Michigan State University

AgBioResearch

In Cooperation With

Michigan Potato Industry Commission

Michigan Potato Research Report

Volume 55

2023

Michigan Potato Industry Commission • 3515 West Rd. Ste. A, East Lansing, MI, 48823
517-253-7370 • info@mipotato.com • mipotatoindustry.com

January 5, 2024

To all Michigan Potato Growers and Shippers,

The Michigan Potato Industry Commission continues to provide over $183,000 in direct funding on an annual basis for potato research. This research is one of the core components that continue to move the Michigan potato industry forward. Expanding research has provided increased insights into varieties, disease, soil fertility, and storage management. Research outcomes continue to provide a competitive advantage for the industry in Michigan and to provide Michigan with a highly respected reputation among the national industry professionals.

The following research report was compiled with the help of the Michigan State University AgBioResearch and Michigan State University Extension. On behalf of all parties, we are proud to present you with the results of the 2023 potato research projects.

We hope that each of you finds value in the investment made in these projects and can apply some of the results directly to strengthen your own operation.

We would like to thank our many suppliers, researchers, and industry partners who are involved in making this year's research season a success even on the heels of a global pandemic. As the industry faces new challenges and strives to improve upon best practices, we are inspired by the level of cooperation within the industry and look forward to future success together.

Sincerely,

Kelly Turner

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

Table of Contents

2023 MICHIGAN POTATO RESEARCH REPORT

C. M. Long, Coordinator

INTRODUCTION AND ACKNOWLEDGMENTS

The 2023 Potato Research Report contains reports of the many potato research projects conducted by Michigan State University (MSU) potato researchers at several locations. The 2023 report is the 55th 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 goes 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 Trina VanAtta, MSU for organizing and compiling this final draft.

WEATHER

The overall 6-month average maximum and minimum temperatures during the 2023 growing season were consistent with the 15-year averages at 74ºF and 49ºF respectively (Table 1). April through June had slightly warmer temperatures than the maximum average. All other months were consistent with or slightly cooler than the 15-year averages. Daytime extreme heat events were below average in 2023 with no time in which temperatures exceeded 90ºF during the summer. Extreme high nighttime temperatures were also below average in 2023, with 47 hours of nighttime temperatures above 70ºF over 18 days, compared to the seven-year average of 110 hours over 25 days (Table 3).

Rainfall for April through September was 19.59 inches, which was 0.96 inches above the 15-year average (Table 2). A total of 5.5 inches of irrigation water over 8 applications was applied to Comden 1 between late May and late August. In general, May, June, and September were drier than average while April, July, and August had more precipitation than average.

Table of Contents

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

													6-Month	
	April		May		June		July		August		September		Average	
Year	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
2009	56	33	67	45	76	54	75	53	76	56	74	49	71	48
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**
15-Year Average	56	34	71	45	78	55	82	60	80	57	74	50	73	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
2009	3.94	2.15	2.43	2.07	4.74	1.49	16.82
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	19.50
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	0.70	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**
15-Year Average	3.35	3.24	2.99	2.94	3.68	2.41	18.63

Table of Contents

Table 3. Seven-year heat stress summary (from May 1st – Sept. 30th)*

Year	Temperatures > 90°F		Night (10pm-8am) Temperatures > 70°F	
	Hours	Days	Hours	Days
2017	14	3	80	18
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**
Average	7	2	110	25

GROWING DEGREE DAYS

Table 4 summarizes the cumulative growing degree days (GDD) for 2023 while providing historical data from 2011-2023. GDD are presented from May 1st – September 30th using the Baskerville-Emin method with a base temperature of 40°F. The total GDD base 40 at the end of September in 2023 was 3707 (Table 4), which is 113 GDD lower than the 13-year average of 3820.

Table 4. Growing Degree Days* - Base 40°F.

Year	Cumulative Monthly Totals				
	May	June	July	August	September
2011	567	1354	2388	3270	3848
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**
Average	561	1332	2274	3159	3820

*2011-2023 data from the weather station at MSU Montcalm Research Center "Enviro-weather", Michigan Weather Station Network, Entrican, MI.

Table of Contents

PREVIOUS CROPS, TILLAGE AND FERTILIZERS

The general potato research area utilized in 2023 was Montcalm Research Center property in the field referred to as 'Comden 1.' This acreage was planted to oats in the spring of 2022 with crop residue disked into the soil in fall and sprayed off in the spring of 2023. In the spring of 2023, the recommended rate of potash was broadcast applied following deep chisel plowing. The ground was vertical tilled and direct planted to potatoes. The area was not fumigated with Vapam prior to potato planting, but Admire Pro® was applied in-furrow at planting.

The soil test analysis for the general crop area (taken in November 2022) was as follows:

	lbs/A			
pH	P	K	Ca	Mg
6.4	248 (124 ppm)	164 (82 ppm)	1152 (576 ppm)	186 (93 ppm)

The fertilizers used in the general plot area are as follows (fertilizer variations used for specific research projects are included in the individual project reports).

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 0-0-0-21Ca-12Mg 10%B 0-0-62 0-0-0-18Zn	300 lbs/A 500 lbs/A 300 lbs/A 12 lbs/A 375 lbs/A 1 gal/A	0-0-66-33Mg-66S 0-0-0-105Ca-80S 0-0-0-63Ca-36Mg 1.2 lb. B 0-0-233 1.9 lb. Zn
At-planting	28-0-0 10-34-0	13 gpa 7 gpa	21-6-0 14-49-0
At-cultivation	28-0-0 10-34-0	40 gpa 20 gpa	118-0-0 21-71-0
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

HERBICIDES AND PEST CONTROL

A pre-emergence application of Linex4l/Dual II at 1.25 qts/A was made in late May. Matrix SG was applied in-furrow at planting at a rate of 1 fl oz/A.

Post emergence, Tricor/Dual II was applied in late June at 1.25 qts/A.

Assail 30sg was applied in mid-June at 15 gal/A and Besiege were applied in late June at 7 fl oz/A.

Potato vines were desiccated with Reglone in early September at a rate of 32 oz/A.

Table of Contents

Funding: Federal Grant, MPIC and Potatoes USA/SNAC

2023 On-Farm Potato Variety Trials

Chris Long, Trina VanAtta, Azamat Sardarbekov, Ian Smith,
Bernard M. Schroeter, Johnny Graves, Dr. Dave Douches
Cooperator: James DeDecker (Presque Isle Co.)

INTRODUCTION

Our main objectives for on-farm potato variety trials 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 encourage the commercialization of new varieties in the state of Michigan. We share our results with growers, breeders, and processors across the country to aid in the development of new varieties. In 2023, we conducted 33 on-farm potato variety trials with 12 growers in 11 counties.

Processing trial cooperators were: 4-L Farms (Kalamazoo), Black Gold Farms (St. Joseph), Hampton Potato Growers (Bay), Lennard Ag. Co. (Branch, St. Joseph), Main Farms (Montcalm), Sandyland Farms (Montcalm), Verbrigghe Farms (Delta), and Walther Farms, Inc. (St. Joseph). We also conducted processing trials at the Michigan State University (MSU) Montcalm Research Center (Montcalm). The Potatoes USA/Snacking Nutrition and Convenience International (SNAC Int.) chip trial was conducted at Sandyland Farms (Montcalm).

Fresh market trial cooperators were: 4-L Farms (Kalamazoo), Elmaple Farms (Kalkaska), Horkey Bros. (Monroe), Jenkins Farms (Kalkaska), Kitchen Farms, Inc. (Antrim), Lennard Ag. Co. (St. Joseph), Styma Potato Farms (Presque Isle), Verbrigghe Farms (Delta), and Walther Farms, Inc. (St. Joseph, Tuscola)

PROCEDURE

A. Processing Variety Trials

We evaluated 90 chip processing varieties in 2023. To evaluate selected processing lines, we used the following check varieties: Atlantic, Lamoka, and Snowden. For all trials, we used 10” in-row seed spacing and 34” rows (Table 2).

Most of our processing trials were strip trials. These trials consisted of a single 75’ strip for each variety of which we harvested and graded a single 23-ft section. For each variety in the Walther Farms, Inc. trials, we planted three 15-ft long rows and harvested the center row. We also conducted multi-acre block plantings of promising, non-commercialized trials at Black Gold Farms, Sackett Potatoes, Sandyland Farms, Lennard Ag. Co., and Walther Farms Three Rivers and Cass City locations. Agronomic production practices for these block plantings varied based on each grower’s production system.

B. Processing Variety Trials

We conducted the Potatoes USA/SNAC Int. Trial for Michigan at Sandyland Farms, LCC (Montcalm County). We planted ten varieties in 300' strips and harvested three 23-ft sections of row for each variety. Our check varieties were 'Lamoka' and 'Snowden' (Tables 3 to 7). For more details on this trial, please reference the 2023 annual report published by Potatoes USA.

C. Fresh Market Trials

Within the fresh market trials, we evaluated 148 primary entries (this does not include entries from Potatoes USA/NFPT trial) which included: 53 russet, 26 red, 56 yellow, 5 novelty, and 8 round white types (Tables 9 and 10). To evaluate selected table-stock lines, we used the following check varieties:
Red: Dark Red Norland
Round White: Reba, Superior
Russet: Goldrush, Russet Norkotah, Silverton Russet, Russet Burbank
Yellow: Yukon Gold
Novelty: Blackberry
We planted all trials with 34" wide rows and 10" in-row seed spacing.

We evaluated most of the fresh market trials as strip trials. These trials consisted of a single 75' strip for each variety of which we harvested and graded a single 23-ft section. We planted the NFPT trial at Walther Farms, Inc. as single 15' long strips and harvested the entire strip (Table 11). 2023 was the fifth year conducting an early generation tablestock variety trial with red skin, white flesh, and yellow skin potato varieties. This trail was planted and harvested like the NFPT trial and took place at Walther Farms, Inc (Table 12). We planted Walther Farms, Inc. trials with three 15-ft rows and harvested the middle row. We also conducted multi-acre block plantings of promising, non-commercialized trials at Styma Potato Farms, Lennard Ag. Co., Kitchen Farms and Walther Farms Three Rivers. Agronomic production practices for these block plantings varied based on each grower's production system.

RESULTS

A. Processing Variety Trial Results

We recorded general descriptions, pedigrees, and scab ratings for all varieties tested in 2023 (Table 1) and evaluated these varieties based on yield, specific gravity, internal quality, common scab ratings, and maturity (Table 2). Below are four superior processing varieties from 2023.

> **MSDD247-11:** This Michigan State University variety had been evaluated for two years, most recently at five locations in 2023. It had a slightly below average yield of 443 cwt/A US#1 tubers in 2023 with 90% A-sized tubers and 8% B-sized tubers. The specific gravity of 1.089 was above the trial average of 1.080. The common scab rating was 0.5, below the trial average. No stem end defect was observed during chipping after harvest, making MSDD247-11 desirable for chip processing. The vine vigor was higher than average, but the plant matured earlier than other evaluated in 2023. The tubers had deeper eyes and an attractive round type.

NY174: This Cornell University variety was evaluated at six locations in 2023 and has been under evaluation by the Potato Outreach Program since 2021. The US#1 yield of 582 cwt/A was above average, as was the total yield of 647 cwt/A. There were 90% A-sized tubers and no oversized potatoes, a desirable quality for chip processing. The specific gravity of 1.082 was slightly above average. Internal quality was very good with only seven percent vascular discoloration and no other defects. The common scab rating and stem end defect score were both consistent with the trial average. The fresh chip quality was excellent with attractive bright chips. Storage chip quality in the Box Bin trial is also promising with consistently attractive chips and limited chip defects. This early maturing variety had a flat round to oval type with heavier netted skin.

AF6565-8: This University of Maine variety was evaluated at eight locations in 2023. It had a very high US#1 and total yield of 585 cwt/A and 637 cwt/A, respectively. It had a high percentage of A sized tubers with only one percent each of oversize and pickout tubers. The specific gravity of 1.082 was above the trial average of 1.080. The fresh chip score and stem end defect score were both below the trial average with good chip quality observed. The tuber appearance was variable with some deeper eyes observed. Vine vigor and maturity in AF6565-8 were both consistent with the trial average. Internal quality was good with only six percent vascular discoloration observed in 2023. This variety is in the Box Bin trial and currently displays excellent chip quality.

NY179: This Cornell University variety was evaluated at eight locations in 2023 and has been in Michigan variety trials since 2021 with a total of 24 trial entries. It had an above average yield of 584 cwt/A and total yield of 644 cwt/A. There were 10% B-sized tubers present but no oversized tubers, which is an acceptable size profile for the processing industry. Specific gravity was 1.080 at the trial average. Internal quality was good with no internal brown spot or brown center observed and less than five percent hollow heart and vascular discoloration. The fresh chip color score of 1.1 was good, and the stem end defect score of 0.3 was below the trial average. NY179 is common scab susceptible and had a higher incidence than average in 2023 across all locations. This variety has a moderately vigorous vine and mid-season vine maturity. The tubers had medium netted skin and a long oval type. It will be further evaluated in storage in the Box Bin trial.

B. Potatoes USA/SNAC Int. Chip Trial

In 2023, we conducted the Potatoes USA / SNAC Int. Michigan chip trial at Sandyland Farms, LLC in Montcalm County. We compared yield, size distribution, and specific gravity of eight test varieties to Lamoka and Snowden (Table 3). We also evaluated at-harvest raw tuber quality (Table 4) and sent samples to Herr Foods, Inc. (Nottingham, PA) where potatoes were processed and scored for out of the field chip quality (Table 5). We assessed blackspot bruise susceptibility (Table 6), calculated stand and stem count (Table 8), and conducted pre-harvest panels for each variety (Tables 7A and B).

The varieties with the highest US#1 yields were AF6200-4 and MSAFB635-15 with US#1 yields of 594 cwt/A and 544 cwt/A. AF6200-4 and Lamoka had the highest percentage of US #1 tubers, 95% and 93%. The average specific gravity of the trial was 1.085 (Table 3). AF6165-9 had 27% hollow heart, the highest incidence in the trial. NY174, NY177, and AF6200-3 had excellent internal quality with all defects at or below the trial mean (Table 4). Samples collected on October 10th were processed by Herr's Foods, Inc. on October 16th. NY174 was ranked first by Herrs with a SNAC color of 2.0 and 17.1% total defects. AF6200-4 was ranked last with a higher and less desirable SNAC score of 3.0 and 52.9% total defects (Table 5). Black spot bruise assessments demonstrated that NY174 and MSAFB635-15 were most resistant to black spot bruising, while NY177 and AF6200-4 were most susceptible (Table 6). AF6200-4 produced the largest tubers with an average tuber weight of 6.8 oz/tuber, while NY177 had the smallest tubers with an average weight of 3.8 oz/tuber. AF6165-9 had 5.1 stems per plant, the highest in the trial, while NY177 had 3.3 stems per plant, the lowest in the trial (Table 8).

C. Fresh Market and Variety Trial Results

We recorded general descriptions, pedigrees, and scab ratings for all fresh market varieties evaluated in 2023 (Table 8) and assessed these varieties based on yield, specific gravity, internal quality, common scab ratings, and maturity (Tables 9 and 10). The NFPT and Early Generation Tablestock trials screen potato selections under initial evaluation. In 2023, 60 NFPT-designated russet varieties and an additional 33 russet selections were evaluated (Table 11). Continued evaluation of these varieties are determined based on national performance. In total, 59 red skin potato varieties from Cornell University, University of Maine, Michigan State University, Colorado State University, Texas A & M University, and North Dakota State University potato breeding programs were grown in Michigan. Of these, 18 varieties were chosen for continued evaluation in Michigan (Table 12). They were be grown in 15-foot plots in 2023. Below are top performing russet, yellow, red, white, and novelty fresh pack varieties. All varieties evaluated in 2023, including pedigrees, scab score, and characteristics are listed in Table 13.

Russets

A08433-4sto: This USDA Idaho variety was evaluated at ten locations in 2023 and has been under evaluation since 2016. It had the third highest yield in the trial, 557 cwt/A US#1 tubers, and 689 cwt/A total yield. The tuber size profile was very large with 18% oversize tubers, higher than the trial average of 14%, but this may be successfully managed with cultural practices during the growing season. Internal quality was acceptable with the higher-than-average hollow heart incidence related to the higher proportion of oversize potatoes. The specific gravity was average for the trial. The tubers were attractive with appealing lighter russet skin. A08433-4sto has consistently displayed agronomic and visual appeal in Michigan research trials.

A12327-5VR: During its third year under evaluation, this USDA Idaho variety was planted at six locations in 2023. It had a very high US#1 yield of 616 cwt/A, the second highest in the trial. This was due to its very large tuber type with 42% A-sized tubers and 49% oversized tubers. The specific gravity of 1.075 was slightly below average. Despite the larger tuber size, internal quality was good with only five percent hollow heart observed in 2023. The common scab score was lower than average, indicating potential tolerance to the pathogen. The tubers had deeper eyes, darker skin, and moderate alligator hide.

AF6377-10: This University of Maine variety had a high US#1 yield of 499 cwt/A and 95% US#1 tubers. Due to the larger tuber size profile, 40% of tubers were oversized. The specific gravity of 1.073 was below the trial average of 1.077. Internal quality was good despite the larger tuber size, with no hollow heart and only five percent vascular discoloration observed in 2023. There was no incidence of common scab across the four locations evaluated in 2023, suggesting potential tolerance to the pathogen. Some tubers had slight alligator hide and skinning, but the oblong blocky type was consistent and attractive.

Portage Russet: This University of Wisconsin entry has recently been named and released, it was evaluated as W13A11229-1Rus. It has been evaluated in Michigan for five years and was in ten trials in 2023. It had above average US#1 and total yields, with 70% A-sized tubers, nine percent oversize tubers, and 16% B-sized tubers. The specific gravity of 1.082 was above the trial average. Internal quality was acceptable with 13% hollow heart and eight percent vascular discoloration. The tubers had some sticky stolons, lighter russet skin, and a few tubers were pointed.

Yellow Flesh

Colomba: This yellow-fleshed variety had the third highest #1 yield of 599 cwt/A with 91% US #1 tubers in seven trials. The specific gravity of 1.055 was below the trial average of 1.068. Internal quality was excellent with six percent vascular discoloration and one percent internal brown spot. The waxiness and flesh color scores were both higher than the trial averages. Colomba had a longer type, slightly netted skin, and some deeper eyes. It has consistently displayed good agronomic and visual traits over the past four years under evaluation.

MSGG093-11Y: This Michigan State University was evaluated at six locations for the first time in 2023. It had an above average US#1 yield of 582 cwt/A with 87% A-sized tubers. The specific gravity of 1.071 was above the trial average, and internal quality was excellent with only five percent brown center observed in 2023. Yellow skin waxiness and flesh color were both above average. The blocky round to oval tubers had light netted skin and a nice appearance. The vine maturity was slightly below average in 2023.

W13103-2Y: This University of Wisconsin variety had an above average total and US#1 yield with 88% A-sized tubers. It was evaluated at seven locations in 2023, the second year in Michigan trials. The specific gravity of 1.061 was below the trial average. Internal quality was excellent with one percent vascular discoloration. Common scab incidence was slightly above the trial average, suggesting potential susceptibility. The tubers were round to oval with good visual appeal. The waxiness and flesh color were both rated above the trial average.

Montana: This variety has been evaluated by the Potato Outreach Program since 2021 and was observed at seven locations in 2023. It has a smaller tuber size profile than average with 24% B-sized potatoes, but a high US#1 yield of 503 cwt/A and total yield of 657 cwt/A. Internal quality was excellent with only one percent vascular discoloration and brown center observed. Both the yellow skin waxiness and yellow flesh color were rated much higher than average due to the excellent visual appeal of the tubers. The tubers were oval to oblong with some greening.

Red Skin

NDAF113484B-1: This variety has been under evaluation in Michigan since 2018 and was planted at two locations in 2023. It had the second highest yield of red skin tablestock entries with 525 cwt/A US#1 yield and 582 cwt/A total yield. There were 90% A-sized tubers, much higher than average. The internal quality was excellent with no defects observed. The vine was larger and more vigorous than average but had an earlier and therefore more desirable vine maturity. Waxiness, skin color, and skin color uniformity were all rated above average compared to other red skin tablestock varieties. The tubers had a blocky round type with slight skinning.

NDTX050169-1R: This variety was evaluated for the first time in 2023 at two locations. The yield was below average with 246 cwt/A US#1 yield and 347 cwt/A total yield. The tubers were smaller than average with 23% B-sized potatoes. Internal quality and common scab ratings were both excellent, with no defects or scab observed. NDTX050169-1R had high visual appeal with above average skin color and skin color uniformity ratings. Skin waxiness was slightly lower than average. The tubers had some sticky stolons, a consistent type, and attractive appearance.

Round White

05.6556.1: This Real Potatoes varieties was evaluated at six locations in 2023. It had an above average total yield of 644 cwt/A with 84% A-sized tubers, above the trial average. The specific gravity of 1.048 was below the average of 1.068. Internal quality was excellent with one percent vascular discoloration observed. Vine vigor and vine maturity were consistent with the trial average. Skin waxiness was above average, and nice smooth bright skin was noted during grading. While tuber size was consistent, there was some variability in the tuber shape.

Sifra: During the second year under evaluation, this HZPC entry was evaluated at seven locations. It has a very high US #1 and total yield, 562 cwt/A and 678 cwt/A, respectively. There were 81% US#1 tubers, consistent with the trial average. Internal quality was good with no defects observed. The tubers had a uniform flat oval appearance with a few sticky stolons. This variety has full season maturity.

Volare: This entry had the highest US#1 yield of all round white tablestock potatoes in 2023 when evaluated across eight locations. The specific gravity of 1.058 was below the trial average, and internal defects were at or slightly higher than the trial average. The tubers were flattened oval with an attractive uniform appearance. The tubers have a desirable thin skin with minimal netting and slight to no skinning, contributing to a high visual appeal.

Table of Contents

Novelty

Blackberry: This Michigan State University selection had purple skin and flesh, and an above average yield of 411 cwt/A US #1 tubers. It produced 89% A sized tubers and 10% B sized tubers. Blackberry had no internal defects but was only evaluated at one location in 2023. Some tubers had chimeral eyes with white pigmentation, while most other tubers had consistent purple skin and deep purple flesh. It has full season vine maturity and a moderately vigorous vine.

