to have 15-hill plots of earlier generation selections for a total of 132 lines plus controls for the chip, russet and table markets.

In each of these trials, the yield was graded into four size classes (pick outs, Bs, As, oversize) using the new Kerian sizer on the grading line, incidence of external and internal defects in >3.25 in. (8.25 cm) diameter potatoes were recorded. Samples were taken for specific gravity, chip-processing, disease tests and bruising tests. Chip quality was assessed on composite tuber samples, taking two slices from each tuber. Chips were fried at 345°F (174°C) for 2 minutes 15 seconds or until fully cooked. The chip color was measured visually with the SFA 1-5 color chart. Stem end scores were also recorded. Tuber samples were also stored at 45°F (7.2°C) for chip-processing out of storage in January and April. The lines in the agronomic trials were assessed for common scab resistance at the nursery at the Montcalm Research Center. There has been very strong scab disease pressure at the new Montcalm Scab Disease Nursery for nine years now. The 2022 late blight trial was conducted at the MSU campus Plant Pathology Farm. The simulated blackspot bruise (from 50°F tuber temperature) results for average spots per tuber have also been incorporated into the summary sheets.

RESULTS

A. Agronomic trials from Montcalm Research Center

Tables 1-7 summarize the agronomic results from the Montcalm Research Center. The scab and late blight trial results are added to the tables as well as the blackspot bruise data. The lines that show promise in 2024 are highlighted in green. We based our overall assessment for agronomic production, appearance, disease resistance, maturity, bruise resistance and processing quality for the chipping lines.

B. Potato Common Scab Evaluation (Tables 8 and 9)

Each year, a replicated field trial is conducted to assess resistance to common scab. The scab trial is now located at the Montcalm Research Center where high common scab disease pressure was observed in the previous nine years. This location is being used for the early generation observational scab trial (109 lines) and the scab variety trial (148 lines) and diploid scab trial (120). In 2024, the scab infection was a good level with the susceptible controls having some coverage of pitted scab.

We use a rating scale of 0-5 based upon a combined score for scab coverage and lesion severity. Usually examining one year's data does not indicate which varieties are resistant but it should begin to identify ones that can be classified as susceptible to scab. Our goal is to evaluate important advanced selections and varieties in the study at least three years to obtain a valid estimate of the level of resistance in each line. The 2022-2024 scab ratings are based upon the Montcalm Research Center site. **Table 8** categorizes many of the varieties and advanced selections tested in 2024 over a three-year period. The varieties and breeding lines are placed into nine categories based upon scab infection level and lesion severity. A rating of 0 indicates zero scab infection. A score of 1.0 indicates a trace amount of infection. A moderate resistance (1.2 – 1.5) correlates with <10% infection without pitting. Scores of 4.0 or greater are found on lines with >50% surface infection and severe pitted lesions.

The check varieties Red Norland, Yukon Gold, Mackinaw, Lamoka, Atlantic, and Snowden can be used as references (in bold, **Table 8**). The table is sorted in ascending order by 2024 scab rating. This year's results continue to indicate that we have been able to breed numerous lines with resistance to scab. Average scab ratings ranged from 0.3 – 3.5 for the variety trial. A total of 85 entries tested had a scab rating of 1.7 or lower in 2023. Most notable scab resistant MSU lines are found in the trial summaries **(Tables 1-7)**. Of the 109 early generation selections that were evaluated, 74 had scab resistance (scab rating of ≤ 1.5) (**Table 9**).

C. Late Blight Trial (Table 10)

In 2024, the late blight trial was planted at the East Lansing campus Plant Pathology farm. All entries were planted in late June for late blight evaluation. These include lines tested in a replicated manner from the agronomic variety trial and entries in the early generation observation plots. The trials were inoculated two times in August with the US-23 genotype of *P. infestans*. Late blight infection was progressed well and data was collected into September. 44 of 138 lines were classified as late blight resistant in the replicated trial. Over half of the lines were also PVY resistant. Select early generation lines were tested for late blight resistance. 27 of 90 selections were classified as resistant.

D. Blackspot Bruise Susceptibility (Table 11)

Evaluations of advanced seedlings and new varieties for their susceptibility to blackspot bruising are also important in the variety evaluation program. Based upon the results collected over the past years, the non-bruised check sample has been removed from our bruise assessment. A composite bruise sample of each line in the trials consisted of 25 tubers (a composite of 4 replications) from each line, collected at the time of grading. The 25-tuber sample was held in 50°F (10°C) storage overnight and then was placed in a hexagon plywood drum and tumbled 10 times to provide a simulated bruise. The samples were peeled in an abrasive peeler in October and individual tubers were assessed for the number of blackspot bruises on each potato. These data are shown in **Table 11**. The bruise data are represented in two ways: percentage of bruise free potatoes and average number of bruises per tuber. A high percentage of bruise-free potatoes is the desired goal; however, the numbers of blackspot bruises per potato is also important. Cultivars which show blackspot incidence greater than Atlantic are approaching the bruise-susceptible rating. In addition, the data is grouped by trial, since the bruise levels can vary between trials. In 2024, the bruise levels were higher than previous years. There are many lines with lower blackspot bruise potential across the trials. Some of our advanced selections are similar to or less than Atlantic and Snowden in their level of bruising. A few lines will high susceptibility to bruise were identified and will be discontinued from testing. All the bruise ratings are also found in the variety trial tables (**Tables 1-7**).

E. National Chip Processing Trial (NCPT) data available on-line

The Potatoes USA-funded National Chip Processing Trial (NCPT) is an effort to synergize the strengths of the public breeding programs in the U.S. to identify improved chip-processing varieties for the industry. Cooperating breeding programs include the USDA (Idaho and Maryland) and land grant universities (Colorado, Maine, Michigan, Minnesota, North Carolina, North Dakota, New York, Oregon, Wisconsin and Texas). The coordinated breeding effort includes early-stage evaluation of key traits (yield, specific gravity, chip color, chip defects and shape) from coordinated trials in 10 locations. Since the inception of the trial in 2010, over 1,200 different potato entries, including reference varieties, have been evaluated. The data for all the lines tested are summarized on a searchable, centralized database housed at Medius (https://potatoesusa.medius.re). More than 45 promising new breeding lines from the trials have been fast-tracked for larger-scale commercial trials and processor evaluation. The NCPT is also a feeder for the national SNAC International trials. We are using the NCPT trials to more effectively identify promising new selections. Notable MSU lines that have been identified are MSW485-2 (Huron Chipper), MSX540-4 (Mackinaw), MSV030-4 (Petoskey), and MSZ242-13 (Dundee). Our newest graduates of the NCPT are MSBB058-1, MSDD247-11 and MSDD247-07 . Minituber production and/or commercial seed have been produced of the newer lines and will be tested in Michigan in 2025.

Table 1

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

ADVANCED CHIP-PROCESSING TRIAL
MONTCALM RESEARCH CENTER
May 6 to September 17, 2024 (134 days)
DD Base 40°F 3200.1[9]

			CWT/A		PERCENT OF TOTAL[1]								PERCENT (%) TUBER QUALITY[4]							3-YR AVG
LINE	PVY Resistant	N	US#1	TOTAL	US#1	Bs	A1	A2	OV	PO	SP GR	CHIP SCORE[2]	HH	IBS	BC	SCAB[5]	MAT[6]	BRUISE[7]	LB[8]	US#1 CWT/A
NY174		2	520	568	91	8	71	20	0	1	1.086	1.0	0	0	0	1.7	2.0	3.8	LBMR	-
ND13220C-3		2	515	646	80	18	72	7	0	2	1.093	1.0	10	0	0	1.8	2.5	0.8		-
MSDD376-4	PVYR	2	502	574	87	12	67	21	0	0	1.086	1.0	5	0	0	1.2	3.5	2.1	LBR	492
MSGG282-20	PVYR	2	477	500	95	4	43	51	1	1	1.080	1.0	0	0	0	1.2	3.0	1.6	LBR	-
MSBB636-11	PVYR	2	454	477	95	4	36	58	1	1	1.076	1.0	0	0	0	1.2	2.0	0.2	LBMR	539
Dundee		2	451	487	93	7	61	32	0	0	1.100	1.0	0	0	0	1.0	3.5	2.3	LBS	381
Mackinaw	PVYR	2	436	473	92	8	74	18	0	0	1.091	1.0	0	0	0	1.5	2.5	2.0	LBR	409
MSDD244-05	PVYR	2	428	449	95	5	52	42	0	0	1.083	1.0	0	0	10	1.2	2.5	1.5	LBMR	405
NY177		2	412	466	88	11	74	13	1	0	1.097	1.0	0	10	0	1.7	2.0	3.4	LBR	-
MSEE207-2	PVYR	2	408	433	94	5	46	48	0	1	1.079	1.0	0	0	0	1.0	3.0	1.1	LBMR	469
MSAA076-6		2	407	450	91	8	64	26	1	1	1.087	1.0	0	5	0	1.3	2.5	2.6	LBMS	417
MSDD249-9	PVYR	2	407	420	97	3	42	53	1	0	1.084	1.0	5	0	0	1.5	3.0	1.4	LBMR	444
MSBB610-13	PVYR	2	395	407	97	3	53	44	0	0	1.077	1.0	0	0	0	1.5	2.0	0.8	LBMR	395
Petoskey		2	389	438	89	11	73	15	0	0	1.093	1.0	0	0	0	1.7	2.5	2.3	LBS	376
MSDD247-07	PVYR	2	380	423	90	10	66	23	0	0	1.100	1.0	0	0	0	1.3	3.0	2.1	LBMR	387
MSEE031-3	PVYR	2	367	391	94	6	72	22	0	0	1.082	1.0	0	0	0	1.0	2.0	1.6	LBMR	335*
MSBB617-02	PVYR	2	366	387	94	5	52	43	0	1	1.083	1.0	0	0	0	1.2	2.0	0.7	LBMR	-
Bliss (NY163)		2	364	412	88	11	72	15	1	1	1.086	1.0	0	0	0	1.2	2.0	1.0	LBS	312
MSBB058-1		2	361	395	91	8	66	25	1	1	1.088	1.0	0	0	0	1.5	3.0	2.0	LBMS	399
MSFF038-3	PVYR	2	361	396	91	8	70	21	1	1	1.082	1.0	0	0	0	1.5	2.5	2.8	LBR	385*
Manistee		2	351	427	82	18	69	13	0	0	1.080	1.0	0	0	0	2.3	2.0	0.6	LBS	311*
Atlantic		**2**	**324**	**365**	**89**	**8**	**62**	**26**	**0**	**4**	**1.085**	**1.0**	**5**	**0**	**0**	**2.9**	**1.5**	**1.5**	**LBS**	**273**
MSBB230-1		2	320	380	84	16	68	16	0	0	1.084	1.0	0	0	0	2.3	2.0	2.8	LBMR	341*
Snowden		**2**	**314**	**415**	**75**	**25**	**72**	**2**	**0**	**0**	**1.082**	**1.0**	**0**	**10**	**0**	**3.2**	**2.0**	**1.9**	**LBMS**	**283**
MSDD247-11	PVYR	2	312	359	87	13	74	13	0	0	1.094	1.0	5	0	5	0.8	2.0	1.5	LBR	336
MSDD244-15	PVYR	2	308	319	96	4	61	35	0	0	1.082	1.0	0	0	0	0.7	2.5	2.4	LBR	369
MSFF035-2		2	305	337	90	6	58	33	0	4	1.074	-	0	0	0	2.0	1.5	-	LBMR	-
Lamoka		**2**	**304**	**347**	**87**	**11**	**82**	**5**	**0**	**2**	**1.084**	**1.0**	**0**	**0**	**0**	**1.8**	**2.0**	**1.2**	**LBMS**	**326**
MSGG190-1	PVYR	2	302	371	81	17	79	3	0	1	1.078	1.0	0	0	0	1.2	2.0	0.9	LBMR	-
MSEE016-07		2	289	310	93	7	55	38	0	0	1.088	-	0	0	0	1.5	3.0	-	LBR	328*
MSFF029-10	PVYR	2	287	372	77	23	75	2	0	0	1.084	1.0	0	0	0	2.2	2.5	0.7	LBMR	-
MSEE182-3	PVYR	2	250	308	81	19	77	4	0	0	1.078	1.5	0	0	0	0.7	2.0	0.7	LBMR	275*
MSAA260-3		2	243	291	82	14	50	32	0	4	1.078	1.0	0	0	0	1.7	2.5	2.6	LBMS	425
Sinatra		2	196	302	65	35	63	1	0	1	1.091	1.0	0	0	0	1.3	2.0	1.1	LBMS	-
MEAN			368	415							1.085					1.5	2.4	1.7		391
$HSD_{0.05}$			247	247							0.008						2.1			

[1]SIZE: B: < 1 7/8 in.; A1: >1 7/8-<2 9/16 in.; A2: > 2 9/16-< 3.25 in.; OV: > 3.25 in.; PO: Pickouts.
[2]CHIP SCORE: SNAC Scale (Out of the field); Ratings: 1-5; 1: Excellent, 5: Poor.
[4]QUALITY: HH: Hollow Heart; BC: Brown Center; IBS: Internal Brown Spot. Percent of 20 Oversize and/or A-size tubers cut.
[5]SCAB DISEASE RATING: MSU Scab Nursery; 0: No Infection; 1: Low Infection <5%; 3: Intermediate; 5: Highly Susceptible.
[6]MATURITY RATING: August 24, 2024; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).
[7]BRUISE: Simulated blackspot bruise test, average number of spots per tuber.
[8]LB Late blight (*P. infestans* US-23) foliar disease reaction. R=Resistant, MR=Moderate Resistance, MS=Moderate Susceptibility, S=Susceptible

Plant Date: 5/6/24
Vine Kill: 8/29/24
Days from planting to vine kill: 115

[9]Enviroweather: Entrican Station. Planting to vine kill

Table 2

NORTH CENTRAL REGIONAL TRIAL
MONTCALM RESEARCH CENTER
May 7 to September 04, 2024 (120 days)
DD Base 40°F 2882.0[5]

			CWT/A		PERCENT OF TOTAL[1]							PERCENT (%) TUBER QUALITY[2]			
LINE	PVY RESISTANT	N	US#1	TOTAL	US#1	Bs	A1	A2	OV	PO	SP GR	HH	IBS	BC	SCAB[3]	MAT[4]
Chip																
W20036-8		1	629	702	90	7	45	45	0	4	1.085	0	0	0	-	3.0
MSII075-1		1	546	616	89	11	75	13	0	1	1.091	0	20	0	1.0	3.0
MSII176-3	PVYR	1	519	601	86	12	13	73	0	1	1.085	0	0	0	3.5	2.0
MSII129-1	PVYR	1	516	569	91	9	73	17	0	0	1.087	0	0	0	2.0	2.0
MSII147-8	PVYR	1	475	508	94	6	67	27	0	0	1.082	0	0	0	1.0	2.0
MSII040-1		1	470	539	87	11	74	14	0	2	1.089	0	0	0	1.5	2.0
Lamoka		**2**	**441**	**474**	**93**	**6**	**75**	**18**	**0**	**1**	**1.080**	**0**	**0**	**0**	**1.8**	**2.0**
MSII117-10	PVYR	1	432	505	86	14	76	9	0	0	1.077	0	0	0	1.0	2.0
W20005-18		1	430	456	94	6	67	27	0	0	1.075	0	0	0	-	3.0
MSII117-01		1	424	462	92	8	84	8	0	0	1.088	0	0	0	1.5	2.0
W20001-15		1	423	514	82	18	77	6	0	0	1.094	0	0	0	-	2.0
W20004-39		1	416	522	80	19	69	10	0	1	1.092	0	10	0	-	2.0
MSII150-3	PVYR	1	410	448	92	8	64	28	0	0	1.083	0	0	0	2.5	2.0
W20001-7		1	405	472	86	14	76	10	0	0	1.084	0	0	0	-	3.0
MSII126-4	PVYR	1	395	419	94	6	74	20	0	0	1.075	0	0	0	0.0	1.0
MSII108-6	PVYR	1	392	417	94	6	23	71	0	0	1.067	0	0	0	1.0	3.0
MSII147-9	PVYR	1	392	491	80	17	72	7	0	3	1.071	0	0	0	0.5	3.0
Snowden		**2**	**389**	**472**	**83**	**17**	**76**	**7**	**0**	**0**	**1.080**	**0**	**0**	**0**	**3.2**	**2.0**
W20004-26		1	385	433	89	9	64	24	0	2	1.086	0	0	0	-	2.0
MSII084-1		1	384	421	91	6	69	22	0	3	1.078	0	0	0	3.0	2.0
MSII128-4	PVYR	1	383	419	91	9	58	34	0	0	1.088	0	0	0	2.0	3.0
MSII088-1	PVYR	1	379	581	65	35	64	1	0	0	1.087	0	0	0	2.5	3.0
MSII186-1		1	362	489	74	26	73	1	0	0	1.079	0	0	0	1.5	2.0
MSII108-4	PVYR	1	355	405	88	12	77	11	0	0	1.087	0	0	0	2.5	2.0
MSII211-3		1	351	402	87	8	47	41	0	5	1.071	0	0	0	1.5	2.0
MN18W17037-027		1	351	396	89	11	70	19	0	0	1.080	0	0	0	-	2.0
MSII105-1		1	335	356	94	5	76	18	0	1	1.085	0	0	0	1.0	2.0
MN19TX18211-001		1	325	389	84	16	77	7	0	0	1.068	0	0	0	-	1.0
ND20165-4		1	324	400	81	19	67	14	0	0	1.073	0	0	0	-	2.0
MN21ND1845B-017		1	322	402	80	14	52	26	2	6	1.075	30	0	10	-	3.0
MSII160-1	PVYR	1	321	448	72	28	69	3	0	0	1.081	0	0	0	3.0	2.0
W20022-2		1	316	348	91	7	60	30	0	2	1.077	0	0	0	-	2.0

LINE	PVY RESISTANT	N	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	A1	A2	OV	PO	SP GR	PERCENT (%) TUBER QUALITY[2] HH	IBS	BC	SCAB[3]	MAT[4]
MSII132-2		1	312	391	80	20	66	13	0	0	1.084	0	0	0	3.0	2.0
W20005-23		1	292	349	84	16	75	9	0	0	1.077	0	0	10	-	3.0
MSII214-1		1	292	314	93	6	44	49	0	1	1.082	0	10	0	2.5	2.0
MSII142-1		1	284	284	100	0	100	0	0	0	1.078	0	0	0	1.0	2.0
MN19AF6892-009		1	266	290	92	8	74	18	0	0	1.083	0	0	0	-	2.0
MSII063-2		1	255	323	79	21	63	16	0	0	1.088	0	0	0	-	2.0
ND2070-9		1	252	315	80	18	65	15	0	2	1.069	0	0	0	-	2.0
MN18W17043-002		1	249	284	88	12	72	15	0	0	1.088	0	0	0	-	2.0
W20023-2		1	247	303	81	19	72	9	0	0	1.076	0	0	0	-	2.0
MSII168-1		1	230	378	61	39	61	0	0	0	1.087	0	0	0	2.0	2.0
MN19TX18032-001		1	198	310	64	36	61	3	0	0	1.074	0	0	0	-	1.0
MN21ND1930-004		1	197	271	73	17	66	7	0	10	1.065	0	0	0	2.5	3.0
MSII107-5		1	187	277	68	32	58	10	0	0	1.085	0	0	0	1.0	2.0
MSII163-1		1	181	301	60	39	60	0	0	1	1.088	0	0	0	0.5	2.0
MSII119-2		1	172	336	51	49	51	0	0	0	1.083	0	0	0	1.0	2.0
MSII107-7		1	140	255	55	45	53	2	0	0	1.075	0	0	0	1.0	2.0
MN21TX20059-007		1	138	233	59	37	57	2	0	4	1.063	0	30	0	-	1.0
MEAN			345	414							1.080				1.7	2.1
Russet																
W20059-12rus		1	507	637	80	14	68	12	0	7	1.064	0	0	0	-	3.0
MN21CO19222-002		1	468	735	64	23	56	7	0	14	1.080	40	0	0	-	1.0
W20047-7rus		1	430	517	83	15	63	20	0	2	1.075	0	0	0	-	2.0
MN19AOR16059-001		1	407	488	83	9	59	24	0	8	1.078	0	0	0	-	2.0
MN18W17091-015		1	401	517	78	8	55	22	0	14	1.071	0	0	0	-	2.0
W20054-3rus		1	397	418	95	5	56	39	0	0	1.068	0	0	0	-	2.0
AND20063-1Russ		1	394	520	76	3	28	47	0	21	1.073	50	0	0	-	3.0
W20096-17rus		1	381	412	93	5	67	26	0	2	1.076	0	0	0	-	2.0
AND19027-1Russ		1	360	475	76	22	72	4	0	2	1.081	0	0	0	-	1.0
W20066-10rus		1	354	494	72	28	70	1	0	0	1.079	0	0	10	-	3.0
MN21CO19222-001		1	352	593	59	23	52	7	0	18	1.075	80	0	0	-	3.0
W20096-26rus		1	350	470	74	21	60	15	0	5	1.080	30	0	0	-	2.0
W19039-6rus		1	347	448	77	14	70	7	0	9	1.069	0	0	0	-	1.0
MN21ND2015-001		1	328	472	69	9	44	26	0	21	1.081	50	0	0	-	2.0
W20051-9rus		1	325	408	80	14	73	7	0	6	1.086	20	0	0	-	2.0
MN18W17076-001		1	293	372	79	7	57	14	7	14	1.075	0	0	0	-	2.0
W19039-3rus		1	262	303	87	13	79	7	0	0	1.062	0	0	0	-	1.0
ND20126-2Russ		1	254	311	82	18	78	4	0	0	1.073	0	0	0	-	3.0
MN21CO19073-001		1	225	426	53	43	50	2	0	4	1.073	0	0	0	-	1.0
Russet Norkotah		**2**	**215**	**313**	**69**	**21**	**56**	**13**	**0**	**11**	**1.066**	**5**	**0**	**0**	-	**1.0**
W20050-10rus		1	210	340	62	38	62	0	0	0	1.061	0	0	0	-	1.0