Table of Contents

Table 1. 2023 Chip Processing Variety Descriptions

Entry	Pedigree	2023 Scab Rating*	Characteristics
AC13125-5W	Saginaw Chipper	0.0	Nice bright round appearance, common scab resistant, early season vine maturity
AF5933-4	Eva x AF4386-16	1.5	Smaller round uniform type, average yield, early season maturity
AF6165-9	Beacon Chipper x AF290-5	2.0	Variable shape, flat type, common scab susceptible, average yield
AF6200-4	Sebec x Tundra	1.2	Flat blocky round type, inconsistent shape, above average yield, mid-season maturity
AF6206-3	AF4386-16 x Lamoka	1.3	Bright skin, nice blocky round to oval type, high yield, common scab susceptible
AF6552-2	NY148 x Lamoka	0.8	Light netted skin, blocky round type, average yield, later season maturity
AF6555-2	NY148 x MSR127-2	1.0	Small type, bright skin, surface scab, low yield, average maturity
AF6565-8	WAF10131-19 x MSR127-2	0.9	Poor appearance, deeper eyes, blocky type, above average yield, average maturity
AF6652-3	MSAFB626-5 x AF4648-2	0.4	Bright skin, variable type, above average yield, earlier maturity
AF6655-1	MSR061-1 x NY152	0.6	Blocky round type, heavy netted skin, above average yield, earlier maturity

Table of Contents

2023 Processing Varieties Cont.

Entry	Pedigree	2023 Scab Rating*	Characteristics
AF6665-3	NY132 x MSR127-2	1.0	Flat oval type, some pointed tubers, average yield, mid-season maturity
AF6669-10	NY148 x AF5682-3	0.5	Bright skin, small round tubers, moderate common scab resistant, below average yield
AF6671-10	NY148 x AF5549-1	0.3	Flat round type, moderate skinning, early maturity, above average yield
AF6675-1	NY152 x B3054B-2	1.0	Heavy netted skin, blocky oval type, common scab susceptible, average yield
AF6872-11	Pike x Manistee	1.5	Netted skin, blocky round type, pitted scab, average yield, earlier maturity
AF6878-15	Tundra x AF5040-8	1.0	Misshapen pickouts, flat round type, common scab susceptible, above average yield
AF6883-8	Tundra x AF5416-2	1.2	Light netted skin, flat oval type, average yield, early maturity, common scab susceptible
AF6883-15	Tundra x AF5416-2	0.7	Variable appearance and skin finish, average yield, very early maturity
AF6886-3	Waneta x Tundra	1.0	Blocky round type , average yield, early maturity
AF6892-6	NY178 x Tundra	0.5	Round to oblong blocky type, netted skin, high yield, late maturity

Table of Contents

2023 Processing Varieties Cont.

Entry	Pedigree	2023 Scab Rating*	Characteristics
AF6894-12	AF4157-6 x Tundra	1.5	High yield, early maturity, light netted skin, round type
AF6896-1	AF4552-5 x Pike	0.5	Below average yield, small flat round type, moderate growth crack, early maturity
AF6898-1	AF4552-5 x NY128	0.3	Average yield, pointed tubers, trace heat knobs, early maturity
AF6901-8	AF4648-2 x Nicolet	0.5	Below average yield, early maturity, bright skin color, round blocky type
AF6911-4	MSAFB611-5 x NY152	1.5	Average yield, compressed shape, bright thin skin, mid-season maturity
AF6969-3	University Of Maine	0.3	Bright, blocky round type, average yield, earlier maturity, moderate common scab resistant
AF6978-1	NY121 x Nicolet	1.2	Later maturity, large flat type, skinning, average yield
AF6979-3	NY121 x AF4552-5	0.5	Above average yield, variable skin finish, very early maturity
AF6980-1	NY150 x Nicolet	0.2	Pointed tubers, variable skin and type, average yield, early maturity
AR2018-07	Real Potatoes	1.7	Small type, dark skin, slight growth crack, average to above average yield, common scab susceptible

Table of Contents

2023 Processing Varieties Cont.

Entry	Pedigree	2023 Scab Rating*	Characteristics
Atlantic	Wauseon x Lenape	1.5	Variable oval type, netted skin, average to above average yield, early maturity
B3012-1	B2588-6 x B1829-5	0.7	Good internal quality, variable oval type, netted skin, average yield
B3306-2	BTD0013-14 x BNC199-1	0.8	Average yield, oval to oblong type, light yellow flesh, good internal quality
B3379-2	B3012-3 x B3044-2	0.8	Average to above average yield, light purple eyes, variable type, hollow heart
B3379-6	B3012-3 x B3044-2	0.7	Purple eyes, blocky round type, average yield, moderate hollow heart
B3381-4	B3172-3 x B2954-1	1.2	Uniform oval type, light yellow flesh, below average yield, hollow heart
B3403-6	NY121 x B2489-6	2.0	High yield, nice type and appearance, scab susceptible, good internal quality
B3471-1	BTD0013-44 x B1709-6	2.0	Below average yield, oval type, pitted scab, light netted skin, good internal quality
Bliss	NYE50-8 x NYE48-2	0.6	Small round type, bright skin, trace points, average yield, some vascular discoloration
BNC549-1	NCB2497-17 x NCB2489-5	1.3	Low yield, common scab susceptible, smaller oval type, good internal quality

Table of Contents

2023 Processing Varieties Cont.

Entry	Pedigree	2023 Scab Rating*	Characteristics
BNC726-5	NC372-2 x Atlantic	0.8	Early maturity, small round type, below average yield, hollow heart
BNC742-2	Accumulator x NC268-1	0.3	Good internal quality, bright skin, round blocky type, below average yield
Dundee	MSR169-8Y x MSU383-A	0.6	High yield, growth crack, oval type, mid-season maturity
Lady Liberty (NY152)	B38-14 x Marcy	0.0	Above average yield, attractive round type, bright appearance, hollow heart
Lamoka (NY139)	NY120 x NY115	1.4	Above average yield, oval to pointed tubers, some deeper eyes, netted skin, some hollow heart and vascular discoloration
Mackinaw (MSX540-4)	Saginaw Chipper x Lamoka	1.0	High yield, mid-season maturity, flat oval type, light netted skin, common scab susceptible
Manistee	Snowden x MSH098-2	1.0	Above average yield, compressed type, heavy netted skin, deep eyes, early maturity
MSAA076-6	MSR127-2 x MSS297-3	0.9	Average yield, some internal defects, small round unifrom type, growth cracks, deeper eyes
MSAA217-3	Beacon Chipper (UEC) x Atlantic	0.8	High yield, blocky round to oval type, deeper eyes, internal defects

Table of Contents

2023 Processing Varieties Cont.

Entry	Pedigree	2023 Scab Rating*	Characteristics
MSAA252-7	NY148 x MSQ089-1	1.0	High yield, rough blocky type, heavy netted skin, good internal quality, later maturity
MSAA260-03	MSQ086-3 x Atlantic	0.9	Average yield, small flat round type, moderate growth crack, some vascular discoloration
MSAFB635-15	NYH15-5 x MSS297-3	1.3	Average yield, uniform blocky round type, moderate skinning, common scab susceptible
MSBB058-1	NY148 x MSR127-2	0.4	Above average yield, blocky round type, moderate skinning, some vascular discoloration
MSBB230-1	NY148 x MSQ089-1	0.6	Round blocky type, some pitted scab, above average yield, vascular discoloration
MSBB610-13	NY148 x MST096-2Y	0.7	Large round blocky type, growth cracks, good internal quality, above average yield
MSBB614-15	Saginaw Chipper x MSR127-2	0.6	Heavy netted skin, growth crack, some sticky stolons, high yield, later maturity
MSBB630-2	Lady Liberty x Kalkaska	0.5	Large round type, some misshapen tubers, trace sticky stolons, average yield, moderate internal defects

Table of Contents

2023 Processing varieties Cont.

Entry	Pedigree	2023 Scab Rating*	Characteristics
MSDD244-05	Mackinaw x MSR127-2	0.3	Round flat type, deeper apical eyes, high yield, some vascular discoloration
MSDD247-07	Mackinaw x MSV383-B	1.0	Above average yield, recessed stem end, slight skin, early maturity, some internal defects
MSDD247-11	Mackinaw x MSV383-B	0.5	Deeper eyes, attractive round type, above average yield, early maturity
MSDD249-9	Michigan State University	1.7	Large oval type, consistent appearance, high yield, early maturity, common scab susceptible
MSDD372-07	NY148 x Missaukee	1.1	Average yield, blocky round type, consistent appearance and shape, later maturity
MSDD376-4	NY148 x MSV033-1	0.4	Flat blocky type, heavy netted skin, sticky stolons, high yield, moderate internal defects
MSDD553-01	Mackinaw x MSQ086-3	1.0	Blocky round type, slight skinning, trace pointed tubers, above average yield, average maturity
MSEE031-3	MSZ219-14 x Lamoka	0.7	Average yield, variable shape, some scab, vascular discoloration and internal brown spot

Table of Contents

2023 Processing varieties Cont.

Entry	Pedigree	2023 Scab Rating*	Characteristics
MSEE035-4	MSZ219-14 x MSS164-1	0.5	Average yield, trace growth crack, light netted skin, mid-season maturity
MSEE207-2	MSZ022-19 x MSZ219-46	0.2	Blocky round type, medium netted skin, slight sheep nose, above average yield, average maturity
MSFF038-3	Mackinaw x MSR127-2	1.2	Deeper eyes, heavy skin, round type, above average yield, early maturity
MSGG242-1	MSBB060-1 x MSBB626-11	0.2	Attractive small round type, good appearance, average yield, internal brown spot
MSW474-1	MSN190-2 x MSP516-A	0.1	Uniform round type, deeper eyes, light skin, average yield, common scab resistant
Mystere	Patate Lac-Saint-Jean	1.5	Bright light skin, flat round to oval type, below average yield, vascular discoloration
NC470-3	Marcy x NC182-5	0.5	Above average yield, severe skinning, sticky stolons, growth cracks, hollow heart
NC821-30	NC41-1 x NC182-5	0.3	Blocky round type, heavy netted skin, average yield, some hollow heart, average maturity
NY174	NY148 x E48-2	0.9	Above average yield, flat round to oval type, heavier skin, early maturity

Table of Contents

2023 Processing varieties Cont

Entry	Pedigree	2023 Scab Rating*	Characteristics
NY177	NY148 x NYE48-2	1.8	Average yield, medium netted skin, uniform type, some vascular discoloration
NY179	Andover x Lady Liberty	1.7	Above average yield, long oval type, medium netted skin, early maturity
NYT22-1	L8-12 x Atlantic	0.7	Above average yield, variable type, light netted skin, some vascular discoloration
NYU15-8	Lady Liberty x Pike	0.8	Above average yield, flat oval type, light netted skin, vascular discoloration
NYU20-10	NY156 x NY148	2.0	Average yield, small round type, some lenticel scarring, vascular discoloration, common scab susceptible
NYU34-5	NYM18-2 x Waneta	1.3	Trace of purple blushing around eyes, round blocky type, average yield, vascular discoloration
NYU34-6	NYM18-2 x Waneta	1.0	Average yield, small flat oval type, average maturity
NYU44-7	NYN16-11 x Manistee	1.3	Above average yield, medium netted skin, round type, hollow heart
Petoskey (MSV030-4)	Beacon Chipper x MSG227-2	0.7	Above average yield, heavy netted skin, round type, a few compressed tubers
Snowden (W855)	B5141-6 x Wischip	1.4	Average yield, flat round type, some pink eyes, trace sticky stolons, vascular discoloration

Table of Contents

2023 Processing varieties Cont

Entry	Pedigree	2023 Scab Rating*	Characteristics
SP327	Sunrise Potato	0.3	Above average yield,round blocky type, bright skin, some internal brown spot, early maturity
TX18170-4W	Monserrate x TX12484-2W	2.0	Very low yield, smaller size profile, slight growth crack, good internal quality
TX19009-2W	NDTX081648CB-13W x NDTX05977s-1W	1.8	Below average yield, smaller size profile, slight growth crack, early maturity
WAF17045-2	MSR061-1 x Tundra	0.3	Average yield, small round type, moderate skinning, heavy skin, hollow heart, early maturity
WAF17049-2	NYWN25-1 x Tundra	0.1	Above average yield, lighter skin, slight growth crack, oval type, hollow heart, high specific gravity
Winterset	NY115 x BC0894-2W	1.2	Above average yield, flat round type, slight skinning, early maturity, moderate internal defects

*Scab rating based on 0-5 scale: 0 = most resistant and 5 = most susceptible. Common scab data provided by Potato Outreach Program. Line descriptions provided by various potato breeding programs and updated by Potato Outreach Program following Evaluations at various trial locations throughout Michigan.

Table of Contents

Table 2. 2023 Michigan Statewide Chip Processing Potato Variety Trials
Overall Averages - Twelve Locations

	CWT/A		PERCENT OF TOTAL[1]							RAW TUBER QUALITY[4] (%)								
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR[2]	OTF CHIP SCORE[3]	HH	VD	IBS	BC	COMMON SCAB RATING[5]	SED SCORE[6]	VINE VIGOR[7]	VINE MATURITY[8]	COMMENTS
SP327[kl]	764	842	91	7	91	0	2	1.070	1.5	0	2	14	0	0.3	1.5	3.9	2.7	round blocky type, bright skin
AF6206-3[cek]	752	798	95	4	94	1	1	1.084	1.0	0	7	0	0	1.3	0.2	4.0	3.5	bright skin, nice blocky round to oval type
MSDD376-4[abcefgkl]	708	757	94	6	93	1	0	1.087	1.1	11	9	3	0	0.6	0.4	4.0	3.5	flat blocky type, heavy netted skin, sticky stolons
Winterset[bdk]	662	721	92	7	91	1	1	1.086	1.3	3	0	10	3	1.2	0.3	3.0	2.7	flat round type, slight skinning
MSDD249-9[aeg]	634	643	98	2	94	4	0	1.082	1.0	3	3	0	0	1.7	0.7	3.8	2.8	large oval type, consistent appearance
MSDD553-1[abcefgkl]	629	678	93	6	92	1	1	1.079	1.1	1	13	0	0	1.0	0.5	3.3	3.4	blocky round type, slight skinning, trace pointed tubers
MSBB630-2[abcdefgikl]	622	701	87	11	84	3	2	1.078	1.3	9	7	2	2	0.5	0.3	3.3	3.7	large round type, some misshapen tubers, trace sticky stolons
AF6675-1[abefkl]	604	702	85	13	85	0	2	1.070	1.2	0	21	2	0	1.0	0.3	3.5	2.4	heavy netted skin, blocky oval type
Lady Liberty[af]	598	660	91	8	91	0	1	1.078	1.0	5	20	0	0	0.0	0.2	4.0	2.8	attractive round type, bright appearance
Manistee[adef]	**587**	**639**	**92**	**7**	**90**	**2**	**1**	**1.080**	**1.0**	**3**	**10**	**5**	**0**	**1.0**	**0.2**	**4.3**	**2.9**	**compressed type, heavy netted skin, deep eyes**
AF6565-8[acedfgkl]	585	637	92	7	91	1	1	1.082	1.0	0	6	0	0	0.9	0.2	3.8	3.0	poor appearance, deeper eyes, blocky type
NY179[abcegikl]	584	644	90	10	90	0	0	1.080	1.1	4	3	0	0	1.7	0.3	3.4	2.8	long oval type, medium netted skin
NY174[aefghl]	582	647	90	7	90	0	3	1.082	1.0	0	7	0	0	0.9	0.4	3.8	2.8	flat round to oval type, heavier skin
MSW474-1[acdefgl]	581	661	88	11	87	1	1	1.084	1.0	0	7	2	0	0.1	0.3	4.2	3.2	uniform round type, deeper eyes, light skin
MSAA252-7[bdk]	577	606	95	5	92	3	0	1.080	1.2	3	0	0	0	1.0	0.1	3.0	4.0	rough blocky type, heavy netted skin
MSEE035-4[afl]	573	641	89	7	88	1	4	1.087	1.0	3	6	1	0	0.5	0.8	3.7	3.0	trace growth crack, light netted skin
MSFF038-3[abcdef]	568	617	92	6	92	0	2	1.079	1.3	8	2	0	3	1.2	0.3	3.7	2.8	deeper eyes, heavy skin, round type
AF6200-4[cdeghl]	558	597	94	4	92	2	2	1.077	1.1	1	2	1	0	1.3	0.2	3.9	3.1	flat blocky round type, inconsistent shape
AF6886-3[l]	548	576	95	4	88	7	1	1.066	1.0	0	13	17	7	1.0	0.3	3.7	2.7	blocky round type
MSBB614-15[abcefgkl]	547	582	95	2	93	2	3	1.079	1.1	4	1	0	0	0.6	0.2	3.3	3.9	heavy netted skin, growth crack, some sticky stolons
MSAA217-3[acdefgkl]	545	567	96	3	91	5	1	1.087	1.1	14	8	4	0	0.8	0.6	3.9	3.1	blocky round to oval type, deeper eyes
NYU34-6[cf]	544	629	86	13	85	1	1	1.093	1.0	0	10	0	0	1.0	0.3	4.0	3.5	small flat oval type
WAF17049-2[abefkl]	543	587	92	6	92	0	2	1.100	1.1	18	1	0	0	0.1	0.1	3.4	3.1	lighter skin, slight growth crack, oval type
AC13125-5W[l]	541	592	91	9	90	1	0	1.057	1.0	13	7	7	0	0.0	0.8	4.2	1.7	nice bright round appearance
Petoskey[el]	537	581	92	6	92	0	2	1.081	1.3	0	9	0	0	0.7	0.7	4.7	3.0	heavy netted skin, round type, a few compressed tubers
NYT22-1[cl]	535	580	93	6	91	2	1	1.070	1.0	0	10	0	0	0.7	0.3	3.8	3.5	variable type, light netted skin
Mackinaw[abcdefgijkl]	534	595	90	9	89	1	1	1.086	1.1	2	4	5	0	1.0	0.2	3.8	3.3	flat oval type, light netted skin
AF6894-12[l]	533	577	92	8	92	0	0	1.076	1.0	0	10	10	0	1.5	0.6	2.7	2.7	light netted skin, round type
NYU15-8[ef]	533	593	90	8	90	0	2	1.079	1.0	0	30	0	0	0.8	0.3	4.0	3.3	flat oval type, light netted skin
MSEE207-2[abcef]	532	585	92	6	89	3	2	1.075	1.1	0	4	0	0	0.2	0.8	4.1	3.4	blocky round type, medium netted skin, slight sheep nose
AF6892-6[k]	527	571	92	8	92	0	0	1.076	1.0	0	0	0	0	0.5	0.2	2.5	2.0	round to oblong blocky type, netted skin
AF6969-3[l]	526	552	95	4	87	8	1	1.063	2.0	3	7	3	0	0.3	0.7	3.3	2.7	bright blocky round type
MSDD372-07[fgl]	520	579	89	11	89	0	0	1.091	1.0	1	3	6	0	1.1	0.5	3.6	3.7	blocky round type, consistent appearance and shape
MSAA076-6[abcdefgkl]	520	594	87	10	87	0	3	1.087	1.2	4	9	3	1	0.9	0.3	3.7	3.2	small round unifrom type, growth cracks, deeper eyes
MSGG242-1[abcef]	517	613	83	15	83	0	2	1.081	1.6	0	10	52	0	0.2	0.8	3.7	3.0	attractive small round type, good appearance
AF6552-2[egj]	516	560	91	8	88	3	1	1.076	1.0	0	0	0	3	0.8	0.2	3.3	3.7	light netted skin, blocky round type
AR2018-07[afk]	513	586	87	12	87	0	1	1.076	1.5	10	7	13	0	1.7	0.4	3.8	2.8	small type, dark skin, slight growth crack
Lamoka[acefhji]	**513**	**572**	**90**	**7**	**88**	**2**	**3**	**1.080**	**1.0**	**2**	**16**	**8**	**0**	**1.4**	**0.3**	**4.4**	**2.9**	**oval to pointed tubers, some deeper eyes, netted skin**
AF6878-15[l]	504	555	91	6	91	0	3	1.086	1.0	0	7	0	0	1.0	0.8	4.0	3.2	misshapen pickouts, flat round type
AF6872-11[k]	501	589	85	12	85	0	3	1.090	1.5	0	0	0	0	1.5	0.2	2.5	2.5	netted skin, blocky round type, pitted scab
B3379-2[bd]	497	560	89	10	89	0	1	1.089	1.3	40	0	0	0	0.8	0.2	4.8	3.3	light purple eyes, variable type
NC470-3[bdk]	494	544	91	7	91	0	2	1.090	1.3	23	3	0	0	0.5	0.3	2.8	3.8	severe skinning, sticky stolons, growth cracks
AF6665-3[abefkl]	494	572	85	14	85	0	1	1.077	1.1	2	6	2	2	1.0	0.3	3.6	3.0	flat oval type, some pointed tubers
B3403-6[d]	491	544	90	10	90	0	0	1.093	1.0	0	0	0	0	2.0	0.0	4.0	3.5	nice type and appearance, scab succeptible

	CWT/A		PERCENT OF TOTAL[1]							RAW TUBER QUALITY[4] (%)								
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR[2]	OTF CHIP SCORE[3]	HH	VD	IBS	BC	COMMON SCAB RATING[5]	SED SCORE[6]	VINE VIGOR[7]	VINE MATURITY[8]	COMMENTS
MSAFB635-15[abcdefghijk]	489	584	82	18	82	0	0	1.085	1.2	1	5	1	1	1.3	0.4	3.7	3.0	uniform blocky round type, moderate skinning
Snowden[abcdefghjkl]	**486**	**560**	**85**	**14**	**85**	**0**	**1**	**1.086**	**1.2**	**4**	**20**	**3**	**0**	**1.4**	**0.4**	**3.9**	**3.0**	**flat round type, some pink eyes, trace sticky stolons**
AF6671-10[abefl]	479	522	92	7	92	0	1	1.080	1.1	0	4	2	2	0.3	0.7	3.6	2.5	flat round type, moderate skinning
MSBB230-1[gl]	474	525	91	8	90	1	1	1.082	1.0	0	19	0	0	0.6	0.8	3.2	2.8	round blocky type, some pitted scab
B3379-6[bdk]	470	543	86	14	85	1	0	1.086	1.8	13	0	0	3	0.7	0.5	3.5	2.5	purple eyes, blocky round type
AF6652-3[befkl]	469	519	90	8	90	0	2	1.078	1.1	3	20	0	0	0.4	1.4	3.1	2.8	bright skin, variable type
AF6978-1[l]	464	516	90	7	88	2	3	1.073	1.0	10	7	0	0	1.2	1.7	3.0	3.5	large flat type, skinning
AF6655-1[abefkl]	461	509	90	8	90	0	2	1.076	1.1	8	23	0	0	0.6	0.3	3.4	2.8	blocky round type, heavy netted skin
Dundee[befgl]	457	506	90	6	90	0	4	1.096	1.1	4	3	0	0	0.6	0.2	3.4	3.2	growth crack, oval type
AF5933-4[abcdefgkl]	447	518	83	16	83	0	1	1.085	1.0	3	7	0	0	1.5	0.3	3.4	2.2	smaller round uniform type
Bliss[acefgijl]	443	515	84	15	84	0	1	1.081	1.0	0	6	0	0	0.6	0.2	3.9	2.7	small round type, bright skin, trace points
MSDD247-11[acfgl]	443	487	90	8	90	0	2	1.089	1.0	0	5	0	2	0.5	0.0	4.1	2.7	deeper eyes, attractive round type
Mystere[abcdefgkl]	439	547	78	21	78	0	1	1.072	1.1	0	16	0	0	1.5	0.2	3.4	2.6	bright light skin, flat round to oval type
MSDD244-05[gl]	438	467	95	3	71	24	2	1.078	1.0	0	7	0	0	0.3	0.1	2.8	3.0	round flat type, deeper apical eyes
B3012-1[bdk]	437	557	79	20	79	0	1	1.073	1.2	0	0	0	0	0.7	0.6	3.0	2.3	variable oval type, netted skin
Atlantic[bdk]	**433**	**488**	**90**	**8**	**89**	**1**	**2**	**1.080**	**1.5**	**23**	**7**	**3**	**0**	**1.5**	**0.5**	**3.7**	**2.7**	**slight skinning, round to pointed tubers**
MSBB058-1[cfgl]	426	459	93	6	93	0	1	1.088	1.0	0	8	0	0	0.4	0.1	3.0	3.3	blocky round type, moderate skinning
AF6883-15[l]	424	483	88	11	87	1	1	1.070	1.0	0	7	3	0	0.7	0.3	3.8	1.5	variable appearance and skin finish
TX19009-2W[l]	423	532	79	18	79	0	3	1.070	1.0	3	10	0	0	1.8	0.1	3.8	2.7	smaller size profile, slight growth crack
MSBB610-13[adk]	422	458	92	7	91	1	1	1.075	1.3	0	0	0	0	0.7	0.0	2.5	2.3	large round blocky type, growth cracks
NC821-30[bdk]	422	501	83	14	83	0	3	1.092	1.2	7	0	0	0	0.3	0.1	3.0	3.3	blocky round type, heavy netted skin
AF6980-1[l]	421	511	82	14	82	0	4	1.068	1.0	0	0	0	0	0.2	1.6	3.5	1.7	pointed tubers, variable skin and type
B3306-2[bdk]	419	506	83	17	83	0	0	1.078	1.7	0	0	0	10	0.8	1.1	4.0	2.3	oval to oblong type, light yellow flesh
AF6898-1[l]	415	510	82	16	82	0	2	1.068	1.0	5	20	0	0	0.3	1.4	3.5	2.2	pointed tubers, trace heat knobs
NYU44-7[cf]	413	452	91	9	91	0	0	1.087	1.0	20	5	0	0	1.3	0.3	4.0	3.3	medium netted skin, round type
AF6883-8[l]	413	470	88	12	88	0	0	1.077	1.0	3	7	0	0	1.2	0.3	4.5	2.2	light netted skin, flat oval type
MSEE031-3[fgl]	411	463	88	9	88	0	3	1.083	1.0	2	10	10	2	0.7	0.3	3.7	2.4	variable shape, some scab
AF6165-9[bcfghkl]	411	481	85	14	85	0	1	1.085	1.1	33	8	1	2	2.0	0.3	3.9	2.7	variable shape, flat type
NY177[gh]	398	488	82	17	82	0	1	1.096	1.0	0	4	0	0	1.8	0.6	3.5	3.0	medium netted skin, uniform type
WAF17045-2[abefkl]	395	449	88	11	87	1	1	1.078	1.3	18	2	3	0	0.3	0.3	3.6	2.9	small round type, moderate skinning, heavy skin
MSDD247-07[acfgl]	393	431	91	8	91	0	1	1.096	1.0	5	8	3	2	1.0	0.1	3.7	2.8	recessed stem end, slight skin
AF6911-4[l]	392	485	81	19	81	0	0	1.075	1.0	0	10	3	0	1.5	0.6	3.0	3.0	compressed shape, bright thin skin
NYU34-5[cf]	384	439	88	12	87	1	0	1.076	1.0	10	20	0	0	1.3	0.7	4.0	2.8	trace of purple blushing around eyes, round blocky type
B3381-4[bck]	371	533	70	19	70	0	11	1.087	2.3	37	0	0	3	1.2	1.8	4.5	2.5	uniform oval type, light yellow flesh
AF6979-3[l]	370	396	93	6	93	0	1	1.063	1.0	0	15	0	0	0.5	0.0	3.3	1.0	variable skin finish
MSAA260-03[abcdefgkl]	359	421	84	12	83	1	4	1.077	1.2	0	8	4	1	0.9	0.2	3.6	3.1	small flat round type, moderate growth crack
AF6896-1[k]	346	441	79	21	79	0	0	1.081	1.5	0	0	0	0	0.5	1.3	2.5	2.5	netted skin, round oblong type
AF6669-10[abefkl]	339	432	75	25	75	0	0	1.077	1.1	2	12	1	2	0.5	0.1	3.3	2.8	bright skin, small round tubers
BNC726-5[bdk]	329	426	73	26	73	0	1	1.079	1.2	20	0	0	0	0.8	0.3	3.3	2.8	small round type
B3471-1[d]	296	386	77	19	77	0	4	1.073	2.5	0	0	0	0	2.0	3.8	4.0	3.5	oval type, pitted scab, light netted skin
NYU20-10[ce]	290	355	82	17	82	0	1	1.077	1.0	5	25	0	0	2.0	0.1	4.0	3.3	small round type, some lenticel scarring
AF6901-8[k]	229	313	73	26	73	0	1	1.078	1.5	0	10	0	0	0.5	0.2	2.0	2.5	bright skin color, round blocky type
AF6555-2[k]	222	336	66	33	66	0	1	1.067	1.0	0	10	0	0	1.0	0.3	2.0	3.0	small type, bright skin, surface scab
BNC742-2[bdk]	203	268	76	23	76	0	1	1.066	1.3	3	0	0	0	0.3	0.2	3.0	2.0	bright skin, round blocky type
BNC549-1[bdk]	174	347	50	47	50	0	3	1.078	1.2	0	0	0	0	1.3	0.2	3.2	2.7	smaller oval type
TX18170-4W[k]	38	131	29	71	29	0	0	1.065	1.0	0	0	0	0	2.0	0.3	2.0	2.5	smaller size profile, slight growth crack
MEAN	**474**	**539**	**86**	**12**	**85**	**1**	**2**	**1.080**	**1.2**	**5**	**7**	**2**	**1**	**0.9**	**0.5**	**3.5**	**2.9**	