LINE	PVY RESISTANT	N	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	A1	A2	OV	PO	SP GR	PERCENT (%) TUBER QUALITY[2] HH	IBS	BC	SCAB[3]	MAT[4]
W20039-15rus		1	196	218	90	7	84	6	0	3	1.058	0	0	0	-	1.0
W20040-2rus		1	193	399	48	34	46	2	0	17	1.073	0	0	0	-	2.0
W20085-22rus		1	184	329	56	25	56	0	0	19	1.088	0	0	0	-	2.0
W20084-2rus		1	175	365	48	48	48	0	0	4	1.075	0	0	0	-	3.0
W20053-1rus		1	173	321	54	40	53	1	0	6	1.050	0	0	0	-	1.0
MN21CO19018-001		1	166	234	71	24	70	1	0	5	1.076	0	0	0	-	1.0
MN21ND1955-002		1	160	284	56	9	49	7	0	35	1.064	0	10	0	-	1.0
Russet Burbank		**2**	**157**	**348**	**46**	**40**	**42**	**2**	**2**	**15**	**1.074**	**0**	**0**	**0**	-	**1.5**
MN21CO19074-003		1	144	261	55	42	55	0	0	3	1.077	0	0	0	-	1.0
MN21AF7214-001		1	133	259	52	44	52	0	0	4	1.073	0	0	0	-	2.0
MN21CO19187-001		1	132	219	60	40	60	0	0	0	1.075	0	0	0	-	2.0
MN19CO17074-003		1	124	170	73	25	69	4	0	2	1.072	0	0	0	-	2.0
MN21ND1867-002		1	102	167	61	39	61	0	0	0	1.081	0	30	0	-	1.0
MN21ND1955-003		1	74	193	39	31	38	1	0	30	1.083	20	0	0	-	3.0
MEAN			268	384							1.073				-	1.8
Red																
ND20102-5R		1	510	576	89	4	57	32	0	8	1.068	0	0	0	-	2.0
MSII415-3R	PVYR	1	469	542	87	9	42	44	0	5	1.069	0	0	0	2.0	3.0
ND2090-2R		1	461	514	90	9	46	43	0	1	1.055	0	0	0	-	2.0
Dark Red Norland		**2**	**438**	**478**	**92**	**8**	**82**	**10**	**0**	**0**	**1.058**	**0**	**0**	**0**	**0.9**	**1.0**
MN19ND1759-001		1	438	488	90	10	69	18	3	0	1.062	0	0	0	-	2.0
ND2093-6R		1	419	489	86	14	71	15	0	0	1.067	0	0	0	-	2.0
ND2089-1R		1	369	410	90	7	49	41	0	3	1.057	0	0	0	-	2.0
MSII409-05R		1	344	452	76	24	68	8	0	0	1.054	0	0	0	-	1.0
ND2089-17R		1	339	398	85	13	56	29	0	2	1.060	0	0	0	-	2.0
ND20142-3R		1	331	375	88	9	65	23	0	3	1.057	0	0	0	-	1.0
ND2092-16R		1	328	363	90	9	48	39	3	1	1.056	0	0	0	-	2.0
ND2090-6R		1	303	367	82	6	46	29	7	12	1.061	10	0	0	-	2.0
ND2089-11R		1	302	378	80	20	66	14	0	0	1.068	0	0	0	-	3.0
AFND7576-1R		1	292	315	93	1	69	24	0	6	1.067	0	0	0	-	2.0
MSII418-07R		1	282	315	90	10	38	52	0	0	1.056	0	0	0	-	2.0
ND2092-17R		1	281	335	84	16	75	9	0	0	1.061	0	0	0	-	2.0
MSFF228-2RY		1	251	404	62	32	60	2	0	6	1.062	0	0	0	-	1.0
MN21ND2013-002		1	180	215	84	8	52	32	0	8	1.059	0	0	0	-	1.0
ND2096-4R		1	165	290	57	41	56	1	0	2	1.060	0	0	0	-	2.0
MN18W17026-004		1	96	200	48	44	34	1	14	8	1.059	0	0	0	-	1.0
MSFF145-2R		1	50	175	28	72	28	0	0	0	1.068	0	0	0	-	1.0
MN21ND2037-002		1	18	125	14	86	13	1	0	0	1.052	0	0	0	-	1.0
ND2093-4R		1	7	144	5	95	3	3	0	0	1.062	0	0	0	-	1.0
MEAN			290	363							1.061				-	1.7

	PVY		CWT/A		PERCENT OF TOTAL[1]							PERCENT (%) TUBER QUALITY[2]				
LINE	RESISTANT	N	US#1	TOTAL	US#1	Bs	A1	A2	OV	PO	SP GR	HH	IBS	BC	SCAB[3]	MAT[4]
Table/Speciality																
MSII414-2PP	PVYR	1	643	685	94	6	41	51	2	0	1.066	0	0	0	1.5	3.0
Columba		2	465	523	89	10	76	13	0	1	1.049	0	0	0	1.0	1.0
MSII353-2Y		1	451	515	88	6	67	21	0	6	1.057	0	0	0	2.0	3.0
Dark Red Norland		**2**	**438**	**478**	**92**	**8**	**82**	**10**	**0**	**0**	**1.058**	**0**	**0**	**0**	**0.9**	**1.0**
MSII306-05Y		1	435	485	90	10	56	33	0	0	1.062	0	0	0	-	3.0
MSII301-4	PVYR	1	421	483	87	13	79	9	0	0	1.063	0	0	0	2.5	1.0
MN19TX18206-002		1	420	589	71	27	69	2	0	2	1.075	0	0	0	-	2.0
MN21AF7330-003		1	420	544	77	22	64	14	0	1	1.074	0	0	0	-	2.0
MSII416-2RR	PVYR	1	358	421	85	14	76	9	0	1	1.064	0	0	0	0.5	2.0
MN21AF7348-001		1	328	442	74	19	60	15	0	6	1.077	50	0	0	-	3.0
AW08112-4P/Y		1	310	438	71	29	68	2	0	0	1.066	0	0	0	-	1.0
MSII326-1		1	310	375	82	18	78	4	0	0	1.059	0	0	0	2.0	1.0
MSII325-1Y		1	309	464	67	33	65	2	0	0	1.055	0	0	0	2.0	1.0
MSII414-6PP		1	285	308	93	6	66	27	0	1	1.055	0	0	0	-	4.0
W16050-3P/Y		1	277	432	64	33	60	4	0	3	1.066	0	0	0	-	1.0
MSFF200-4PYSPL	PVYR	1	272	365	75	25	75	0	0	0	1.055	0	0	0	-	3.0
ND20122-4pY		1	262	482	54	46	53	1	0	0	1.068	0	0	0	-	3.0
MSII400-1RR		1	130	298	44	47	44	0	0	9	1.055	0	0	0	1.0	1.0
MSII336-1		1	83	148	56	44	56	0	0	0	1.052	0	0	0	3.5	2.0
MEAN			348	446							1.062				1.7	2.0
$HSD_{0.05}$			240	333							0.007					2.1

[1]SIZE: B: < 1 7/8 in.; A1: >1 7/8-<2 9/16 in.; A2: > 2 9/16-< 3.25 in.; OV: > 3.25 in.; PO: Pickouts.

[2]QUALITY: HH: Hollow Heart; BC: Brown Center; IBS: Internal Brown Spot. Percent of 10 Oversize and/or A-size tubers cut.

[3]SCAB DISEASE RATING: MSU Scab Nursery; 0: No Infection; 1: Low Infection <5%; 3: Intermediate; 5: Highly Susceptible.

[4]MATURITY RATING: August 24, 2024; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

Plant Date: 5/7/24

Vine Kill: 8/22/24

Days from planting to vine kill: 107

[5]Enviroweather: Entrican Station. Planting to vine kill

Table 3

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

ADAPTATION TRIAL, TABLESTOCK LINES
MONTCALM RESEARCH CENTER
May 6 to September 10, 2024 (127 days)
DD Base 40°F 3200.1[7]

LINE	PVY RESISTANT	N	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	A1	A2	OV	PO	SP GR	PERCENT (%) TUBER QUALITY[2] HH	IBS	BC	SCAB[3]	MAT[4]	BRUISE[5]	LB[6]
MSGG039-11Y		2	534	576	93	6	65	28	0	1	1.073	0	0	0.0	2.3	2.0	0.3	LBMR
MSGG127-3R		2	528	605	87	13	61	26	0	0	-	0	0	0.0	2.5	3.5	-	LBR
MSFF031-6		2	514	550	94	6	56	37	0	1	1.072	0	0	0.0	1.0	2.0	2.2	LBMR
MSGG039-08Y		2	509	742	69	29	67	2	0	2	1.067	0	0	0.0	3.0	2.0	0.7	LBMR
Blackberry		2	481	626	77	21	66	11	0	3	1.069	0	0	0.0	1.7	3.0	0.5	LBMR
Jelly		2	445	546	82	10	67	14	0	8	1.077	0	0	0.0	2.2	3.0	0.5	LBR
MSGG084-1		2	426	492	86	11	61	26	0	2	1.070	5	5	0.0	1.8	2.0	-	LBMS
MSFF335-2RR		2	416	559	74	25	66	8	0	1	1.068	0	0	0.0	1.3	3.0	-	LBMR
MSCC553-1R		2	406	454	89	8	48	40	1	3	1.073	0	0	0.0	2.0	2.5	0.6	LBR
Reba		**2**	**385**	**400**	**96**	**3**	**52**	**44**	**0**	**0**	**1.070**	**0**	**0**	**0.0**	**2.7**	**2.0**	0.9	LBS
MSFF305-1RY		2	374	433	86	11	59	27	0	3	1.068	0	0	0.0	1.8	3.0	0.5	LBR
Columba		**2**	**324**	**420**	**77**	**22**	**73**	**5**	**0**	**1**	**1.053**	**0**	**0**	**0.0**	**1.0**	**1.0**	**0.2**	LBS
MSBB371-1YSPL		2	296	343	87	13	64	23	0	1	1.069	0	0	0.0	1.0	1.0	0.8	LBS
MSGG135-1R		2	282	492	57	43	55	2	0	0	1.073	0	0	0.0	1.0	3.0	0.6	LBR
Dark Red Norland		**2**	**232**	**292**	**79**	**20**	**78**	**2**	**0**	**0**	**1.058**	**0**	**0**	**0.0**	**0.9**	**2.0**	**-**	LBS
MSCC282-3RR		2	209	325	64	32	59	5	0	4	1.080	0	0	0.0	0.5	3.0	-	LBR
Yukon Gold		**2**	**197**	**261**	**75**	**19**	**63**	**12**	**0**	**6**	**1.072**	**5**	**0**	**0.0**	**2.5**	**2.0**	0.7	LBS
Queen Anne		2	146	257	54	43	52	2	0	3	1.064	0	0	0.0	1.8	2.5	0.8	LBS
MEAN			372	465							1.069				1.7	2.4	0.7	
$HSD_{0.05}$			224	263							0.008					2.6		

[1]SIZE: B: < 1 7/8 in.; A1: >1 7/8-<2 9/16 in.; A2: > 2 9/16-< 3.25 in.; OV: > 3.25 in.; PO: Pickouts.
[2]QUALITY: HH: Hollow Heart; BC: Brown Center; IBS: Internal Brown Spot. Percent of 20 Oversize and/or A-size tubers cut.
[3]SCAB DISEASE RATING: MSU Scab Nursery; 0: No Infection; 1: Low Infection <5%; 3: Intermediate; 5: Highly Susceptible.
[4]MATURITY RATING: August 24, 2024; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).
[5]BRUISE: Simulated blackspot bruise test average number of spots per tuber.
[6]LB: Late blight (*P. infestans* US-23) foliar disease reaction. R=Resistant, MR=Moderate Resistance, MS=Moderate Susceptibility, S=Susceptible

Plant Date: 5/6/24
Vine Kill: 8/29/24
Days from planting to vine kill: 115

[7]Enviroweather: Entrican Station. Planting to vine kill

Table 4

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

PRELIMINARY TRIAL, CHIP-PROCESSING LINES
MONTCALM RESEARCH CENTER
May 6 to September 10, 2024 (127 days)
DD Base 40°F 3200.1[7]

LINE	PVY RESISTANT	N	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	A1	A2	OV	PO	SP GR	OTF SFA	PERCENT (%) TUBER QUALITY[2] HH	IBS	BC	SCAB[3]	MAT[4]	BRUISE[5]	LB[6]
Huron Chipper		1	722	786	92	7	62	30	0	1	1.086	1	0	0	0	1.3	3.0	1.2	LBR
MSHH069-3	PVYR	1	628	656	96	2	38	58	0	2	1.082	1.0	0	0	0	1.3	3.0	2.1	LBMR
MSGG409-2	PVYR	1	617	655	94	5	50	44	1	1	1.091	2	0	0	0	1.5	4.0	2.5	LBR
MSHH063-2	PVYR	1	605	691	88	12	61	25	1	0	1.081	1.0	40	0	0	2.3	3.0	2.0	LBMR
MSHH034-12	PVYR	1	560	598	94	6	46	46	2	0	1.093	1.0	0	0	0	1.3	3.0	2.2	LBR
MSHH048-4	PVYR	1	542	578	94	6	47	45	2	0	1.087	1.0	0	0	0	2.2	3.0	1.9	LBMR
MSHH068-10	PVYR	1	535	576	93	7	68	25	0	0	1.090	1.0	0	0	0	2.3	2.0	2.3	LBMR
MSHH043-10	PVYR	1	528	580	91	8	46	45	0	1	1.092	1.0	0	0	0	1.0	3.0	3.9	LBMR
MSHH018-3	PVYR	1	509	531	96	4	58	38	0	0	1.083	1	0	0	0	1.5	2.0	4.4	LBR
MSHH043-03	PVYR	1	509	608	84	16	76	7	0	0	1.077	1.0	0	0	0	1.0	3.0	0.6	LBR
MSBB058-4		1	470	539	87	13	75	12	0	0	1.083	1	0	0	0	1.5	3.0	2.3	LBR
MSCC376-01		1	464	476	97	3	48	49	0	0	1.084	2	0	0	0	1.2	3.0	2.5	LBS
MSGG268-4	PVYR	1	459	514	89	11	68	21	0	0	1.080	1	0	0	0	0.7	3.0	0.3	LBMR
MSHH064-2	PVYR	1	448	486	92	6	47	40	5	1	1.088	1.5	0	10	0	1.5	2.0	2.9	LBMS
MSHH056-03	PVYR	1	446	515	87	11	79	8	0	2	1.078	1.0	0	0	0	1.2	4.0	0.9	LBR
MSBB614-11	PVYR	1	443	492	90	10	77	13	0	0	1.076	1	0	0	0	0.7	2.0	1.2	LBMR
NYU34-6		1	437	511	85	12	76	10	0	3	1.095	1.0	20	10	0	2.2	2.0	2.3	LBMR
MSHH015-5	PVYR	1	432	454	95	4	56	39	0	0	1.093	1	0	0	0	0.8	2.0	2.8	LBMR
MSHH130-1	PVYR	1	426	493	86	13	72	14	0	0	1.087	1.0	0	0	0	1.8	2.0	1.3	LBMS
MSHH134-20	PVYR	1	406	443	92	8	76	15	0	0	1.084	1.0	0	0	0	0.7	3.0	2.5	LBR
MSAA076-4		1	404	516	78	22	75	3	0	0	1.089	1	0	20	0	1.0	2.0	2.1	LBMS
MSHH053-04	PVYR	1	386	401	96	3	39	55	3	1	1.089	1.5	10	0	0	1.2	3.0	1.6	LBR
MSGG294-1	PVYR	1	378	428	88	12	71	17	0	0	-		0	0	0	2.3	3.0	-	LBMR
MSHH113-06	PVYR	1	377	465	81	16	71	10	0	2	1.082	1.0	0	20	0	1.5	2.0	2.1	LBMR
MSEE025-1	PVYR	1	374	381	98	2	56	42	0	0	1.080	1	0	0	0	1.3	3.0	1.3	LBMR
AC13126-1Wadg		1	371	403	92	7	51	41	0	1	1.082	1	0	0	0	2.0	3.0	1.6	LBMS
MSCC012-1		1	345	367	94	6	64	31	0	0	1.071	1	0	0	0	0.8	3.0	1.3	LBMR
MSCC058-1		1	341	365	93	4	49	44	0	2	1.087	1	30	0	0	1.8	2.0	2.2	LBS
MSHH004-2	PVYR	1	337	387	87	13	58	29	0	0	1.075	1	10	0	0	1.5	2.0	0.6	LBR
MSHH053-19	PVYR	1	329	379	87	13	70	17	0	0	1.091	1.0	0	0	0	1.0	3.0	2.6	LBMS
MSBB058-3	PVYR	1	325	346	94	6	54	40	0	0	1.091	2	0	0	0	1.5	4.0	4.0	LBR
MSHH137-1	PVYR	1	325	404	81	13	73	7	0	6	1.085	1.0	0	0	0	0.8	2.0	1.1	LBMR
MSHH040-4		1	317	327	97	3	49	48	0	0	1.077	1.0	0	0	0	1.2	2.0	2.2	LBS
Atlantic		1	**310**	**345**	**90**	**10**	**74**	**16**	**0**	**0**	**1.087**	**1**	**10**	**0**	**0**	**2.9**	**3.0**	**1.8**	**LBS**
MSHH066-6	PVYR	1	310	315	98	2	29	66	2	0	1.076	1.0	0	0	0	1.0	3.0	1.3	LBMR
MSGG302-1	PVYR	1	300	356	84	7	28	46	11	9	1.077	1	20	0	0	1.0	3.0	0.5	LBR
MSGG302-3	PVYR	1	291	347	84	14	59	25	0	2	1.084	1	0	10	0	2.7	3.0	0.3	LBR
MSHH018-4	PVYR	1	278	319	87	12	57	30	0	1	1.083	1	10	0	0	1.8	3.0	1.1	LBMR

LINE	PVY RESISTANT	N	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	A1	A2	OV	PO	SP GR	OTF SFA	PERCENT (%) TUBER QUALITY[2] HH	IBS	BC	SCAB[3]	MAT[4]	BRUISE[5]	LB[6]
MSHH056-19	PVYR	1	272	306	89	11	71	18	0	0	1.075	-	0	0	0	1.5	4.0	-	LBMS
Snowden		1	**263**	**348**	**76**	**24**	**72**	**3**	**0**	**0**	**1.084**	**1.0**	**10**	**0**	**0**	**3.2**	**1.0**	**1.8**	**LBS**
MSHH119-1		1	261	296	88	11	59	29	0	1	1.077	1.0	0	0	0	1.5	2.0	0.6	LBS
MSHH046-1	PVYR	1	253	276	92	8	54	37	0	0	1.088	1.0	0	0	0	1.3	2.0	2.0	LBMR
F160032-06		1	252	340	74	26	68	7	0	0	1.078	1	0	0	0	2.7	2.0	1.1	LBS
MSBB038-1		1	168	190	89	11	57	31	0	0	1.069	1	0	0	0	0.8	3.0	0.9	LBS
MSZ263-4		1	161	188	85	9	46	39	0	6	1.075	-	0	0	0	1.7	2.0	-	LBMR
AC13125-5W		1	154	203	76	23	70	5	0	1	1.064	1	0	0	10	1.8	2.0	0.9	-
MEAN			393	439							1.083					1.5	2.7	1.8	

[1]SIZE: B: < 1 7/8 in.; A1: >1 7/8-<2 9/16 in.; A2: > 2 9/16-< 3.25 in.; OV: > 3.25 in.; PO: Pickouts.

[2]QUALITY: HH: Hollow Heart; BC: Brown Center; IBS: Internal Brown Spot. Percent of 10 Oversize and/or A-size tubers cut.

[3]SCAB DISEASE RATING: MSU Scab Nursery; 0: No Infection; 1: Low Infection <5%; 3: Intermediate; 5: Highly Susceptible.

[4]MATURITY RATING: August 24, 2024; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

[5]BRUISE: Simulated blackspot bruise test average number of spots per tuber.

[6]LB: Late blight (*P. infestans* US-23) foliar disease reaction. R=Resistant, MR=Moderate Resistance, MS=Moderate Susceptibility, S=Susceptible

Plant Date: 5/6/24
Vine Kill: 8/29/24
Days from planting to vine kill: 115

[7]Enviroweather: Entrican Station. Planting to vine kill

Table 5

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

PRELIMINARY TRIAL, TABLESTOCK LINES
MONTCALM RESEARCH CENTER
May 6 to September 10, 2024 (127 days)
DD Base 40°F 3200.1[7]

LINE	PVY RESISTANT	N	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	A1	A2	OV	PO	SP GR	PERCENT (%) TUBER QUALITY[2] HH	IBS	BC	SCAB[3]	MAT[4]	BRUISE[5]	LB[6]
MSGG221-3		1	535	586	91	9	74	17	0	0	1.073	0	0	0	1.8	2.0	0.5	LBMR
MSHH206-11		1	489	545	90	10	63	27	0	0	1.070	0	0	0	3.5	2.0	1.7	LBMS
05 6556.1 (Chas)		1	405	490	83	17	76	6	0	0	1.048	0	0	0	1.5	1.0	0.0	LBR
MSGG078-7		1	366	600	61	39	60	1	0	0	1.070	0	0	0	2.3	2.0	0.5	LBR
IPB8343-5W/Y		1	362	461	78	22	76	2	0	0	1.077	0	0	0	1.0	1.0	0.8	LBMS
MSHH185-4		1	361	424	85	14	77	8	0	1	1.071	0	0	0	1.9	2.0	1.0	LBMR
Sifra		1	357	577	62	32	59	3	0	6	1.072	0	0	0	2.8	2.0	0.7	LBR
MSGG207-1		1	331	479	69	31	65	4	0	0	1.073	0	0	0	2.2	3.0	0.6	LBMR
MSFF050-1		1	326	352	93	3	38	54	0	4	1.076	0	0	0	1.0	3.0	1.2	LBMS
Noya		1	322	519	62	27	62	0	0	11	1.076	0	10	0	3.2	3.0	-	LBMR
MSHH224-1Y		1	319	444	72	25	67	4	0	3	1.058	0	0	0	1.2	2.0	0.7	LBMS
IPB8343-8W/Y		1	304	409	74	26	67	7	0	0	1.066	0	0	0	3.2	2.0	0.2	LBMS
Christel		1	297	425	70	30	68	2	0	0	1.057	0	0	0	1.3	1.0	0.4	LBMS
W13103-2Y		1	293	365	80	20	68	12	0	0	1.059	0	0	0	1.8	1.0	0.1	LBMS
Dark Red Norland		**1**	**270**	**333**	**81**	**19**	**80**	**1**	**0**	**0**	**1.059**	**0**	**0**	**0**	**0.9**	**2.0**	**0.3**	**LBS**
IPB83432-W/Y		1	247	358	69	31	67	2	0	0	1.064	0	20	0	0.0	1.0	0.5	LBMS
Jacqueline Lee		1	234	456	51	42	51	0	0	6	-	0	0	0	2.7	2.0	-	LBMR
Constance		1	221	379	58	38	57	1	0	4	1.068	0	10	0	1.5	2.0	0.8	LBR
Tyson		1	191	263	73	20	65	8	0	7	1.059	0	0	0	1.3	2.0	0.3	LMBS
Gala		1	171	314	54	46	54	0	0	0	1.061	0	0	0	2.5	2.0	0.0	LBMS
MI-3		1	162	382	42	52	40	2	0	6	1.071	10	0	0	2.5	3.0	0.6	LBMR
W15240-2Y		1	157	311	51	48	51	0	0	2	1.063	0	0	0	1.7	1.0	0.5	-
Marta		1	156	446	35	50	34	1	0	15	1.061	0	0	0	2.0	1.0	0.3	LBMS
Natalia		1	141	290	48	52	48	0	0	0	1.051	0	0	0	2.5	1.0	0.6	LBMS
Camelia		1	123	257	48	51	47	1	0	1	1.061	0	0	0	2.7	2.0	0.4	LBR
Jule		1	48	303	16	84	16	0	0	0	1.065	0	0	0	1.2	2.0	0.0	LBMR
MEAN			276	414							1.065				1.9	1.8	0.5	

[1]SIZE: B: < 1 7/8 in.; A1: >1 7/8-<2 9/16 in.; A2: > 2 9/16-< 3.25 in.; OV: > 3.25 in.; PO: Pickouts.
[2]QUALITY: HH: Hollow Heart; BC: Brown Center; IBS: Internal Brown Spot. Percent of 10 Oversize and/or A-size tubers cut.
[3]SCAB DISEASE RATING: MSU Scab Nursery; 0: No Infection; 1: Low Infection <5%; 3: Intermediate; 5: Highly Susceptible.
[4]MATURITY RATING: August 24, 2024; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).
[5]BRUISE: Simulated blackspot bruise test average number of spots per tuber.
[6]LB: Late blight (*P. infestans* US-23) foliar disease reaction. R=Resistant, MR=Moderate Resistance, MS=Moderate Susceptibility, S=Susceptible

Plant Date:	5/6/24
Vine Kill:	8/29/24
Days from planting to vine kill:	115

[7]Enviroweather: Entrican Station. Planting to vine kill

Table 6

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

PRELIMINARY TRIAL, PIGMENTED LINES
MONTCALM RESEARCH CENTER
May 6 to September 10, 2024 (127 days)
DD Base 40°F 3200.1[7]

	PVY		CWT/A		PERCENT OF TOTAL[1]							PERCENT (%) TUBER QUALITY[2]						
LINE	RESISTANT	N	US#1	TOTAL	US#1	Bs	A1	A2	OV	PO	SP GR	HH	IBS	BC	SCAB[3]	MAT[4]	Bruise[5]	LB[6]
MSHH179-04RY		1	471	532	89	11	48	41	0	0	-	0	0	0.0	3.0	3.0	-	LBR
MSHH176-2R		1	413	470	88	12	66	21	0	0	1.068	0	0	0.0	2.2	2.0	0.8	LBR
Dark Red Norland		**1**	**374**	**413**	**91**	**9**	**90**	**1**	**0**	**0**	**1.061**	**0**	**0**	**0.0**	**0.9**	**1.0**	**0.3**	**LBS**
MSFF030-1WR		1	370	445	83	15	78	5	0	2	1.060	0	0	0.0	1.8	2.0	0.2	LBMR
MSHH170-5RR		1	368	480	77	20	64	12	0	4	1.071	10	0	0.0	0.3	1.0	-	LBR
MSFF338-1PP		1	354	461	77	23	66	10	0	0	1.060	0	0	0.0	1.7	3.0	-	LBMR
MSHH161-06R		1	347	388	89	5	34	50	5	6	1.063	0	0	0.0	1.8	3.0	0.0	LBR
MSHH228-3PP		1	339	466	73	26	58	15	0	2	1.063	0	0	0.0	2.7	2.0	0.3	LBR
MSHH149-17R		1	332	398	83	15	69	15	0	2	1.071	0	0	0.0	2.8	2.0	#REF!	LBMR
MSGG158-11PP		1	312	432	72	28	59	14	0	0	-	0	0	0.0	2.2	3.0	-	LBMR
MSHH160-05R		1	295	339	87	13	54	33	0	0	-	0	0	0.0	2.2	3.0	-	LBR
MSHH155-6RY		1	291	394	74	25	69	5	0	1	-	0	0	0.0	1.8	3.0	-	LBR
NDAF113484B-1R		1	275	338	81	16	77	5	0	3	1.060	0	0	0.0	1.3	1.0	0.3	LBS
Cerata KWS		1	253	325	78	19	58	20	0	4	1.062	0	0	0.0	1.2	2.0	0.2	LBMR
MSHH164-03RY		1	253	290	87	11	70	18	0	1	1.077	0	0	0.0	0.8	1.0	0.4	LBR
Spuds n' Stripes Forever		1	248	309	80	19	70	10	0	1	1.057	0	0	0.0	2.3	1.0	0.7	LBR
MSHH172-3PP		1	209	240	87	11	58	30	0	2	1.066	0	0	0.0	2.0	1.0	0.5	LBMS
HZA 13-1486		1	189	335	56	44	55	1	0	0	1.065	0	0	0.0	1.3	1.0	0.2	LBMR
MSHH161-04RY		1	153	192	79	19	62	18	0	2	-	0	0	0.0	2.2	2.0	-	LBR
MSCC720-1WR		1	148	291	51	49	49	2	0	0	-	0	0	0.0	3.0	2.0	-	LBMR
MSFF198-13PY		1	117	251	46	53	46	0	0	1	1.062	0	0	0.0	1.7	1.0	0.6	-
MSFF335-1RR		1	100	294	34	64	32	2	0	2	1.071	0	0	0.0	2.5	2.0	-	LBMS
MSHH180-04R		1	15	108	14	86	14	0	0	0	-	0	0	0.0	3.2	2.0	-	LBMS
MEAN			271	356							1.065				2.0	1.9	#REF!	

[1]SIZE: B: < 1 7/8 in.; A1: >1 7/8-<2 9/16 in.; A2: > 2 9/16-< 3.25 in.; OV: > 3.25 in.; PO: Pickouts.
[2]QUALITY: HH: Hollow Heart; BC: Brown Center; IBS: Internal Brown Spot. Percent of 10 Oversize and/or A-size tubers cut.
[3]SCAB DISEASE RATING: MSU Scab Nursery; 0: No Infection; 1: Low Infection <5%; 3: Intermediate; 5: Highly Susceptible.
[4]MATURITY RATING: August 24, 2024; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).
[5]BRUISE: Simulated blackspot bruise test, average number of spots per tuber.
[6]LB: Late blight (*P. infestans* US-23) foliar disease reaction. R=Resistant, MR=Moderate Resistance, MS=Moderate Susceptibility, S=Susceptible

Plant Date: 5/6/24
Vine Kill: 8/29/24
Days from planting to vine kill: 115

[7]Enviroweather: Entrican Station. Planting to vine kill

Table 7

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

DIPLOID REPLICATED TRIAL
MONTCALM RESEARCH CENTER
May 6 to September 12, 2024 (129 days)
DD Base 40°F 3200.1[5]

		CWT/A		PERCENT OF TOTAL[1]							PERCENT (%) TUBER QUALITY[2]				
LINE	N	US#1	TOTAL	US#1	Bs	A1	A2	OV	PO	SP GR	HH	IBS	BC	SCAB[3]	MAT[4]
MSII1505-1	2	474	587	80	12	51	28	1	8	1.065	0	5	0	3.0	2.0
MSII1054-1	2	411	504	80	18	69	11	0	2	1.081	0	0	0	3	3.5
MSHH614-A7	2	409	440	93	3	45	48	0	4	1.061	0	0	0	3	2.5
MSHH614-A4	2	400	512	78	22	75	3	0	0	1.081	0	0	0	3	4.0
MSHH685-A1	2	399	540	74	26	66	8	0	0	1.084	35	0	0	3	4.0
MSII1188-1	2	397	503	79	18	61	18	0	3	1.076	30	5	10	2	3.0
MSHH614-A1	2	375	426	88	12	59	29	0	0	1.066	50	0	15	3	3.5
MSFF747-02	2	356	564	62	28	57	6	0	10	1.089	0	0	10	3	2.5
MSGG653-02	2	350	486	72	26	66	6	0	2	1.089	0	0	0	1	2.5
MSII1172-1	2	342	422	80	20	59	20	1	1	1.060	0	70	0	2	2.5
MSII1148-1	2	337	414	81	16	72	9	0	3	1.080	0	0	0	2	3.0
MSII1109-1	2	337	421	77	18	54	24	0	5	1.074	0	0	5	2	3.0
Atlantic	**2**	**336**	**354**	**94**	**6**	**56**	**36**	**2**	**0**	**1.085**	**25**	**5**	**0**	**3**	**2.5**
MSII1594-2Y	2	328	489	67	20	56	11	0	13	1.091	0	0	0	2.5	3.0
Mackinaw	**2**	**322**	**336**	**96**	**4**	**63**	**33**	**0**	**0**	**1.091**	**0**	**0**	**0**	**2**	**3.0**
MSFF788-01	2	321	430	75	20	67	8	0	5	1.079	0	0	0	3	3.5
MSII1545-1	2	308	525	60	37	54	6	0	3	1.079	0	0	0	2.0	2.5
MSHH1041-4	2	306	441	69	30	65	4	0	0	1.081	0	5	5	2	3.0
MSII1002-1	2	294	436	67	33	62	5	0	0	1.080	10	5	5	1	3.5
MSII1503-2RP	1	273	372	73	27	62	11	0	0	1.068	10	0	0	2.5	1.0
MSII1001-1	2	269	368	74	25	66	7	0	1	1.082	0	5	0	2	3.0
MSII1519-1	2	264	344	76	21	66	11	0	2	1.074	0	0	0	1.5	1.5
MSHH601-A4	2	250	320	78	22	64	13	0	0	1.073	0	0	0	2	4.0
MSII1111-1	2	243	385	62	36	60	3	0	2	1.078	0	0	0	2	3.0

LINE	N	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	A1	A2	OV	PO	SP GR	PERCENT (%) TUBER QUALITY[2] HH	IBS	BC	SCAB[3]	MAT[4]
MSGG626-03	2	240	453	53	47	51	2	0	0	1.076	0	5	5	2	3.0
MSEE824-04	2	239	311	77	22	71	6	0	1	1.084	25	0	0	2	1.5
MSHH970-A6	2	235	355	66	34	61	5	0	1	1.086	0	0	0	3	2.0
MSHH710-A2	2	232	273	85	14	49	36	0	1	1.073	0	0	0	3	2.0
MSII1199-1	2	220	298	72	15	59	12	1	12	1.083	45	0	0	3.8	3.5
MSHH878-02	2	207	342	60	36	56	4	0	4	1.084	5	0	0	2	3.5
MSHH606-A2	2	202	300	68	29	60	8	0	3	1.067	0	0	0	2	3.0
MSHH970-A1	2	193	243	79	20	76	3	0	0	1.082	0	5	0	1	2.5
MSHH1042-A2	2	192	279	68	26	67	1	0	6	1.077	0	0	5	3	3.0
MSII1081-1	2	190	245	77	17	76	1	0	5	1.094	5	0	0	2	3.5
MSII1075-1	2	189	296	64	28	60	4	0	8	1.072	0	0	0	2	2.5
MSFF725-3	2	188	305	61	29	58	3	0	10	1.075	0	0	0	2	2.0
MSHH600-A2	1	185	260	71	26	67	4	0	3	1.083	0	20	0	1	2.0
MSII1071-1	2	184	244	75	25	70	4	0	0	1.082	0	0	0	2	3.0
MSII1545-1	2	174	323	57	40	52	6	0	2	1.079	10	5	5	2.0	2.5
MSII1139-3	2	172	312	54	40	49	4	1	6	1.069	5	0	0	3	2.5
MSBB795-1	2	166	243	68	25	65	3	0	7	1.074	0	0	0	3	3.5
MSII1503-1PP	2	162	279	57	37	53	4	0	5	1.072	10	0	0	3.3	2.0
MSHH602-A1	2	160	235	66	24	60	6	0	10	1.068	0	5	5	3	2.5
MSHH1500-A7	2	140	228	61	36	60	1	0	2	1.090	0	0	0	1	2.5
MSHH1045-01	2	136	255	53	46	52	1	0	1	1.075	0	0	0	3	4.0
MSHH1042-A1	2	126	268	47	53	47	1	0	0	1.089	10	0	5	1	3.5
MSII1594-3Y	2	120	196	58	42	55	3	0	0	1.067	0	0	0	2.5	2.0
MSHH601-A2	2	117	129	91	7	41	48	2	2	1.076	0	0	0	2	3.0
MSHH601-A9	2	112	148	75	23	72	3	0	2	1.071	0	0	0	2	2.5
MSHH1040-A6	2	112	295	38	60	38	0	0	2	1.081	0	0	0	3	3.0
MSII1598-1RY	2	111	281	39	61	39	0	0	0	1.079	0	0	0	1.0	1.0
MSII1593-2	1	90	180	50	48	50	0	0	2	1.088	0	10	0	2.2	3.0
MSGG563-A4	2	88	257	34	64	34	0	0	2	1.083	0	0	0	3	1.5
MSII1123-2	2	77	157	50	50	49	1	0	1	1.085	0	0	5	2	2.0

LINE	N	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	A1	A2	OV	PO	SP GR	PERCENT (%) TUBER QUALITY[2] HH	IBS	BC	SCAB[3]	MAT[4]
MSII1511-1PP	2	73	183	38	49	38	0	0	13	1.078	0	0	0	2.0	1.0
MSHH1040-A5	2	71	189	37	55	37	0	0	8	1.073	0	0	0	2	3.0
MSII1612-1	1	57	99	58	42	55	3	0	0	1.082	0	0	0	2.0	4.0
MSII1642-1	1	47	128	36	55	36	0	0	9	1.074	0	0	0	1.3	1.0
MSII1075-2	2	36	170	21	72	21	0	0	6	1.085	0	0	0	2	2.5
MEAN		226	328							1.078				2.2	2.7
$HSD_{0.05}$		353	400							0.015					2.4

[1]SIZE: B: < 1 7/8 in.; A1: >1 7/8-<2 9/16 in.; A2: > 2 9/16-< 3.25 in.; OV: > 3.25 in.; PO: Pickouts.

[2]QUALITY: HH: Hollow Heart; BC: Brown Center; IBS: Internal Brown Spot. Percent of 20 Oversize and/or A-size tubers cut.

[3]SCAB DISEASE RATING: MSU Scab Nursery; 0: No Infection; 1: Low Infection <5%; 3: Intermediate; 5: Highly Susceptible. Plant Date: 5/6/24

[4]MATURITY RATING: August 24, 2024; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering). Vine Kill: 8/29/24

[5]Enviroweather: Entrican Station. Planting to vine kill Days from planting to vine kill: 115

Table 8

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

2022-24 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, MONTCALM RESEARCH CENTER , MI

LINE	3-YR* AVG.	2024 RATING	2024 WORST	2024 N	2023 RATING	2023 WORST	2023 N	2022 RATING	2022 WORST	2022 N
Sorted by ascending 2024 Average Rating;										
MSHH170-5RR	-	0.3	0.5	3						
MSCC282-3RR	-	0.5	0.5	3						
MSBB614-11	-	0.7	1.5	3						
MSDD244-15	0.9	0.7	1.0	3	1.2	2.0	3	1.0	1.5	3
MSEE182-3	0.7	0.7	1.0	3	0.3	0.5	3	1.2	2.0	3
MSGG268-4	-	0.7	1.0	3						
MSHH134-20	-	0.7	1.0	3						
FL2137	1.3*	0.8	1.0	3	1.8	2.5	3			
MSBB038-1	-	0.8	1.0	3						
MSCC012-1	-	0.8	1.0	3						
MSDD247-11	0.8	0.8	1.0	3	0.5	0.5	3	1.2	2.0	3
MSHH015-5	-	0.8	1.0	3						
MSHH137-1	-	0.8	1.0	3						
MSHH164-03RY	-	0.8	1.0	3						
Dark Red Norland	**1.1**	**0.9**	**1.5**	**9**	**0.9**	**1.5**	**9**	**1.3**	**2.0**	**6**
Colomba	1.4*	1.0	1.5	3	1.8	3.0	3			
Dundee (MSZ242-13)	0.9	1.0	2.0	3	0.8	1.0	3	0.8	1.0	3
IPB8343-5W/Y	-	1.0	1.5	3						
MSAA076-4	-	1.0	1.5	3						
MSBB371-1YSPL	1.1	1.0	1.5	3	1.2	2.0	3	1.2	2.0	3
MSEE031-3	1.1	1.0	1.0	3	0.8	1.0	3	1.3	1.5	3
MSEE207-2	0.7	1.0	1.5	3	0.3	0.5	3	0.7	1.0	3
MSFF031-6	1.1	1.0	1.5	3	1.0	1.5	3	1.3	1.5	3
MSFF050-1	1.2	1.0	1.5	3	0.8	1.0	3	1.7	3.0	3
MSGG135-1R	1.4*	1.0	1.0	3	1.8	2.0	2			
MSGG302-1	1*	1.0	1.0	3	1.0	1.5	2			
MSHH043-03	-	1.0	1.0	3						
MSHH043-10	-	1.0	1.0	3						
MSHH053-19	-	1.0	1.5	3						
MSHH066-6	-	1.0	1.0	3						
Bliss (NY163)	1.6	1.2	1.5	3	1.7	2.0	3	2.0	2.5	3
Cerata KWS	-	1.2	2.0	3						
Jule	-	1.2	2.0	3						
MSBB617-02	-	1.2	1.5	3						
MSBB636-11	1.0	1.2	1.5	3	0.7	1.0	3	1.2	1.5	3
MSCC376-01	-	1.2	1.5	3						
MSDD244-05	0.9	1.2	1.5	3	0.7	1.0	3	1.0	1.0	3
MSDD376-4	1.4	1.2	1.5	3	1.3	2.0	3	1.7	2.0	3
MSGG190-1	1.8*	1.2	1.5	3	2.5	3.0	3			
MSGG282-20	-	1.2	1.5	3						
MSHH040-4	-	1.2	1.5	3						
MSHH053-04	-	1.2	1.5	3						
MSHH056-03	-	1.2	1.5	3						
MSHH224-1Y	-	1.2	1.5	3						
Christel	-	1.3	1.5	3						
Huron Chipper	-	1.3	2.0	3						
HZA 13-1486	-	1.3	2.0	3						
MSAA076-6	1.2	1.3	1.5	3	0.8	1.0	3	1.3	2.0	3
MSDD247-07	1.3	1.3	1.5	3	1.0	1.0	3	1.7	2.0	3
MSEE025-1	1.2*	1.3	1.5	3	1.0	1.5	3			

LINE	3-YR* AVG.	2024 RATING	2024 WORST	2024 N	2023 RATING	2023 WORST	2023 N	2022 RATING	2022 WORST	2022 N
Sorted by ascending 2024 Average Rating;										
MSFF335-2RR	1.2	1.3	1.5	3	1.2	1.5	3	1.2	2.0	3
MSHH034-12	-	1.3	1.5	3						
MSHH046-1	-	1.3	1.5	3						
MSHH069-3	-	1.3	1.5	3						
NDAF113484B-1R	-	1.3	2.0	3						
Sinatra	-	1.3	1.5	3						
Tyson	-	1.3	1.5	3						
05 6556.1 (Chas)	-	1.5	2.0	3						
Constance	-	1.5	2.5	3						
Lamoka	**1.6**	**1.5**	**1.5**	**3**	**1.3**	**1.5**	**3**	**2.0**	**2.5**	**3**
Mackinaw[PVYR, LBR]	1.3	1.5	2.0	3	0.7	1.5	6	1.8	2.5	6
MSBB058-1	1.3	1.5	2.0	3	1.3	1.5	2	1.2	1.5	3
MSBB058-3	1.3	1.5	2.5	3	1.3	1.5	2	1.2	1.5	3
MSBB058-4	-	1.5	2.0	3						
MSBB610-13	1.5	1.5	2.5	3	1.2	1.5	3	1.8	2.5	3
MSDD249-9	1.5	1.5	2.0	3	1.0	1.5	3	2.0	2.0	3
MSEE016-07	1.3	1.5	2.0	3	0.8	1.0	3	1.5	2.5	3
MSFF038-3	1.7	1.5	2.0	3	1.7	2.5	3	1.8	2.0	3
MSGG409-2	-	1.5	1.5	3						
MSHH004-2	-	1.5	2.0	3						
MSHH018-3	-	1.5	1.5	3						
MSHH056-19	-	1.5	2.5	3						
MSHH064-2	-	1.5	1.5	3						
MSHH113-06	-	1.5	1.5	3						
MSHH119-1	-	1.5	2.0	3						
Blackberry	1.5	1.7	2.0	3	1.2	2.0	3	1.7	2.5	3
MSAA260-3	1.6	1.7	2.0	3	1.7	2.0	3	1.5	1.5	3
MSFF198-13PY	-	1.7	2.0	3						
MSFF338-1PP	1.9	1.7	2.0	3	1.8	2.5	3	2.3	3.0	3
MSHH157-4RR	-	1.7	2.0	3						
MSZ263-4	-	1.7	2.0	3						
NY174	-	1.7	2.5	3						
NY177	-	1.7	2.0	3						
Petoskey	1.5	1.7	2.0	3	1.3	1.5	6	1.7	2.0	3
W15240-2Y	-	1.7	2.0	3						
ND13220C-3	-	1.8	2.0	4						
W13103-2Y	-	1.8	2.0	4						
AC13125-5W	-	1.8	2.5	3						
MSCC058-1	-	1.8	2.5	3						
MSFF030-1WR	1.8*	1.8	2.5	3	1.8	2.0	3			
MSFF305-1RY	1.5	1.8	2.5	3	1.3	2.0	3	1.3	1.5	3
MSGG084-1	1.5*	1.8	3.0	3	1.2	1.5	3			
MSGG221-3	-	1.8	3.0	3						
MSHH018-4	-	1.8	2.0	3						
MSHH130-1	-	1.8	2.5	3						
MSHH155-6RY	-	1.8	2.0	3						
MSHH161-06R	-	1.8	2.0	3						
Queen Anne	-	1.8	2.0	3						
MSHH185-4	-	1.9	2.0	4						
AC13126-1Wadg	-	2.0	2.5	3						
Marta	-	2.0	2.5	3						
MSCC553-1R	1.8	2.0	2.5	3	2.2	2.5	3	1.2	1.5	3
MSFF035-2	1.3	2.0	3.5	3	0.7	1.0	3	1.2	1.5	3
MSGG137-1R	2.3*	2.0	2.5	3	2.7	3.5	3			

LINE	3-YR* AVG.	2024 RATING	2024 WORST	2024 N	2023 RATING	2023 WORST	2023 N	2022 RATING	2022 WORST	2022 N
Sorted by ascending 2024 Average Rating;										
MSHH172-3PP	-	2.0	2.0	3						
Jelly	2.2*	2.2	2.5	3	2.2	2.5	3			
MSFF029-10	2.3	2.2	2.5	3	2.0	2.0	3	2.7	3.0	3
MSGG158-11PP	1.8*	2.2	2.5	3	1.5	3.0	3			
MSGG207-1	-	2.2	2.5	3						
MSHH048-4	-	2.2	2.5	3						
MSHH160-05R	-	2.2	2.5	3						
MSHH161-04RY	-	2.2	2.5	3						
MSHH176-2R	-	2.2	3.0	3						
NYU34-6	-	2.2	2.5	3						
Manistee	2.6	2.3	3.0	3	2.5	3.0	3	2.8	3.5	3
MSBB230-1	2*	2.3	2.5	3	1.7	2.0	3			
MSGG039-11Y	2.4*	2.3	2.5	3	2.5	3.0	3			
MSGG078-7	-	2.3	2.5	3						
MSGG294-1	-	2.3	2.5	3						
MSHH063-2	-	2.3	3.0	3						
MSHH068-10	-	2.3	2.5	3						
Spuds n' Stripes Forever	-	2.3	3.5	3						
Gala	-	2.5	3.0	3						
MI-3	-	2.5	3.0	3						
MSFF335-1RR	-	2.5	3.0	3						
MSGG127-3R	2.8*	2.5	3.0	3	3.0	3.5	3			
Natalia	-	2.5	3.0	4						
Spartan Splash	2.2	2.5	3	3	1.7	2.5	3	2.3	2.5	3
Yukon Gold	**2.6**	**2.5**	**3**	**3**	**2.7**	**3.0**	**3**	**2.7**	**3.0**	**3**
MSCC512-1PP	-	2.6	3.0	4						
Camelia	2.8*	2.7	3.0	3	3.0	3.5	3			
F160032-06	-	2.7	3.0	3						
Jacqueline Lee	2.7	2.7	3.5	3	2.7	3.5	3	2.8	3.5	3
MSGG302-3	-	2.7	3.0	3						
MSHH228-3PP	-	2.7	3.5	3						
Reba	**2.4**	**2.7**	**3**	**3**	**2.0**	**2.5**	**3**	**2.5**	**3.0**	**3**
MSHH149-17R	-	2.8	3.5	3						
Sifra	2.8*	2.8	3.5	3	2.8	3.5	3			
Snowden	**3.1**	**2.9**	**4**	**6**	**3.0**	**3.5**	**6**	**3.3**	**3.5**	**6**
Atlantic	**2.9**	**2.9**	**3.5**	**7**	**2.6**	**3.0**	**6**	**3.1**	**3.5**	**6**
IPB8343-2W/Y	-	3.0	3.0	3						
MSCC720-1WR	-	3.0	3.5	3						
MSGG039-08Y	3*	3.0	3.5	3	3.0	3.5	3			
MSHH179-04RY	-	3.0	3.5	3						
IPB8343-8W/Y	-	3.2	3.5	3						
MSHH180-04R	-	3.2	4.0	3						
Noya	-	3.2	3.5	3						
MSHH206-11	-	3.5	4.0	3						
Mean		**1.7**			**1.6**			**1.7**		
$HSD_{0.05}$ =										

SCAB DISEASE RATING: MSU Scab Nursery plot rating of 0-5; 0: No Infection; 1: Low Infection <5%, no pitted leisions; 3: Intermediate >20%, some pitted leisions (Susceptible, as commonly seen on Atlantic); 5: Highly Susceptible, >75% coverage and severe pitted leisions.

N = Number of replications.