2023 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]Sandyland Farms, Set 1 Storage Trial
[j]Verbrigghe Farms, Fresh Chip Trial
[k]Walther Farms, Fresh Trial
[l]Walther Farms, Replicated Storage Trial

[1]SIZE

Bs: < 1 7/8"
As: 1 7/8" - 3 1/4"
OV: > 3 1/4"
PO: Pickouts

[2]SPECIFIC GRAVITY

Data not replicated

[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 3. Yield, Size Distribution*, Specific Gravity									
	Yield (cwt/A)		Percent Size Distribution						
Entry	US#1	TOTAL	US#1	Small	Mid-Size	Large	Culls	Specific Gravity
AF6200-4	594[a]	627[a]	95[a]	5[c]	94[a]	1	0	1.080[cd]
MSAFB635-15	544[ab]	624[a]	87[c]	13[b]	87[b]	0	0	1.087[b]
Snowden	**521[ab]**	**588[a]**	**89[bc]**	**11[b]**	**88[b]**	**0**	**1**	**1.085[b]**
NY174	497[abc]	577[a]	86[c]	13[b]	86[b]	0	1	1.079[d]
Lamoka	**488[bc]**	**527[ab]**	**93[ab]**	**6[c]**	**93[a]**	**0**	**1**	**1.083[bc]**
NY177	481[bc]	602[a]	80[d]	20[a]	80[c]	0	0	1.095[a]
AF6165-9	402[c]	466[b]	86[c]	14[b]	86[b]	0	0	1.085[b]
MEAN	**504**	**573**	**88**	**12**	**88**	**0**	**0**	**1.085**
ANOVA p-value	**0.0308**	**0.0493**	**<.0001**	**<.0001**	**<.0001**	**0.6389**	**0.1052**	**<.0001**
LSD	**99.5**	**104.4**	**4.3**	**3.8**	**4.00**	**-**	**-**	**0.003**

*small <1 7/8"; mid-size 1 7/8"-3 1/4"; large >3 1/4"

Table 4. At-Harvest Tuber Quality. Sandyland Farms, Howard City, Michigan.				
	Raw Tuber Quality[1] (%)			
Entry	HH	VD	IBS	BC
AF6200-4	3[b]	0	0[b]	0[b]
MSAFB635-15	7[b]	13	0[b]	0[b]
Snowden	**0[b]**	**20**	**0[b]**	**0[b]**
NY174	0[b]	0	0[b]	0[b]
Lamoka	**3[b]**	**10**	**17[a]**	**0[b]**
NY177	0[b]	7	0[b]	0[b]
AF6165-9	27[a]	0	3[b]	7[a]
MEAN	**6**	**7**	**3**	**1**
ANOVA P-value	**0.0102**	**0.0565**	**0.0405**	**0.0153**
LSD	**13.8**	**-**	**10.8**	**3.8**

[1]Internal Defects. HH = hollow heart, VD = vascular discoloration, IBS = internal brown spot, BC = brown center.

Table 5. Post-Harvest Chip Quality[1] for the 2023 SNAC Trial at Sandyland Farms						
		SNAC[2]	Percent Chip Defects[3]			
Rank	Entry	Color	Internal	External	Total	Comments
1	NY174	2.0	7.0	10.1	17.1	some scab, 2.5 to 4.75 inches
2	**Snowden**	**3.0**	**12.2**	**7.2**	**19.4**	**minor scab, 2.5 to 4.5 inches**
3	NY177	3.0	14.9	15.0	29.9	scab, 2.25 to 3.5 inches
4	**Lamoka**	**3.0**	**10.3**	**6.7**	**17.0**	**some rot, 2.75 to 4 inches**
5	MSAFB635-15	3.5	17.0	8.6	25.6	scab, stem end defect, 1.75 to 4.5 inches
6	AF6165-9	3.0	21.8	24.1	45.9	hollow heart, heavy scab, rot, 2.5 to 4.75 inches
7	AF6200-4	3.0	17.5	35.4	52.9	scab, bruise, 2.5 to 4.5 inches

[1] Samples collected October 10th and processed by Herr Foods, Inc., Nottingham, PA on October 16th

[2] SNAC Color: 1 = lightest, 5 = darkest

[3] Percent Chip Defects are a percentage by weight of the total sample; comprised of undesirable color, greening, internal defects and external defects

Lines are sorted by Herr's ranking: 1(best) to 7 (worst)

Table of Contents

Table 6. Black Spot Bruise Test for the 2023 SNAC Trial at Sandyland Farms

Entry	A. Check Samples[1]: # of Bruises Per Tuber 0	1	2	3	4	5	Total Tubers	Percent Bruise Free	Average Bruises Per Tuber	B. Simulated Bruise Samples[2]: # of Bruises Per Tuber 0	1	2	3	4	5	Total Tubers	Percent Bruise Free	Average Bruises Per Tuber
NY174	7	11	6	0	1	0	25	28	1.1	5	7	9	3	0	1	25	20	1.6
MSAFB635-15	11	9	2	3	0	0	25	44	0.9	8	7	3	2	3	2	25	32	1.6
Lamoka	**15**	**7**	**2**	**1**	**0**	**0**	**25**	**60**	**0.6**	**2**	**8**	**6**	**7**	**1**	**1**	**25**	**8**	**2.0**
Snowden	**11**	**10**	**2**	**2**	**0**	**0**	**25**	**44**	**0.8**	**3**	**6**	**7**	**3**	**3**	**3**	**25**	**12**	**2.2**
AF6165-9	11	10	4	0	0	0	25	44	0.7	2	7	6	4	5	1	25	8	2.2
NY177	1	8	7	7	0	2	25	4	2.1	1	3	6	4	9	2	25	4	2.9
AF6200-4	5	9	5	3	2	1	25	20	1.6	1	4	2	3	2	13	25	4	3.6

[1]Tuber samples collected at harvest and held at room temperature for later abrasive peeling and scoring.

[2]Tuber samples collected at harvest, held at 50ºF for 12 hours, then placed in a 6 sided plywood drum and rotated 10 times to produce simulated bruising. They were then held at room temperature for later abrasive peeling and scoring.

Table 7A. Pre-Harvest Panel for the 2023 SNAC Trial at Sandyland Farms, Taken on 8/14/2023

Entry	Specific Gravity	Glucose[1] %	Sucrose[2] Rating	Canopy Rating[3]	Canopy Uniform.[4]	Average[5] Tuber Weight
AF6165-9	1.094	0.002	1.041	100	75	3.36
AF6200-4	1.089	0.003	0.565	50	75	4.96
Lamoka	**1.089**	**0.002**	**0.716**	**50**	**100**	**4.83**
MSAFB635-15	1.093	0.002	0.415	100	100	3.45
NY174	1.083	0.002	0.385	75	100	4.14
NY177	1.089	0.002	0.714	100	100	2.75
Snowden	**1.086**	**0.002**	**0.692**	**75**	**75**	**3.03**

Table 7B. Pre-Harvest Panel for the 2023 SNAC Trial at Sandyland Farms, Taken on 8/28/2023

Entry	Specific Gravity	Glucose[1] %	Sucrose[2] Rating	Canopy Rating[3]	Canopy Uniform.[4]	Average[5] Tuber Weight
AF6165-9	1.080	0.002	0.735	100	100	4.62
AF6200-4	1.082	0.004	0.581	75	75	5.22
Lamoka	**1.080**	**0.003**	**1.011**	**50**	**75**	**5.89**
MSAFB635-15	1.093	0.003	0.765	75	75	3.71
NY174	1.083	0.002	0.295	75	75	4.26
NY177	1.096	0.002	0.505	75	100	6.24
Snowden	**1.089**	**0.003**	**0.854**	**-**	**-**	**3.55**

1 Percent Glucose is the percent of glucose by weight in a given amount of fresh tuber tissue.

2 Sucrose Rating is the percent of sucrose by weight in a given amount of fresh tuber tissue X10.

3 The Canopy Rating is a percent rating of green foliage (0 is all brown, dead foliage, 100 is green, vigorous foliage).

4 The Canopy Uniformity is a percentage of how uniform the foliage health is at the date of observation.

5 The Average Tuber Weight is the total tuber weight collected, divided by the number of tubers reported in ounces.

Table of Contents

Table 8. At-Harvest Tuber Characteristics.[1] Sandyland Farms, Howard City, Michigan.				
Entry	**Stems per Plant**	**Tubers per Plant**	**Tubers per Stem**	**Average Tuber Weight (oz)**
AF6200-4	3.9	9.7	2.5	6.8
MSAFB635-15	3.7	15.0	4.0	4.4
Snowden	**5.0**	**12.5**	**2.5**	**4.9**
NY174	3.5	12.3	3.5	4.9
Lamoka	**2.7**	**10.2**	**3.8**	**6.3**
NY177	3.3	17.0	5.2	3.8
AF6165-9	5.1	11.3	2.2	4.9
MEAN	**3.9**	**12.6**	**3.4**	**5.1**

[1]Stand and hill counts were colllected during harvest on the first yield dig. Tuber counts were conducted during grading.

Table of Contents

Table 9. 2023 Michigan Statewide Russet Potato Variety Trials
Overall Averages - Thirteen Locations

LINE	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR[2]	RAW TUBER QUALITY[3] (%) HH	VD	IBS	BC	COMMON SCAB RATING[4]	VINE VIGOR[5]	VINE MATURITY[6]	COMMENTS
AAF15169-3[fl]	650	767	85	4	68	18	10	1.081	0	0	0	0	0.8	4.5	3.5	prominent eyes, misshapen tubers
A12327-5VR[abdeim]	616	683	91	3	42	49	6	1.075	5	2	2	0	0.3	3.5	3.4	deeper eyes, moderate alligator hide, darker skin
A08433-4STO[abcdeghijm]	557	689	81	12	63	18	7	1.077	10	5	0	0	0.5	3.5	4.1	oblong blocky type, light to medium russet skin
Vanguard[adfgim]	557	637	87	7	70	18	5	1.068	0	1	3	0	0.2	3.5	2.4	nice dark russet skin, oblong type, trace growth cracks
Umatilla[glm]	537	785	69	12	65	5	18	1.086	11	1	0	1	0.2	3.9	3.6	deeper eyes, misshapen and pointed tubers
AF6298-2[gl]	522	630	83	10	70	13	7	1.088	40	5	5	0	0.3	3.0	2.8	nice appearance and skin
AAF15402-1[fl]	515	607	85	3	59	27	11	1.076	0	0	15	0	0.5	2.8	3.3	growth crack, pointed tubers
AF5736-16[gim]	512	578	89	7	72	16	5	1.091	7	4	0	0	0.1	3.7	4.4	flat oblong to long type, medium russet skin
AF6997-1[fl]	511	632	78	19	72	5	4	1.089	5	5	0	0	1.0	3.0	3.8	variable type and appearance
AAF15193-9[fl]	511	603	85	11	74	11	4	1.078	0	10	0	0	1.0	4.0	2.8	flat blocky oblong type
A09086-1LB[abcdeghim]	506	606	83	15	65	17	3	1.084	1	2	0	2	1.1	3.7	3.5	blocky large type, variable light skin
Rickey Russet[abcdegim]	505	606	84	11	71	13	5	1.074	0	10	5	0	0.1	3.6	2.8	heavy russet skin, oblong type, nice, light yellow flesh
AAF15193-6[fl]	502	679	77	5	61	16	18	1.074	0	0	0	0	0.8	4.3	3.0	variable type, pointed tubers
AF6377-10[gikm]	499	530	95	4	55	40	1	1.073	0	5	0	0	0.0	3.1	2.5	slight alligator hide, skinning, blocky oblong type, nice
AF6750-3[gl]	494	608	81	9	61	19	11	1.070	5	0	0	0	0.5	3.0	3.3	dark russet skin, growth crack
Reveille Russet[abcdfghim]	489	570	85	7	56	29	8	1.067	0	7	4	0	0.1	2.7	3.1	large blocky type, growth cracks, trace prominent eyes
AF7001-5[fl]	465	581	79	14	38	41	7	1.080	5	5	0	0	0.3	3.5	3.3	large blocky type, trace pointed tubers
A09136-9LB[acdfgikm]	464	535	88	6	62	26	6	1.087	15	2	1	0	0.6	4.1	3.6	slight alligator hide, lighter skin, variable type
AF7015-2[fl]	456	526	87	5	57	30	8	1.069	0	0	20	0	0.5	3.8	3.3	oblong type, marginal appearance
NDAF1791-3[fl]	453	620	63	33	56	7	4	1.094	0	10	0	0	0.8	3.3	4.5	long tubular type, light skin
NDAF1791-1[fl]	449	573	78	12	74	5	9	1.095	0	5	0	0	0.3	3.3	3.8	variable type, misshapen pickouts
A10071-1[abdim]	442	535	82	11	70	12	7	1.072	5	11	2	2	0.4	4.3	2.7	dark russet skin, long tubular type
AF5521-1[bcdfgim]	440	475	93	4	62	31	3	1.080	5	0	4	0	1.2	3.6	3.2	oval to oblong type, light russet skin, nice appearance
Portage Russet[abcdegimhj]	438	547	79	16	70	9	5	1.082	13	8	0	0	0.4	3.1	3.3	sticky stolons, lighter skin, trace pointed tubers
A11737-1LB[m]	430	543	79	14	66	13	7	1.080	3	3	3	0	1.0	3.5	3.5	misshapen pointed tubers, variable type
NDAF1791-6[fl]	419	564	68	28	61	7	4	1.091	0	5	15	5	1.5	3.0	3.5	pointed tubers, smaller, oblong type
A15057-2TE[abcdegim]	416	470	89	8	69	20	3	1.072	2	5	4	0	0.3	3.6	2.7	oblong to long type, skinning, darker skin
Silverton Russet[abcdfghijl]	**415**	**492**	**83**	**11**	**69**	**14**	**6**	**1.071**	**3**	**5**	**4**	**3**	**0.3**	**3.9**	**3.2**	**nice type and appearance, trace growth crack**
AF6340-6[abcdfgim]	411	515	79	19	72	7	2	1.067	4	11	1	0	0.7	3.1	2.9	recessed eyes, oblong to long type
COTX10080-2Ru[abcdfgm]	403	483	83	11	69	14	6	1.068	4	8	1	0	0.3	2.7	3.2	nice skin, slight alligator hide, oblong type
AF6377-12[abcdfgim]	400	475	83	12	62	21	5	1.077	13	3	1	1	0.3	3.2	3.0	prominent eyes, dark russet skin, growth crack, nice
AF6997-3[fl]	399	596	68	11	54	13	22	1.081	0	10	15	0	1.0	3.5	3.0	poor appearance, deep eyes, tubular type
AAF15291-5[fl]	394	611	63	22	59	4	15	1.078	5	0	15	0	0.8	4.5	3.5	misshapen pickouts, variable type
AAF15247-3[fl]	392	468	84	11	71	13	5	1.069	0	0	0	0	0.3	3.5	3.0	heavy dark russet skin, nice appearance
A13074-1TE[abcekm]	388	495	79	13	68	11	8	1.080	2	15	2	7	0.3	3.8	3.2	variable type and appearance
A11175-12TE[abdegim]	386	464	82	12	66	16	6	1.075	0	11	1	0	0.4	3.3	3.2	deeper eyes, blocky oval to oblong type
Russet Norkotah[abcdfgijlm]	**374**	**459**	**79**	**14**	**63**	**16**	**7**	**1.072**	**11**	**5**	**3**	**0**	**0.4**	**3.6**	**2.9**	**variable type and appearance, trace alligator hide**
AF7008-1[fl]	369	468	80	19	70	9	2	1.070	0	0	15	0	0.0	3.8	3.3	small blocky type, medium russet skin
AC12090-3RU[dim]	357	464	72	24	66	7	3	1.074	10	0	0	0	0.0	3.2	2.9	long oval to oblong type, purple eye pigmentation
W13008-1RUS[abcdegim]	337	427	78	14	63	16	7	1.076	9	7	1	0	0.3	3.9	3.0	oblong to long type, alligator hide, lighter skin
NDAF1762-7[fl]	334	496	68	26	67	1	6	1.086	0	15	20	0	0.5	3.3	3.3	pointed tubers, medium russet skin
CO13003-1RU[abcdfgim]	327	449	71	26	66	5	3	1.076	11	5	6	5	0.4	2.9	3.0	slight skinning, nice appearance, blocky type
COAF16090-14[fl]	326	467	71	15	66	5	14	1.070	5	0	15	0	1.3	3.3	2.8	smaller oblong type, pointed tubers
A09119-4LB[b]	322	399	81	13	71	10	6	1.087	20	10	10	0	2.5	2.5	2.5	pointed oblong type, medium russet skin

	CWT/A		PERCENT OF TOTAL[1]						RAW TUBER QUALITY[3] (%)							
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR[2]	HH	VD	IBS	BC	COMMON SCAB RATING[4]	VINE VIGOR[5]	VINE MATURITY[6]	COMMENTS
Goldrush[abcdfgim]	**321**	**468**	**69**	**16**	**61**	**8**	**15**	**1.068**	**3**	**3**	**3**	**1**	**0.1**	**2.9**	**2.9**	**variable skin and type, growth crack, oblong**
CO15016-1RUsto[lm]	307	549	56	28	52	4	16	1.071	4	4	0	0	0.3	2.7	3.3	nice, pointed tubers, bottlenecks
AF6989-3[fl]	299	409	73	19	69	3	9	1.089	10	5	5	0	0.0	2.3	3.3	flat oblong type, nice
Russet Burbank[cgl]	**292**	**626**	**49**	**32**	**48**	**1**	**19**	**1.077**	**0**	**7**	**0**	**0**	**0.3**	**3.3**	**3.3**	**pointed and misshapen tubers, long tubular type**
CO14371-3RU[lm]	271	450	59	29	57	3	11	1.066	0	14	0	0	0.5	3.3	3.7	smaller, growth crack, alligator hide
COTX08121-1RU[bi]	163	223	71	26	71	0	3	1.066	10	5	0	0	0.0	3.0	2.8	small oblong type
ATX15097-1RU[b]	154	236	66	15	53	13	19	1.078	0	0	40	0	1.5	1.0	2.5	low yield, misshapen pointed tubers
ATX16119-1RU[b]	118	255	46	48	46	0	6	1.092	0	0	20	0	2.0	2.0	2.5	smaller tubers, medium russet skin, oblong type
COTX18174-1RU[o]	46	135	34	63	34	0	3	1.067	0	0	50	0	1.5	2.5	2.5	small tubers, oblong to pointed type
MEAN	**409**	**524**	**76**	**16**	**63**	**14**	**8**	**1.077**	**5**	**5**	**6**	**1**	**0.6**	**3.3**	**3.2**	

2023 Russet Variety Trial Sites
[a]4-L Farm
[b]Elmaple Farms
[c]Horkey Farms
[d]Jenkins Farms
[e]Kitchen Farms, Mini Bulk Trial
[f]Kitchen Farms, Strip Trial
[g]Lennard Ag. Co.
[h]Sandyland Farms
[i]Styma Potato Farms
[j]Verbrigghe Farms
[k]Walther Farms, NFPT Trial
[l]Walther Farms, NFPT Add On Trial
[m]Walther Farms, Replicated Norkotah Trial

[1]**SIZE**
Russets
Bs: < 4 oz
As: 4 - 10 oz
OV: > 10 oz
PO: Pickouts

[2]**SPECIFIC GRAVITY**
Data not replicated

[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 emergen

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

Table 10. 2023 Michigan Statewide Tablestock Potato Variety Trials
Overall Averages - Nine Locations