*2-Year Average.

Table 9

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

2024 SCAB DISEASE EARLY GENERATION TRIAL SUMMARY
SCAB NURSERY, MONTCALM RESEARCH CENTER, MI

LINE	2024 RATING	2024 N	LINE	2024 RATING	2024 N
Sorted by ascending 2023 Rating:					
MSII147-3	0.5	1.0	MSJJ103-3R	1.0	1.0
MSII147-9	0.5	1.0	MSJJ175-1	1.0	1.0
MSII163-1	0.5	1.0	Castle Russet	1.5	1.0
MSII416-2RR	0.5	1.0	MSII040-1	1.5	1.0
MSII416-6R	0.5	1.0	MSII117-01	1.5	1.0
MSJJ011-1	0.5	1.0	MSII186-1	1.5	1.0
MSJJ042-07	0.5	1.0	MSII211-3	1.5	1.0
MSJJ044-4	0.5	1.0	MSII414-2PP	1.5	1.0
MSJJ083-1RR	0.5	1.0	MSII418-7R	1.5	1.0
MSJJ097-1R	0.5	1.0	MSJJ004-1	1.5	1.0
MSJJ099-5RR	0.5	1.0	MSJJ010-05	1.5	1.0
MSJJ108-1	0.5	1.0	MSJJ016-1	1.5	1.0
MSJJ150-1	0.5	1.0	MSJJ039-3	1.5	1.0
MSJJ188-3	0.5	1.0	MSJJ041-10	1.5	1.0
MSJJ188-5	0.5	1.0	MSJJ043-08	1.5	1.0
MSJJ212-2RR	0.5	1.0	MSJJ044-02	1.5	1.0
MSII075-1	1.0	1.0	MSJJ044-06	1.5	1.0
MSII105-1	1.0	1.0	MSJJ116-1	1.5	1.0
MSII107-5	1.0	1.0	MSJJ163-1Y	1.5	1.0
MSII107-7	1.0	1.0	MSII062-3	2.0	1.0
MSII108-6	1.0	1.0	MSII128-4	2.0	1.0
MSII117-10	1.0	1.0	MSII129-1	2.0	1.0
MSII119-2	1.0	1.0	MSII168-1	2.0	1.0
MSII142-1	1.0	1.0	MSII325-1Y	2.0	1.0
MSII147-8	1.0	1.0	MSII326-1	2.0	1.0
MSII306-5Y	1.0	1.0	MSII353-2Y	2.0	1.0
MSII400-1RR	1.0	1.0	MSII415-3R	2.0	1.0
MSJJ006-1	1.0	1.0	MSJJ014-7	2.0	1.0
MSJJ007-4	1.0	1.0	MSJJ040-8	2.0	1.0
MSJJ014-5	1.0	1.0	MSJJ041-07	2.0	1.0
MSJJ033-5	1.0	1.0	MSJJ043-17	2.0	1.0
MSJJ034-1	1.0	1.0	MSJJ044-05	2.0	1.0
MSJJ039-6	1.0	1.0	MSJJ081-4RY	2.0	1.0
MSJJ041-3	1.0	1.0	MSJJ104-4R	2.0	1.0
MSJJ041-14	1.0	1.0	MSJJ194-1Y	2.0	1.0
MSJJ042-01	1.0	1.0	MSJJ197-2	2.0	1.0
MSJJ042-11	1.0	1.0	MSJJ220-1R	2.0	1.0
MSJJ042-19	1.0	1.0	MSII088-1	2.5	1.0
MSJJ043-1	1.0	1.0	MSII108-4	2.5	1.0
MSJJ043-18	1.0	1.0	MSII150-3	2.5	1.0
MSJJ054-1	1.0	1.0	MSII214-1	2.5	1.0

LINE	2024 RATING	2024 N	LINE	2024 RATING	2024 N
Sorted by ascending 2023 Rating:					
MSII301-4	2.5	1.0	MSJJ123-2	2.5	1.0
MSII409-5R	2.5	1.0	MSJJ190-1WR	2.5	1.0
MSII414-06PP	2.5	1.0	MSII084-1	3.0	1.0
MSJJ009-2	2.5	1.0	MSII132-2	3.0	1.0
MSJJ041-11	2.5	1.0	MSII160-1	3.0	1.0
MSJJ041-12	2.5	1.0	MSJJ044-01	3.0	1.0
MSJJ042-12	2.5	1.0	MSJJ168-1	3.0	1.0
MSJJ051-4	2.5	1.0	MSJJ203-3Y	3.0	1.0
MSJJ056-3	2.5	1.0	MSII176-3	3.5	1.0
MSJJ086-2P	2.5	1.0	MSII237-1	3.5	1.0
MSJJ103-2R	2.5	1.0	MSII336-1	3.5	1.0
MSJJ104-5R	2.5	1.0	MSJJ154-1	3.5	1.0
MSJJ107-4	2.5	1.0	MSJJ204-1	3.5	1.0
MSJJ120-2	2.5	1.0			

Table 10

2024 MSU LATE BLIGHT VARIETY TRIAL
PLANT PATHOLOGY FARM, LANSING, MI

Line Sort:				*RAUDPC Sort:*			
LINE	N	RAUDPC[1] MEAN	LB RESISTANCE[2]	LINE	N	RAUDPC[1] MEAN	LB RESISTANCE[2]
05 6556.1 (Chas)	3	1.4	LBR	MSFF305-1RY	3	0.7	LBR
AC13126-1Wadg	3	15.2	LBMS	MSBB058-3	3	0.7	LBR
Atlantic	**3**	**34.5**	**LBS**	MSDD244-15	3	0.8	LBR
Blackberry	3	10.2	LBMR	MSGG302-3	3	1.0	LBR
Bliss (NY163)	3	30.2	LBS	MSHH1610-6R	1	1.2	LBR
Camelia	3	2.8	LBR	MSGG409-2	3	1.3	LBR
Cerata KWS	3	6.5	LBMR	05 6556.1 (Chas)	3	1.4	LBR
Christel	3	25.6	LBMS	MSDD376-4	3	1.5	LBR
Columba	**3**	**33.1**	**LBS**	MSHH228-3PP	2	1.5	LBR
Constance	3	3.9	LBR	MSHH161-06R	2	1.6	LBR
Dark Red Norland	**3**	**35.5**	**LBS**	MSHH160-05R	3	1.7	LBR
F160032-06	3	37.4	LBS	MSCC282-3RR	3	1.8	LBR
FL2137	3	22.3	LBMS	MSEE016-07	3	2.0	LBR
Gala	3	22.7	LBMS	MSGG135-1R	3	2.0	LBR
HZA 13-1486	3	5.5	LBMR	MSHH134-20	3	2.0	LBR
IPB8343-2W/Y	3	24.7	LBMS	MSGG282-20	3	2.2	LBR
IPB8343-5W/Y	3	23.5	LBMS	MSHH004-2	3	2.2	LBR
IPB8343-8W/Y	3	20.2	LBMS	MSGG127-3R	2	2.6	LBR
Jacqueline Lee	3	6.3	LBMR	MSHH155-6RY	3	2.6	LBR
Jelly	3	5.0	LBR	MSHH170-5RR	3	2.6	LBR
Jule	3	12.6	LBMR	MSHH179-04RY	3	2.7	LBR
Lamoka	**3**	**25.2**	**LBMS**	MSGG302-1	3	2.8	LBR
Mackinaw	**3**	**3.3**	**LBR**	Camelia	3	2.8	LBR
Marta	2	22.3	LBMS	MSGG078-7	3	3.1	LBR
MI-3	3	5.9	LBMR	MSBB058-4	3	3.2	LBR
MSAA076-4	3	16.3	LBMS	MSHH176-2R	3	3.2	LBR
MSAA076-6	3	24.5	LBMS	**Mackinaw**	**3**	**3.3**	**LBR**
MSAA260-3	3	25.5	LBMS	MSHH056-19	3	3.3	LBR
MSBB058-1	3	25.5	LBMS	MSGG221-3	2	3.4	LBR
MSBB058-3	3	0.7	LBR	NY177	3	3.4	LBR
MSBB058-4	3	3.2	LBR	MSHH018-3	3	3.6	LBR
MSBB190-1	3	6.1	LBMR	MSCC553-1R	2	3.7	LBR
MSBB230-1	3	9.8	LBMR	MSDD247-11	3	3.9	LBR
MSBB610-13	3	10.2	LBMR	Constance	3	3.9	LBR
MSBB614-11	3	5.8	LBMR	MSHH034-12	3	4.0	LBR
MSBB617-02	3	5.6	LBMR	MSHH053-04	3	4.1	LBR
MSBB636-11	3	10.8	LBMR	Spuds n' Stripe	3	4.2	LBR
MSCC012-1	3	13.3	LBMR	MSHH164-03RY	3	4.4	LBR
MSCC282-3RR	3	1.8	LBR	MSHH161-04RY	2	4.6	LBR
MSCC512-1PP	2	11.7	LBMR	Sifra	3	4.6	LBR
MSCC553-1R	2	3.7	LBR	Jelly	3	5.0	LBR
MSCC720-1WR	3	9.3	LBMR	MSHH056-03	3	5.0	LBR
MSDD244-05	3	8.9	LBMR	MSHH043-03	3	5.1	LBR
MSDD244-15	3	0.8	LBR	MSFF038-3	3	5.2	LBR
MSDD247-07	3	8.0	LBMR	MSZ263-4	2	5.5	LBMR
MSDD247-11	3	3.9	LBR	HZA 13-1486	3	5.5	LBMR
MSDD249-9	3	5.7	LBMR	MSHH063-2	3	5.5	LBMR
MSDD376-4	3	1.5	LBR	MSHH149-17R	3	5.6	LBMR
MSEE016-07	3	2.0	LBR	MSBB617-02	3	5.6	LBMR
MSEE025-1	3	6.2	LBMR	MSDD249-9	3	5.7	LBMR
MSEE031-3	3	11.2	LBMR	MSBB614-11	3	5.8	LBMR

Line Sort:				*RAUDPC Sort:*			
LINE	N	RAUDPC[1] MEAN	LB RESISTANCE[2]	LINE	N	RAUDPC[1] MEAN	LB RESISTANCE[2]
MSEE182-3	3	9.2	LBMR	MSGG039-0Y8	1	5.8	LBMR
MSEE207-2	3	6.2	LBMR	MI-3	3	5.9	LBMR
MSFF029-10	3	10.1	LBMR	MSGG039-11Y	3	5.9	LBMR
MSFF030-1WR	3	10.6	LBMR	MSGG137-1R	3	5.9	LBMR
MSFF031-6	3	8.2	LBMR	MSBB190-1	3	6.1	LBMR
MSFF035-2	3	13.1	LBMR	MSGG207-1	3	6.2	LBMR
MSFF038-3	3	5.2	LBR	MSEE025-1	3	6.2	LBMR
MSFF050-1	3	18.7	LBMS	MSEE207-2	3	6.2	LBMR
MSFF305-1RY	3	0.7	LBR	MSGG190-1	3	6.2	LBMR
MSFF335-1RR	3	24.4	LBMS	Jacqueline Lee	3	6.3	LBMR
MSFF335-2RR	3	8.2	LBMR	Cerata KWS	3	6.5	LBMR
MSFF338-1PP	3	12.5	LBMR	MSHH113-06	3	6.5	LBMR
MSGG039-0Y8	1	5.8	LBMR	MSHH137-1	3	6.8	LBMR
MSGG039-08Y	2	7.3	LBMR	MSHH048-4	3	7.1	LBMR
MSGG039-11Y	3	5.9	LBMR	NYU34-6	3	7.1	LBMR
MSGG078-7	3	3.1	LBR	MSHH015-5	3	7.1	LBMR
MSGG084-1	3	14.0	LBMS	MSGG039-08Y	2	7.3	LBMR
MSGG127-3R	2	2.6	LBR	MSHH018-4	3	7.4	LBMR
MSGG135-1R	3	2.0	LBR	MSHH066-6	3	7.8	LBMR
MSGG137-1R	3	5.9	LBMR	MSHH043-10	3	7.9	LBMR
MSGG158-11PP	3	8.9	LBMR	MSDD247-07	3	8.0	LBMR
MSGG190-1	3	6.2	LBMR	Noya	3	8.0	LBMR
MSGG207-1	3	6.2	LBMR	MSHH046-1	3	8.2	LBMR
MSGG221-3	2	3.4	LBR	MSFF335-2RR	3	8.2	LBMR
MSGG268-4	3	9.1	LBMR	MSFF031-6	3	8.2	LBMR
MSGG282-20	3	2.2	LBR	NY174	3	8.3	LBMR
MSGG294-1	3	10.4	LBMR	MSHH157-4RR	3	8.5	LBMR
MSGG302-1	3	2.8	LBR	MSDD244-05	3	8.9	LBMR
MSGG302-3	3	1.0	LBR	MSGG158-11PP	3	8.9	LBMR
MSGG409-2	3	1.3	LBR	MSGG268-4	3	9.1	LBMR
MSHH004-2	3	2.2	LBR	MSEE182-3	3	9.2	LBMR
MSHH015-5	3	7.1	LBMR	MSCC720-1WR	3	9.3	LBMR
MSHH018-3	3	3.6	LBR	MSHH069-3	3	9.5	LBMR
MSHH018-4	3	7.4	LBMR	MSBB230-1	3	9.8	LBMR
MSHH034-12	3	4.0	LBR	MSFF029-10	3	10.1	LBMR
MSHH040-4	3	30.3	LBS	MSBB610-13	3	10.2	LBMR
MSHH043-03	3	5.1	LBR	Blackberry	3	10.2	LBMR
MSHH043-10	3	7.9	LBMR	MSGG294-1	3	10.4	LBMR
MSHH046-1	3	8.2	LBMR	MSHH068-10	3	10.5	LBMR
MSHH048-4	3	7.1	LBMR	MSFF030-1WR	3	10.6	LBMR
MSHH053-04	3	4.1	LBR	MSBB636-11	3	10.8	LBMR
MSHH053-19	3	16.3	LBMS	MSEE031-3	3	11.2	LBMR
MSHH056-03	3	5.0	LBR	MSCC512-1PP	2	11.7	LBMR
MSHH056-19	3	3.3	LBR	MSHH185-4	3	12.1	LBMR
MSHH063-2	3	5.5	LBMR	MSFF338-1PP	3	12.5	LBMR
MSHH064-2	3	14.9	LBMS	Jule	3	12.6	LBMR
MSHH066-6	3	7.8	LBMR	MSFF035-2	3	13.1	LBMR
MSHH068-10	3	10.5	LBMR	MSCC012-1	3	13.3	LBMR
MSHH069-3	3	9.5	LBMR	MSGG084-1	3	14.0	LBMS
MSHH113-06	3	6.5	LBMR	Tyson	3	14.3	LBMS
MSHH119-1	3	30.8	LBS	W13103-2Y	3	14.6	LBMS
MSHH130-1	3	18.0	LBMS	MSHH064-2	3	14.9	LBMS
MSHH134-20	3	2.0	LBR	MSHH206-11	3	15.0	LBMS
MSHH137-1	3	6.8	LBMR	AC13126-1Wadg	3	15.2	LBMS

Line Sort:					*RAUDPC Sort:*			
LINE	N	RAUDPC[1] MEAN	LB RESISTANCE[2]		LINE	N	RAUDPC[1] MEAN	LB RESISTANCE[2]
MSHH149-17R	3	5.6	LBMR		MSAA076-4	3	16.3	LBMS
MSHH155-6RY	3	2.6	LBR		MSHH053-19	3	16.3	LBMS
MSHH157-4RR	3	8.5	LBMR		**Snowden**	**6**	**17.9**	**LBMS**
MSHH160-05R	3	1.7	LBR		MSHH130-1	3	18.0	LBMS
MSHH161-04RY	2	4.6	LBR		Natalia	3	18.6	LBMS
MSHH161-06R	2	1.6	LBR		MSFF050-1	3	18.7	LBMS
MSHH164-03RY	3	4.4	LBR		IPB8343-8W/Y	3	20.2	LBMS
MSHH170-5RR	3	2.6	LBR		MSHH224-1Y	3	21.0	LBMS
MSHH172-3PP	3	23.7	LBMS		FL2137	3	22.3	LBMS
MSHH176-2R	3	3.2	LBR		Marta	2	22.3	LBMS
MSHH179-04RY	3	2.7	LBR		Sinatra	2	22.4	LBMS
MSHH180-04R	3	24.9	LBMS		Gala	3	22.7	LBMS
MSHH185-4	3	12.1	LBMR		IPB8343-5W/Y	3	23.5	LBMS
MSHH206-11	3	15.0	LBMS		MSHH172-3PP	3	23.7	LBMS
MSHH224-1Y	3	21.0	LBMS		MSFF335-1RR	3	24.4	LBMS
MSHH228-3PP	2	1.5	LBR		MSAA076-6	3	24.5	LBMS
MSHH1610-6R	1	1.2	LBR		IPB8343-2W/Y	3	24.7	LBMS
MSZ263-4	2	5.5	LBMR		MSHH180-04R	3	24.9	LBMS
Natalia	3	18.6	LBMS		Queen Anne	3	25.1	LBMS
NDAF113484B-1R	3	32.2	LBS		**Lamoka**	**3**	**25.2**	**LBMS**
Noya	3	8.0	LBMR		MSBB058-1	3	25.5	LBMS
NY174	3	8.3	LBMR		MSAA260-3	3	25.5	LBMS
NY177	3	3.4	LBR		Christel	3	25.6	LBMS
NYU34-6	3	7.1	LBMR		Bliss (NY163)	3	30.2	LBS
Queen Anne	3	25.1	LBMS		MSHH040-4	3	30.3	LBS
Reba	**3**	**33.0**	**LBS**		**Yukon Gold**	**3**	**30.4**	**LBS**
Sifra	3	4.6	LBR		MSHH119-1	3	30.8	LBS
Sinatra	2	22.4	LBMS		NDAF113484B-1R	3	32.2	LBS
Snowden	**6**	**17.9**	**LBMS**		**Reba**	**3**	**33.0**	**LBS**
Spuds n' Stripe	3	4.2	LBR		**Columba**	**3**	**33.1**	**LBS**
Tyson	3	14.3	LBMS		**Atlantic**	**3**	**34.5**	**LBS**
W13103-2Y	3	14.6	LBMS		**Dark Red Norland**	**3**	**35.5**	**LBS**
Yukon Gold	**3**	**30.4**	**LBS**		F160032-06	3	37.4	LBS

[1]Ratings indicate the average plot RAUDPC (Relative Area Under the Disease Progress Curve).
[2]LB Resistance: LBR=Resistant, LBMR=Moderate Resistance, LBMS=Moderate Susceptibility, LBS=Susceptible
LB Isolate used: US-23

Table 11

2024 MSU LATE BLIGHT EARLY GENERATION TRIAL
PATHOLOGY FARM EAST, LANSING, MI

LINE	RAUDPC[1] MEAN	LB RESISTANCE[2]	N	LINE	RAUDPC[1] MEAN	LB RESISTANCE[2]	N
Sorted by ascending 2024 RAUDPC							
MSII415-3R	0.2	LBR	1	MSJJ044-02	10.0	LBMR	1
MSII416-2R	0.3	LBR	1	MSII409-5R	10.2	LBMR	1
MSJJ188-5	0.5	LBR	1	MSJJ154-1	10.2	LBMR	1
MSJJ204-1	0.5	LBR	1	MSJJ040-8	10.4	LBMR	1
MSII414-6PP	0.6	LBR	1	MSII108-4	11.3	LBMR	1
MSII150-3	0.8	LBR	1	MSJJ041-14	11.6	LBMR	1
MSII416-6R	1.1	LBR	1	MSII418-7R	11.7	LBMR	1
MSJJ043-17	1.3	LBR	1	MSJJ056-3	12.5	LBMR	1
MSJJ188-3	1.3	LBR	1	MSII160-1	13.2	LBMR	1
MSII414-2P	1.4	LBR	1	MSJJ044-05	13.2	LBMR	1
MSJJ041-07	1.4	LBR	1	MSJJ116-1	13.6	LBMR	1
MSJJ033-5	1.6	LBR	1	MSII168-1	13.9	LBMS	1
MSJJ103-3R	1.6	LBR	1	MSII105-1	14.2	LBMS	1
MSJJ051-4	2.2	LBR	1	MSJJ168-1	14.6	LBMS	1
MSJJ203-3Y	2.3	LBR	1	MSJJ190-1WR	15.6	LBMS	1
MSJJ220-1R	2.5	LBR	1	MSII084-1	16.0	LBMS	1
MSII088-1	2.6	LBR	1	MSJJ150-1	16.0	LBMS	1
MSII306-5Y	2.7	LBR	1	MSII353-2Y	18.1	LBMS	1
MSII117-01	2.8	LBR	1	MSJJ041-12	18.3	LBMS	1
MSJJ054-1	2.8	LBR	1	MSII237-1	18.7	LBMS	1
MSII128-4	3.0	LBR	1	MSJJ042-01	19.1	LBMS	1
MSJJ009-2	3.0	LBR	1	MSJJ042-12	19.4	LBMS	1
MSJJ039-3	3.2	LBR	1	MSJJ042-07	19.7	LBMS	1
MSJJ039-6	3.6	LBR	1	MSII063-2	20.0	LBMS	1
MSJJ006-1	3.8	LBR	1	MSJJ086-2P	20.3	LBMS	1
MSJJ043-08	4.0	LBR	1	MSJJ010-05	20.6	LBMS	1
MSJJ044-06	4.7	LBR	1	MSJJ097-1	22.6	LBMS	1
MSII147-9	6.0	LBMR	1	MSJJ007-4	22.9	LBMS	1
MSJJ044-4	6.6	LBMR	1	MSJJ016-1	23.3	LBMS	1
MSII117-10	6.7	LBMR	1	MSJJ120-2	24.0	LBMS	1
MSJJ103-2R	6.9	LBMR	1	MSJJ163-1Y	24.3	LBMS	1
Castle Russet	7.2	LBMR	1	MSJJ212-2RR	24.3	LBMS	1
MSJJ042-11	8.0	LBMR	1	MSJJ011-1	24.4	LBMS	1
MSJJ175-1	8.1	LBMR	1	MSII163-1	24.5	LBMS	1
MSJJ043-18	8.2	LBMR	1	MSII119-2	25.7	LBMS	1
MSJJ034-1	8.3	LBMR	1	MSJJ123-2	26.2	LBMS	1
MSII176-3	8.4	LBMR	1	MSJJ194-1Y	27.5	LBS	1
MSII075-1	8.5	LBMR	1	MSJJ044-01	28.2	LBS	1
MSII211-3	8.7	LBMR	1	MSII142-1	28.9	LBS	1
MSJJ041-11	8.8	LBMR	1	MSII325-1Y	30.6	LBS	1
MSJJ041-3	9.4	LBMR	1	MSII132-2	32.1	LBS	1
MSJJ042-19	9.4	LBMR	1	MSII400-1R	32.4	LBS	1
MSII186-1	9.8	LBMR	1	MSII326-1	33.1	LBS	1
MSJJ083-1RR	9.8	LBMR	1	MSII301-4	35.8	LBS	1
MSJJ099-5RR	9.9	LBMR	1	MSJJ041-10	37.5	LBS	1

[1]Ratings indicate the average plot RAUDPC (Relative Area Under the Disease Progress Curve).
[2]LB Resistance: LBR=Resistant, LBMR=Moderate Resistance, LBMS=Moderate Susceptibility, LBS=Susceptible
LB Isolate used: US-23

Table 12

2024 BLACKSPOT BRUISE SUSCEPTIBILITY TEST
SIMULATED BRUISE SAMPLES*

ENTRY	SP GR	NUMBER OF SPOTS PER TUBER 0	1	2	3	4	5+	PERCENT (%) BRUISE FREE	AVERAGE SPOTS/TUBER
ADAPTATION TRIAL, CHIP-PROCESSING LINES									
MSBB636-11	1.076	21	4	0	0	0	0	84	0.2
Manistee	1.080	13	8	4	0	0	0	52	0.6
MSEE182-3	1.078	17	4	3	1	1	0	65	0.7
MSBB617-02	1.083	12	9	4	0	0	0	48	0.7
MSFF029-10	1.084	11	10	4	0	0	0	44	0.7
ND13220C-3	1.093	11	3	6	0	0	0	55	0.8
MSBB610-13	1.077	13	7	3	1	1	0	52	0.8
MSGG190-1	1.078	12	7	3	3	0	0	48	0.9
Bliss (NY163)	1.086	8	9	7	1	0	0	32	1.0
MSEE207-2	1.079	11	4	7	3	0	0	44	1.1
Sinatra	1.091	6	12	6	1	0	0	24	1.1
Lamoka	**1.084**	**6**	**10**	**6**	**3**	0	0	**24**	**1.2**
MSDD249-9	1.084	7	9	3	5	0	1	28	1.4
MSDD244-05	1.083	5	10	4	5	1	0	20	1.5
MSDD247-11	1.094	7	8	4	4	1	1	28	1.5
Atlantic	**1.085**	**6**	**7**	**3**	**5**	**0**	**1**	**27**	**1.5**
MSGG282-20	1.080	4	8	10	1	2	0	16	1.6
MSEE031-3	1.082	4	10	7	4	0	1	15	1.6
FL2137	**1.084**	**4**	**10**	**5**	**3**	**3**	**0**	**16**	**1.6**
Snowden	**1.082**	**2**	**7**	**10**	**5**	**0**	**1**	**8**	**1.9**
Mackinaw	1.091	3	6	8	4	1	2	13	2.0
MSBB058-1	1.088	3	7	7	5	1	2	12	2.0
MSDD376-4	1.086	3	5	7	8	1	1	12	2.1
MSDD247-07	1.100	4	6	7	4	5	1	15	2.1
Petoskey	1.093	4	5	4	5	4	2	17	2.3
Dundee	1.100	2	6	9	3	1	4	8	2.3
MSDD244-15	1.082	0	6	9	5	4	1	0	2.4
MSAA260-3	1.078	2	3	9	6	1	5	8	2.6
MSAA076-6	1.087	1	3	9	6	3	3	4	2.6
MSFF038-3	1.082	0	4	9	5	1	5	0	2.8
MSBB230-1	1.084	2	5	1	7	7	3	8	2.8
NY177	1.097	0	1	7	5	5	7	0	3.4
NY174	1.086	0	1	4	5	2	12	0	3.8
ADAPTATION TRIAL, TABLESTOCK LINES									
Columba	**1.053**	**20**	**5**	**0**	**0**	0	0	**80**	**0.2**
MSGG039-11Y	1.073	19	4	2	0	0	0	76	0.3
Jelly	1.077	15	7	2	0	0	0	63	0.5
Blackberry	1.069	13	11	1	0	0	0	52	0.5
MSFF305-1RY	1.068	14	9	2	0	0	0	56	0.5
MSCC553-1R	1.073	14	7	3	1	0	0	56	0.6
MSGG135-1R	1.073	13	8	4	0	0	0	52	0.6
Yukon Gold	**1.072**	**11**	**11**	**3**	**0**	**0**	**0**	**44**	**0.7**
MSGG039-08Y	1.067	12	8	5	0	0	0	48	0.7
MSBB371-1YSPL	1.069	13	5	6	1	0	0	52	0.8
Queen Anne	1.064	8	14	3	0	0	0	32	0.8
Reba	**1.070**	**11**	**9**	**3**	**1**	**0**	**1**	**44**	**0.9**
MSFF031-6	1.072	3	6	8	2	4	2	12	2.2
PRELIMINARY TRIAL, CHIP-PROCESSING LINES									
MSGG268-4	1.080	18	7	0	0	0	0	72	0.3
MSGG302-3	1.084	17	7	0	0	0	0	71	0.3
MSGG302-1	1.077	14	10	1	0	0	0	56	0.5
MSHH043-03	1.077	12	6	1	1	0	0	60	0.6
MSHH004-2	1.075	15	7	2	1	0	0	60	0.6
MSHH119-1	1.077	13	10	2	0	0	0	52	0.6
MSHH056-03	1.078	9	11	4	1	0	0	36	0.9

ENTRY	SP GR	NUMBER OF SPOTS PER TUBER 0	1	2	3	4	5+	PERCENT (%) BRUISE FREE	AVERAGE SPOTS/TUBER
PRELIMINARY TRIAL, CHIP-PROCESSING LINES									
AC13125-5W	1.064	13	6	1	5	0	0	52	0.9
MSBB038-1	1.069	9	13	1	0	2	0	36	0.9
F160032-06	1.078	6	6	7	0	0	0	32	1.1
MSHH137-1	1.085	4	9	6	0	0	0	21	1.1
MSHH018-4	1.083	7	12	1	3	1	0	29	1.1
Huron Chipper	1.086	3	11	6	0	0	0	15	1.2
MSBB614-11	1.076	8	8	6	2	1	0	32	1.2
MSHH066-6	1.076	5	11	6	1	1	0	21	1.3
MSCC012-1	1.071	9	6	4	1	2	1	39	1.3
MSEE025-1	1.080	4	11	3	1	2	0	19	1.3
MSHH130-1	1.087	5	11	6	4	0	0	19	1.3
MSHH053-04	1.089	4	8	8	5	0	0	16	1.6
AC13126-1Wadg	1.082	3	10	8	2	2	0	12	1.6
Atlantic	**1.087**	**4**	**7**	**3**	**3**	**1**	**2**	**20**	**1.8**
Snowden	**1.084**	**3**	**6**	**9**	**6**	**1**	**0**	**12**	**1.8**
MSHH048-4	1.087	2	10	3	6	1	1	9	1.9
MSHH046-1	1.088	1	4	10	2	2	0	5	2.0
MSHH063-2	1.081	1	8	8	6	2	0	4	2.0
MSHH069-3	1.082	3	6	5	2	1	3	15	2.1
MSHH113-06	1.082	0	6	8	8	0	0	0	2.1
MSAA076-4	1.089	0	6	9	2	3	0	0	2.1
MSCC058-1	1.087	3	6	6	6	2	2	12	2.2
MSHH040-4	1.077	4	2	9	6	4	0	16	2.2
MSHH034-12	1.093	5	2	3	7	2	2	24	2.2
NYU34-6	1.095	2	4	7	4	0	3	10	2.3
MSHH068-10	1.090	1	4	11	1	1	3	5	2.3
MSBB058-4	1.083	1	6	6	8	4	0	4	2.3
MSGG409-2	1.091	2	2	5	7	4	0	10	2.5
MSCC376-01	1.084	1	4	6	5	1	3	5	2.5
MSHH134-20	1.084	0	3	7	7	3	0	0	2.5
MSHH053-19	1.091	1	6	2	2	9	0	5	2.6
MSHH015-5	1.093	1	2	5	6	5	1	5	2.8
MSHH064-2	1.088	0	4	4	5	4	3	0	2.9
MSHH043-10	1.092	0	1	3	5	6	12	0	3.9
MSBB058-3	1.091	0	0	4	4	6	11	0	4.0
MSHH018-3	1.083	0	0	0	3	9	13	0	4.4
PRELIMINARY TRIAL, TABLESTOCK LINES									
Gala	1.061	23	0	0	0	0	0	100	0.0
Jule	1.065	27	0	0	0	0	0	100	0.0
05 6556.1 (Chas)	1.048	24	1	0	0	0	0	96	0.0
W13103-2Y	1.059	22	3	0	0	0	0	88	0.1
IPB8343-8W/Y	1.066	21	3	1	0	0	0	84	0.2
Tyson	1.059	18	7	0	0	0	0	72	0.3
Marta	1.061	18	6	1	0	0	0	72	0.3
Camelia	1.061	18	5	2	0	0	0	72	0.4
Christel	1.057	19	3	3	0	0	0	76	0.4
IPB83432-W/Y	1.064	13	11	0	0	0	0	54	0.5
MSGG078-7	1.070	16	7	1	1	0	0	64	0.5
W15240-2Y	1.063	17	7	3	0	0	0	63	0.5
MSGG221-3	1.073	15	7	3	0	0	0	60	0.5
MSGG207-1	1.073	13	10	2	0	0	0	52	0.6
Natalia	1.051	11	14	0	0	0	0	44	0.6
MI-3	1.071	12	11	2	0	0	0	48	0.6
MSHH224-1Y	1.058	13	6	6	0	0	0	52	0.7
Sifra	1.072	10	12	3	0	0	0	40	0.7
Constance	1.068	11	8	5	0	0	0	46	0.8
IPB8343-5W/Y	1.077	9	12	4	0	0	0	36	0.8
MSHH185-4	1.071	8	7	9	0	0	0	33	1.0
MSFF050-1	1.076	7	10	5	2	1	0	28	1.2
Spartan Splash		4	10	7	4	0	0	16	1.4
MSHH206-11	1.070	4	6	10	3	0	1	17	1.7

ENTRY	SP GR	NUMBER OF SPOTS PER TUBER 0	1	2	3	4	5+	PERCENT (%) BRUISE FREE	AVERAGE SPOTS/TUBER
PRELIMINARY TRIAL, PIGMENTED LINES									
MSHH161-06R	1.063	24	1	0	0	0	0	96	0.0
Cerata KWS	1.062	19	4	0	0	0	0	83	0.2
HZA 13-1486	1.065	19	6	0	0	0	0	76	0.2
MSFF030-1WR	1.060	19	6	0	0	0	0	76	0.2
MSHH228-3PP	1.063	18	7	0	0	0	0	72	0.3
NDAF113484B-1R	1.060	19	5	1	0	0	0	76	0.3
Dark Red Norland	**1.061**	**17**	**8**	**0**	**0**	**0**	**0**	**68**	**0.3**
MSHH164-03RY	1.077	17	6	2	0	0	0	68	0.4
MSHH172-3PP	1.066	15	8	2	0	0	0	60	0.5
MSFF198-13PY	1.062	13	8	3	0	0	0	54	0.6
Spuds n' Stripes Forever	1.057	16	3	4	2	0	0	64	0.7
MSHH176-2R	1.068	9	12	4	0	0	0	36	0.8
MSHH149-17R	1.071	7	12	6	0	0	0	28	1.0
USPB/SFA TRIAL CHECK SAMPLES (Not bruised)									
W17043-37	1.086	14	9	2	0	0	0	56	0.5
W17AF6670-1	1.083	10	8	3	4	0	0	40	1.0
Lamoka	**1.082**	**11**	**6**	**4**	**4**	**0**	**0**	**44**	**1.0**
W17066-34	1.091	7	7	7	3	1	0	28	1.4
Snowden	**1.084**	**4**	**9**	**6**	**6**	**0**	**0**	**16**	**1.6**
ND13220C-3	1.095	7	7	4	5	0	2	28	1.6
NY174	1.087	7	3	8	4	3	0	28	1.7
MSBB058-1	1.090	3	4	6	4	5	3	12	2.5
AF6206-3	1.097	1	2	5	8	4	5	4	3.1
NY177	1.099	1	1	5	4	6	8	4	3.5
AF6206-5	1.102	2	1	4	3	6	9	8	3.5
USPB/SFA TRIAL BRUISE SAMPLES									
W17066-34	1.091	8	5	7	3	1	1	32	1.5
Lamoka	**1.082**	**5**	**3**	**6**	**8**	**2**	**1**	**20**	**2.1**
W17043-37	1.086	2	3	7	5	4	4	8	2.7
NY174	1.087	1	1	7	7	3	6	4	3.1
Snowden	**1.084**	**1**	**4**	**6**	**1**	**2**	**11**	**4**	**3.3**
AF6206-5	1.102	0	3	4	5	6	7	0	3.4
W17AF6670-1	1.083	0	4	3	3	4	11	0	3.6
ND13220C-3	1.095	0	1	4	4	6	10	0	3.8
MSBB058-1	1.090	0	0	2	4	5	14	0	4.2
AF6206-3	1.097	0	1	2	2	5	15	0	4.2
NY177	1.099	0	0	0	1	3	21	0	4.8
NATIONAL COORDINATED PROCESSORS TRIAL (Tier 2 entries)									
AF6671-10	1.086	18	1	0	1	0	0	90	0.2
MSEE182-3	1.078	14	4	0	0	0	0	78	0.2
TX19009-2W	1.076	16	3	1	0	0	0	80	0.3
B3379-2	1.087	14	6	0	0	0	0	70	0.3
Lamoka	**1.081**	**13**	**6**	**1**	**0**	**0**	**0**	**65**	**0.4**
A16150-1C	1.084	11	6	1	0	0	0	61	0.4
AF6872-11	1.089	11	8	1	0	0	0	55	0.5
Bliss (NY163)	1.092	11	8	1	0	0	0	55	0.5
W19027-51	1.086	11	8	1	0	0	0	55	0.5
AF6880-9	1.076	10	8	2	0	0	0	50	0.6
NYU34-3	1.094	11	7	1	1	0	0	55	0.6
AOR10902-2	1.081	10	4	3	1	0	0	56	0.7
W19031-14	1.087	8	10	3	0	0	0	38	0.8
MSDD244-05	1.082	8	9	2	1	0	0	40	0.8
NY179	1.081	9	6	5	0	0	0	45	0.8
NC1046-03	1.086	8	8	3	1	0	0	40	0.9
MSEE207-2	1.079	8	7	4	1	0	0	40	0.9
W17065-11	1.103	7	8	5	0	0	0	35	0.9
B3471-1	1.079	6	9	5	0	0	0	30	1.0
Dundee (MSZ242-13)	1.099	6	9	5	0	0	0	30	1.0
NC1042-19	1.081	8	6	5	1	0	0	40	1.0

ENTRY	SP GR	NUMBER OF SPOTS PER TUBER 0	1	2	3	4	5+	PERCENT (%) BRUISE FREE	AVERAGE SPOTS/TUBER
NATIONAL COORDINATED PROCESSORS TRIAL (Tier 2 entries)									
NYT7-7	1.087	5	11	4	0	0	0	25	1.0
NC958-B	1.080	6	8	6	0	0	0	30	1.0
W19009-15	1.091	7	10	1	1	0	1	35	1.0
BNC973-7	1.080	7	8	3	1	1	0	35	1.1
W19023-24	1.091	4	11	6	0	0	0	19	1.1
A13125-3C	1.085	4	10	5	1	0	0	20	1.2
AF6883-8	1.085	6	8	5	0	0	1	30	1.2
AF6565-8	1.084	4	10	4	2	0	0	20	1.2
NC470-3	1.087	6	5	5	3	0	0	32	1.3
NY173	1.080	8	4	4	2	2	0	40	1.3
W19031-8	1.092	3	10	4	2	1	0	15	1.4
Snowden	**1.081**	**3**	**8**	**5**	**4**	**0**	**0**	**15**	**1.5**
W19026-12	1.083	4	7	5	2	2	0	20	1.6
Atlantic	**1.087**	**4**	**5**	**7**	**3**	**1**	**0**	**20**	**1.6**
MSEE031-3	1.082	3	8	4	4	1	0	15	1.6
NY181	1.091	3	7	5	4	1	0	15	1.7
NYT34-1	1.099	1	8	8	3	0	0	5	1.7
B3379-6	1.084	6	5	6	2	1	2	27	1.7
ND13220C-3	1.095	3	6	9	0	0	2	15	1.7
MN18W17043-006	1.081	9	2	3	1	1	4	45	1.8
B3296-3	1.085	1	9	5	3	2	0	5	1.8
NYU15-8	1.082	4	6	4	3	2	1	20	1.8
AF6978-1	1.080	3	4	6	6	1	0	15	1.9
NY180	1.084	2	6	6	4	2	0	10	1.9
BNC811-15	1.087	0	7	7	6	0	0	0	2.0
MSDD247-11	1.097	0	6	9	5	0	0	0	2.0
NY174	1.088	0	5	9	3	1	0	0	2.0
MSDD376-4	1.087	2	3	10	2	1	2	10	2.2
MSDD247-07	1.100	1	6	4	7	1	1	5	2.2
MSBB058-1	1.087	3	3	4	6	4	0	15	2.3
NC1030-77	1.083	1	6	1	6	2	1	6	2.3
NC1036-13	1.085	1	5	6	5	1	2	5	2.3
NY175	1.087	0	1	6	6	5	2	0	3.1

* Thirteen to twenty-five (dependent on the number of replications used) A-size tuber samples were collected at harvest, held at 50 F at least 12 hours, and placed in a six-sided plywood drum and rotated ten times to produce simulated bruising. Samples were abrasive-peeled and scored 10/24/24.
The table is presented in ascending order of average number of spots per tuber.

Investigating the use of impaction samplers and qPCR methods for detection of foliar pathogens in potato fields, 2024

Sarah Ruth[1], Mio Satoh-Cruz[1], Jack Pritchard[1], Azamat Sardarbekov[1], Steve Whittington[2], Chris Long[1], and Jaime F. Willbur[1]; [1]Department of Plant, Soil and Microbial Sciences; [2]Michigan State University Extension, Montcalm County Office.

Following a potato late blight outbreak in Montcalm County in 2022, and repeated late blight detections in Michigan and neighboring regions since 2019, we investigated low-cost spore samplers to support visual scouting efforts. Spore samplers coupled with quantitative PCR assays had potential to be an efficient and inexpensive tool for early detection of late blight outbreaks. We repeated testing of rotating arm impaction samplers deployed in the 2024 growing season to: 1) monitor for *P. infestans* sporangia in commercial fields 2) investigate the range of detection from an inoculated field.

Materials and Methods

i. *Commercial detection*

Rotating arm impaction samplers were built according to the Check et al. (2024) (Fig. 1). Samplers were placed near six commercial potato fields located in Montcalm County. One sampler was deployed at each commercial site and at the Montcalm Research Center in Stanton, MI. The Montcalm fields were selected for proximity to previous late blight detections in 2022. Each week, sampling rods were collected and transported to MSU where their DNA was extracted, and a quantitative polymerase chain reaction (qPCR) assay was performed (Lees et al. 2012).

Fig. 1. Rotating arm impaction sampler deployed in a commercial potato field in 2023.

ii. *Range from an inoculated source*

The range of detection for these spore samplers was evaluated using an inoculated potato research trial located at the Plant Pathology Farm in East Lansing, MI. The field was initially inoculated on August 21, however, symptom development was unsuccessful so an additional inoculation was performed on September 12. Late blight symptoms were then first detected visually on September 16. One sampler was placed on the eastern edge of the field and served as a positive control. Two more were placed 500 m northeast of the inoculated field, a distance which has previously been used as an outer limit of spore sampler detection (Aylor et al. 2011). One trap was maintained at a height of 4 ft, the other was positioned at 20 ft to better capture long-distance sporangial movement. All three samplers were monitored weekly.

Results and Conclusions

i. *Commercial detection*

In 2024, late blight was detected in commercial potato fields and confirmed July 23 and August 5 in St. Joseph County, Michigan. However, our spore traps were not located near the incident site as sampling was only conducted in Montcalm County in 2024. From the six samplers placed in commercial fields in Montcalm, no detectable levels of *P. infestans* DNA were obtained from the qPCR results. In one location, a very weak suspect signal was detected (Cq value = 39.0) on September 06, 2024, however, no symptoms were observed and the timing was near vine kill. This value corresponds with <1 infectious sporangia detected and the participating operations were notified accordingly.

ii. Range from an inoculated source

The sampler placed immediately at the edge of the inoculated field detected *P. infestans* the same week as visual symptom development, after the second inoculation, and for several subsequent weeks. However, no positive detections were made at 4- or 20-ft samplers placed 500 m from the inoculated site (Table 1).

Table 1. Cq values obtained from samplers near an inoculated late blight field at the plant pathology farm in East Lansing, MI. Samples were collected weekly, and dates represent the last date of the sampling period. Dates marked with a "-" had no detectable level of late blight in the qPCR test. Dates marked with an "x" were not sampled at that location. The field was inoculated twice on August 21 and September 12 and the first visual detection was made on September 16. On September 23, a wide range of well-developed foliar symptoms were observed.

Location	Sampler Height (ft)	July					August										September				
		29	5	12	19	26	27	28	29	30	28	3	4	5	6	9	13	**16**	20	25	30
Field edge	4	x	x	x	x	-	-	-	-	-	-	-	-	-	**38.3**	-	**33.6**	**35.4**	**27.8**	**31.5**	**31.1**
500m NE	4	-	-	-	-	x	x	x	x	-	x	x	x	x	-	x	x	x	-	x	x
500m NE	20	-	-	-	-	x	x	x	x	-	x	x	x	x	x	x	x	x	x	x	x

Overall Summary

Second-year testing demonstrated that the rotating arm impaction samplers, combined with qPCR assays, could be used detect late blight from fields in Michigan and may be of useful to augment visual scouting efforts. Across two years of testing, these samplers did offer timely *P. infestans* confirmation (with a lower limit of detection at 1 sporangia/sample) of sporulating lesions in adjacent fields within the week of earliest visual symptoms.

Similar to the previous year, however, spore trap distance and height will be an important consideration since the sampler located 500 m NE from inoculated field failed to detect at 4- or 20-ft. This indicated that low-cost stationary spore traps may not have a far-reaching detection range, as expected based on previous studies. In the second year of trap deployment, there also were some technical difficulties that interfered with continuous sample collection. In the future, a permanent technician to maintain and repair existing samplers would be recommended to facilitate reliable and larger-scale monitoring efforts.

Acknowledgements

We would like to thank the grower cooperators who allowed us to test samplers in their fields, our fellow researchers and undergraduate research assistants in the Michigan State University Potato and Sugar Beet Pathology and Potato Outreach programs, the Montcalm Research Center, the Michigan Potato Industry Commission, and Michigan State University Project GREEEN for the continued support of our research.

Check et al. 2024. It's a Trap! Part I: Exploring the Applications of Rotating-Arm Impaction Samplers in Plant Pathology. Plant Dis. 108:1910-1922. https://doi.org/10.1094/PDIS-10-23-2096-FE

Check et al. 2024. It's a Trap! Part II: An Approachable Guide to Constructing and Using Rotating-Arm Air Samplers. Plant Dis. 108. https://doi.org/10.1094/PDIS-01-24-0131-SR

Assessment of variety resistance to four postharvest diseases of potato in Michigan, 2024

Sarah Ruth, Mio Satoh-Cruz, Chris Long, and Jaime F. Willbur; Plant, Soil and Microbial Sciences

Cultivars with postharvest disease resistance can provide economical and effective management. However, robust phenotyping of variety responses is needed. In this study, commercial lines and germplasm from chipping, yellow and red market classes were assessed for resistance to four major postharvest diseases: Fusarium dry rot, bacterial soft rot, pink rot, and Pythium leak.

Materials and Methods

During 2023-24, 21 chipping lines, 6 russet, and 12 yellow lines comprising commercial varieties and research germplasm were assessed for resistance response to dry rot, soft rot, pink rot, and leak. Chipping lines were obtained from three MSU Potato Outreach Program field locations at Walther Farms (St. Joseph County), Hampton Potato Growers (Bay County), and the Montcalm Research Center (Montcalm County). Russet and yellow materials were obtained from two MSU Potato Outreach Program on-farm trials at 4-L Farms (Kalamazoo County) and Kitchen Farms (Otsego County). All materials were tested at two replicate timepoints (5 tubers/location/timepoint/disease).