		CWT/A		PERCENT OF TOTAL[1]						RAW TUBER QUALITY[3] (%)							YELLOW FLESH		RED SKIN				
	LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR[2]	HH	VD	IBS	BC	COMMON SCAB RATING[4]	VINE VIGOR[5]	VINE MATURITY[6]	WAXINESS[7]	FLESH COLOR[8]	WAXINESS[7]	SKIN COLOR[9]	UNIFORMITY[10]	SILVER SCURF[11]	COMMENTS
	ATX5325s-3W/Y[a]	1090	1226	89	8	88	1	3	1.071	0	0	70	0	0.0	4.0	3.5	1.5	2.0					buff skin, round to oval type
	Floridana[cef]	629	708	89	9	89	0	2	1.062	0	0	0	3	1.2	3.7	3.5	3.3	3.3					blocky round to oval type, slight rhizoctonia
	Colomba[abcdfgh]	599	655	91	7	88	3	2	1.055	0	6	1	0	0.4	3.9	2.6	3.8	3.2					long type, slight buff skin, deeper eyes
	Paroli[abcdfh]	588	674	87	7	87	0	6	1.067	0	2	0	0	0.3	4.0	2.8	3.6	3.8					blocky type, pointed tubers, growth cracks, deeper eyes
	MSGG039-11Y[abcefi]	582	661	88	7	87	1	5	1.071	0	0	0	5	0.3	3.4	2.9	3.7	2.8					blocky round to oval type, light netted skin
	MSII344-02[c]	573	656	87	12	87	0	1	1.067	0	0	0	0	1.0	2.5	3.5	4.0	3.0					flat oval to oblong type, slight rhizoctonia
	Alaska Bloom[acei]	546	639	84	15	84	0	1	1.052	0	8	5	0	0.0	4.0	3.1	2.9	1.0					pink eyes, flay blocky type, buff skin, round to oval type
	Melody[afi]	538	635	84	10	84	0	6	1.071	0	0	13	0	0.5	4.0	3.2	3.7	3.0					light buff skin, prominent lenticels
	Noya[abcfh]	529	631	85	10	85	0	5	1.074	0	0	0	10	0.6	3.2	3.5	3.5	1.0					bright appearance, oval to oblong type
	Constance[cdabfgh]	523	622	81	17	78	3	2	1.065	0	0	1	0	0.6	3.9	2.9	3.6	3.7					flat oblong type, nice appearance
	W13103-2Y[abcdfgh]	523	576	91	8	88	3	1	1.061	0	1	0	0	0.6	3.6	3.1	3.4	3.8					round to oval type, buff skin, nice appearance
	Jelly[abefgich]	513	587	86	10	83	3	4	1.071	0	3	1	0	0.4	3.5	3.6	3.1	4.1					flat oblong type, variable appearance
	Bonnata[ah]	508	627	82	10	82	0	8	1.070	0	10	10	0	0.3	4.0	2.8	3.0	2.2					flat round to oval type, lenticel scarring
	Montana[abcdfgh]	503	657	73	24	73	1	2	1.058	0	1	0	1	0.7	3.5	3.0	4.0	4.8					oval to oblong type, light buff skin, greening
	W15240-2Y[abcdfgh]	498	616	80	18	80	0	2	1.062	0	1	1	0	0.5	3.4	2.9	3.6	3.1					small round type, bright appearance, slight greening
	Golden Globe[abcdfgh]	492	558	88	11	88	0	1	1.062	0	4	0	0	0.1	4.1	2.8	3.5	3.1					flat round to oval type, trace netted skin
	COTX10118-4Wpe/Y[abef]	492	695	69	24	69	0	7	1.059	0	3	0	0	0.4	3.1	3.3	2.6	3.4					purple splashes around eyes, poor variable appearance
	WAF14096-5[bcdfgh]	490	555	88	12	86	2	0	1.072	0	1	0	0	0.7	3.5	3.5	2.8	3.4					pink eyes, uniform blocky round type
	PSS09/118/6[abcefhi]	475	654	71	23	71	0	6	1.055	0	0	0	4	0.4	3.4	3.1	3.7	3.4					flat oval to oblong type, slight alligator hide
	Sensation[bdfh]	462	548	84	13	84	0	3	1.061	0	2	0	0	1.1	3.1	3.0	3.8	3.1					flat oval type, heavy netted skin, points
	MSGG039-08Y[abcefi]	455	642	69	26	69	0	5	1.068	0	0	0	0	1.3	3.5	3.1	3.2	2.8					variable flat oval type, buff skin
	Camelia[abcdefih]	454	541	84	13	83	0	4	1.060	0	3	0	0	0.8	3.4	3.1	3.5	4.1					flat oval type, rougher skin
	Tessa[abcdfgih]	450	539	83	14	83	0	3	1.074	0	3	0	1	1.0	3.8	3.3	3.1	3.1					oval to oblong type, medium netted skin, tubular
	Bonafide[abce]	447	487	91	7	91	0	2	1.066	0	5	0	0	0.5	3.6	3.0	2.9	3.0					blocky round type, netted skin, deeper eyes
	NDAF1710Y-1[i]	418	470	89	10	89	0	1	1.090	10	0	0	0	0.0	4.0	4.0	4.0	3.0					bright appearance, flat oval type, buff skin
	Christel[abcdfgih]	417	576	72	25	71	1	3	1.058	5	10	10	0	0.1	3.6	3.0	3.9	4.2					flat round to oval type, nice appearance
YELLOW SKIN TYPE	AF6566-1[i]	410	441	93	7	93	0	0	1.097	0	0	0	0	0.5	4.0	3.5	3.0	3.0					flat oval type, buff skin
	Queen Anne[abcefgi]	394	570	69	27	69	0	4	1.062	0	0	0	0	0.8	3.3	3.1	3.8	4.1					oval to long type, bright smooth skin
	CMK2009-630-00[ef]	390	508	77	19	77	0	4	1.085	40	0	0	0	0.8	4.8	3.0	3.0	3.0					buff skin, acceptable appearance
	IPB8343-8W/Y[cfh]	383	477	80	17	79	1	3	1.073	0	0	0	3	0.4	3.8	2.9	3.6	3.7					deeper eyes, variable type, trace points
	Bernice[bdfh]	383	477	79	18	79	0	3	1.065	0	3	0	0	0.6	3.5	2.5	3.3	3.4					heavy buff skin, oval type, slight growth crack
	NDTX081451CB-1Y/Y[abcefh]	382	609	58	40	58	0	2	1.086	2	0	0	2	0.9	3.8	3.0	3.2	2.9					buff skin, oval to oblong type, scab
	AF6889-4[efh]	380	432	88	9	88	0	3	1.080	33	0	20	4	0.3	4.2	3.8	3.6	3.1					variable type, prominent pink eyes, blocky round type
	AF6868-6[afh]	374	421	89	10	89	0	1	1.086	8	0	0	0	0.8	4.2	3.3	3.3	3.0					heat sprouts, pink eyes, trace points
	W15248-17Y[abcdfgh]	372	442	83	16	82	1	1	1.056	1	0	0	3	0.3	3.5	2.5	3.8	3.5					oblong type, buff skin, trace alligator hide
	IPB8343-5W/Y[abh]	362	518	70	28	70	0	2	1.068	0	1	0	0	0.9	3.3	2.7	3.2	3.4					small round type, recessed apical ends
	Vanilla[bdfh]	356	499	72	26	72	0	2	1.067	0	0	25	0	0.9	3.4	3.4	3.5	3.0					round type, flaky skin, nice appearance
	AF6888-15[h]	355	395	88	11	88	0	1	1.086	0	0	0	0	0.0	4.0	3.0	3.5	2.7					blocky flat type, poor appearance
	Yukon Gold[abcefi]	**348**	**390**	**88**	**10**	**87**	**1**	**2**	**1.072**	**19**	**7**	**3**	**5**	**0.8**	**3.5**	**2.7**	**3.0**	**2.9**					**blocky round type, buff skin**
	AORTX09037-1W/Y[abcefh]	319	438	69	27	69	0	4	1.070	0	5	2	0	1.0	3.6	3.0	2.5	2.3					small variable oval type, growth cracks, netted skin
	Acoustic[e]	317	400	79	15	79	0	6	1.079	10	0	0	0	0.5	4.0	3.5	3.5	3.0					flat round to oval type, buff skin
	AORTX09037-5W/Y[i]	307	432	71	28	71	0	1	1.075	0	0	0	0	0.0	4.0	2.5	4.0	1.0					small flat round type, slight buff skin
	NYT61-3[c]	306	372	82	9	82	0	9	1.074	10	0	0	0	0.0	1.5	4.0	4.0	4.0					pink eye, variable type
	IPB8343-2W/Y[cfh]	293	405	71	27	71	0	2	1.062	0	0	10	0	0.5	4.2	2.9	3.3	3.9					small round type, deeper eyes
	Tyson[eh]	282	346	81	14	81	0	5	1.073	0	0	0	0	0.3	3.8	3.3	4.0	1.8					small uniform round type, points
	MSBB371-1YSPL[be]	265	343	77	19	77	0	4	1.071	0	0	0	0	0.0	2.3	3.0	3.0	2.0					variable shape, purple splashed eyes
	IBP8343-3W/Y[h]	236	393	60	38	60	0	2	1.078	0	0	3	0	0.0	4.0	2.8	3.7	3.0					flat round type, buff skin
	Caledonia Pearl[acdfh]	234	465	51	46	51	0	3	1.064	0	0	2	0	0.2	4.2	2.8	3.1	2.1					flat round to oval type, uniform appearance
	Goldeye[eih]	223	462	48	48	48	0	4	1.063	0	0	0	0	0.6	3.8	2.4	3.3	3.6					variable type, buff skin
	Sound[e]	204	429	48	50	48	0	2	1.068	0	0	0	0	2.0	3.5	3.5	4.0	3.0					flat oblong to long type, netted skin, variable
	IPB8343-3W/Y[ac]	177	279	64	35	64	0	1	1.060	0	0	0	0	0.0	3.5	2.0	4.0	3.0					small oval type, nice appearance
	A08120-4Y[abcdfgh]	173	347	46	52	46	0	2	1.069	0	10	0	1	0.2	3.9	3.5	2.8	2.4					buff skin, pink blush eyes, round to oval
	TX17734-1Y/Yi	157	283	55	37	55	0	8	1.074	0	0	0	0	1.0	3.0	3.0	4.0	3.5					oblong to long type, poor shape and appearance
	Polaris Gold[c]	109	182	60	39	60	0	1	1.058	0	0	0	0	0.0	3.0	3.5	3.0	4.0					flat oval type, smaller tubers
	MEAN	**413**	**522**	**77**	**20**	**77**	**0**	**3**	**1.069**	**3**	**2**	**3**	**1**	**0.5**	**3.6**	**3.1**	**3.4**	**3.1**					

	LINE	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	PERCENT OF TOTAL[1] Bs	PERCENT OF TOTAL[1] As	PERCENT OF TOTAL[1] OV	PERCENT OF TOTAL[1] PO	SP GR[2]	RAW TUBER QUALITY[3] (%) HH	RAW TUBER QUALITY[3] (%) VD	RAW TUBER QUALITY[3] (%) IBS	RAW TUBER QUALITY[3] (%) BC	COMMON SCAB RATING[4]	VINE VIGOR[5]	VINE MATURITY[6]	YELLOW FLESH WAXINESS[7]	YELLOW FLESH FLESH COLOR[8]	RED SKIN WAXINESS[7]	RED SKIN SKIN COLOR[9]	RED SKIN UNIFORMITY[10]	RED SKIN SILVER SCURF[11]	COMMENTS
RED SKIN TYPE	MSGG127-3R[acefh]	564	610	92	7	91	0	2	1.073	0	0	0	6	0.2	3.7	3.4			3.1	3.3	3.5	1.0	blocky round type, moderate skinning
	NDAF113484B-1[fi]	525	582	90	4	90	0	6	1.063	0	0	0	0	0.3	4.5	2.5			4.0	4.0	4.5	1.0	blocky round type, slight skinning
	AF6932-4[i]	509	583	87	5	85	2	8	1.073	0	0	0	0	0.0	4.0	3.0			3.0	4.0	4.0	1.0	flat oval type, growth cracks
	AF6963-8[h]	502	536	94	4	93	1	2	1.075	0	0	0	0	0.0	4.0	3.2			3.5	2.2	3.7	1.0	poor skin color, growth cracks, blocky type
	Becca Rose[abcefh]	467	555	84	15	84	0	1	1.064	0	3	0	0	0.3	3.8	3.8			3.5	4.4	4.5	1.0	slight sticky stolons, skinning, nice skin color
	AF6963-1[h]	432	498	87	10	87	0	3	1.077	0	0	0	0	0.0	4.0	3.2			3.3	3.3	3.3	1.0	flat oval type, pointed tubers, slight skinning
	AAF11546-3[abcefh]	416	531	77	19	76	0	5	1.064	0	0	0	0	0.4	3.6	3.0			3.4	3.8	3.7	1.5	pointed tubers, variable type, skinning
	AF6938-4[h]	397	451	87	6	87	0	7	1.065	0	7	0	0	0.0	4.0	3.2			3.2	3.0	3.7	1.0	round blocky type, poor appearance
	Dark Red Norland[abcefgih]	**396**	**446**	**88**	**9**	**87**	**1**	**3**	**1.064**	**1**	**0**	**1**	**0**	**0.1**	**3.8**	**2.3**			**3.5**	**3.9**	**3.6**	**1.0**	**lighter red skin, variable type**
	AF6965-5[h]	386	414	93	6	93	0	1	1.079	17	0	0	0	0.2	4.0	2.8			3.0	1.3	3.7	1.0	poor color and appearance, moderate skinning
	MSGG135-1R[acefh]	379	550	68	31	68	0	1	1.071	2	0	0	0	0.1	3.4	3.5			3.1	2.6	3.6	1.2	compressed round type, light pink skin
	W17005-3R[abcdfgh]	369	465	77	20	77	0	3	1.066	0	0	0	0	0.4	3.8	3.1			2.8	4.2	4.3	0.9	nice appearance, slight lenticels, round blocky type
	W17026-4R[abcdfgh]	367	497	72	26	72	0	2	1.062	0	0	0	0	0.2	3.6	2.8			3.0	4.0	4.3	0.9	smaller round to oval type, variable skin
	NDAF1727Y-1[h]	363	408	89	5	89	0	6	1.068	27	0	0	3	0.0	4.0	3.2			3.2	3.7	3.7	1.0	round blocky type, slight skinning
	BNC839-5[efh]	332	403	83	15	83	0	2	1.070	0	0	0	0	0.2	4.7	3.1			3.9	4.4	4.3	1.9	flat oval type, severe skinning
	BNC981-1[f]	307	344	89	9	89	0	2	1.073	0	0	0	0	0.0	5.0	3.0			3.0	4.0	3.5	1.0	blocky round type, variable skin
	BNC917-2[aceh]	302	343	88	8	85	3	4	1.063	0	0	0	10	0.1	2.5	2.8			3.3	4.1	4.1	1.0	moderate skinning, round blocky type
	W16025-5R[abcdfgh]	298	363	80	19	80	0	1	1.064	0	0	0	0	0.5	3.8	2.8			3.1	2.5	3.6	0.7	consistent type, rhizoctonia, light skin color
	A11582-1R[abcefih]	271	437	62	32	62	0	6	1.058	0	1	0	0	0.1	3.4	2.9			3.5	4.1	4.0	1.0	poor type and appearance, second growth, skinning
	CO15113-1R[fi]	264	322	82	18	82	0	0	1.074	0	0	0	0	0.3	3.8	2.5			3.0	4.0	4.5	1.0	small round uniform type
	NDA8512C-1R[acdfh]	254	335	75	14	75	0	11	1.064	1	0	0	0	0.1	3.5	2.8			3.4	4.1	4.2	1.5	smaller type, moderate growth crack, deep eyes
	NDTX050169-1R[ai]	246	347	71	23	71	1	5	1.068	0	0	0	0	0.0	3.5	3.8			3.0	4.0	4.5	1.0	sticky stolons, small, nice appearance
	MSCC553-1R[fh]	235	296	77	19	77	0	4	1.075	0	0	0	0	0.5	3.7	3.1			3.5	3.8	4.5	1.0	small uniform round type, moderate skinning
	COTX15083-1R[i]	233	293	80	19	80	0	1	1.062	0	10	0	0	0.0	3.0	3.0			4.0	5.0	5.0	1.0	small blocky round type, consistent appearance
	MSII432-01[c]	225	314	72	24	72	0	4	1.059	0	0	0	0	0.0	2.0	3.0			4.0	4.0	5.0	1.0	variable type, moderate alligator hide
	CO15084-4R[h]	196	317	61	38	61	0	1	1.075	0	0	0	0	0.0	4.0	3.2			3.8	4.3	4.7	1.0	round to oval type, attractive skin color
	MEAN	**355**	**432**	**81**	**16**	**81**	**0**	**4**	**1.068**	**2**	**1**	**0**	**1**	**0.2**	**3.7**	**3.0**			**3.4**	**3.7**	**4.1**	**1.1**	
ROUND WHITE TYPE	Volare[abcdfgih]	644	706	91	7	86	5	2	1.058	1	3	3	0	0.4	3.9	2.8	3.7						flat oval type, misshapen tubers, nice
	Sifra[abdfgih]	562	678	69	15	81	2	2	1.067	0	0	0	0	0.8	3.7	3.9	3.6						flat oval type, slight sticky stolons, lenticels
	05.6556.1[abfhcd]	545	644	84	12	84	0	4	1.048	0	1	0	0	0.6	3.7	3.0	3.9						nice smooth bright skin, variable tuber shape
	Allison[abcdfgh]	545	680	79	17	79	0	4	1.063	1	4	1	3	0.4	3.6	3.6	3.0						oblong type, netted skin
	MSDD088-1[abcefi]	540	600	89	8	89	0	3	1.070	0	3	0	2	0.2	3.5	3.3	3.0						Reba-type, blocky oval, netted skin
	MSGG084-1[abcef]	484	535	90	7	89	1	3	1.061	6	0	0	10	0.3	3.3	3.0	2.7						flaky skin, deep eyes, growth crack
	Reba[abcefgi]	**438**	**461**	**95**	**3**	**94**	**1**	**2**	**1.066**	**14**	**0**	**0**	**2**	**0.4**	**3.5**	**2.9**	**3.1**						**deep apical eyes, large blocky oval type**
	NY178[abcefi]	346	411	84	12	84	0	4	1.059	3	0	2	7	0.7	3.2	2.7	3.8						long flat type, netted skin, bright
	MEAN	**513**	**589**	**85**	**10**	**86**	**1**	**3**	**1.061**	**3**	**1**	**1**	**3**	**0.5**	**3.5**	**3.1**	**3.3**						
NOVELTY TYPE	**Blackberry[e]**	**411**	**463**	**89**	**10**	**89**	**0**	**1**	**1.063**	**0**	**0**	**0**	**0**	**0.5**	**3.5**	**4.0**							**moderate skinning, white chimeral eyes**
	MSFF228-2RY[aef]	335	473	67	23	67	0	10	1.071	0	0	0	3	0.0	3.5	3.5		3.8	3.3	3.8	4.0	1.0	pointed tubers, oblong to long type
	MSGG158-11PP[e]	320	408	78	21	77	1	1	1.064	0	0	0	0	0.5	4.0	3.5							blocky type, moderate skinning
	MSFF335-2RR[e]	285	340	84	14	83	1	2	1.057	0	0	0	0	0.5	2.5	4.5			4.0	5.0	5.0	1.0	slight skinning, variable type
	MSFF305-1RY[e]	269	368	73	25	73	0	2	1.074	0	0	0	0	0.0	4.5	4.5			2.5	3.0	3.5	1.0	small blocky type, moderate skinning
	MEAN	**324**	**410**	**78**	**19**	**78**	**0**	**3**	**1.066**	**0**	**0**	**0**	**1**	**0.3**	**3.6**	**4.0**		**3.8**	**3.3**	**3.9**	**4.2**	**1.0**	
	TRIAL MEAN	**401**	**497**	**79**	**18**	**79**	**0**	**3**	**1.068**	**2**	**1**	**2**	**1**	**0.4**	**3.6**	**3.1**	**3.4**	**3.1**	**3.3**	**3.7**	**4.1**	**1.1**	

2023 Table Variety Trial Sites
[a]4-L Farm
[b]Horkey Farms
[c]Jenkins Farms
[d]Kitchen Farms, Mini Bulk Trial
[e]Kitchen Farms, Strip Trial
[f]Styma Potato Farms
[g]Verbrigghe Farms
[h]Walther Farms Replicated Trial
[i]Walther Farms Strip Trial

[1]SIZE
Non-russet tablestock
Bs: < 1 7/8"
As: 1 7/8" - 3 1/4"
OV: > 3 1/4"
PO: Pickouts

[2]SPECIFIC GRAVITY
Data not replicated

[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
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 11. 2023 Russet Potato Variety Trial
Walther Farms NFPT and Added Lines

Planting: 4/27/23 Vine Kill: 9/1/23 Harvest: 9/21/23

GDD_{40}: 3448

	CWT/A		PERCENT OF TOTAL[1]						RAW TUBER QUALITY[3] (%)							
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR[2]	HH	VD	IBS	BC	COMMON SCAB RATING[4]	VINE VIGOR[5]	VINE MATURITY[6]	COMMENTS
AF6314-12"	840	1038	81	6	52	29	13	1.081	0	0	100	0	1.0	3.0	4.0	many pointed tubers, misshapen pickouts, heat knobs
AAF15010-1"	826	1000	82	10	66	16	8	1.103	10	10	40	0	0.0	3.5	4.5	poor shape and appearance
AF6384-2	810	958	85	10	61	24	5	1.081	0	30	10	0	1.0	4.0	3.5	flat blocky oblong type, misshapen pickouts
AAF15086-5	790	880	90	6	55	35	4	1.082	0	10	0	0	1.5	3.5	3.5	alligator hide, less uniform type, misshapen pickouts
AOR10071-8	777	827	94	6	78	16	0	1.088	0	30	0	0	1.5	4.5	3.0	nice blocky oval type, lighter russet skin
A15053-17	758	908	83	8	52	31	9	1.064	0	30	0	0	1.0	3.5	3.5	lighter russet skin, flat oblong blocky type, misshapen tubers
AOR16118-1	716	816	88	7	69	19	5	1.088	20	0	0	0	0.5	3.5	4.5	light russet skin, silver scurf or black dot, nice type
A15094-13"	712	936	76	9	64	12	15	1.067	40	0	0	0	1.0	3.5	4.0	long tubular type, bottlenecks, apical purple pigmentation
AOR15227-2	711	830	86	5	55	31	9	1.101	0	0	20	0	0.5	3.5	3.5	knobs, less uniform, nice dark russet skin
A15175-1	700	832	84	11	76	8	5	1.095	0	30	0	0	0.5	3.5	3.0	knobs in pickouts, light to medium russet skin, deeper eyes
COA15494-8*	697	759	92	6	65	27	2	1.077	0	20	50	0	0.5	3.0	4.0	nice type, attractive dark russet skin, slight alligator hide
AF6749-3	690	813	85	5	69	16	10	1.082	0	0	0	0	0.5	3.0	3.5	attractive skin, prominent eyes, pointed ends
A15077-9TE	681	768	88	7	45	43	5	1.084	60	0	0	0	1.0	3.5	4.5	growth crack, alligator hide, blocky type
AOR15166-2*	681	760	89	4	67	22	7	1.097	0	10	0	0	0.5	3.0	4.0	blocky oval to oblong type, nice appearance
AAF15180-3*	678	797	85	8	70	15	7	1.075	0	0	30	0	0.5	3.5	2.5	medium russet, nice type and appearance
AF6465-7	665	777	86	6	57	29	8	1.073	10	20	30	0	1.0	3.5	4.0	dark russet, blocky oblong to oval type, alligator hide
A16051-3"	641	855	75	10	56	19	15	1.076	0	20	0	0	1.5	2.5	3.5	knobs, growth cracks, lighter russet skin, variable type
A15102-11"	638	729	87	8	69	18	5	1.084	0	0	40	0	1.5	3.0	3.5	prominent eyes, knobs, lighter russet skin, tubular
A13074-1TE"	632	805	78	12	62	16	10	1.088	0	30	0	0	0.5	3.5	4.0	apical growth crack, alligator hide
AF6814-1"	627	744	85	4	55	30	11	1.088	0	0	0	0	0.5	2.5	3.5	flaky russet skin, prominent eyes, misshapen pickouts
A16117-4"	618	761	82	4	63	19	14	1.081	10	0	0	0	1.0	4.0	4.0	poor appearance, misshapen tubers, skinning
A18476-3ADG*	601	703	85	12	71	14	3	1.077	0	20	0	0	0.5	2.5	4.0	medium russet skin, oval to oblong type, nice appearance
A15084-4"	595	889	67	10	53	14	23	1.089	0	20	40	0	1.5	4.0	4.5	knobs, heat sprouts
NDAF13242B-3	595	728	82	18	81	1	0	1.079	0	10	0	0	1.5	3.0	2.5	small round type
A11887-5ADG"	590	830	71	10	58	13	19	1.078	0	10	10	0	1.5	3.0	3.0	pointed tubers, misshapen pickouts
A18682-8STO"	583	742	79	8	60	19	13	1.095	20	0	0	0	1.0	3.0	4.5	severe black dot and scurf, poor appearance
A15038-6	575	669	86	8	59	27	6	1.068	0	20	10	20	0.5	3.5	4.0	medium dark russet skin, nice type
AF5762-8*	574	651	88	9	83	5	3	1.096	0	0	30	0	0.5	3.5	4.5	nice skin, consistent type, slight apical alligator hide
AAF16069-2	572	762	75	14	65	10	11	1.081	0	0	40	0	0.5	3.0	4.0	bottlenecks, points, heavier dark russet skin, variable type
A18503-2STO	569	679	84	14	76	8	2	1.096	10	0	0	0	1.5	2.0	4.5	flat oval to oblong type, nice uniform skin
AOR15152-2"	566	882	65	3	35	30	32	1.079	0	20	0	0	1.0	3.5	4.5	poor type and appearance, lighter skin
AF6377-10	551	590	93	7	58	35	0	1.071	0	10	0	0	0.0	2.0	2.5	nice skin and appearance, trace sheep nose, slight sticky stolons
A13085-2"	550	735	74	10	69	5	16	1.070	0	20	0	0	1.0	3.5	3.0	bottlenecks, medium russet skin, less uniform type
A15190-8CR"	541	747	73	10	60	13	17	1.081	0	20	0	0	0.5	3.5	3.5	tubular, light russet skin, bottlenecks
A13072-7*	540	580	93	5	61	32	2	1.077	0	30	40	0	0.5	3.5	3.5	nice appearance, heavier russet skin, blocky type
A15258-1	537	644	83	10	71	12	7	1.063	0	0	0	0	0.5	2.5	2.5	slight skinning, light russet skin, tubular type
AAF14025-2"	537	880	61	20	55	6	19	1.100	0	0	30	0	1.5	4.0	5.0	non uniform tubular type, knobs, lighter russet skin
AF6446-17	524	636	83	8	62	21	9	1.078	20	0	0	0	1.0	3.5	2.5	large tubers, attractive blocky type
A10861-3CR	523	633	83	14	64	19	3	1.075	20	20	50	0	0.5	3.0	4.0	nice light skin, pointed tubers, flat to oval type
AOR15194-2	521	617	85	7	67	18	8	1.082	0	10	0	0	1.0	3.5	4.0	prominent eyes, nice russet skin, misshapen pickouts
A09136-9LB"	502	611	82	9	54	28	9	1.094	0	10	10	0	1.5	4.0	4.5	light to medium russet, poor appearance
A18679-3STO	502	754	66	5	51	15	29	1.082	10	0	20	0	1.0	2.5	5.0	severe knobs, bottlenecks, misshapen pickouts
A15254-5"	487	741	66	9	55	11	25	1.077	0	0	20	0	1.0	3.5	4.0	bottlenecks, misshapen and pointed tubers
A13091-5	482	549	87	10	63	24	3	1.080	0	40	0	0	1.0	4.0	2.5	growth cracks, moderate rot, nice russet skin
COAF16253-1"	471	796	60	4	39	21	36	1.078	0	0	0	0	1.0	4.0	3.0	bottlenecks, knobs, not uniform