Asymptomatic tubers were rinsed with tap water and air-dried overnight at ambient conditions. For all pathogens, 10uL of inoculum was injected to a 1 cm depth at the apical and basal ends of each tuber using a Hamilton® syringe (710 series, 100-uL volume). Tubers were inoculated with suspensions of the following: 2×10^4 *Fusarium sambucinum* conidia/mL in potato dextrose broth; 2×10^4 *Phytophthora erythroseptica* zoospores/mL in Petri's solution; 5×10^4 *Pythium ultimum* oogonia/mL in potato dextrose broth; or 8×10^8 *Pectobacterium carotovorum* cfu/mL in LB broth. Two additional *Fusarium* spp., identified during surveys of Michigan storage piles, were also used in dry rot screening. Tests for dry rot and pink rot were incubated in paper bags under ambient conditions for 28 or 6 days, respectively. Pythium leak and soft rot tests were incubated in plastic bags with moist paper towels at room temperature for 6 days. After incubation, tubers were sliced longitudinally through inoculation sites and internal symptom width and depth were measured using digital calipers. Data was analyzed using an analysis of variance (ANOVA) conducted with the generalized linear mixed model (GLIMMIX) procedure in SAS v. 9.4, and means were compared using Fisher's protected LSD (α=0.05).

Overall Summary

Postharvest resistance to four diseases was screened in chipping (Figure 1), russet (Figure 2), and yellow (Figure 3) potato entries using Michigan pathogen isolates. No clear relationship was observed between resistance responses to different diseases; however, several varieties including Dundee (previously MSZ242-13), MSAFB635-15, and Bliss, possessed at least moderate resistance to three or four diseases (see Figure 5 for examples of Bliss symptoms). While dry rot responses to *F. graminearum* and *F. sambucinum* generally followed similar trends, several varieties may have seemed more or less resistant depending on the species used (Figure 4). Ongoing screening will help inform management practices and breeding directions. In 2024-25, screening is in progress for eight chipping lines of interest.

Acknowledgements

We would like to thank the grower cooperators and key industry representatives who contributed to this research, our fellow researchers and undergraduate research assistants in the Michigan State University Potato and Sugar Beet Pathology and Potato Outreach programs, the Montcalm Research Center, the Michigan Potato Industry Commission, MSU AgBioResearch, and the MSU RTSF Genomics Core for their continued support of our research.

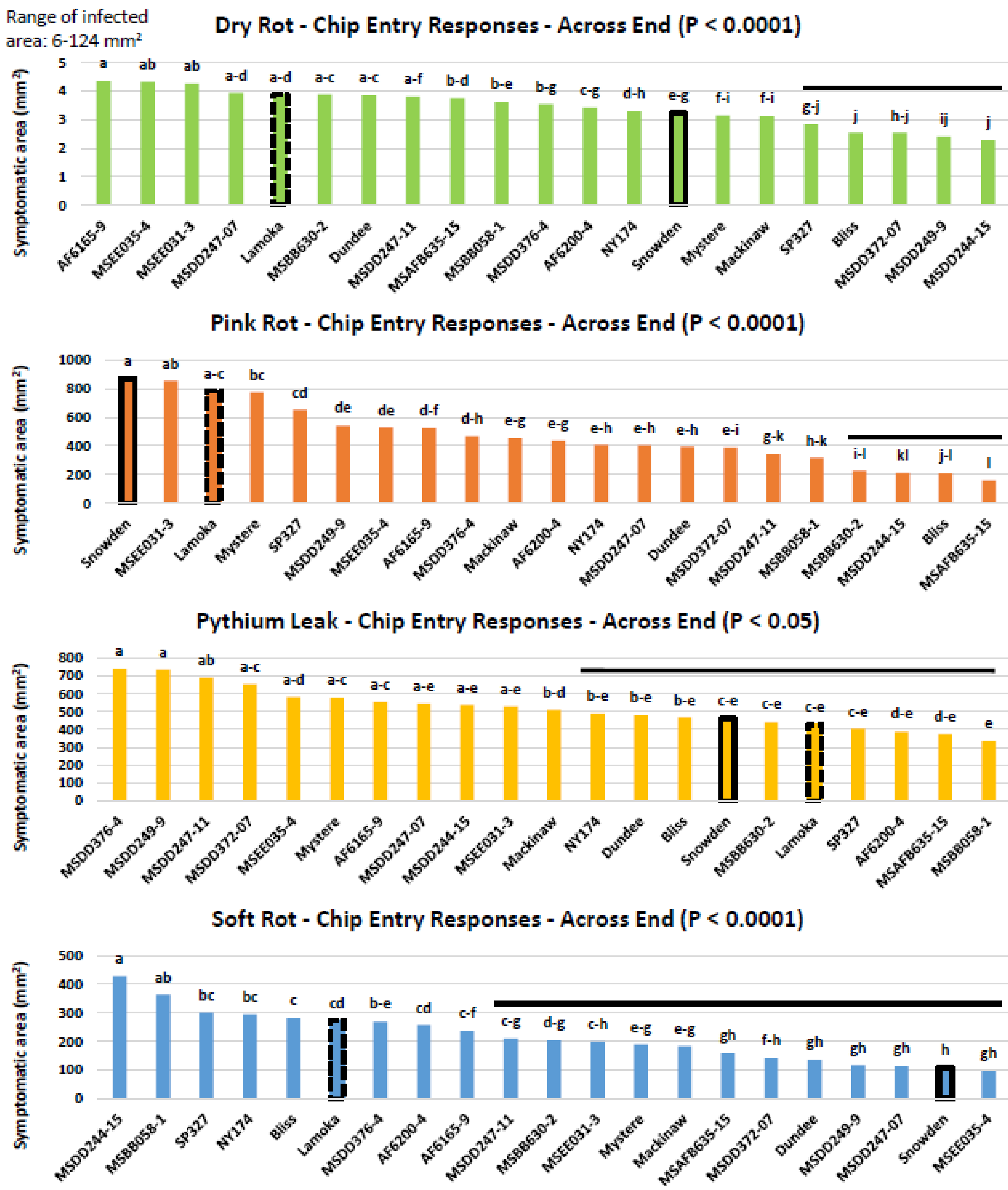

Figure 1. Responses of 21 chipping potato lines to dry rot, pink rot, Pythium leak, and soft rot. Bars with the same letter not significantly different based on Fisher's protected LSD (α=0.05). Means are across apical and basal end responses ($P < 0.0001$) for dry rot, pink rot, soft rot, and Pythium leak ($P < 0.05$). Tubers were from three MSU Potato Outreach Program field locations (Walther Farms, Hampton Potato Growers, and the Montcalm Research Center) tested in two replicate timepoints. Lamoka (dotted outline) and Snowden (solid outline) were used as commercial checks.

Figure 2. Responses of 6 russet potato lines to dry rot, pink rot, Pythium leak, and soft rot. Bars with the same letter not significantly different based on Fisher's protected LSD (α=0.05). Means are across apical and basal end responses (*P* < 0.0001) in tubers from three MSU Potato Outreach Program field locations (4-L Farms and Kitchen Farms) tested in two replicate timepoints.

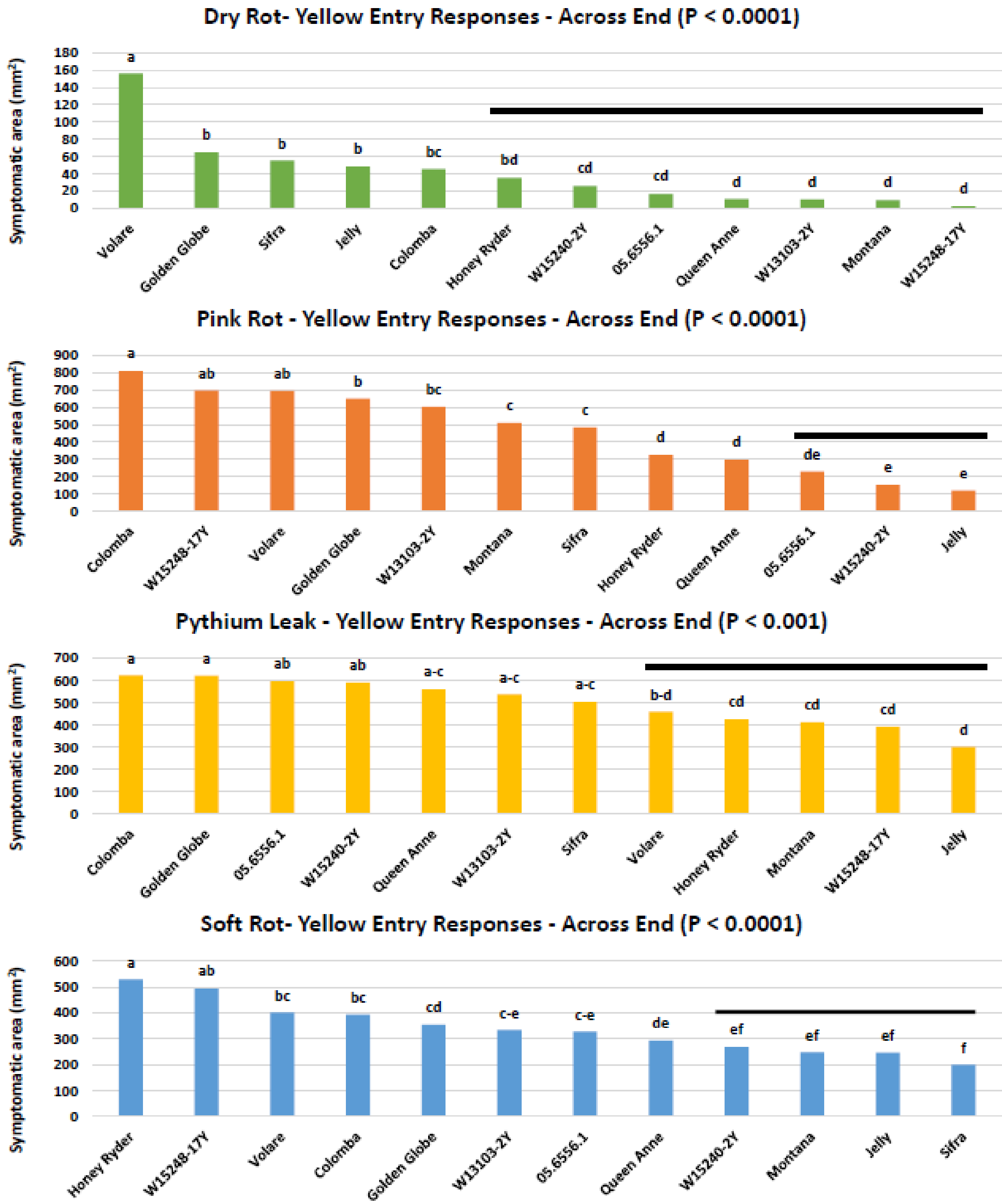

Figure 3. Responses of 12 yellow potato lines to dry rot, pink rot, Pythium leak and soft rot. Bars with the same letter not significantly different based on Fisher's protected LSD (α=0.05). Means are across apical and basal end responses (*P* < 0.0001) in tubers from two MSU Potato Outreach Program field locations (4-L Farms and Kitchen Farms) tested in two replicate timepoints.

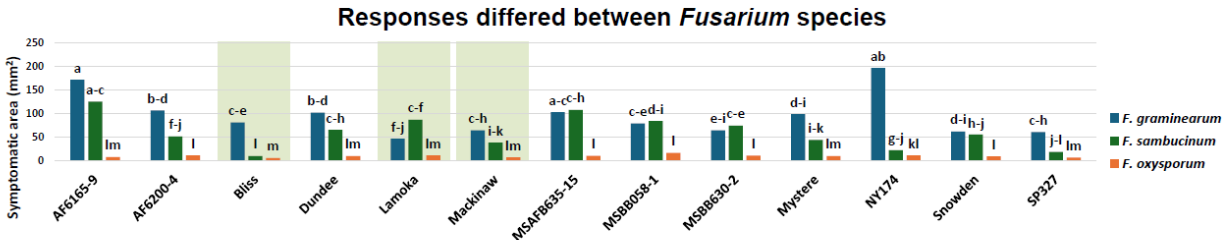

Figure 4. Responses of 13 chipping potato lines to dry rot caused by three species of *Fusarium* prevalent in Michigan potato samples: *F. graminearum* (blue), *F. sambucinum* (green) and *F. oxysporum* (orange). Bars with the same letter not significantly different based on Fisher's protected LSD (α=0.05). Significant variable responses were observed across apical and basal end ($P < 0.0001$).

Figure 5. Examples of typical symptoms for each of the four tested postharvest diseases. Bliss had greater resistance to pink rot, Pythium leak and dry rot, while Lamoka tended to be more susceptible, and Mackinaw exhibited moderate resistance to soft rot, dry rot, and leak.

Diagnostic optimization of viral detection and characterization of Potato virus Y for the Michigan seed potato certification program, 2024

Mio Satoh-Cruz[1], Stefanie Rhodes[2], Damen Kurzer[3], Elizabeth Dorman[2] and Jaime Willbur[1]; [1]Michigan State University, Dept. Plant, Soil and Microbial Science, Potato and Sugar Beet Pathology; [2]Michigan Department of Agriculture and Rural Development, Pesticide and Plant Pest Management Division, Plant Pathology; [3]Michigan Seed Potato Association

The MSU Potato and Sugar Beet Pathology (PSBP) program continues to work with the Michigan Department of Agriculture and Michigan Seed Potato Association to: 1) investigate improved detection options to identify accurate, timely, and cost-effective methods for use in Michigan seed potato certification, 2) monitor PVY strain and other tuber necrotic virus prevalence in Michigan seed potatoes, and 3) investigate PVY strain by chipping potato variety responses.

Materials & Methods:

We were evaluating immunocapture-reverse transcription-polymerase chain reaction (IC-RT-PCR) (Chikh-Ali and Karasev, 2015) methods used by Montana, Idaho and Wisconsin certification programs. In 2024, we shifted to using IC-RT-PCR methods for faster and cost-effective methods to screen for PVY in seed tubers. These methods will be further compared for accuracy, efficiency, and cost for adoption in Michigan. In 2024-25 postharvest testing, at least five commercial seed operations voluntarily submitted samples for direct tuber testing, either coring on-farm or sending tubers to MDARD. This option will not be used for certification but will be available to provide growers early virus information.

We are further collecting comparison data from field plot samples collected by Dr. Zsofia Szendrei from MSU Vegetable Entomology program. We tested total 32 plots (8 treatments, 4 replicates) with Silverton Russet or Mackinaw varieties. Samples of 100 tubers were collected from each plot. Direct tuber testing with IC-RT-PCR was conducted in 10-tuber subsamples at least two weeks postharvest. Cored samples were then suberized and sent to Hawaii for planting and winter grow-out. Results from direct tuber and leaflet ELISA methods will be compared. Subsets of positive samples will be subject to PVY strain confirmation by RT-PCR (Chikh-Ali et al. 2013; Lorenzen et al. 2006, 2010; Mackenzie et al. 2015).

We also are repeating assays to assess PVY strain by variety responses (Gundersen et al. 2019). Based on Michigan survey observations, three chipping lines and varieties of interest were selected for repeat greenhouse experiments (Lamoka, NY163, and Manistee) and screened using three prevalent PVY strains (N-Wi, NTN, N:O) in a greenhouse assay. These experiments are currently in progress for 2024-2025.

Results & Conclusions:

Prevalence of PVY strain types in Michigan seed growing regions

PVY strain prevalence survey will be performed in leaf material received from Hawaii, currently in progress for the 2024 field season. Survey of seed lots for two other tuber necrotic viruses, Potato mop-top virus (PMTV) and Tobacco rattle virus (TRV), in Michigan is also ongoing.

Screening of PVY strain x variety responses

In repeated bioassay experiments, potato variety responses of daughter plants were measured after mechanical infection of mother plants with four PVY strains for growth chamber and three strains for greenhouse assays. We observed mild to severe foliar symptoms depending on strain and variety. From growth chamber assays, aboveground biomass was reduced by seedborne N-Wi and O infection on both resistant and susceptible varieties (Figure 1). Reduced relative tuber yield for all strains was observed in susceptible compared to resistant varieties, however NTN and O resulted in greater impact (Figure 1). In these experiments, yield of PVY-resistant varieties, Mackinaw and Lady Liberty, appear less impacted by mother plant infections while others appear more sensitive to certain strains (e.g., Snowden and Lamoka to N-Wi and NTN, Petoskey and Snowden to strain O, and NY163 to strain N-Wi and NTN). Confirmation of these observations is in progress, and will identify PVY resistance to multiple strains, further informing variety selection and breeding efforts.

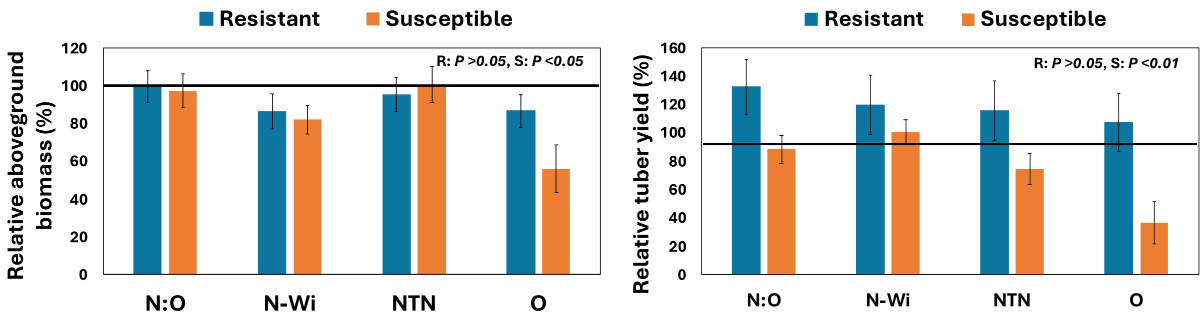

Figure 1. Relative aboveground biomass and tuber yield of resistant vs. susceptible entries growth chamber bioassay. Results are from second-generation plants and represent 5 to 8 replications across two timepoints.

Overall Summary:

- Direct tuber methods using IC-RT-PCR will be complement observations made in summer and winter field inspections and to offer a rapid option for use in seed certification testing, particularly in latent varieties, and early decision making.
- Observations from the past five years of PVY strain prevalence observations was published in peer-reviewed APS journal: Satoh-Cruz et al. 2025. Prevalence of the *Potato Virus Y* Strain Composition Impacting Michigan Seed Potato Production. Plant Health Prog. https://doi.org/10.1094/PHP-06-24-0063-S.
- Bioassay results of variety by strain screening efforts suggest tuber yield impacts and foliar symptoms may be observed from seed infected with common Michigan strains.

Acknowledgements:

We would like to thank the Michigan potato growers, the Michigan Potato Industry Commission, the Michigan Seed Potato Association, the Michigan Department of Agriculture and Rural Development, as well as the USDA-NIFA-SCRI Grant No. 2020-51181-32136 and national Potato Virus Initiative: Developing Solutions for the continued support and productive collaborations necessary to continue this research.

Evaluation of in-furrow, banded at re-hill, and foliar fungicides to manage early blight and brown spot of potato in Michigan, 2024

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Keywords: Adastrio, Delaro 325 SC, Elatus, Endura, Headline, Lucento, Luna Tranquility, Miravis Prime, Omega 500F, Propulse, Provysol, Quadris, Scala 60 SC, Super Tin 4L, Topguard EQ, Velum Prime, Velum Rise

Commercially available fungicides were tested to determine their efficacy in managing potato early blight (*Alternaria solani*) and brown spot (*Alternaria alternata*). A field trial was established at the Montcalm Research Center in Stanton, MI. Soil type at the station is loamy sand. A randomized complete block design was used with four replicates. US#1 'Lamoka' potatoes were cut into 2-oz seed pieces and left to suberize for 14-days. The trial was hand planted 23 May, and in-furrow treatments were applied before closing rows. A CO_2-powered backpack sprayer, equipped with TJ2501E nozzles, was used to apply fungicides in-furrow at 6 gal/A. Plots were two rows wide (34-in row spacing) by 18 ft long and seeded at 1.2 seed/row-ft. Banded treatments were applied at re-hilling on 26 June using a CO_2-powered backpack sprayer, equipped with TJ2504 nozzles at 20 gal/A. Due to the trial's proximity to commercial potato fields, a blanket application of Manzate Max (1.6 qt/A) or Echo 720 (1.5 pts/A) was applied weekly after row-closure to the entire trial to reduce the risk of late blight developing near commercially grown potatoes. Beginning at 50% row closure, four foliar applications (C, D, E, and F) were made across programs on 1 July, 8 July, 22 July, and 8 August. Foliar fungicides were applied at a volume of 20 gal/A via CO_2-powered backpack sprayer (TJ8004XR nozzles). Plots were inoculated on 19 July and 30 July with *A. solani* solution (8 x 10^3 conidia/mL) at a volume of 20 gal/A using the previously mentioned equipment. Stand establishment was monitored and foliar disease data (combined early blight and brown spot observations) were collected regularly throughout the growing season. The trial was harvested 26 September, and both rows were dug and later graded. The final disease incidence (DI), disease severity (DS), estimated yield, and estimated marketable yield (cwt/A) were compared among treatments. 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).

Disease pressure was moderate, and differences were observed among the foliar DI (P = 0.001) and foliar DS ($P < 0.0001$). All treated programs had significantly lower incidence (4.0-13.8%) and severity (4.0-7.5%) than the control (DI=25%, DS=13.8%). Though not significantly different from most of the other programs, the lowest DI value was observed in program 2 and the lowest DS values were observed in programs 6 and 17. No significant differences were observed in yield or marketable yield.

No.	Treatment (Rate[v]) Timing[w]	Disease Incidence (%)[x, y]		Disease Severity (%)[y]		Total Yield (cwt/A)	Marketable Yield (cwt/A)
1	Treated Control[z]	25.0	a	13.8	a	245	226
2	Velum Rise (13 fl oz) A + Propulse (10 fl oz) D + Scala 60 SC (7 fl oz) E	4.0	d	5.0	b	229	203
3	Velum Rise (13 fl oz) A + Propulse (10 fl oz) D + Luna Tranquility (11.2 fl oz) E	11.3	b-d	5.0	b	276	247
4	Elatus 45 WG (6.4 oz) A + Miravis Prime (10 fl oz) DE	7.5	b-d	5.0	b	268	245
5	Velum Rise (13 fl oz) A + Endura (5.5 oz) DE + Provysol (4 fl oz) DE	4.3	d	7.5	b	227	202
6	Velum Rise (13 fl oz) A + Delaro (8 fl oz) C + Luna Tranquility (11.2 fl oz) E	6.3	b-d	4.0	b	243	224
7	Velum Rise (13 fl oz) A + Quadris (9 fl oz) C + Miravis Prime (10 fl oz) E	13.8	b	7.5	b	254	231
8	Elatus (6.4 oz) A + Quadris (9 fl oz) C + Omega 500F (8 fl oz) D + Miravis Prime (10 fl oz) E	7.5	b-d	5.0	b	219	200
9	Velum Rise (13 fl oz) A + Headline (9 fl oz) C + Endura (5.5 oz) DE + Provysol (4 fl oz) DE	5.3	cd	5.0	b	279	248
10	Velum Rise (13 fl oz) A + Velum Prime (6.5 fl oz) D + Scala 60 SC (7 fl oz) E	7.8	b-d	7.5	b	223	196
11	Velum Rise (13 fl oz) A + Velum Prime (6.5 fl oz) C + Scala 60 SC (7 fl oz) E	8.8	b-d	6.3	b	229	213
12	Adastrio (18 fl oz) B	8.5	b-d	5.8	b	249	222
13	Topguard EQ (28 fl oz) B	5.5	cd	5.0	b	283	258
14	Lucento (5.5 fl oz) B	7.8	b-d	6.3	b	214	194
15	Adastrio (9 fl oz) DE+ Super Tin 4L (5 fl oz) F + Endura (7 oz) F	12.5	bc	7.5	b	213	198
16	Adastrio (9 fl oz) E + Super Tin 4L (5 fl oz) F + Endura (7 oz) F	10.0	b-d	5.0	b	235	216
17	Luna Tranquility (11.2 fl oz) DE + Super Tin 4L (5 fl oz) F+ Endura (7 oz) F	9.0	b-d	4.0	b	232	211
	SE	*2.8*		*1.1*		*2.8*	*1.1*
	P-value	*0.001*		*<0.0001*		*0.001*	*<0.0001*
	LSD	*7.9*		*3.2*		*7.9*	*3.2*

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

[w] Application letters code for the following dates: A=23 May (in-furrow at plant), B=26 June (re-hill), C=1 July (50% row closure), D=8 July (row closure), E=22 July, F=8 August.