A18070-6	466	598	78	17	72	6	5	1.073	0	20	0	0	1.0	3.0	3.0	growth cracks, nice medium russet skin, smaller type
A13038-3	464	573	81	3	60	21	16	1.083	0	10	0	0	0.5	2.5	4.0	knobs, misshapen tubers, medium russet skin
AFA6346-2	445	737	60	12	60	0	28	1.076	0	10	0	0	1.5	2.0	4.5	growth cracks, poor type and appearance
OR170058-20	438	528	83	14	78	5	3	1.084	0	10	0	0	0.5	4.0	2.0	light russet skin, flat oval type
A15094-11"	434	754	57	17	54	3	26	1.066	0	20	0	0	0.0	3.5	4.5	misshapen tubers, light skin, growth crack, knobs
A16137-6STO	430	547	79	12	66	13	9	1.074	0	20	20	0	0.5	3.0	2.5	flat to oblong type, medium russet skin, slight skinning
OR11222-4	408	918	45	6	29	16	49	1.072	0	20	0	0	0.5	4.0	3.0	
A15028-2TE	399	507	79	15	70	9	6	1.074	0	0	0	0	0.5	2.5	2.0	medium russet skin, variable type, smaller tubers
A18072-7"	397	663	60	24	55	5	16	1.058	0	10	0	0	2.0	3.0	4.0	growth crack, alligator hide, light skin
A15101-2PMTV	358	431	83	13	70	13	4	1.078	0	0	0	0	0.0	2.5	2.5	nice uniform dark russet skin, round to oval type, smaller tubers
A15038-2"	338	530	63	14	53	10	23	1.063	0	10	0	0	0.5	3.5	3.5	heat knobs, heat sprouting, rot
A15169-6"	324	462	70	17	58	12	13	1.083	10	0	10	0	0.5	3.0	4.5	knobs, poor type
CO15016-1RUsto	280	523	54	31	51	3	15	1.069	0	0	0	0	0.5	2.5	3.5	nice skin, lots of knobs and bottlenecks, small
Russet Burbank	**266**	**779**	34	**27**	**32**	**2**	**39**	**1.080**	**0**	**0**	**0**	**0**	**0.0**	**4.0**	**4.0**	**tubular, light skin, severe misshapen tubers**
A15041-11TE"	177	251	71	27	67	4	2	1.074	0	0	0	0	0.5	2.5	4.0	small type, medium russet skin
AAF15169-3	837	998	84	4	52	32	12	1.084	0	0	0	0	1.0	4.0	3.0	silver scurf or black dot, misshapen pickouts, knobs
Russet Norkotah	**797**	**880**	91	**6**	**60**	**31**	**3**	**1.077**	**0**	**0**	**20**	**0**	**0.5**	**3.5**	**2.5**	**alligator hide**
NDAF1791-3	773	889	87	8	74	13	5	1.093	0	20	0	0	1.0	3.0	4.5	pointed tubers, variable type, sticky stolons
Silverton Russet	**763**	**850**	90	**5**	**66**	**24**	**5**	**1.076**	**0**	**0**	**20**	**0**	**1.0**	**4.0**	**3.5**	**medium russet skin**
AF6997-1	733	831	88	11	80	8	1	1.089	10	10	0	0	0.5	3.0	3.5	uniform type, black dot or silver scurf
MN19AOR16061-007*	722	864	83	10	71	12	7	1.077	0	10	50	0	0.5	3.0	4.0	dark russet skin, misshapen pickouts, nice appearance
NDAF1791-6	666	800	83	10	69	14	7	1.090	0	10	30	0	1.5	3.0	3.0	flat oblong to long type, rot, pointed tubers
AAF15402-1	659	776	85	3	39	46	12	1.070	0	0	30	0	1.0	2.5	3.0	growth crack, bottlenecks, less uniform
AF6750-3"	614	727	84	6	59	25	10	1.067	0	0	0	0	1.0	2.5	3.0	rot, heavy russet skin, bottlenecks, growth crack
AAF15193-9	571	663	86	10	68	18	4	1.077	0	20	0	0	1.0	3.5	2.0	slight soft rot, flat blocky oblong type
A12304-1STO	569	736	77	17	71	6	6	1.079	0	20	40	0	1.0	2.5	3.5	flat oblong type, pointed tubers, variable skin
NDAF1791-1	569	706	81	12	74	7	7	1.095	0	10	0	0	0.0	3.0	3.5	variable type, medium to dark russet skin
AF7015-2	563	637	89	4	48	41	7	1.067	0	0	40	0	0.5	2.5	3.0	large blocky type, moderate skinning
AF7001-5"	559	670	83	14	72	11	3	1.079	0	10	0	0	0.5	3.0	3.0	lighter skin, flat oblong type, slight points
Umatilla	555	921	60	15	57	3	25	1.086	20	0	0	0	0.0	3.5	3.5	nice skin, severe points and knobs
A11381-3	535	636	84	9	61	23	7	1.082	0	10	0	0	1.0	3.0	3.5	round type, medium russet skin, heat knobs
A13036-12"	530	680	78	10	69	9	12	1.077	0	20	0	0	0.5	4.0	4.5	apical sprouting, variable type
MN19CO17021-003"	525	674	78	8	54	24	14	1.074	40	0	30	0	1.0	3.5	4.0	growth crack, light russet skin, tubular type
AAF15291-5	522	726	72	16	65	7	12	1.075	10	0	30	0	1.0	4.0	3.5	variable type
AF6298-2*	509	620	82	13	77	5	5	1.088	0	10	10	0	0.5	2.5	2.5	smaller blocky oblong type, nice medium russet skin
AAF15193-6"	498	803	62	6	47	15	32	1.069	0	0	0	0	1.5	4.0	2.5	misshapen tubers, some rot, severe points and growth cracks
A15051-1TE"	485	641	75	16	73	2	9	1.083	10	10	20	0	0.0	3.0	5.0	alligator hide, bottlenecks, variable shape
AF6997-3"	471	734	64	12	55	9	24	1.079	0	20	30	0	1.0	3.0	2.5	knobs, severe bottlenecks, tubular type
AAF15247-3*	452	542	83	9	62	21	8	1.063	0	0	0	0	0.5	3.0	2.5	dark russet skin, nice appearance
A12169-5"	432	589	73	8	50	23	19	1.078	0	20	0	0	1.5	2.5	2.5	growth cracks, knobs, flat pointed type
ATX18679-2RU	428	697	62	33	61	1	5	1.097	0	0	0	0	0.5	3.0	5.0	alligator hide, misshapen tubers
MN19AOR17020-009*	394	463	85	10	59	26	5	1.079	0	10	0	0	0.0	2.0	2.0	attractive russet skin, blocky oblong type
AF7008-1	394	518	76	22	64	12	2	1.066	0	0	30	0	0.0	3.0	3.0	medium russet skin, blocky oblong type, trace knobs
AF6989-3	391	524	75	14	72	3	11	1.090	0	10	10	0	0.0	2.0	2.5	knobs, flat oblong type
COAF16090-14"	391	571	69	10	62	7	21	1.064	0	0	30	0	1.5	3.0	2.5	pointed tubular type, knobs
NDAF1762-7	361	546	66	26	65	1	8	1.083	0	30	40	0	0.5	3.0	3.0	medium russet type, pointed tubers, not uniform
MN19CO17072-005"	328	453	73	23	67	6	4	1.078	0	0	30	0	0.5	3.0	3.0	small round type
CO14371-3RU	192	379	51	35	51	0	14	1.062	0	20	0	0	0.5	3.0	4.5	variable type, growth cracks
MEAN	**553**	**712**	**78**	**11**	**62**	**16**	**11**	**1.080**	**4**	**10**	**12**	**0**	**0.8**	**3.2**	**3.5**	

[1]SIZE	[2]SPECIFIC GRAVITY	[3]RAW TUBER QUALITY	[4]COMMON SCAB RATING	FIELD DATA	
Russets	Data not replicated	**(percent of tubers out of 10)**	0.0: Complete absence of surface or pitted lesions	Planting Date	4/27/23
Bs: < 4 oz		HH: Hollow Heart	1.0: Presence of surface lesions	Vine Kill Date	9/1/23
As: 4 - 10 oz		VD: Vascular Discoloration	2.0: Pitted lesions on tubers, though coverage is low	Harvest Date	9/21/23
OV: > 10 oz		IBS: Internal Brown Spot	3.0: Pitted lesions common on tubers	Days (planting to vine kill)	127
PO: Pickouts		BC: Brown Center	4.0: Pitted lesions severe on tubers	Days (planting to harvest)	147
			5.0: More than 50% of tuber surface area covered in pitted lesions	GDD_{40} MAWN Station	Constantine
				GDD_{40} (planting to vine kill)	3448

[5]VINE VIGOR RATING	[6]VINE MATURITY RATING			
Date: 6/12/23	Date: 8/17/23	Varieties below the dashed line are added lines	Seed Spacing	10"
Rating 1-5	Rating 1-5	*High visual appeal during grading		
1: Slow emergence	1: Early (vines completely dead)	"Poor visual appeal during grading		
5: Early emergence (vigorous vine, some flowering)	5: Late (vigorous vines, some flowering)			

Table 12. 2023 Early Generation Tablestock Potato Variety Trial

Walther Farms Cass City

Planting: 5/16/23 Vine Kill: 9/9/23 Harvest: 10/4/23

GDD_{40}: 3118

		CWT/A		PERCENT OF TOTAL[1]						RAW TUBER QUALITY[3] (%)							YELLOW FLESH		RED SKIN				
	LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR[2]	HH	VD	IBS	BC	COMMON SCAB RATING[4]	VINE VIGOR[5]	VINE MATURITY[6]	WAXINESS[7]	FLESH COLOR[8]	WAXINESS[7]	SKIN COLOR[9]	UNIFORMITY[10]	SILVER SCURF[11]	COMMENTS
YELLOW FLESH TYPE	MSII320-04	440	472	93	4	93	0	3	1.066	0	0	0	0	0.5	4.0	3.0	4.0	2.0					deep apical eyes, blocky round type
	MSII344-02	299	444	67	27	67	0	6	1.068	0	0	0	0	1.0	3.5	3.0	4.0	3.0					flat oval to oblong type, slight points
	MSII323-04	281	309	91	7	91	0	2	1.067	0	0	10	0	0.5	4.0	3.0	3.5	2.0					bright appearance, shallow eyes, round to oval type
	MSII320-03	278	323	86	10	86	0	4	1.071	0	0	0	0	0.0	3.5	3.0	2.0	3.0					flat round uniform type, buff skin
	CO16279-5Y	270	419	65	31	65	0	4	1.086	0	0	0	0	0.0	4.0	3.0	3.0	4.5					flat round type, buff skin, golden appearance
	MSII323-06	242	322	75	24	75	0	1	1.052	0	20	0	0	0.5	3.5	3.0	3.0	1.5					flat blocky round type, light buff skin, uniform
	MSII344-05	238	298	80	18	80	0	2	1.069	0	0	0	0	1.0	3.5	3.0	3.0	2.5					oval type, bright appearance
	MSII308-05	188	265	71	28	71	0	1	1.068	0	0	0	0	0.5	1.0	3.0	3.5	2.0					nice bright appearance, flat round type, light buff skin
	CO16212-1Y								1.074		10			0.5	4.0	3.0	2.5	4.0					small round type, blush eyes
	MEAN	**280**	**357**	**79**	**19**	**79**	**0**	**3**	**1.069**	**0**	**3**	**1**	**0**	**0.5**	**3.4**	**3.0**	**3.2**	**2.7**					
RED SKIN TYPE	TC19094-1R	209	340	61	27	61	0	12	1.072	0	10	0	0	0.0	3.5	3.0			3.5	4.5	5.0	2.0	blocky round type, light color, trace skinning
	MSII417-02	199	241	83	14	83	0	3	1.066	0	0	0	0	0.0	1.5	3.0		1.0	3.0	2.5	3.0	3.0	round uniform type, slight skinning
	MSII415-01	185	204	91	9	91	0	0	1.064	0	30	10	0	0.0	1.0	3.0			3.5	3.0	3.0	1.0	blocky round type, nice color, slight skinning
	MSII418-12	155	178	87	13	87	0	0	1.076	0	0	0	0	0.0	1.0	3.0			3.0	3.5	3.0	2.5	blocky round to oval type, nice appearance
	COTX15083-1R	130	167	78	21	78	0	1	1.064	0	0	0	0	0.0	2.0	3.5			3.5	4.5	3.5	3.0	small uniform type, dark red color
	ND14324B-7R	80	117	68	32	68	0	0	1.061	0	0	0	0	0.0	1.0	3.0		1.0	4.0	4.0	3.5	2.0	small round type, prominent eyes
	MSII432-03	58	92	63	35	63	0	2	1.063	0	0	0	0	0.0	1.0	3.0		1.5	3.0	3.0	2.5	2.5	smaller flat round to oval type, good color
	TX17802-5R	44	102	43	53	43	0	4	1.067	0	0	0	0	0.0	1.0	3.0			3.5	4.5	5.0	1.0	small uniform round type, nice appearance
	MEAN	**133**	**180**	**72**	**26**	**72**	**0**	**3**	**1.067**	**0**	**5**	**1**	**0**	**0.0**	**1.5**	**3.1**		**1.2**	**3.4**	**3.7**	**3.6**	**2.1**	
WHITE	AF6735-2	211	263	80	20	80	0	0	1.084	30	20	0	0	0.5	2.5	3.5	3.0						flat round to oval type, bright appearance
	TRIAL MEAN	**206**	**268**	**75**	**22**	**75**	**0**	**3**	**1.069**	**2**	**5**	**1**	**0**	**0.3**	**2.5**	**3.1**	**3.2**	**2.3**	**3.4**	**3.7**	**3.6**	**2.1**	

[1]SIZE
Non-russet tablestock
Bs: < 1 7/8"
As: 1 7/8" - 3 1/4"
OV: > 3 1/4"
PO: Pickouts

[2]SPECIFIC GRAVITY
Data is replicated

[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: 6/26/23
Rating 1-5
1: Slow emergence
5: Early emergence

[6]VINE MATURITY RATING
Date: 8/15/23
Rating 1-5
1: Early (vines completely dead)
5: Late (vigorous vines, some flowering)

FIELD DATA

Planting Date	5/16/23
Vine Kill Date	9/9/23
Harvest Date	10/4/23
Days (planting to vine kill)	116
Days (planting to harvest)	141
GDD_{40} MAWN Station	Fairgrove
GDD_{40} (planting to vine kill)	3118
Seed Spacing	10"

[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 13. 2023 Russet and Tablestock Variety Descriptions

Russet Variety Descriptions

Entry	Pedigree	2023 Scab Rating*	Characteristics
Goldrush	ND450-3Rus x Lemhi Russet	0.1	Below average yield, common scab resistant, earlier vine maturity, variable skin and type, growth cracks, oblong
NDAF1762-7	Dakota Russet x ND122441YB-2Russ	0.5	Below average yield, pointed tubers, medium russet skin, mid-season maturity
NDAF1791-1	Payette Russet x Dakota Trailblazer	0.3	Moderate common scab resistant, variable type, misshapen pickouts average yield
NDAF1791-3	Payette Russet x Dakota Trailblazer	0.8	Long tubular type, light skin, below average yield
NDAF1791-6	Payette Russet x Dakota Trailblazer	1.5	Mid-season maturity, pointed tubers, smaller, oblong type, common scab susceptible
Portage Russet (W13A11229-1Rus)	A01325-1 x A06131-19	0.4	Average yield, sticky stolons, lighter skin, trace pointed tubers
Reveille Russet (ATX91137-1Rus)	Bannock Russet x A83343-12	0.1	Large blocky type, growth cracks, trace prominent eyes, moderate common scab resistant, earlier maturity
Russet Burbank	Unknown	0.3	Moderate common scab resistant, pointed and misshapen tubers, long tubular type
Russet Norkotah	ND9526-4Rus x ND9687-5Rus	0.4	Variable type and appearance, trace alligator hide, average yield, earlier maturity, moderate common scab resistant

Table of Contents

2023 Russet Varieties Cont.

Entry	Pedigree	2023 Scab Rating*	Characteristics
Silverton Russet (AC83064-6)	A76147-2 x A7875-5	0.3	Nice type and appearance, trace growth crack, good yield, average specific gravity
Umatilla Russet (AO82611-7)	Butte x A77268-4	0.2	Deeper eyes, misshapen and pointed tubers, later maturity, below average yield, moderate common scab resistant
Vanguard (TX08352-5RUS)	TXA549-1Ru x AOTX98137-1Ru	0.2	Nice dark russet skin, oblong type, trace growth cracks, earlier maturity, above average yield
A08433-4STO	A02611-1 x AOND95249-1	0.5	Oblong blocky type, light to medium russet skin, later maturity, good yield, moderate common scab resistant
A09086-1LB	Palisade Russet x AC96052-1RU	1.1	Blocky large type, variable light skin, good yield, common scab susceptible
A09119-4LB	A00472-20LB x Premier Russet	2.5	Average yield, above average specific gravity, common scab susceptible, pointed oblong type, medium russet skin
A09136-9LB	A02424-83LB x A98345-1	0.6	Slight alligator hide, lighter skin, variable type, average to above average yield
A10071-1	Targhee Russet x AO02183-2	0.4	Average yield, dark russet skin, long tubular type, earlier maturity, moderate common scab resistant

Table of Contents

2023 Russet Varieties Cont.

Entry	Pedigree	2023 Scab Rating*	Characteristics
A11175-12TE	USDA ID	0.4	Deeper eyes, blocky oval to oblong type, average to above average yield, average maturity
A11737-1LB	A96814-65LB x A05084-11	1.0	Smaller size profile, darker skin, below average yield and specific gravity, excellent internal quality
A12327-5VR	A06862-11VR x La Belle Russet	0.3	Very high yield, many oversized tubers, below average specific gravity, nice appearance, moderate hollow heart and vascular discoloration
A13074-1TE	A07431-3 x A06084-1TE	0.3	Average yield, variable type and appearance, moderate common scab resistant, mid-season vine maturity
A15057-2TE	A07390-3LB x A10007-3	0.3	Average to above average yield, oblong to long type, skinning, darker skin, earlier vine maturity
A15169-6	A07088-6 x AF4296-3	0.5	Below average yield, knobs, poor type, very late maturity
AAF15169-3	A07088-6 x AF4296-3	0.8	Above average yield, medium russet skin, light skinning, prominent eyes
AAF15193-6	A071012-4BF x AF4116-9	0.8	Average yield, non-uniform skin, prominent eyes, oblong to long type
AAF15193-9	A071012-4BF x AF4116-9	1.0	Average yield, earlier vine maturity, flat blocky oblong type

Table of Contents

2023 Russet Varieties Cont.

Entry	Pedigree	2023 Scab Rating*	Characteristics
AAF15247-3	AW07791-2 x AF4116-9	0.3	Heavy dark russet skin, nice appearance, average yield
AAF15291-5	Dakota Trailblazer x AF4320-7	0.8	Later maturity, misshapen pickouts, variable type, below average yield
AAF15402-1	A96953-13sto x AF4116-9	0.5	Good yield, mid-season maturity, growth crack, pointed tubers
AC12090-3RU	A05214-3LB x A06021-1T	0.0	Long oval to oblong type, purple eye pigmentation, Low yield, common scab resistant
AF5521-1	AF4320-7 x AF2291-10	1.2	Common scab susceptible, above average yield, oval to oblong type, light russet skin, nice appearance
AF5736-16	AF3317-15 x Dakota Trailblazer	0.1	Late season maturity, flat oblong to long type, medium russet skin, average to above average yield
AF6298-2	A8469-5 x Gemstar Russet	0.3	Average yield, earlier vine maturity, nice appearance and skin, moderate common scab resistant
AF6340-6	Caribou Russet x Russet Norkotah	0.7	Recessed eyes, oblong to long type, below average specific gravity, excellent internal quality, average yield
AF6377-10	A03921-2 x Gemstar Russet	0.0	Slight alligator hide, skinning, blocky oblong type, nice appearance, above average yield, larger tuber size profile

Table of Contents

2023 Russet Varieties Cont.

Entry	Pedigree	2023 Scab Rating*	Characteristics
AF6377-12	A03921-2 x Gemstar Russet	0.3	Blocky type, above average yield, very high specific gravity, moderate hollow heart, common scab resistant
AF6750-3	Targhee Russet x AF5179-4	0.5	Blocky oblong type, below average specific gravity, good internal quality, above average yield
AF6989-3	S.bu8.5 x Nicolet	0.0	Common scab resistant, average yield, average maturity, flat oblong type, nice
AF6997-1	A96953-13 x AF5525-2	1.0	Average yield, common scab susceptible, variable type and appearance
AF6997-3	A96953-13 x AF5525-2	1.0	Low Yield, common scab susceptible, poor appearance, deep eyes, tubular type
AF7001-5	A02507-2LB x AF4124-7	0.3	Average yield, large blocky type, trace pointed tubers, moderate common scab resistant
AF7008-1	A03921-2 x AF5525-2	0.0	Common scab resistant, small blocky type, medium russet skin, average yield
AF7015-2	AF3362-1 x Gemstar Russet	0.5	Good yield, above average specific gravity, oblong type, marginal appearance
ATX15097-1RU	Castle Russet x A98345-1	1.5	Below average yield, low yield, misshapen pointed tubers, early vine maturity, common scab susceptible

Table of Contents

2023 Russet Varieties Cont.

Entry	Pedigree	2023 Scab Rating*	Characteristics
ATX16119-1RU	Dakota Trailblazer x AOR07821-1	2.0	Early vine maturity, smaller tubers, medium russet skin, oblong type, common scab susceptible
CO13003-1RU	Fortress Russet x AC96052-1RU	0.4	Slight skinning, nice appearance, blocky type, low yield, average season maturity
CO14371-3RU	CO07205-4RU x OR05039-4	0.5	Smaller, growth crack, alligator hide, low yield, later season maturity
CO15016-1RUsto	A03921-2 x Pomerelle Russet	0.3	Low yield, moderate common scab resistant, nice, pointed tubers, bottlenecks
COAF16090-14	CO10087-4RU x Goldrush	1.3	Low yield, smaller oblong type, pointed tubers, common scab susceptible
COTX08121-1RU	AC96052-1RU x Blazer Russet	0.0	Common scab resistant, above average specific gravity, small oblong type, early season vine maturity
COTX010080-2RU	CO03364-5RU x CO98067-7RU	0.3	Moderate common scab resistant, average yield, small tubers, oblong to pointed type
COTX18174-1RU	COA05149-2 x CO12267-1RU	1.5	Below average yield, small tubers, oblong to pointed type, common scab susceptible
W13008-1Rus	Canela x W8152-1Rus	0.3	Average yield, moderate common scab resistant, oblong to long type, alligator hide, lighter skin

* Scab rating based on 0-5 scale; 0 = most resistant and 5 = most susceptible. Common scab data provided by Potato Outreach Program. Line descriptions provided by potato breeding programs and updated by Potato Outreach Program following evaluations at trial locations throughout Michigan.

Table of Contents

2023 Yellow Flesh Variety Descriptions

Entry	Pedigree	2023 Scab Rating*	Characteristics
Acoustic	Orchestra x AOB1997-507-015	0.5	Flat round to oval type, buff skin, average yield, later maturity
Bernice	Actrice x Satina	0.6	Heavy buff skin, oval type, slight growth crack, average yield, earlier vine maturity
Bonafide (MSV093-1Y)	McBride x MSP408-14Y	0.5	Above average yield, high proportion A-sized tubers, blocky round type, netted skin, deeper eyes
Bonnata	Bernadette x RZ 95-6643	0.3	flat round to oval type, lenticel scarring, average yield, earlier maturity, moderate common scab resistant
Caledonia Pearl	Orla x Harmony	0.2	Earlier maturity, flat round to oval type, uniform appearance, below average yield, moderate common scab resistant
Camelia	Piccolo Star x VDZ 00-343	0.8	Flat oval type, rougher skin, average yield, common scab susceptible
Christel	Norkia America	0.1	Flat round to oval type, nice appearance, average to above average yield, common scab resistant
Columba	Carerra x Agata	0.4	Above average yield, very low specific gravity, long type, slight buff skin, deeper eyes
Constance	Marabel x AR93-1243	0.6	Average yield, flat oblong type, nice appearance, earlier vine maturity, lower specific gravity

Table of Contents

(2023 Yellow Flesh Varieties Cont.)

Entry	Pedigree	2023 Scab Score*	Characteristics
Floridana	SunRain	1.2	Average to above average yield, common scab susceptible, blocky round to oval type, slight rhizoctonia
Golden Globe (US 624-95)	Berber x 2.6 720-86	0.1	Average to above average yield, flat round to oval type, trace netted skin, common scab resistant
Goldeye	Agria x Triplo	2.4	Below average yield, common scab susceptible, variable type, buff skin
Jelly	Marabel x 173/87/4476L	0.4	Above average yield, flat oblong type, variable appearance, later vine maturity
Melody	VE7447 x W72.22.498	0.5	Average yield, average vine maturity, light buff skin, prominent lenticels
Montana	E 99/73/126 x E 99/89/130	0.7	Oval to oblong type, light buff skin, greening, below average yield, above average specific gravity
Noya	LaTerra x Cyrano	0.6	Average yield, bright appearance, oval to oblong type, average maturity
Paroli (24 205-06)	569 102-99 x 774 105-99	0.3	Average to above average yield, blocky type, pointed tubers, growth cracks, deeper eyes, earlier vine maturity
Polaris Gold (MN04844-07Y)	W2257-2 x Dakota Pearl	0.0	Common scab resistant, below average yield, flat oval type, smaller tubers, below average yield

Table of Contents

(2023 Yellow Flesh Varieties Cont.)

Entry	Pedigree	2023 Scab Score*	Characteristics
Queen Anne (05-043-1)	99-002-14 x Gala	0.8	Oval to long type, bright smooth skin, below average yield, average vine maturity
Sensation	TE 93-26-02 x TE 98-05-31	1.1	Average yield, average vine maturity, flat oval type, heavy netted skin, points, common scab susceptible
Sound	Mondial x CMK2003-707-003	2.0	Flat oblong to long type, netted skin, common scab susceptible, very low yield
Tessa	Carmona x Diplomat	1.0	Average yield, average vine maturity, oval to oblong type, medium netted skin, tubular
Tyson	Sylvana x Curano	0.3	Small uniform round type, points, average yield, moderate common scab resistant
Vanilla	OP4563/24 x Orla	0.9	Low yield, round type, flaky skin, nice appearance, average vine maturity
Yukon Gold	Norgleam x W5279-4	0.8	Good yield, earlier vine maturity, blocky round type, buff skin
A08120-4Y	USDA-ID	0.2	Very low yield, moderate common scab resistant, buff skin, pink blush eyes, round to oval
AF6566-1	WAF10192-3 x AF5040-8	0.5	Above average yield, average maturity, flat oval type, buff skin
AF6868-6	Lamoka x Saikai 35	0.8	Average to above average yield, heat sprouts, pink eyes, trace points, average maturity

Table of Contents

(2023 Yellow Flesh Varieties Cont.)

Entry	Pedigree	2023 Scab Score*	Characteristics
AF6888-15	Waneta x AF5040-8	0.0	Above average yield, common scab resistant, blocky flat type, poor appearance
AF6889-4	Waneta x Saikai 35	0.3	Average to above average yield, later vine maturity, variable type, prominent pink eyes, blocky round type
AORTX09037-1W/Y	Fasan x Ivory Crisp	1.0	Low yield, common scab susceptible, small variable oval type, growth cracks, netted skin
AORTX09037-5W/Y	Fasan x Ivory Crisp	0.0	Common scab resistant, small flat round type, slight buff skin, below average yield
ATX5325s-3W/Y	Elkton x NDA081453CAB-2C	0.0	Average to above average yield, common scab resistant, buff skin, round to oval type
CMK2009-630-001	Meijer	0.8	Buff skin, acceptable appearance, higher specific gravity, below average yield
COTX10118-4Wpe/Y	07S019 x AC03534-2R/Y	0.4	Very low yield, mid-season maturity, purple splashes around eyes, poor variable appearance
IPB8343-2W/Y	Unknown	0.5	Low yield, small round type, deeper eyes, mid-season maturity
IPB8343-3W/Y	Unknown	0.0	Very low yield, low common scab susceptibility, flat round type, buff skin
IPB8343-5W/Y	Unknown	0.9	Low yield, small round type, recessed apical ends, mid-season maturity

(2023 Yellow Flesh Varieties Cont.)

Entry	Pedigree	2023 Scab Rating*	Characteristics
IPB8343-8W/Y	Unknown	0.4	Low yield, deeper eyes, variable type, trace points, earlier season maturity
MSBB371-1Yspl	MSW151-9 x Spartan Splash	0.0	Average yield, common scab resistant, variable shape, purple splashed eyes
MSGG039-08Y	Soraya x MSBB719-01	0.0	Common scab resistant, low yield, variable flat oval type, buff skin, below average yield
MSGG039-11Y	Soraya x MSBB719-01	0.0	Common scab resistant, above average yield, blocky round to oval type, light netted skin
MSII344-02	Morning Gold x Oneida Gold	1.0	Average to above average yield, flat oval to oblong type, slight rhizoctonia
NDAF1710Y-1	793101.3 x ND14437CAB-1	0.0	Common scab resistant, average to above average yield, bright appearance, flat oval type, buff skin
NDTX081451CB-1Y/Y	Dakota Diamond x Gala	0.9	Low yield, buff skin, oval to oblong type, common scab susceptible, average maturity
NYT61-3	NYG70-3 x NY149	0.0	Average yield, common scab resistant, pink eye, variable type, very late maturity
TX17734-1Y/Y	NDTX05977s-1W x NDA081451CB-1CY	1.0	Low yield, common scab susceptible, oblong to long type, poor shape and appearance
W13103-2Y	Soraya x W9576-4Y	0.6	High yield, mid-season maturity, round to oval type, buff skin, nice appearance

Table of Contents

(2023 Yellow Flesh Varieties Cont.)

Entry	Pedigree	2023 Scab Rating*	Characteristics
W15240-2Y	NW64-6 x W9576-11Y	0.5	Average yield, mid-season maturity, small round type, bright appearance, slight greening
W15248-17Y	Oneida Gold x W9576-13Y	0.3	Moderate common scab resistance, early vine maturity, oblong type, buff skin, trace alligator hide
WAF14096-5	A9603-9Y x W9577-8Y	0.7	Average to above average yield, later vine maturity, pink eyes, uniform blocky round type

* Scab rating based on 0-5 scale; 0 = most resistant and 5 = most susceptible. Common scab data provided by Potato Outreach Program. Line descriptions provided by potato breeding programs and updated by Potato Outreach Program following evaluations at trial locations throughout Michigan.

Table of Contents

2023 Red Skin Variety Descriptions

Entry	Pedigree	2023 Scab Rating*	Characteristics
Becca Rose	ND028678-1RY x ND028770B-4R	0.3	Average yield, later vine maturity, slight sticky stolons, skinning, nice skin color
Dark Red Norland	Redkote x ND626	0.1	Lighter red skin, variable type, average to above average yield, moderate common scab resistant
A11582-1R	USDA-ID	0.1	Low yield, poor type and appearance, second growth, skinning, moderate common scab resistant
AAF11546-3	NDA050237B- x ND8555-8R	0.4	Pointed tubers, variable type, skinning, average yield, lower specific gravity
AF6932-4	AF4831-2 x Dark Red Norland	0.0	Common scab resistant, flat oval type, growth cracks, average to above average yield
AF6938-4	NDAF12238Y-2 x AF4831-2	0.0	Common scab resistant, average to above average yield, round blocky type, poor appearance
AF6963-1	Eva x AF4831-2	0.0	Common scab resistant, flat oval type, pointed tubers, slight skinning, average to above average yield
AF6963-8	Eva x AF4831-2	0.0	Common scab resistant, high yield, poor skin color, growth cracks, blocky type
AF6965-5	Eva x NDAF12236Y-2	0.2	High yield, early vine maturity, poor color and appearance, moderate skinning

Table of Contents

2023 Red Skin Varieties Cont.

Entry	Pedigree	2023 Scab Rating*	Characteristics
BNC839-5	NC201-3 x Strawberry Paw	0.2	Average yield, moderate common scab resistant, flat oval type, severe skinning
BNC917-2	BNC203-3 x Super Red Norland	0.1	Average to above yield, moderate skinning, round blocky type, early vine maturity moderate common scab resistant
BNC981-1	Eva x NC566-6	0.0	Common scab resistant, average to above average yield, blocky round type, variable skin
CO15084-4R	CO01198-2R x OR04131-2	0.0	Round to oval type, attractive skin color, common scab resistant, low yield
CO15113-1R	CO05228-4R x NDC081655-1R	0.3	Average yield, small round uniform type, mid-season vine maturity
COTX15083-1R	CO01218-2R x Becca Rose	0.0	Small blocky round type, consistent appearance, common scab resistant, average yield
MSCC553-1R	Red Marker #2 x ND7132-1R	0.5	Below average yield, average vine maturity, small uniform round type, moderate skinning
MSGG127-3R	ND6002-01R x Red Marker #2	0.2	Blocky round type, moderate skinning, high yield, moderate common scab resistant, average maturity
MSGG135-1R	Red Marker #2 x MSXUNK-3P	0.1	Moderate common scab resistant, low yield, compressed round type, light pink skin, later maturity

Table of Contents

2023 Red Skin Varieties Cont.

Entry	Pedigree	2023 Scab Rating*	Characteristics
MSII432-01	W10114-3R x Isle Royale	0.0	Variable type, moderate alligator hide, common scab resistant, average yield
NDA8512C-1R	ND6694C-1R x ND5256-7R	0.1	Average yield, moderate common scab resistant, smaller type, moderate growth crack, deep eyes, early maturity
NDAF113484B-1	ND060570B-1R x ND8555-8R	0.3	Blocky round type, slight skinning, early maturity, high yield, moderate common scab resistant
NDAF1727Y-1	95043.11 x Dakota Ruby	0.0	Round blocky type, slight skinning, common scab resistant, average to above average yield
NDTX050169-1R	ND8555-8R x R89063-83	0.0	Common scab resistant, low yield, sticky stolons, small, nice appearance, later maturity
W16025-5R	Villetta Rose x Dark Red Norland	0.5	Average yield, consistent type, rhizoctonia, light skin color, earlier vine maturity
W17005-3R	Red Endeavor x W8890-1R	0.4	Below average yield, nice appearance, slight lenticels, round blocky type, mid-season maturity
W17026-4R	W9432-4R/Y x Villetta Rose	0.2	Below average yield, smaller round to oval type, variable skin, earlier season maturity, moderate common scab resistant

Table of Contents

* Scab rating based on 0-5 scale; 0 = most resistant and 5 = most susceptible. Common scab data provided by Potato Outreach Program. Line descriptions provided by various potato breeding programs and updated by Potato Outreach Program following evaluations at various trial locations throughout Michigan.

Table of Contents

2023 Round White Variety Descriptions

Entry	Pedigree	2023 Scab Rating*	Characteristics
Allison	HEO98-1620 x Agata	0.4	Average yield, later vine maturity, oblong type, netted skin, moderate common scab resistant
Reba (NY 87)	Monona x Allegany	0.4	Above average yield, moderate common scab resistant, earlier vine maturity, deep apical eyes, large blocky oval type
Sifra	Mondial x Robinta	0.8	Below average yield, full season vine maturity, flat oval type, slight sticky stolons, lenticels
Volare	UK90-60-27 x White Lady	0.4	Above average yield, earlier vine maturity, flat oval type, misshapen tubers, nice appearance
05.6556.1	Real Potatoes	0.6	Average yield, average vine maturity, nice smooth bright skin, variable tuber shape, above average specific gravity
MSDD088-1	NY154 x MSQ086-3	0.2	Good yield, Reba-type, blocky oval, netted skin, average vine maturity
MSGG084-1	MSZ622-02 x MSBB719-01	0.3	Good yield, average vine maturity, flaky skin, deep eyes, growth crack
NY178 (R201-3)	Blue Belle x Genesee	0.7	Average yield, earlier vine maturity, long flat type, netted skin, bright

* Scab rating based on 0-5 scale; 0 = most resistant and 5 = most susceptible. Common scab data provided by Potato Outreach Program. Line descriptions provided by various potato breeding programs and updated by Potato Outreach Program following evaluations at various trial locations throughout Michigan.

Table of Contents

2023 Novelty Variety Descriptions

Entry	Pedigree	2023 Scab Rating*	Characteristics
Blackberry (MSV109-10PP)	COMN07-W112BGA x MSU200-5PP	0.5	Average to above average yield, moderate skinning, white chimeral eyes, later vine maturity
MSFF228-2RY	Merlot x MSX569-1R	0.0	Common scab resistant, mid-season vine maturity, higher specific gravity, pointed tubers, oblong to long type
MSFF305-1RY	Red Marker #2 x MSZ416-8RY	0.0	Common scab resistant, below average yield, higher specific gravity, small blocky type, moderate skinning
MSFF335-2RR	Blackberry x CO098012-5R	0.5	Average yield, later vine maturity, average specific gravity, slight skinning, variable type
MSGG158-11PP	Blackberry x Spartan Red #2	0.5	Average yield, mid-season vine maturity, blocky type, moderate skinning

* Scab rating based on 0-5 scale: 0 = most resistant and 5 = most susceptible. Common scab data provided by Potato Outreach Program. Line descriptions provided by potato breeding programs and updated by Potato Outreach Program following evaluations at trial locations throughout Michigan.

Table of Contents

<u>Investigating Integrated Weed Management Strategies for Potatoes-2023 MPIC Research Report</u>

Erin Burns, Assistant Professor-Weed Science Extension Specialist
Department of Plant, Soil, and Microbial Sciences, Michigan State University

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 (2^{nd}) 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. 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 spring 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, there were no difference in volunteer emergence amongst tillage treatments due to dry warm conditions at planting. However, Callisto applied at V5 increased corn injury by 4% compared to Armezon/Impact treatments, although injury was minimal 5.5% compared to 0.6% for other treatments (Figure 2). Tank mixing insecticides with herbicides had no impact on corn injury. Additionally, there was no lasting impacts of treatments on corn growth or ear development (Figure 3).

Table of Contents

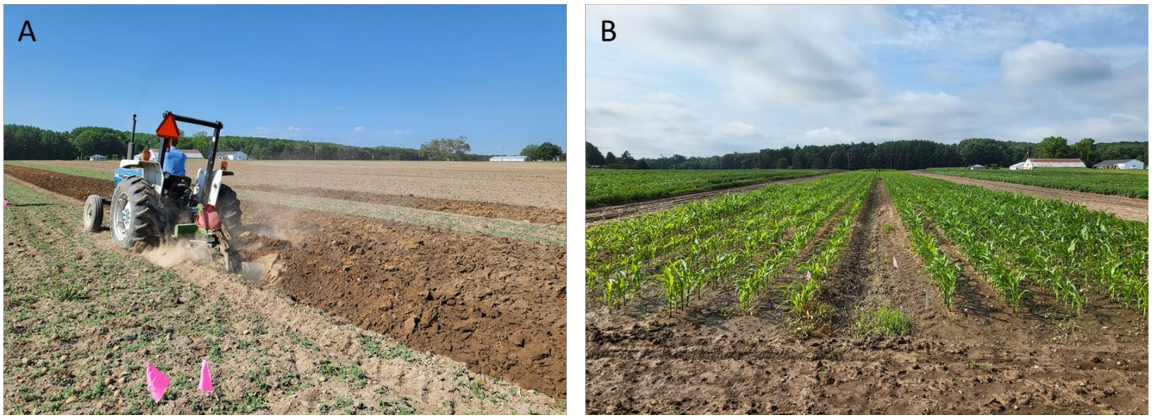


Figure 1. A) Tillage treatments, B) Study after corn planting and herbicide/insecticide applications.

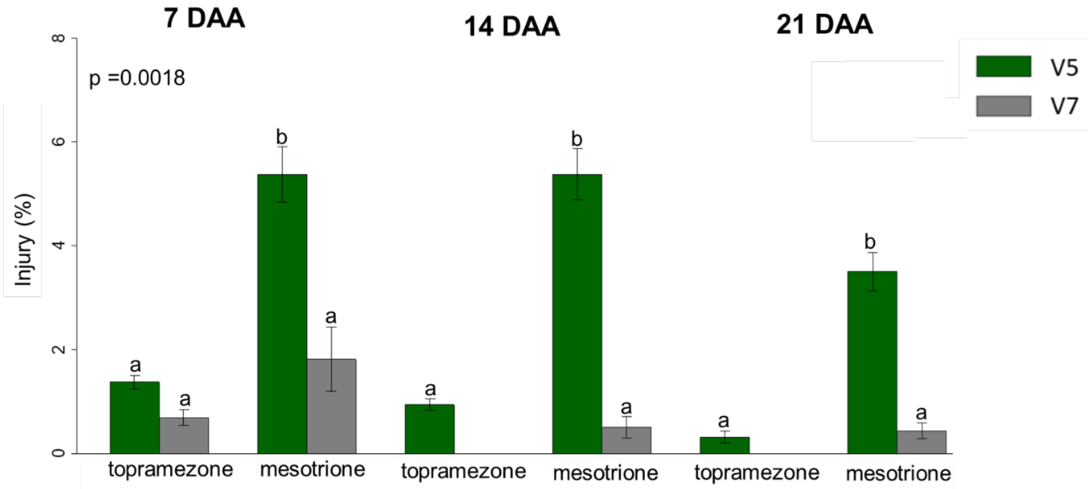


Figure 2. Corn injury (%) evaluated 7, 14, and 21 days after application (DAA) of mesotrione (Callisto) or topramezone (Armezon/Impact).

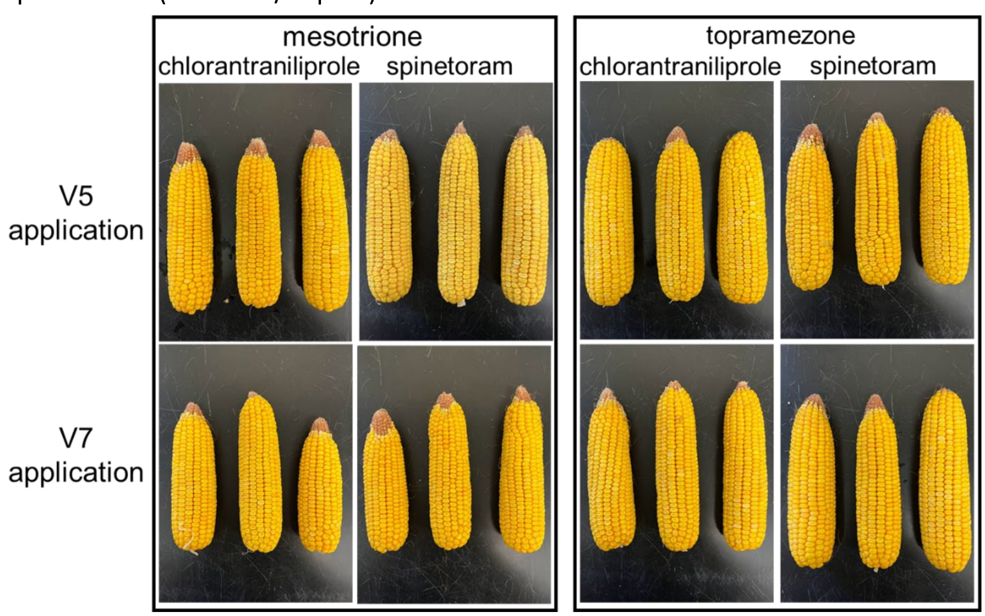


Figure 3. Corn ears at harvest following herbicide mesotrione (Callisto) or topramezone (Armezon/Impact) and insecticide chlorantraniliprole (Coragen) or spinetoram (Radiant) application.

Table of Contents

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 4). 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 5). This delay in potato defoliation led to differences in yield. Yield increased by 53% when trap crop planting was delayed by four weeks compared to at planting (Figure 6). 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 4. Trap crop planting trial.

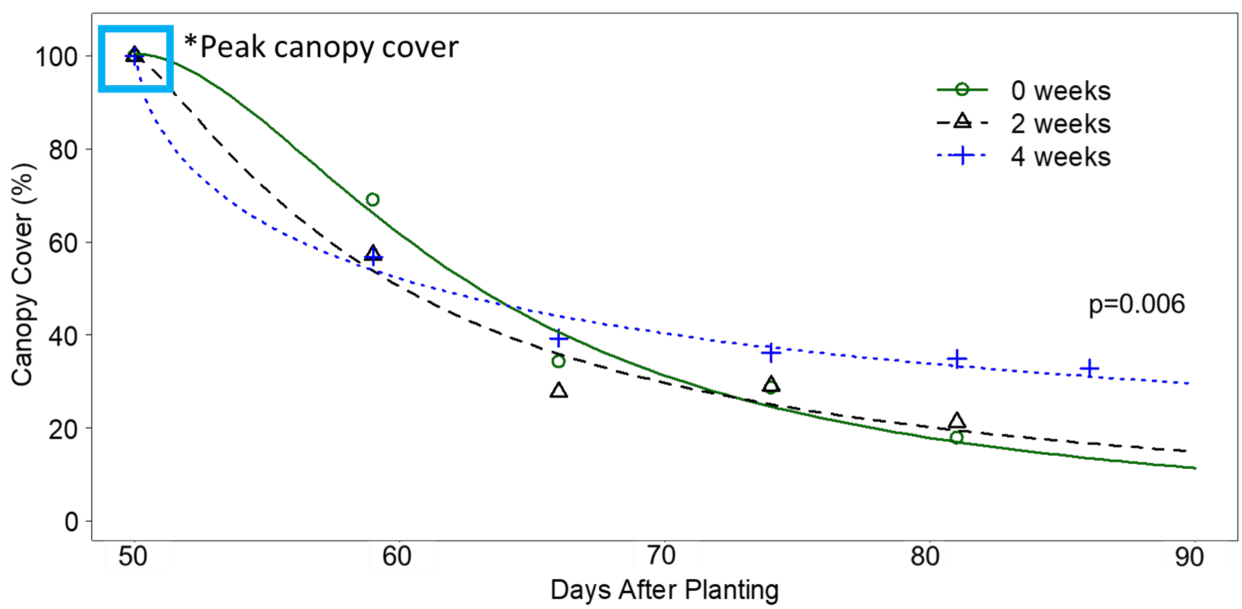


Figure 5. Rate of potato canopy defoliation in bulk crop impacted by timing of trap crop planting.

Table of Contents

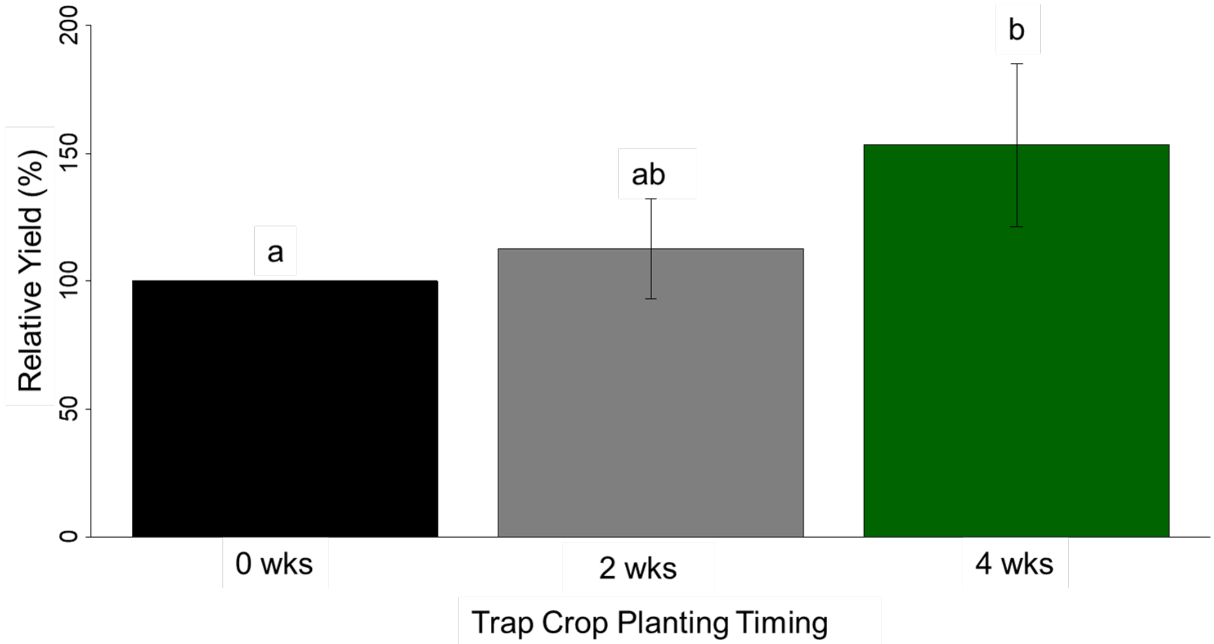


Figure 6. Relative potato yield impacted by timing of trap crop planting.

The Michigan Potato Industry Commission supported this research.

Table of Contents

Michigan Potato Industry Commission Grant Proposal 2023 Report

Project Title: Manure-based amendments as promoters of beneficial soil microbiome for sustainable PED management

Investigator: Marisol Quintanilla

Introduction

Potato early die (PED) is caused by the association of *Pratylenchus penetrans* and *Verticillium dahliae* which reduces potato yield by 30-50%. Current PED management strategies, such as fumigation, have detrimental effects on the soil microbiome thus limiting natural soil biological control systems. Our previous research has concluded that poultry manure and a compost blend (cattle and poultry manure + wood ash) are effective at significantly reducing *P. penetrans* populations and improving potato yield. The pesticidal effect of these products is not fully understood, but literature suggests that it is attributed to a combination of different mechanisms, in which microbial communities play key roles. The overarching goal of the proposed project was to determine if applications of poultry manure and the compost blend are affecting soil microbial communities in any way and if this correlates with *P. penetrans* suppression and plant fitness. We were able to determine the microbial profile of the poultry manure and compost blend, as well as determine its effect on potato soil native microbiome, *P. penetrans* abundance in soil and roots, beneficial nematodes abundance, and plant height and yield.

Materials and Methods

The experiment was established in the summer of 2023 using soil collected from a different commercial potato field located near Lockport Township, MI (41.899160, -85.601069). The soil textural series was a Spink loamy sand with 1.02% organic matter, 3.3% clary, 84.3% sand, and 12.5% silt. In addition, the pH of the soil was 6.0, with a bulk density of 1.68 g/cm^3 and an available water capacity of 0.11 cm/cm (United States Department of Agriculture, Web Soil Survey, 2023). The potato cv. Russet Norkotah had been planted in the field at the time of soil collection. The crop history was a 4-year rotation of seed corn-potato-seed corn-soybean-potato. Every year the field is planted with rye or triticale as cover crops and the soil has never been fumigated nor treated with manures.

Table of Contents

Table 1. Description and nutrient composition of the manure-based amendments used in the 2023 greenhouse experiment.

Manure-Based Amendment	Composition	Carbon:Nitrogen Ratio (C:N)	Nitrogen (TKN[1]) (kg/t)	Phosphate (P_2O_5) (kg/t)	Potash (K_2O) (kg/t)
Compost blend	Cattle and poultry manure Wood ash	9.2:1	22.9	14.1	14
Raw poultry manure	Poultry manure	5:1	33.9	25.5	21.4

The experimental design for the greenhouse experiments was a randomized complete block design with four manure-based amendment treatments, an untreated control, and a positive control using fluopyram (Velum® Prime; FRAC code 7); each treatment had five replicates, for a total of 30 experimental units. The treatments were selected based on results obtained from previous field trials where two different manure-based amendments showed the greatest reduction of *P. penetrans*. One was composted poultry and cattle manure amended with wood ash (compost A), and the second one was raw poultry manure (Morgan Composting Inc. Sears, MI) (Table 1). Because the main goal of this experiment was to determine the influence of the manure-based amendments microbiome on the natural potato soil microbiome, we also included autoclaved compost A and autoclaved raw poultry manure. For the autoclaving process, 200g of each manure-based amendment was autoclaved twice at 121˚C for 30 minutes and that same day, treatments were applied to the respective pots.

The experiment was set up in 1.5-gallon round black plastic pots with drainage holes (21.5 cm in diameter by 21.5 cm deep). Two days before scheduled planting, each pot was filled with a total of 5.5 kg of soil, and manure-based amendment treatments were incorporated with the soil by hand at a rate equal to 3.08 tons/ha. Potato cv. Russet Norkotah seed was obtained from Walther Farms (Three Rivers, MI) and cut into 56.7 g seed pieces; one seed piece was planted in each pot.