[x] Column values followed by the same letter were not significantly different based on Fisher's Protected LSD (α=0.05). If no letter, then means were not significantly different.

[y] Final foliar disease incidence and severity ratings (combined early blight and brown spot) collected 13 August, two weeks post second inoculation.

[z] A blanket application of Manzate Max (1.6 qt/A) or Echo 720 (1.5 pts/A) was applied weekly to the entire trial to reduce the risk of late blight development.

Evaluation of foliar fungicides to manage late blight of potato in Michigan, 2024

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Keywords: BCS-CS55621, Bravo Weather Stik, CX-10082, Latitude, Dithane F-45, Orondis Opti, Orondis Ultra, Reason 500 SC

Experimental and commercially available fungicides were tested to determine their efficacy for managing potato late blight (*Phytophthora infestans*). A field trial conducted at the Michigan State University Plant Pathology Farm in East Lansing, MI. A randomized complete block design was used, with programs replicated four times. Two-oz 'Lamoka' potato seed pieces were hand-planted 28 June. Plots were two rows wide (34-in spacing) by 18 ft long, and seeded at 1.2 seed/row-ft. Foliar programs were initiated 19 August with follow-up applications made weekly until 16 September. A CO_2-powered backpack sprayer, equipped with two TJ 8004XR nozzles, was used to apply fungicides at 20 gal/A. The trial was inoculated at sunset on 21 August (2 x 10^3 zoospores/mL) and 12 September (2.8 x 10^4 zoospores/mL) at 20 gal/A using the previously described equipment. After inoculating the trial, a misting system was used to maintain leaf wetness and facilitate disease development. Foliar disease incidence (DI) and disease severity (DS) ratings (0-100%) were collected for each plot 21 August, 26 August, 2 September, 9 September, 19 September and 23 September. Due to wet, heavy soil conditions, the trial was not harvested. The disease index values (DX) were calculated by multiplying the DI by DS and dividing by 100. The area under the disease progress curve (AUDPC) was calculated for each program using the DX values. The final DI, DS, and AUDPCs were compared among programs. A generalized linear mixed model procedure was used to conduct the ANOVA and mean separations (α=0.05).

Differences were observed in the DI and DS values of programs ($P < 0.0001$). Programs 2-7 (0.0-2.5%) and program 10 (52.3%) had significantly lower DI than the control (71.3%). DS values for programs 2-7 (0.0-3.8%) and program 10 (28.8%) were also significantly lower than the control (52.5%). Programs 2-7 did not differ from each other but had significantly lower DI and DS than program 10. AUDPCs for programs 2-7 and 10 were significantly lower than the control (P<0.0001). The DI, DS, and DX for programs 8 and 9 were not significantly different from the control.

No.	Treatment (Rate[v]) Timing[w]	Disease Incidence[x,y] (%)		Disease Severity[x] (%)		AUDPC[z]	
1	Non-treated control	71.3	a	52.5	a	166.2	a
2	Bravo Weather Stik (1.5 pt) ABCDE	0.6	c	0.4	c	0.1	c
3	Bravo Weather Stik (1.5 pt) ACE + Dithane F-45 (1.6 qt) BD	0.0	c	0.0	c	0.0	c
4	BCS-CS55621 (13.7 fl oz) ABD + Reason 500 SC (5.5 fl oz) AB + Bravo Weather Stik (1.5 pt) CDE	0.0	c	0.0	c	0.0	c
5	Orondis Ultra (8 fl oz) ABD + Bravo Weather Stik (1.5 pt) CE	0.6	c	0.4	c	0.1	c
6	Latitude (29 fl oz) ABCDE	2.5	c	3.8	c	0.8	c
7	Orondis Opti (2.5 pt) ABCDE	0.6	c	0.4	c	0.1	c
8	CX-100082 (16 fl oz) ABCDE	73.8	a	52.5	a	159.7	a
9	CX-100082 (32 fl oz) ABCDE	67.3	ab	45.4	ab	132.7	ab
10	CX-100082 (64 fl oz) ABCDE	52.3	b	28.8	b	62.1	bc
	SE	*4.7*		*6.2*		*24.1*	
	P-value	*<0.0001*		*<0.0001*		*<0.0001*	
	LSD	*14.3*		*17.6*		*69.3*	

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

[w] Application letters code for the following dates: A=19 August, B=26 August, C=2 September, D=9 September, and E=16 September.

[x] Column values followed by the same letter were not significantly different based on Fisher's Protected LSD (α=0.05). If no letter, then means were not significantly different.

[y] Final foliar disease incidence and severity ratings (combined early blight and brown spot) 23 September.

[z] Area under the disease progress curve was calculated using the disease index values from 21 August, 26 August, 2 September, 9 September, 19 September and 23 September.

Assessing the effects of a reservoir tillage practice on water and nutrient management in irrigated Michigan potato fields

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[1]Department of Biosystems and Agricultural Engineering
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Introduction

Potatoes require irrigation due to their shallow root systems and preference for well-drained, sandy soils. Michigan has experienced more erratic precipitation, making it difficult for potato growers to manage irrigation. Improper irrigation schedules or unnecessary irrigation can waste resources and increase the risk of nitrate leaching below the root zone. A practice that could help to increase the resiliency of potato production to climate change is Reservoir tillage (Dammer Diker). Reservoir tillage places reservoirs all along the field and helps to retain water and nutrients, which can reduce erosion and increase resource (water and nutrients) efficiency. Reservoir tillage has been implemented in potato fields in other states. However, the effects of Reservoir tillage on water and nutrient management in Michigan potato fields and Michigan climate have not been well evaluated.

Materials and Methods

In 2024, the project team (MSU Irrigation Lab and MSU Soil Fertility & Nutrient Management Program) collaborated with Walther Farms to evaluate the effects of reservoir tillage (Dammer diker) on retaining water and nutrients in a potato field. The yields and quality of potatoes were also observed. This research consists of two treatments: 1) control and 2) reservoir tillage, which utilizes Dammer-Diker. Each treatment was replicated four times. Teros 12 sensors were installed at 9-, 18-, and 24-inch depths to track the soil moisture, temperature, and electrical conductivity on the hill and between the hills. ZL-6 Metergroup dataloggers were used to collect sensor values every 15 minutes. Suction lysimeters were also installed to monitor nitrate levels. Figure 1 shows the demonstration field and installed Teros 12 sensors and suction lysimeters. Runoff was also measured using customized flumes and buckets. A metal plate was installed at an upgradient of 50 ft. from the collection point, only to collect runoff and sediments from each treatment area. Installed flumes and collection containers are below. Figure 2 shows the installed flumes and collection containers. Potato growth was also monitored during the growing season. Potato yield and quality were also monitored.

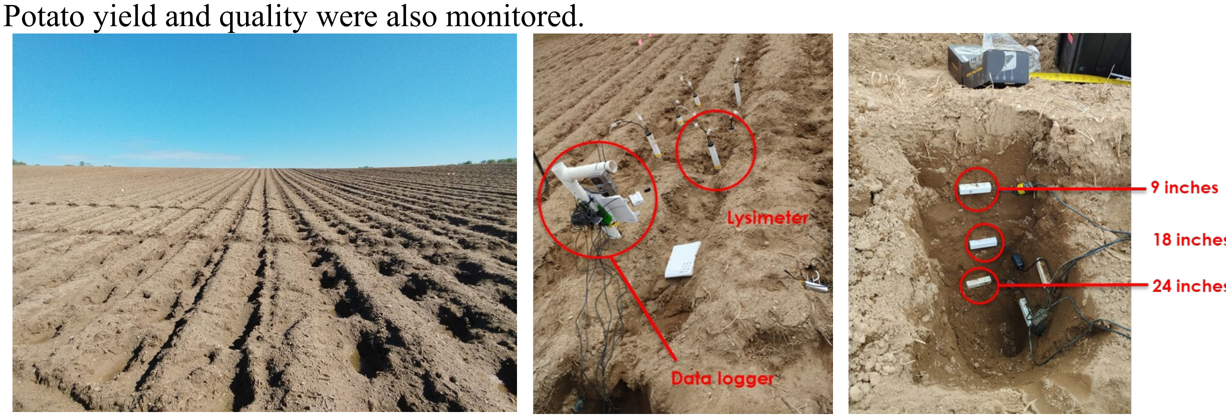

Figure 1. Left: Demonstration site. Center: Installed dataloggers and suction lysimeters. Right: Installed soil moisture, electrical conductivity, and temperature sensors.

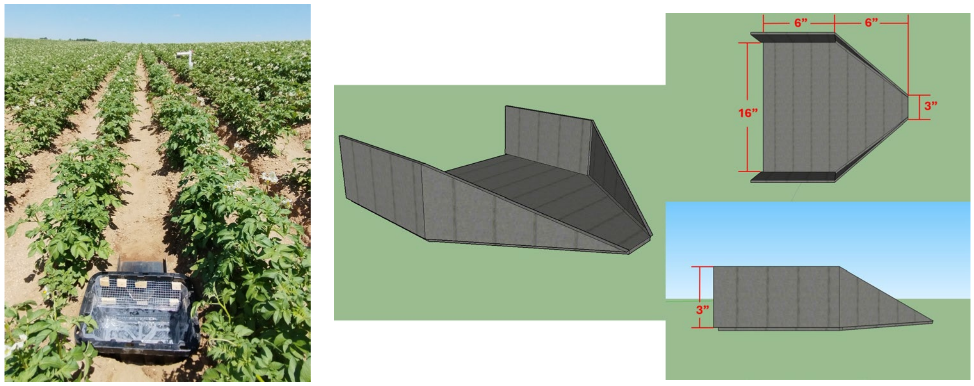

Figure 2. Installed a flume and runoff collection container (left). Design of flume (right).

Results and Conclusions

Figure 3 shows the results of runoff volumes and sediment weights from the demonstration site. The results indicate a statistically significant difference in runoff volume (P-value=0.045) and sediment weight (P-value = 0.001) between the reservoir tillage and control treatments. Overall, field monitoring data from 2024 show that reservoir tillage reduced runoff volume by 56% and sediment weights by 67%, compared to the control treatment. Reservoir tillage improves retaining water and soil within the field, which was confirmed by soil moisture sensor data (Figure 4). Higher soil moisture levels were observed throughout the growing season in the reservoir tillage areas than in control areas.

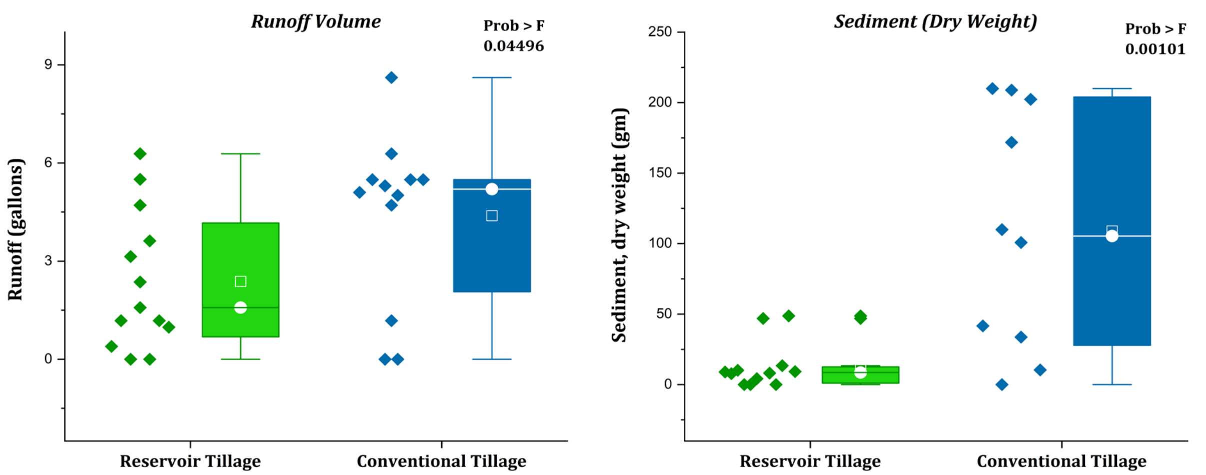

Figure 3. Comparison of runoff volume and sediment weights between the reservoir tillage and conventional tillage.

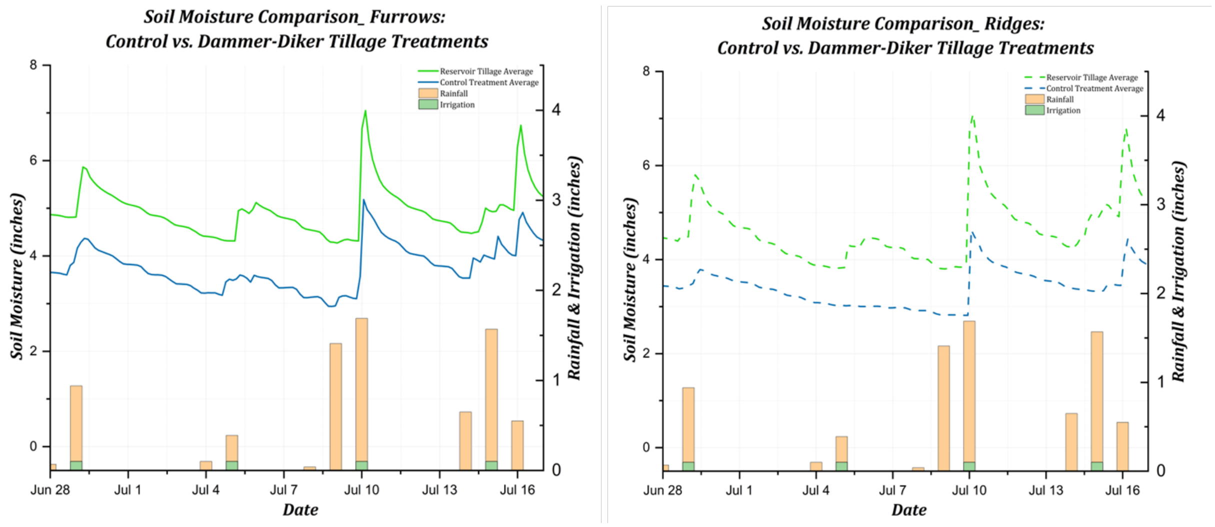

Figure 4. Comparison of composited soil water content from 0 to 24 inch soil depth between reservoir tillage and conventional tillage. Left: Collected soil moisture data at furrow (between the hills). Right: Collected soil moisture data at ridge (on the hill).

Moreover, the team has conducted Electric Resistivity Tomography (ERT) in the demonstration field. ERT is a geophysical method that involves measuring the voltage between electrodes on the Earth's surface after injecting direct current through two other electrodes. By analyzing how the voltage interacts with the subsurface, an Electrical Resistive Image (ERI) can be generated showing the position and profile of subsurface electrical resistivities of the lithology. A benefit of ERT is that it can be used to monitor soil moisture over large areas, which can help provide a comprehensive observation of moisture levels in a field. ERI was created for control and reservoir tillage treatment areas (Figure 5). The preliminary results showed that higher moisture content (low resistivity) was generally found in reservoir tillage treatment areas than control treatment areas. This demonstration shows the potential use of ERT to monitor soil moisture over large areas.

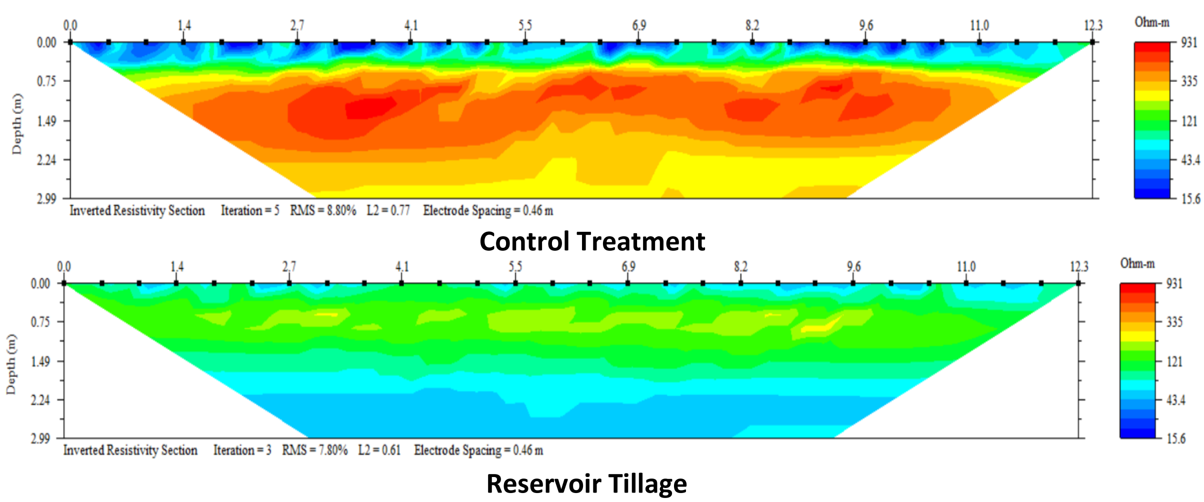

Figure 5. ERI created at control and reservoir tillage areas by MiniSting ERT equipment.

While no statistically significant difference in overall yield was observed between the two treatments, reservoir tillage showed less variation and consistent yield than the control (Figure 6). This consistency in yields suggests that reservoir tillage provides greater reliability in production, which is important for the marketability of potatoes. Quality analysis, including pink eye, IBS, misshape, grub, hollow heart, seed-grade, specific gravity, marketable grade, and oversize, were conducted. No statistical differences were found between the treatments. Nitrate levels in soil data were collected, but additional data collection is needed to fully understand the fate of nitrogen in the field. To comprehensively evaluate the effectiveness of reservoir tillage in a potato field, the project team plans to conduct this study again in 2025.

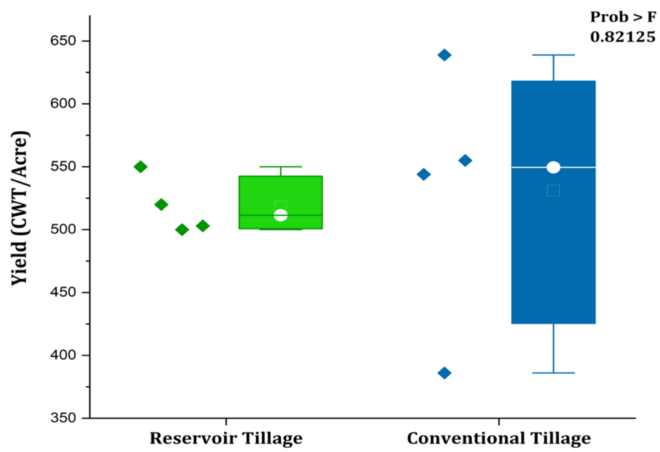

Figure 6. Comparison of potato yields between reservoir tillage and control treatments.

Acknowledgement

We would like to thank the Michigan Potato Industry Commission, Dr. Karl Ritchie, Walther Farms, Lyndon Kelley, Brenden Kelley, Angie Gradiz, Nicolle Ritchie, Greg Rouland, Caden Wade for their invaluable support in successfully completing the field demonstration.

Enhancing Soil Health in U.S. Potato Production Systems – Michigan Year 6

Kurt Steinke, Professor and Extension Soil Fertility Specialist
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Dept. of Plant, Soil, and Microbial Sciences, Michigan State University
See soil.msu.edu for more information.

Location: Clarksville, MI	**Tillage**: Conv., 34-in. row
Planting Date: May 1, 2024 **Harvest**: Sept. 4, 2024	**Trt's**: See below

Summary: The MSU Soil Fertility and Plant Nutrition Program has been a key participant in the USDA-SCRI grant pertaining to enhancing soil health in U.S. potato production systems (2019-2024). In 2023, the grant was on a 5th year no-cost extension with the rotations and treatments maintained. In 2024, funding obtained allowed the Potato Soil Health rotation and treatments to continue through the 2024 growing season in which the 2-year rotation was potato, and the 3-year rotation was winter wheat followed by a cover crop.

Table 1. Treatment design and purpose during the 2019-2024 Potato Soil Health SCRI project, Clarksville, MI.

Treatment	**Abbreviation**	**Variety**	**Fumigation**	**Manure**	**Cover Crop**
National control	NATCTRL	Russet Burbank	None	N	N
No fumigation control	NOFUM	Superior PED susceptible	Metam sodium	N	N
Grower Standard	GRSTAND	Superior PED susceptible	Chloropicrin	N	N
Fumigated/manure	MANURE	Superior PED susceptible	Chloropicrin	Poultry litter	N
Fumigated/cover crop	COVER	Snowden PED tolerant	Chloropicrin	N	Winter rye
"Kitchen Sink"	MAN/CC	Superior PED susceptible	Chloropicrin	Poultry litter	Winter rye

Table 2. Potato yield from 2-year rotation sites in 2020, 2022, and 2024, Clarksville, MI.

Treatment	**Variety**	**Potato Total Yield (cwt A^{-1}) 2020**	**Potato Total Yield (cwt A^{-1}) 2022**	**Potato Total Yield (cwt A^{-1}) 2024**
NATCTRL	Russet	255 c †	203 bc	302 a
NOFUM	**Superior**	**57 a**	**185 ab**	**267 a**
GRSTAND	**Superior**	**156 b**	**144 a**	**319 a**
MANURE	**Superior**	**175 b**	**198 bc**	**293 a**
COVER	Snowden	260 c	245 c	335 a
MAN/CC	**Superior**	**167 b**	**228 bc**	**306 a**
Pr > F		<0.0001	0.0116	0.9884

† Values within the same site and year followed by the same lowercase letter are not significantly different at α=0.05.

Soil health is not a short-term management strategy making outcomes difficult to quantify. Longer-term implementation, increased C loading, reduced disturbance, and increased use of perennial cropping rotations are just a few of the alternative strategies that may be required to enhance the biological aspects of coarse-textured, potato soils moving forward. Soil health indicators can help predict management effects on plant productivity, but these indicators did not perform greater than current soil chemical and physical property indicators. Soil health indicators did not reliably predict management effects on disease suppression.

Other highlights from across the six years of study include the following: Eliminating fumigation had the strongest positive impacts on soil health indicators with cover crops and manure either not impacting these indicators or in some cases impacting in a contradictory manner. Manure and cover crops were not able to mediate the negative effects of fumigation on microbial diversity. Annual application of poultry litter led to an increase in soil test P concentrations (increases up to 63 ppm) and could serve as an environmental issue. Manure applications did increase biological activity, but the addition of cover crops diminished the manure effects. Soil health building practices had no measured effects on C accumulation. Eliminating fumigation only reduced yield the initial implementation year with manure applications have the strongest positive impacts on yield and cover crops inconsistently reducing yield. Eliminating fumigation and cover crops with manure application both suppressed tuber disease infection, and manure application marginally limited verticillium wilt symptoms.

Investigating Integrated Weed Management Strategies for Potatoes-2024 MPIC Research Report

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Michigan potato production is threatened, on an annual basis, by many pests. These pests result in six to ten percent crop loss and in millions of dollars of lost sales. Colorado potato beetle (CPB) is the most important defoliator of potatoes world-wide. CPB has developed resistance to all known classes of insecticides used to control it in commercial production. Adult beetles overwinter in the soil in or near potato fields, they come out in the spring and lay eggs on plants. The summer (2nd) generation begins with eggs that are laid in June. Adults typically emerge in July and emergence is drawn out over the course of weeks making control difficult. Volunteer potatoes further exacerbate CPB damage. Volunteer potatoes are an optimal food source for CPB which then move into neighboring potato fields and defoliate. Historically harsh winter temperatures kill tubers that remain in the field after harvest. Although, in regions where winters are mild and soil temperatures are not cold enough to kill tubers left in the field, tubers can survive, overwinter and become a serious weed problem. Not only do volunteer potatoes compete with crops and reduce yield, but they also harbor insects, diseases, and nematodes that can infest neighboring or future potato crops. Therefore, the objective of these studies was the identification, development, and implementation of integrated tools to control both volunteer potatoes and CPB which is essential to maintaining sustainable potato production in Michigan.