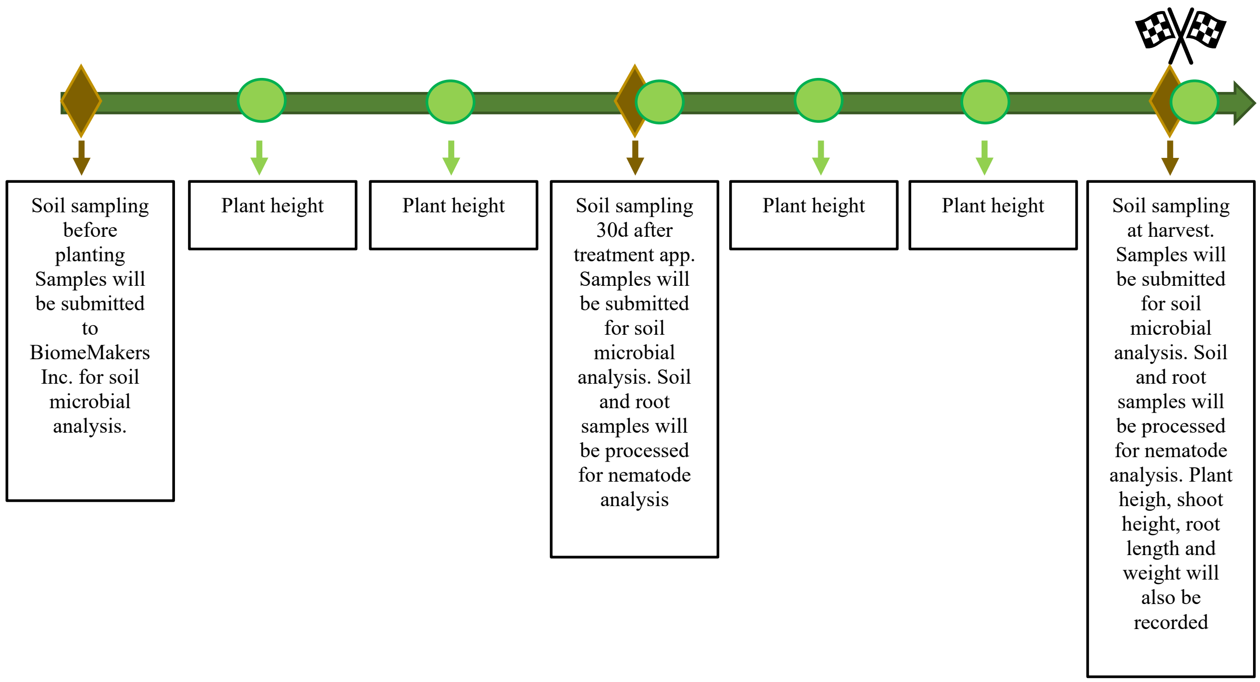
Initial soil samples were taken before treatment application to determine the abundance of different plant-parasitic nematodes and free-living nematodes, however, artificial inoculation of *P. penetrans* was made to ensure the threshold at which symptoms are displayed in potatoes. *Pratylenchus penetrans* inoculum was obtained from the Michigan State University Applied

Nematology Lab *in-vitro* cultures maintained on carrot disks. Two weeks after planting, each pot was artificially inoculated with *P. penetrans* at a rate of 3 nematodes/g of soil, for a total of 16,500 *P. penetrans* mixed stages (juveniles, adults, and eggs) per pot.

One week after inoculation, the respective pots were treated with fluopyram (Velum® Prime; FRAC code 7) by soil drenching at a rate of 496.47 ml/ha, while the untreated pots were treated with an equal amount of water. Pots were watered daily and the greenhouse environmental conditions were 16h:8h light: dark photoperiod at 26°C. The potato variety used in these experiments is medium maturing (95 to 110 days after planting), therefore the experiment was kept for a total of 90 days, which would also allow at least two *P. penetrans* reproduction cycles.

Table of Contents

The measurements taken throughout the growing season were as follows:



Results and Conclusions

<u>Plant Height and Potato Yield</u>

Plants that were treated with manure-based amendments were 10% taller than the untreated control and the Velum control. Interestingly, plants were higher with the "Poultry Manure Sterile" treatment, with an average of 44.2 cm. In contrast, the smallest plants were found in the "Untreated" control with an average of 33.2 cm. Nevertheless, plants were the tallest with applications of manure-based amendments (Figure 1).

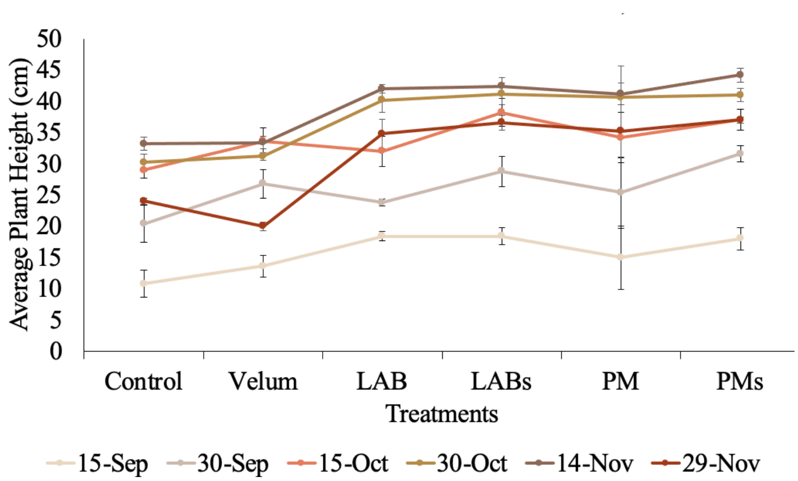


Table of Contents

Figure 1. Average plant height measurements in centimeters were taken every week for the duration of the experiment. The different line colors represent the different points in time in which measurements were taken.

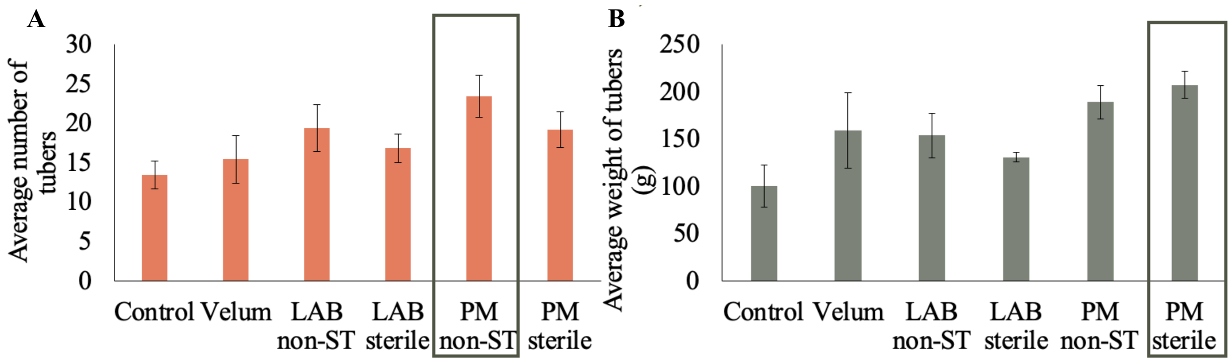


Figure 2. A. Average number of tubers for each treatment and **B.** Average weight of tubers in grams.

On average, the highest number of tubers were found in "Poultry Manure non-Sterile" with 23.4 tubers produced. On the contrary, the "Untreated" control had an average of 13.4 tubers produced. As for the heaviest tubers, "Poultry Manure Sterile" had the heaviest tubers with an average of 207 g, for an average of 19.2 number of tubers, while "Poultry Manure non-Sterile" had an average weight of 188.8 g. As for the "Untreated" control, the average weight was 134 g, however, the lowest weight of tubers was found in "LAB Sterile" with an average of 16.8 tubers with an average weight of 130.6 g (Figure 2).

<u>*Pratylenchus penetrans* Abundance in Soil and Roots</u>

P. Penetrans populations were the lowest with applications of the manure-based amendments. On Average, the lowest number of P. penetrans per 100 cc of soil was found in "Poultry Manure non-Sterile" (135 nems/100 cc of soil), followed by "LAB non-Sterile" (190 nems/100 cc of soil), "LAB Sterile" (191 nems/100 cc of soil), and "PM Sterile" (211 nems/100 cc of soil), in comparison to the "Untreated" control (445 nems/100 cc of soil), and "Velum" (986 nems/100 cc of soil) (Figure 3A).

Table of Contents

Although *P. penetrans* populations within the roots increased over time, the plants that were treated with poultry manure, whether sterile or not, resulted in the lowest number of nematodes found per gram of root (Figure 3B). At harvest, on average, “Poultry Manure non-Sterile” had the lowest numbers of *P. penetrans* per gram of root with 223 nems/g of root, followed by “Poultry Manure Sterile” with 305 nems/g of root. In comparison, the “Untreated” control had an average of 1,786 nems/g of root, while “Velum” had an average of 1,346.9 nems/g of root.

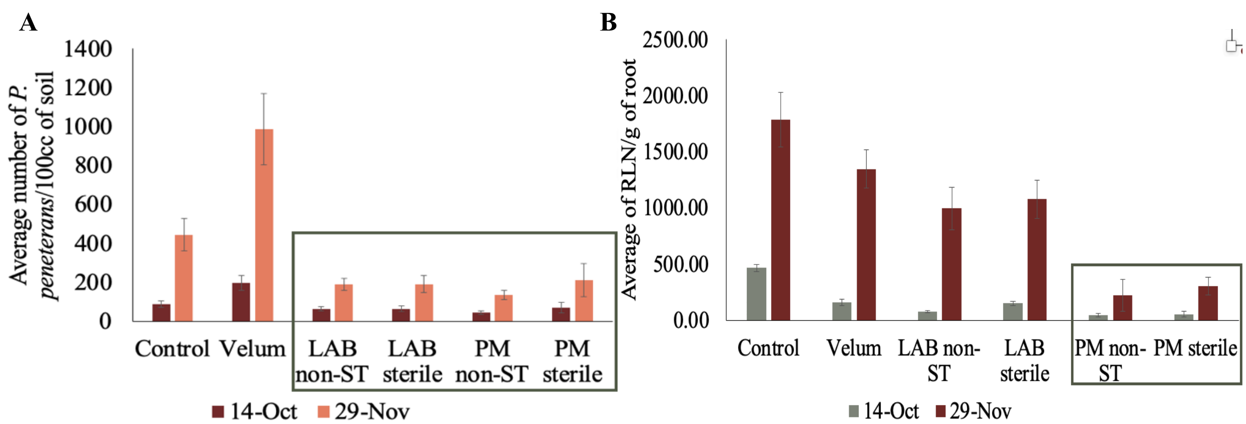


Figure 3. A. The average number of *P. penetrans* per 100 cc of soil 45 days after treatment application and at harvest. **B.** Average number of P. penetrans per gram of root 45 days after treatment application and at harvest.

<u>Free-living Nematodes Abundance in Soil</u>

Free-living nematode abundance increased with applications of manure-based amendments. At harvest, on average, the highest number of free-living nematodes was found in “LAB Sterile” with 6,495 nems/100cc, while the “Untreated” control had an average of 1,524 nems/100 cc of soil, and “Velum” had an average of 1,127 nems/100 cc of soil (Figure 4).

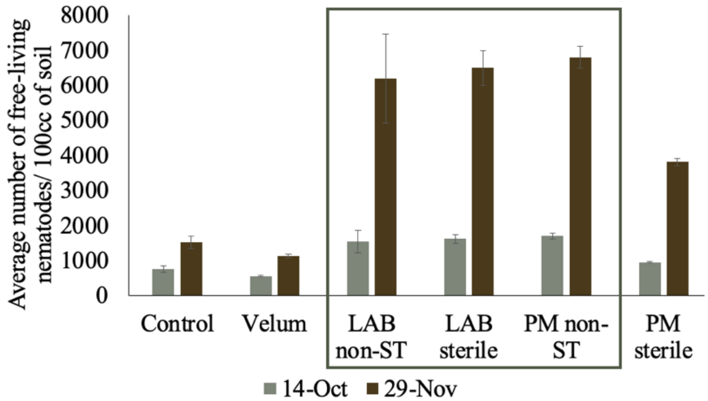


Figure 4. Average of free-living nematode abundance in soil 45 days after treatment application and at harvest.

<u>Effect of Manure-based Amendments Application of Potato Natural Soil Microbiome</u>

The fungal phylum distribution for the poultry manure and the compost blend was different. Poultry manure had a fungal distribution of 84% Ascomycota, 5% Mucoromycota, 4% Mortierellomycota, 3% Basidiomycota and 2% Olpidiomycota. As for the bacterial distribution, there were 58% Firmicutes, 36% Actinobacteriota and 4% Proteobacteria. In contrast, the compost blend had a fungal distribution of 50% Ascomycota, 33% Basidiomycota, and 12% Mortierellomycota. As for the bacteria phyla, 86% were Firmicutes, 9% Actinobacteriota, 3% Proteobacteria and 1% Bacteroidota.

Applications of manure-based amendments significantly affected the potato soil microbiome. 30 days after treatment application, the soil microbiome functionality increased significantly in poultry manure, sterile poultry manure, the compost blend (p-value<0.01), and the sterilized compost blend (p-value=0.05), when compared to the untreated control. Similarly, 90 days after treatment application, the functionality of the different microbial communities increased significantly in poultry manure, sterile poultry manure (p-value<0.01), and the sterilized compost blend (p-value=0.04), when compared to the untreated control.

The predictive functionality analyses determined that compared to the "Untreated" control, "Poultry Manure Sterile" had the highest increase in beneficial microbiome activity such as auxin production, cytokinin production, gibberellin acid production, heavy metal solubilization, salicylic acid, and siderophore production. In contrast, the “LAB” treatments only increased gibberellin acid production and salicylic acid production.

Future Work

Currently, we are working on conducting more statistical analysis to answer the following questions: Is the application of such manure-based amendments stimulating the growth and functionality of beneficial native soil organisms? Are the microbes present in the amendments having an antagonistic effect on the native soil organisms? Are there particular microbial taxa that serve as major predictors of such functional traits? If so, is it the dominant microbes or rare ones? This will aid in answering fundamental questions that will be integrated with future findings from more field, greenhouse, and microplot trials that we have already started. With these results, we will potentially be able to provide a holistic understanding of manure-based amendments' pesticidal effect, which will lead to an improved design of amendments for nematode control.

Acknowledgments

We want to thank the Michigan Potato Industry Commission for funding this project and BiomeMakers Inc. for their DNA sequencing services.

Impacts of Phosphorus Programs on Potato Tuber Set and Yield

Kurt Steinke, Associate Professor, Soil Fertility and Nutrient Management
Andrew Chomas, Research Specialist
Michigan State University
See soil.msu.edu for more information.

Location: Entrican, MI	**Tillage**: Conv., 34-in. row
Planting Date: May 15, 2023 **Harvest**: Sept. 25, 2023	**Trt's**: See below
Soil Type: Loamy sand; 1.5 OM; 6.3 pH; 153 ppm P; 126 ppm K; CEC: 5.5	**Emerge:** June 7 **Hill:** June 19
Variety: Mackinaw	**Replicated**: 4 replications

Treatment (lbs./A)	**Petiole P 30 DAE**	**Petiole P 45 DAE**	**Tubers/ 5 ft row**	**Total A's**	**Total Yield**
	%	%		cwt/A	cwt/A
80 P_2O_5 - At-plant	0.42 ab	0.17 c	27.5	295 cd	336 bc
80 P_2O_5 - Emerge	0.25 c	0.17 c	29.2	299 cd	338 bc
80 P_2O_5 - Split 50/50 At-plant/Emerge	0.35 abc	0.15 c	37.7	353 ab	394 a
160 P_2O_5 - At-plant	0.47 a	0.18 bc	29.0	330 abc	371 ab
160 P_2O_5 - Emerge	0.37 abc	0.23 a	33.1	313 bcd	341 bc
160 P_2O_5 - Split 50/50 At-plant/Emerge	0.45 a	0.22 ab	34.7	376 a	411 a
Check – No P	0.29 bc	0.15 c	31.4	266 d	300 c
LSD $_{(0.10)}$ [a]	**0.16**	**0.034**	**NS**	**48.6**	**44.4**

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

Summary: Phosphorus continues to be both a water quality and production agriculture concern across Michigan including potato production. Questions persist regarding optimal P application timings and whether higher P application rates may be reduced with multiple P application timings. Tuber set is often more sensitive to P additions as compared to yield. Examples do exist where P fertilizer additions may increase total numbers of tubers per plant but without a concurrent increase in yield. Increased tuber set plant^{-1} without increased yield may mistakenly lead to greater rates of P application due to anecdotal causation relationships.

All treatments (other than check) received either 80 or 160 lbs. P_2O_5 per acre applied as 10-34-0. Each P_2O_5 rate was applied 2x2 at-plant, banded at emergence, or 50/50 at-plant and emergence.

Table of Contents

Nitrogen applications were near 225 lb. N/A total applied at emergence, hilling, and post-hilling. Potassium and gypsum were applied according to soil test and grower standard practices.

Trial quality was good. No significant specific gravity differences occurred with all treatments at 1.09. Some reductions in 30 DAE petiole P were observed with low P_2O_5 rates at emergence as compared to at-plant and split applications. No 30 DAE petiole P differences occurred across application timings at the 160 P_2O_5 rate. At 45 DAE, no differences observed at 80 P_2O_5. However at the 160 P_2O_5 rate, 45 DAE petiole P concentrations were greater with emergence applications as compared to at-plant but no differences occurred between emergence and split applications. Tuber counts were not significantly different. Split P_2O_5 applications tended to yield greater than all P_2O_5 at-plant or at emergence. Split P_2O_5 applications at the 80 lb rate yielded similar to split P_2O_5 applications at the 160 lb rate. Please visit soil.msu.edu for further details and other field crop research results.

Potash and Chloride: Plant Uptake and Effects on Potato Production

Kurt Steinke, Associate Professor, Soil Fertility and Nutrient Management
Andrew Chomas, Research Specialist
Michigan State University
See soil.msu.edu for more information.

Location: Entrican, MI	**Tillage**: Conv., 34-in. row
Planting Date: May 15, 2023 **Harvest**: Sept. 25, 2023	**Trt's**: See below
Soil Type: Loamy sand; 1.5 OM; 6.3 pH; 153 ppm P; 126 ppm K; CEC: 5.5	**Emerge:** June 7 **Hill:** June 19
Variety: Mackinaw	**Replicated**: 4 replications

Treatment (lbs./A)	Petiole K 30 DAE	Petiole Cl 30 DAE	Tubers/ 5 ft row	Total Yield	Tuber % K	Tuber % Cl
	%	%		cwt/A	%	%
Check - No K_2O (0 Cl)	9.19 c	1.32 d	25.3 a	349 a	1.54 d	0.12 c
100 K_2O (75 Cl)	9.90 bc	2.03 c	43.0 a	339 a	1.75 c	0.18 bc
200 K_2O (152 Cl)	11.03 a	2.36 bc	29.5 a	343 a	1.86 bc	0.24 b
300 K_2O (227 Cl)	10.39 ab	2.11 c	34.8 a	319 a	2.02 ab	0.26 b
400 K_2O (303 Cl)	11.06 a	2.98 a	31.7 a	351 a	2.23 a	0.39 a
500 K_2O (381 Cl)	11.16 a	2.90 ab	35.0 a	349 a	2.17 a	0.39 a
LSD $_{(0.10)}$ [a]	**0.86**	**0.59**	**NS**	**NS**	**0.19**	**0.07**

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

Summary: Growers apply potassium in greater quantities than nitrogen across many potato agroecosystems. Muriate of potash (i.e., KCl) historically has been the most cost-effective K source but also contains 47% chloride. Chloride is increasingly being discussed as a water quality concern, and chloride toxicity or sensitivity is often discussed but few data available to support. As potash prices have increased over the last several years, interest in negative growth issues from KCl has increased especially considering other K sources come at a significant cost premium.

Potash treatments included six treatments of 0-500 lb K_2O/A applied in 100 lb. K_2O increments. Treatments resulted in chloride applications of 0, 75, 152, 227, 303, and 381 lb Cl/A for corresponding K_2O treatments. Potash was applied pre-plant incorporated the day of planting. Nitrogen applications were near 225 lb. N/A total N applied between emergence, hilling, and

Table of Contents

post-hilling. Phosphorus and gypsum were applied according to soil test and grower standard practices.

Trial quality was good. No significant specific gravity differences occurred with all treatments between 1.09 - 1.10. At K_2O rates > 200 lb./A, reduced canopy closure was observed at 30 DAE. Petiole K 30 DAE concentrations were above critical levels at K_2O rates $\geq$ 200 lb/A with no differences above 200 lb./A. Chloride 30 DAE petiole concentrations were similar at K_2O rates between 100-300 lb./A and significantly greater at the 400 and 500 K_2O rates. Even at the extremely high K_2O application rates of 400-500 lbs./A, chloride petiole concentrations were not considered toxic which literature reports at concentrations > 4.5%.

No statistical differences occurred from K_2O application rates for tuber counts per 5 ft. of row, total A production, or total yield. Tuber K concentrations peaked at 300 lbs. K_2O/A with no differences between the 200 and 300 lb. K_2O application rates. Tuber chloride concentrations peaked at rates $\geq$ 400 lb. K_2O/A with no differences between the 100-300 lb. K_2O/A application rates. For future reference, literature discusses potato petiole chloride concentrations at 0.07-0.14% as deficient, ~1.8% normal, and > 4.5% toxic. Literature cited potato tuber chloride concentrations are considered deficient at 0.1%, 0.2% normal, and 0.33% as high. As environmental concerns related to chloride watershed contamination increase, producers may wish to consider examining irrigation water sources for chloride concentrations to be sure additional or even excessive chloride is not being added to fields via irrigation especially during dry weather periods as observed in Michigan during spring and early summer 2023. Please visit soil.msu.edu for further details and other field crop research results.

Diagnostic optimization of viral detection and characterization of Potato virus Y for the Michigan seed potato certification program, 2023

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:

In 2023, we selected two seed lots for validation of direct tuber testing methods (Chikh-Ali et al. 2013; Lorenzen et al. 2006, 2010; Mackenzie et al. 2015). Samples of 400 tubers were taken from each seed lot. Positive samples from three additional lots were tested to further confirm accuracy. Direct tuber RT-PCR testing was conducted in 25-tuber subsamples. After treatment with Rindite to break dormancy, subsamples were planted and grown out for standard leaflet ELISA. Results from summer visual inspection, direct tuber, and leaflet ELISA methods were compared (Table 1). Subsets of positive samples (from research and commercial testing) will be subject to PVY strain confirmation by RT-PCR.

We also are repeating assays to assess PVY strain by variety responses (Gundersen et al. 2019). Based on Michigan survey observations, four strains (N:Wi, NTN, N:O, O) were obtained from collaborators at the University of Idaho. Six varieties were selected for repeat growth chamber experiments: Snowden, Lamoka, Mackinaw, Lady Liberty, Petoskey, and MSZ242-13 (Dundee). In 2023, three varieties were added, MSW474-1, NY163, and Manistee, and screened using three Michigan PVY isolates (N:Wi, NTN, N:O) in a greenhouse assay. These entries represent current chip varieties used in Michigan and elite experimental varieties originating from the MSU Potato Breeding and Genetics program. These experiments are currently in progress for 2023-24.

Results & Conclusions:

Validation of direct tuber testing methods

In 2023, our experiments indicated 100% accuracy between positive samples from direct tuber tests and positives from leaflet ELISA tests. In addition, there was 90% agreement in these methods for the extra lot samples tested. This year, the conventional leaflet ELISA methods identified higher PVY incidences than corresponding direct tuber tests. The qPCR thresholds used will be re-evaluated and adjusted accordingly. In-progress are several tests evaluating immunocapture-reverse transcription-polymerase chain reaction (IC-RT-PCR) (Chikh-Ali and Karasev, 2015) methods used by Montana, Idaho and Wisconsin certification programs. These methods will be further compared for accuracy, efficiency, and cost for adoption in Michigan.

Table of Contents

Table 1. RT-PCR and ELISA results from seed lots assessed for PVY incidence based on summer field inspections. Results are based on positive PVY detections (%) using direct tuber methods in 2023 (N=number of 25-tuber subsamples tested).

Variety	Typical Symptom Expression	N	Visual Summer (Jun-Jul)	Direct Tuber RT-PCR (Oct-Nov)	Leaflet ELISA Greenhouse[a] (Jan)
A	Reliable	16	0.00	0.53	1.16
B	Reliable	16	0.00	1.86	2.84

[a]Leaflet ELISA test was performed 10 leaf subsamples (N=40).

Prevalence of PVY strain types in Michigan seed growing regions
In 2023-24, PVY strains were characterized from approximately 10,200 tubers tested in 2023-24 (Figure.1). Observations from the past five years suggest that PVY$^{N\text{-}Wi}$ remains most prevalent, however, PVY^{NTN} continues to be detected and we observed one sample with co-infection of PVY$^{N:Wi}$ and PVY^{O} strains this year. NTN and E, as well as some N:Wi isolates, are known tuber necrotic strains. Thus, their frequencies must be closely monitored. Strain typing in leaf material received from Hawaii is currently in progress. Survey of seed lots for tuber necrotic viruses Potato mop-top virus (PMTV) and Tobacco rattle virus (TRV) in Michigan is ongoing.