Objective 1*: Examine the impacts of tillage intensity, herbicide, and insecticide programs on volunteer potatoes in corn*. This study was conducted at the Montcalm Research Center, MSU Plant Pathology Farm, and Kellogg Biological Station. The study followed a split-plot randomized complete block design with tillage intensity (chisel-light intensity vs. moldboard plow-aggressive intensity) as the main plot factor and herbicide-insecticide program timing as the split-plot factor. In the fall potatoes were randomly spread on the soil surface to simulate volunteer potatoes that are left in the field after harvest. Following spreading tillage intensity, light via chisel plow vs. aggressive via moldboard plow, treatments were implemented to assess the impacts of volunteer potato burial depth on emergence. Corn was planted following tillage treatments. Volunteer potatoes were sprayed at two sizes < 6 in (V5 corn) or 6-12 in (V7 corn) with either the herbicides Callisto or Armezon/Impact and with the insecticides Coragen or Radiant (Figure 1). Percent volunteer potato control (0% = no control, 100% = complete control) and corn injury (0% no injury, 100% = complete injury) were evaluated 7, 14, and 21 days after herbicide application and at harvest.

Overall, at two of the three locations there was no difference in volunteer emergence amongst tillage treatments. When we investigated this further, the potatoes that we used at MRC and Plant Pathology were treated with MH-30 a sprout inhibitor which resulted in low spring emergence, this interesting finding will be the target of the 2025 proposal. At the location with good emergence, KBS, the plow treatment resulted in 650% more emerged volunteers than the disk (Figure 2).

Armezon/Impact applied at V3 increased corn injury by 2% compared to Callisto treatments, although injury was minimal 4% compared to 2% for other treatments evaluated 7 days after application (Figure 3). Tank mixing insecticides with herbicides had no impact on corn injury. When evaluating injury 21 days after application all ratings were below 1% (Figure 4). Volunteer potato control also differed by herbicide insecticide treatment. When volunteers were plowed 21 days after application Callisto applied to less than 6 in potatoes resulted in greater than 50% control, all other treatments were below 20% (Figure 5). When volunteers were disked 21 days after application control was much higher (Figure 6).

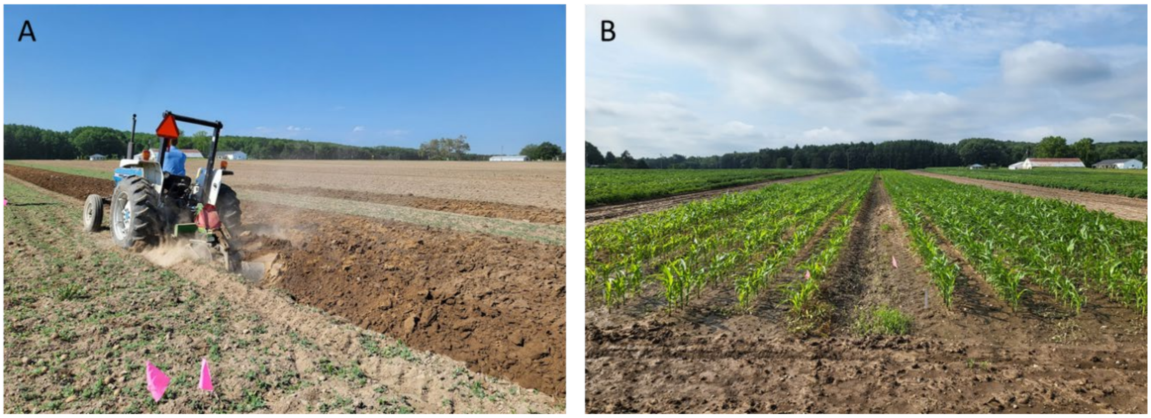

Figure 1. A) Tillage treatments, B) Study after corn planting and herbicide/insecticide applications.

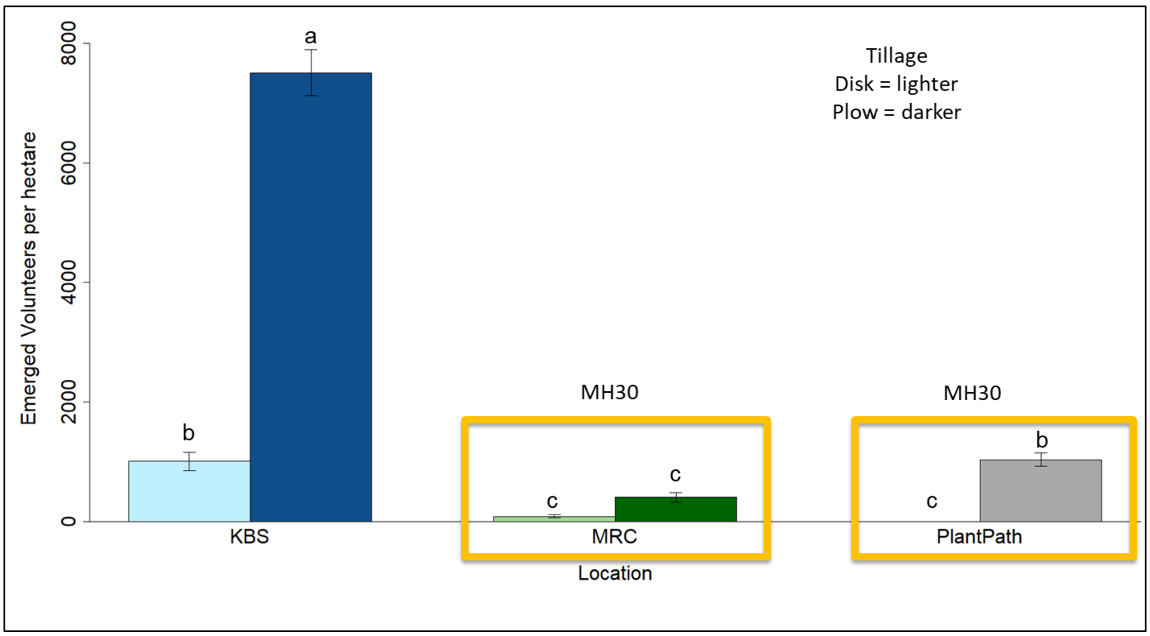

Figure 2. Volunteer potato emergence influenced by tillage treatment.

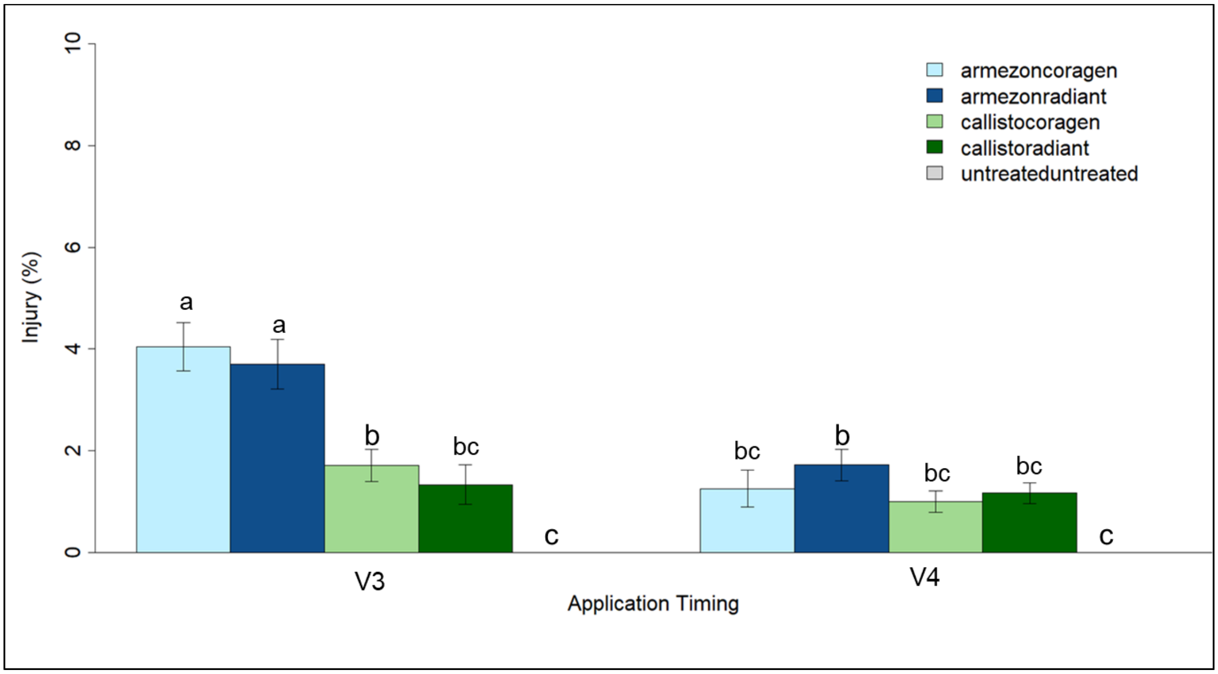

Figure 3. Corn injury 7 days after application.

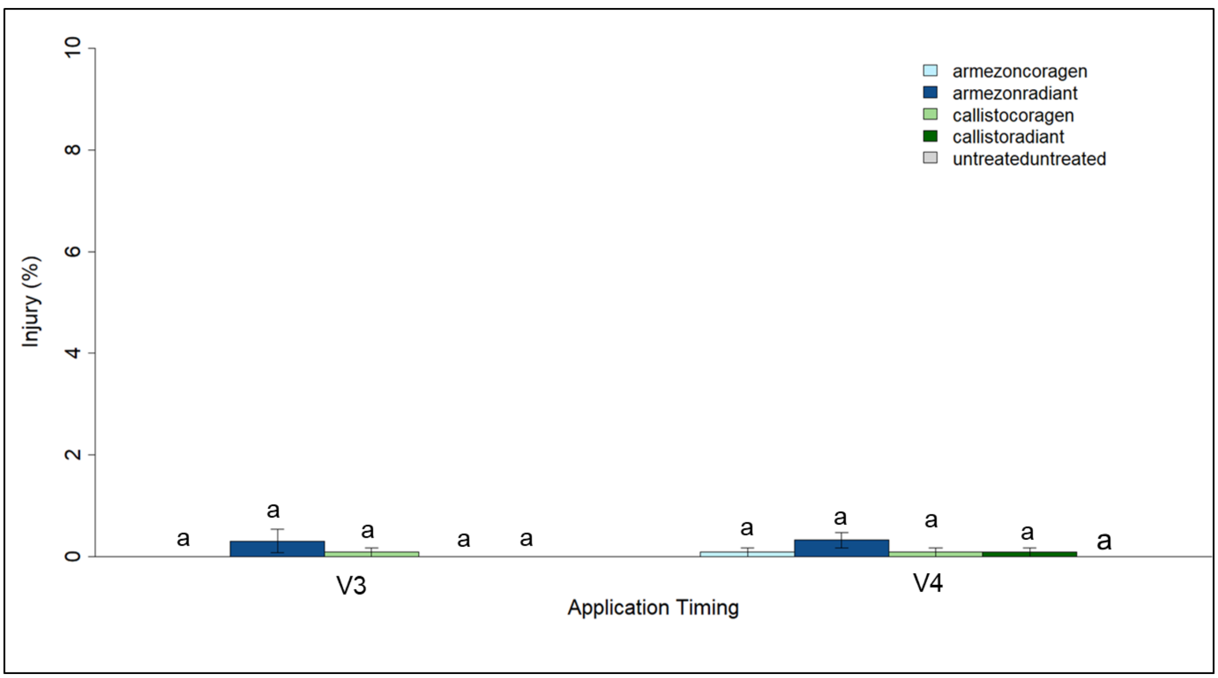

Figure 4. Corn injury 21 days after application.

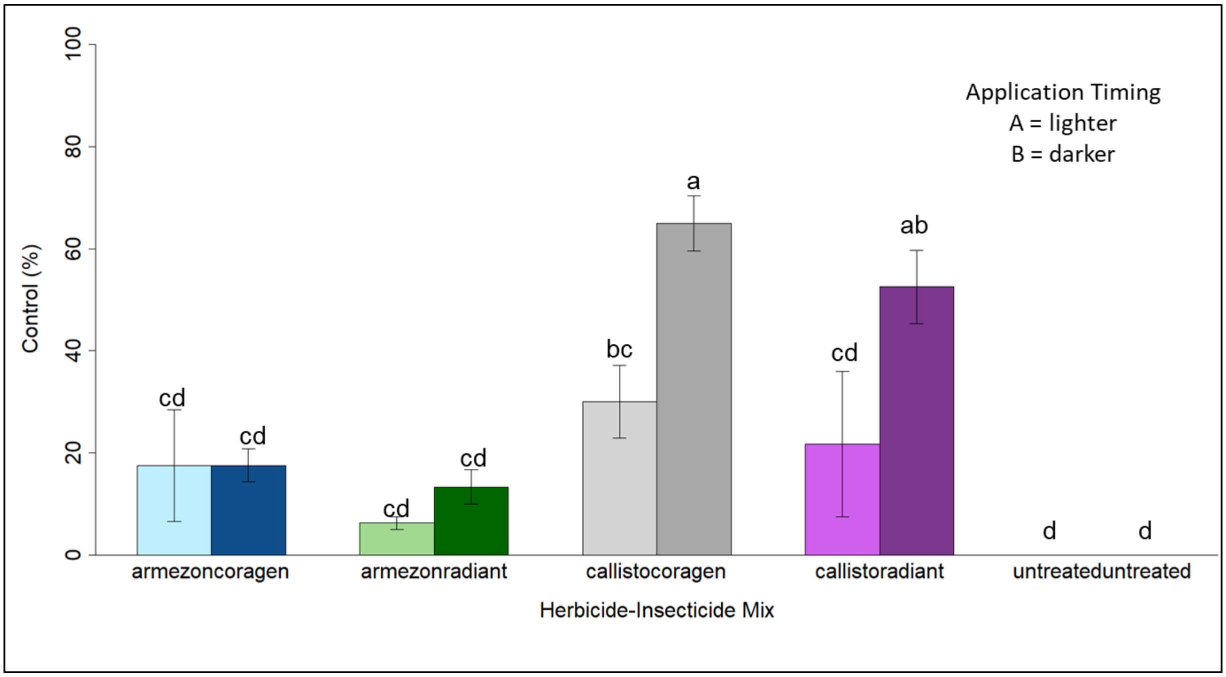

Figure 5. Volunteer control 21 days after application in the plow system.

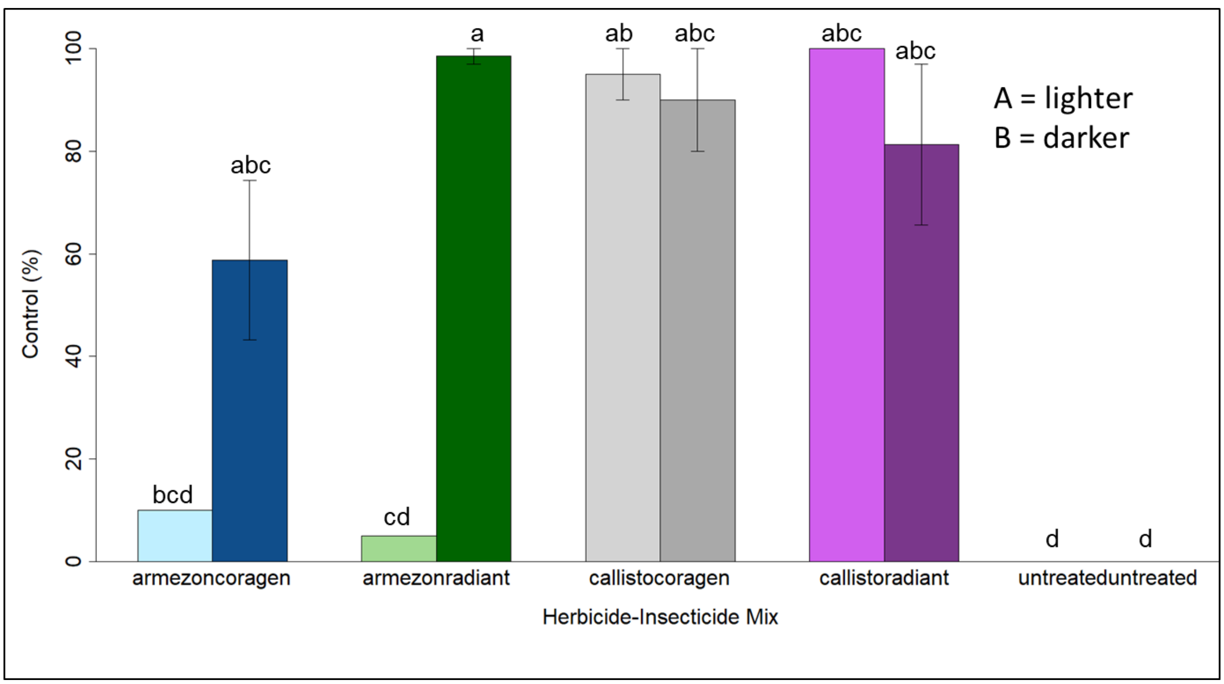

Figure 6. Volunteer control 21 days after application in the disk system.

Objective 2*: Utilize late planted potato trap crops to manage second generation CPB populations*. This study was conducted at the Montcalm Research Center. The study followed a split-plot randomized complete block design with timing of trap crop planting at, two, or four weeks after planting the main bulk crop to assess the impacts of timing of trap crop planting on reductions in CPB populations (Figure 7). Trap crops are planted between overwintering sites and this season's main potato crop to attract CPB prior to reaching the main crop. The trap crop utilized in this study was the cultivated red potato planted in six rows 20 ft long adjacent to the main potato crop planted to Snowden potatoes. Subsample points were established across the rows of bulk potatoes in which we sampled CPB densities and potato percent canopy cover. Potato yield was collected on three subsamples per treatment across the bulk planting. Overall, we found that delaying trap crop planting by four weeks reduced the rate of canopy loss compared to two and at planting trap crop timings (Figure 8). This delay in potato defoliation led to differences in yield. Yield increased by 500% when trap crop planting was delayed by two weeks (bulk2) and 400% by four weeks (bulk4) compared to at planting (bulk0) (Figure 9). Therefore, defoliation and yield can be improved when delaying trap crop planting by four weeks where CPB second generation pressure is high. Furthermore, these management techniques of potato trap crop planting and herbicide-insecticide programs can be combined to reduce loss from these pests in corn and potato rotations.

Figure 7. Trap crop planting trial.

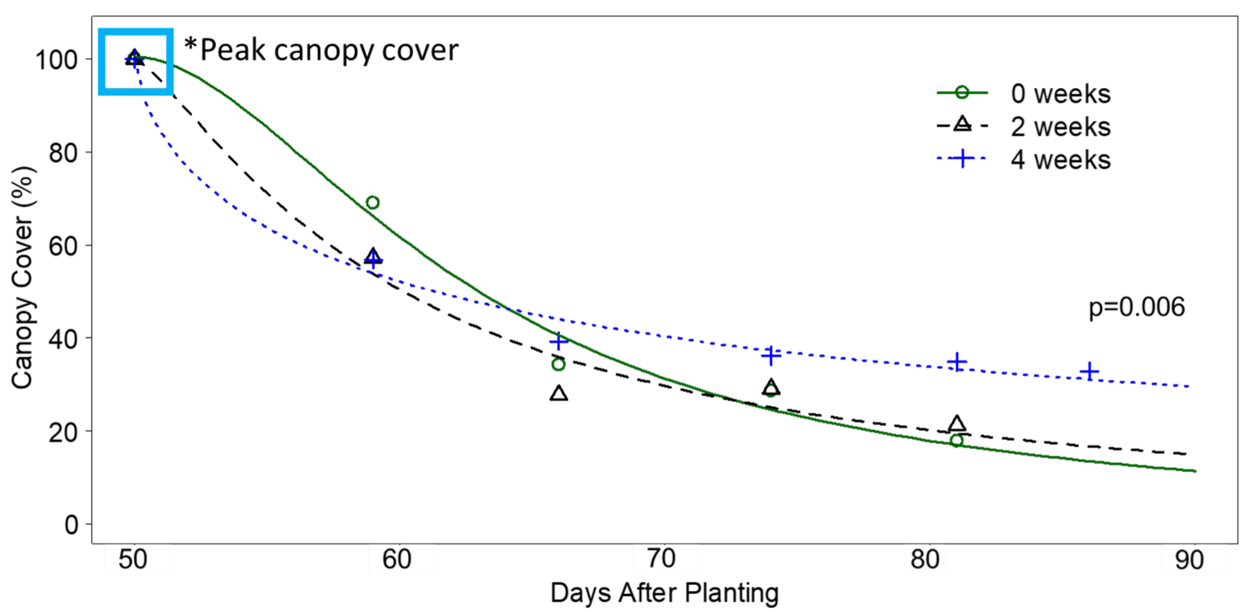

Figure 8. Rate of potato canopy defoliation in bulk crop impacted by timing of trap crop planting.

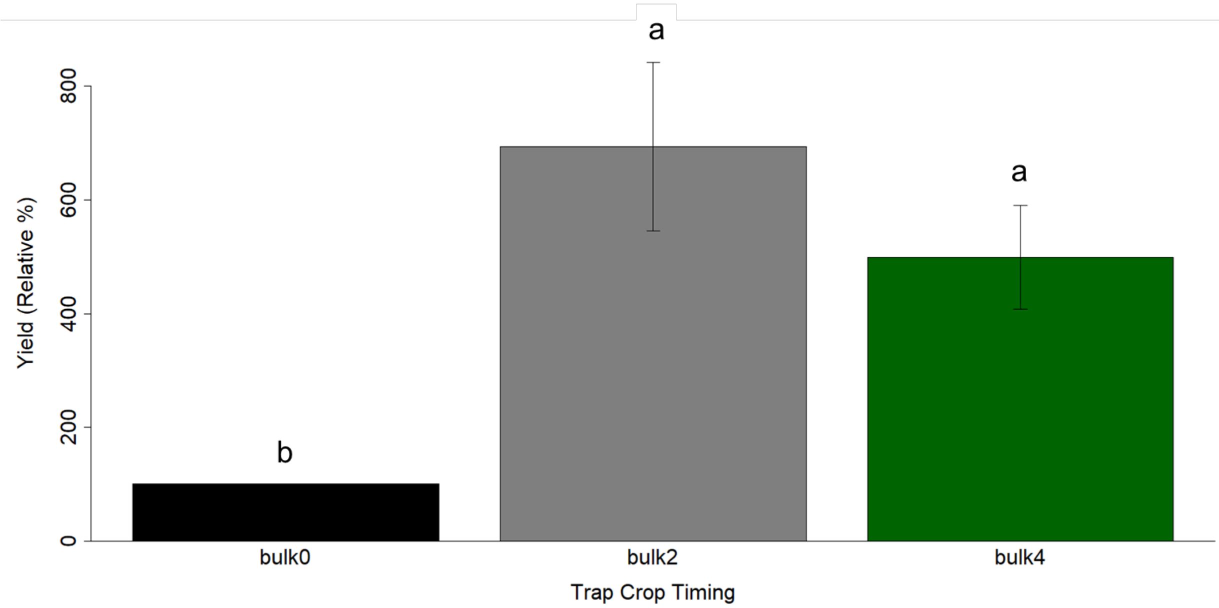

Figure 9. Relative potato yield impacted by timing of trap crop planting.