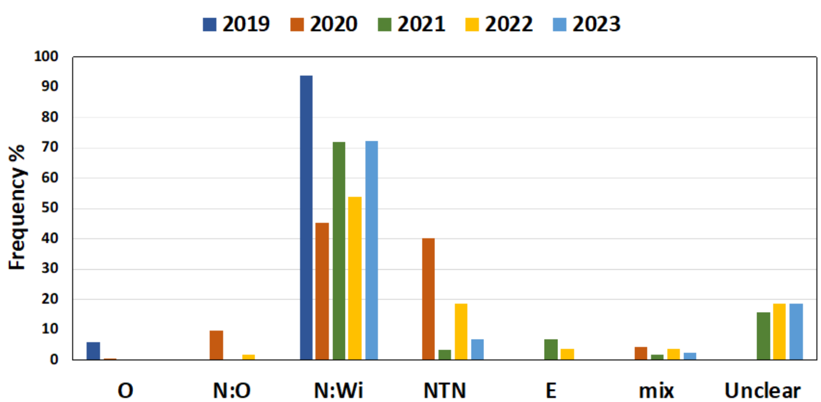


Figure 1. Representative PVY strains collected from Michigan potato seed certification program postharvest tests. In 2020-21, N = 212 positives in 17,752 total samples. In 2021-22, N = 57 positives in 21,600 total samples. In 2022-23, N= 54 positives in 7,150 total samples. IN 2023-24, N= 62 positives in 10,200 total samples. *In 2023, nine positive samples were included as N:Wi; Chikh-Ali et al. (2013) primers indicated suspect N:Wi but confirmation using Lorenzen et al. (2006) multiplex primers did not distinguish between N:O and N:Wi strains.

Screening of PVY strain x variety responses
In repeat bioassay experiment, potato variety responses of daughter plants were measured after mechanical infection of mother plants with four PVY strains for growth chamber and three strain for greenhouse assay. We observed mild to severe foliar symptoms depending on strain and variety. Across varieties, reductions in total tuber weight relative to the mock-inoculated control were observed with N:Wi strains reaching 23% and 38% in growth chamber and greenhouse assays, respectively. Direct tuber tests of daughter tubers showed an average 94.2% (range of 83.0 to 100%) of positive tubers originating from PVY-infected susceptible mother plants. In resistant varieties, Mackinaw and Lady Liberty, no detectable levels of virus were observed in daughter tubers.

In these experiments, yield of PVY-resistant varieties, Mackinaw and Lady Liberty, appear less impacted by seedborne infection 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.

Overall Summary:

- Direct tuber methods continue to agree with grow out methods. These tools aim to 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 suggest that $PVY^{N\text{-}Wi}$ remains most prevalent, however, tuber necrotic strain PVY^{NTN} also continues to be detected.
- 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.

Assessment of variety resistance to four postharvest diseases of potato in Michigan, 2023

Sarah Ruth, Emma Schlachter, David Douches, Chris Long, and Jaime F. Willbur; Department of 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 2022-23, 10 chipping lines, 6 red, and 16 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 the Potatoes USA-SNAC International Trial (Montcalm County) and were tested at three replicate timepoints (4 tubers/timepoint). Red and yellow lines were collected from the Potato Outreach Program on-farm trials at 4-L Farms (Kalamazoo County), Styma Potato Farms (Presque Isle County), and Walther Farms (St. Joseph County) and were tested at two replicate timepoints (5 tubers/location/timepoint).

Asymptomatic tubers were rinsed with tap water, surface disinfested with 10% bleach solution for 30 seconds, and rinsed with deionized water, before air-drying 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, 100uL volume). Tubers were inoculated with suspensions of the following: 2 x 10^4 *Fusarium sambucinum* conidia/mL in potato dextrose broth; 2 x 10^4 *Phytophthora erythroseptica* zoospores/mL in Petri's solution; 5 x 10^4 *Pythium ultimum* oogonia/mL in potato dextrose broth; or 8 x 10^8 *Pectobacterium carotovorum* cfu/mL in LB broth. 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

Experimental methods were optimized for screening postharvest disease resistance in chipping, red, and yellow potato entries using Michigan pathogen isolates. No relationship was observed between resistance responses to different diseases; however, several varieties, including MSZ242-13 (now Dundee) and MSAFB635-15, possessed at least moderate resistance to all four diseases. Ongoing screening will help to inform growing operations, management practices, and breeding directions. In 2023-24, screening is in progress and will be expanded to include additional *Fusarium* sp., identified during surveys of Michigan storage piles.

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 10 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, and soft rot; means for apical end for Pythium leak ($P < 0.05$). Tubers were from the Potatoes USA-SNAC International Trial location in Montcalm County, tested in three replicate timepoints. Lamoka and Snowden (solid outline) were used as commercial checks.

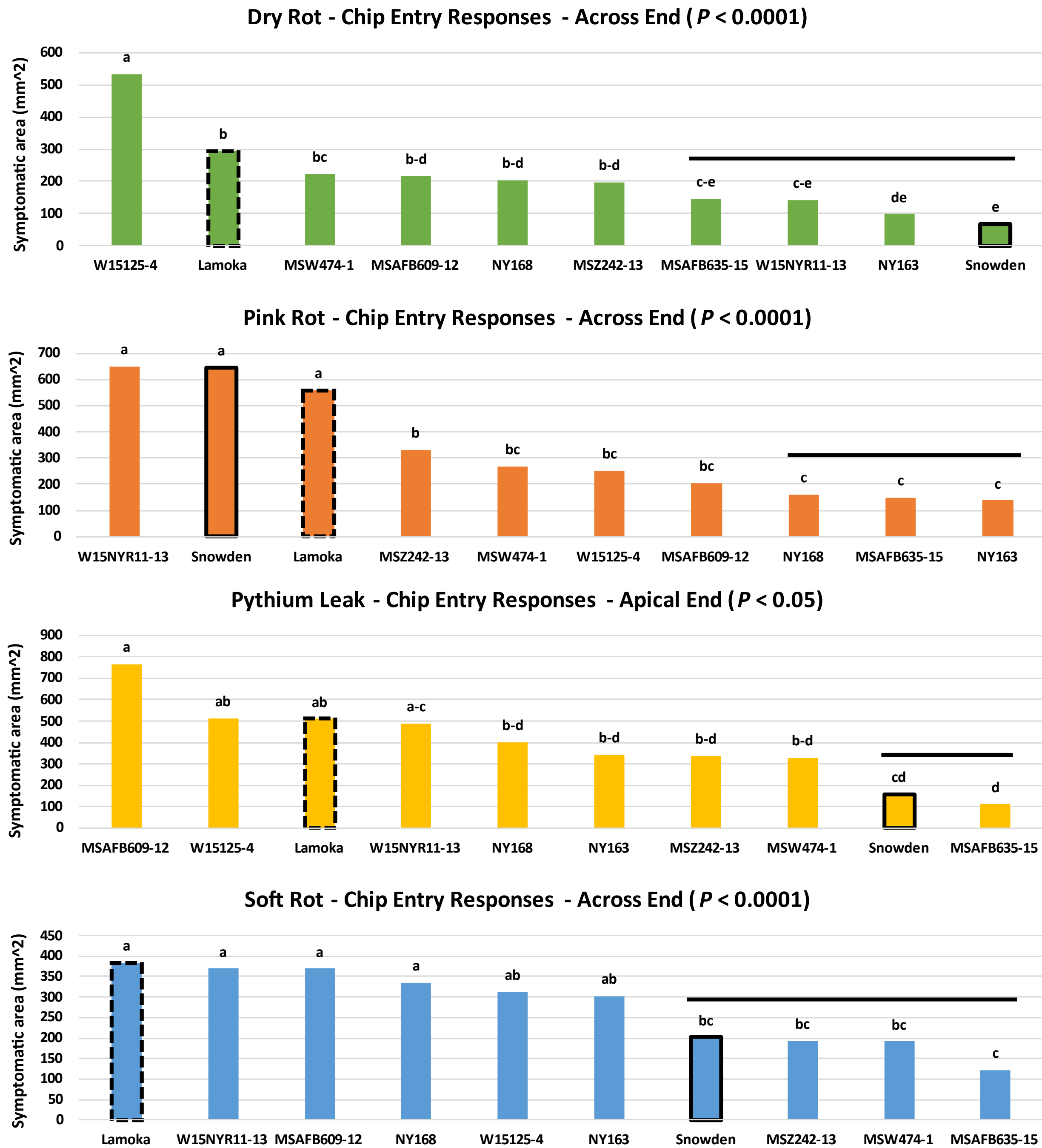


Table of Contents

Figure 2. Responses of 6 red 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, Styma, and Walther's Cass City) tested in two replicate timepoints. Dark Red Norland (outlined in black) was used as a commercial check.

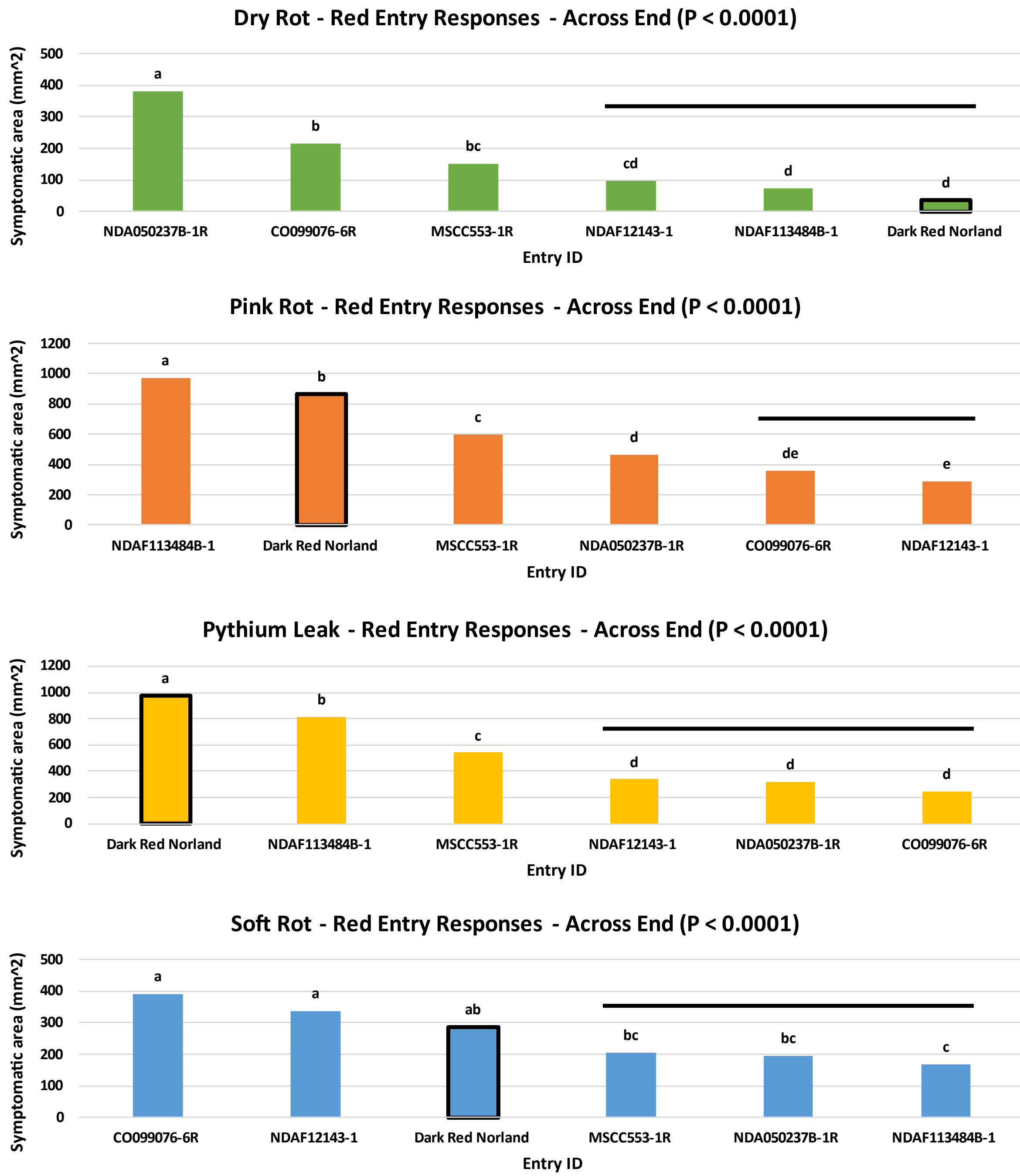
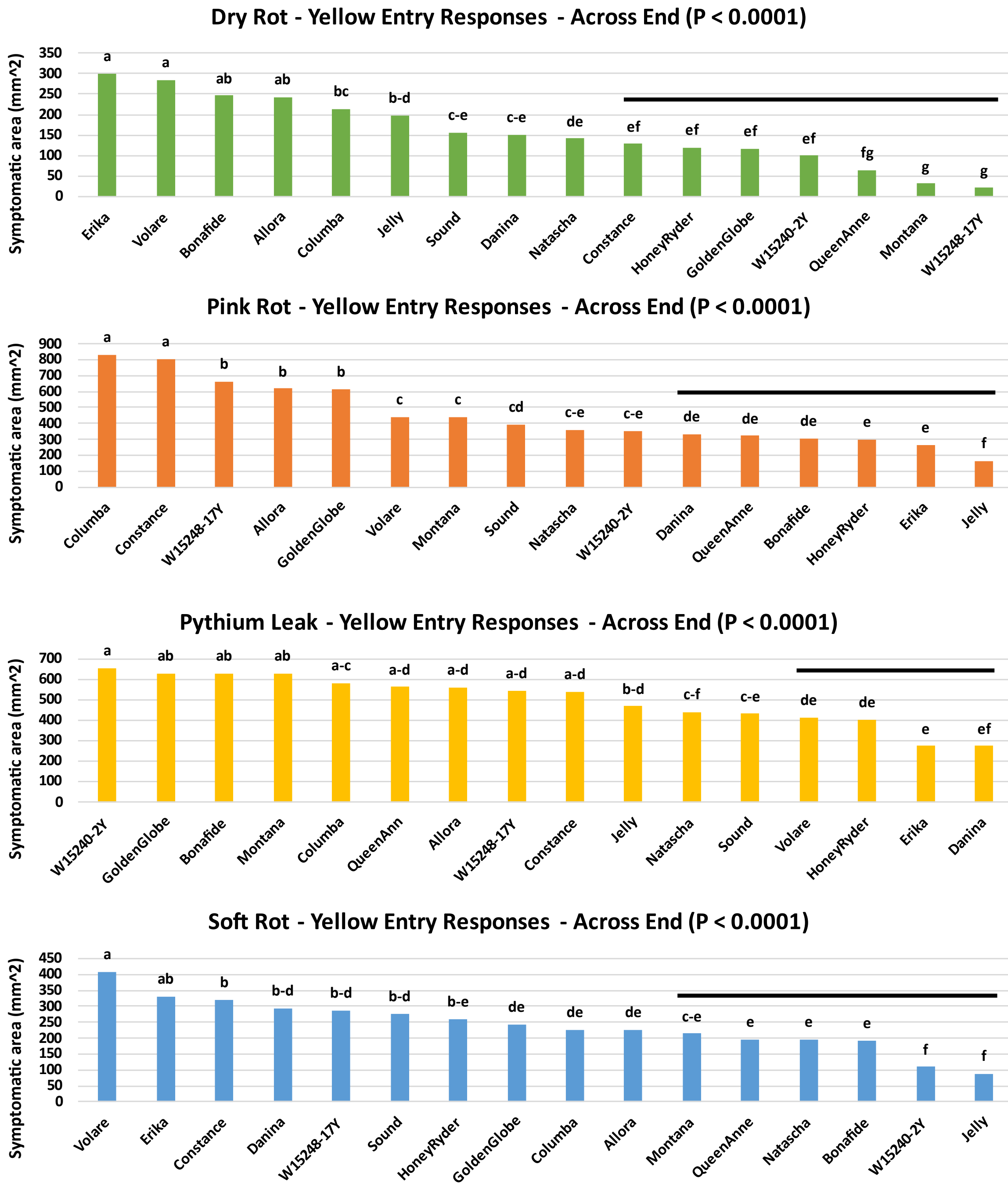


Table of Contents

Figure 3. Responses of 16 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 three MSU Potato Outreach Program field locations (4-L Farms, Styma, and Walther's Cass City) tested in two replicate timepoints.



Investigating the use of impaction samplers and qPCR methods for detection of foliar pathogens in potato fields, 2023

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

Late blight detections were reported in Montcalm County, Michigan in 2022 and in neighboring regions in 2019, 2020, and in 2021. Spore samplers coupled with quantitative PCR assays have the potential to be an efficient and inexpensive tool for early detection of late blight outbreaks. Rotating arm impaction samplers were built and deployed during the 2023 growing season to: 1) monitor for *P. infestans* sporangia in commercial fields 2) investigate the range of detection from an inoculated field, and 3) compare sporangia detection levels to those of a suction-based spore sampler.

Materials and Methods

i. Commercial detection

Twelve rotating arm impaction samplers were built based on schematics developed by the MSU Small Fruit, Field Crops, and Forest Pathology programs (Fig. 1). Samplers were placed near six commercial potato fields located in Montcalm and St. Joseph counties. 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 inoculated on August 31 and symptoms were first detected visually on September 7. One sampler was placed on the Eastern edge of the field and served as a positive control. Two more were placed 500 m northwest 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.

iii. Spore sampler comparison

The rotating arm samplers were also compared with a Burkard 7-day recording volumetric spore trap, which has been shown to collect higher concentrations of spores and was therefore considered a 'gold' standard (Sutton and Jones 1976; Aylor 1993). One rotating arm sampler was placed at the East edge of the inoculated late blight field, immediately adjacent to a Burkard sampler. Rods from the rotating arm sampler were collected daily, and the Cq values were used to estimate the average number of sporangia/ml air (Aylor 2017). For the Burkard samplers, sections of tape corresponding to one day of sampling were examined under a compound light microscope at 100x magnification. Putative sporangia were counted on two cross-sections of the tape comprising one third of the sampling area and counts were normalized to sporangia/ml air.

Results and Conclusions

i. Commercial detection

No late blight was reported in MI in 2023, which was consistent with qPCR results as no sporangia were detected from samplers placed in commercial fields. Preliminary tests verified that the qPCR assay was sensitive to a single sporangium, even on rods coated with grease and field soil, to mimic realistic samples. Standard curves were produced correlating Cq values to concentrations of DNA and numbers of sporangia extracted from the rods (Fig. 2). Future optimization of this assay will implement a more inhibitor-tolerant master mix to improve qPCR efficiency.

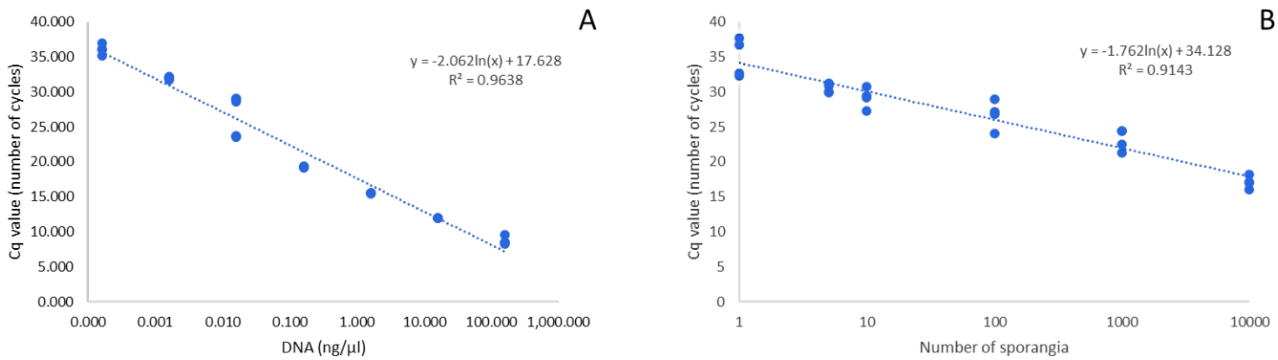


Fig. 2. qPCR standard curves generated using (A) serial dilutions for *P. infestans* DNA and (B) DNA extracted from rods inoculated with known quantities of *P. infestans* sporangia (Thiessen et al 2016).

ii. Range from an inoculated source

The sampler placed on the edge of the inoculated field detected *P. infestans* on the same week as visual scouting. However, no positive detections were made 500 m away at 4 ft and the 20 ft sampler only detected *P. infestans* once during peak infection (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 on Aug 31 and the first visual detection was made on Sep 7.

Location	Sampler Height (ft)	July					August				September				October				
		3	10	17	25	31	7	14	21	28	5	11	18	25	2	9	16	23	30
Field edge	4	-	-	-	-	-	-	**36.6**	-	-	-	**34.7**	**28.6**	**38.3**	**33.2**	**37.5**	-	**29.2**	-
500m NE	4	x	x	x	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-
500m NE	20	x	x	x	x	x	-	-	-	-	-	-	**32.7**	-	-	-	-	-	-

iii. Spore sampler comparison

The Burkard was able to detect infection three days before visual late blight, while the rotating arm sampler made its first detection four days after visual detection. As expected, the Burkard sampler consistently detected higher levels of sporangia compared to the rotating arm sampler (Table 2). Overall, the rotating arm samplers were less sensitive than Burkard standard; however, they offer potential sensitive and low-cost options capable of detecting sporangia within a week of visual symptoms, providing useful information to growers.

Table of Contents

Table 2. Comparison of daily estimates of airborne sporangia/ml air detected by the Burkard and rotating arm samplers. Bolded values indicate positive sporangia detections.

Date	Burkard (sporangia/ml air)	Rotating Arm (sporangia/ml air)	Date	Burkard (sporangia/ml air)	Rotating Arm (sporangia/ml air)
8/31/2023[a]	0.00	0.00	9/16/2023	**0.95**	0.00
9/1/2023	0.00	0.00	9/17/2023	**2.32**	0.00
9/2/2023	0.00	0.00	9/18/2023	**2.00**	**0.01**
9/3/2023	0.00	0.00	9/19/2023	**3.79**	**0.02**
9/4/2023	**0.32**	0.00	9/20/2023	**8.75**	**0.05**
9/5/2023	**0.11**	0.00	9/21/2023	**12.86**	0.00
9/6/2023	**0.11**	0.00	9/22/2023	**24.45**	0.00
9/7/2023[b]	**0.21**	0.00	9/23/2023	**50.89**	**0.04**
9/8/2023	**0.21**	0.00	9/24/2023	**182.40**	0.00
9/9/2023	**0.11**	0.00	9/25/2023	**295.99**	0.00
9/10/2023	**0.32**	0.00	9/26/2023	**161.01**	0.00
9/11/2023	**0.53**	**0.01**	9/27/2023	**359.53**	0.00
9/12/2023	**0.11**	0.00	9/28/2023	**89.88**	0.00
9/13/2023	**0.11**	0.00	9/29/2023	**34.56**	**0.02**
9/14/2023	**0.11**	**0.01**	9/30/2023	**21.92**	**0.01**
9/15/2023	**0.21**	**0.02**	10/1/2023	**19.81**	**0.18**

[a] Date the field inoculation
[b] Date of first visual late blight detection

Overall Summary

First-year testing demonstrated that the rotating arm impaction samplers, combined with qPCR assays, can be used detect late blight from fields in Michigan and may be of useful to augment visual scouting efforts. Additional optimization is needed to address limitations in range of detection and efficiency before large-scale implementation of spore samplers becomes a viable option for commercial growers. Experiments will be repeated in 2024.

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.

POTATO (*Solanum tuberosum* 'Lamoka')
Pythium Leak; *Pythium ultimum*

C. Bloomingdale and J.F. Willbur
Dept. Plant, Soil and Microbial Sciences
Michigan State University
East Lansing, MI 48824

Evaluation of seed treatment and in-furrow fungicides to manage Pythium leak of potato in Michigan, 2023.

A field trial was established at the Montcalm Research Center in Stanton, MI to test the efficacy of seed treatment and in-furrow fungicides for managing Pythium leak of potato. A randomized complete block design was used, and treatments were replicated four times. US#1 'Lamoka' potatoes were cut into 2-oz seed pieces and left to suberize. Seed was treated 23 May via slurry (3.2 fl oz/cwt) in a cement mixer and the trial was hand-planted 24 May in loamy sand soil. Plots were two rows wide (34-in row spacing) by 20 ft long and seeded at 1.2 seed/row-ft. Inoculations and in-furrow applications were made before closing furrows. Plots were inoculated with a wet millet and rye mix infested with *P. ultimum* at a volume of 12.5 mL/row-ft. Fungicides were applied using a CO_2-powered backpack sprayer, equipped with TJ2503 nozzles (6 gal/A; 43 psi). Program 10 received three foliar applications using a CO_2-powered backpack sprayer, equipped with TJ8003 nozzles (20 gal/A; 40 psi). Application dates were 4 Jul (nickel size tubers), 11 Jul, and 18 Jul. Stand establishment was monitored early season and disease data were collected after harvest. Both rows of plots were harvested on 10 Oct. After grading, a target of 50 tubers were selected to put in storage to assess leak incidence at a future time. Stored tubers were longitudinally cut in half 16 Nov to assess internal leak incidence. Stem counts from 29 Jun, internal leak incidence (DI), 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).

Significant differences were observed among stem counts ($P < 0.001$). Stem counts in the trial ranged from 49.5 to 86.5 stems per plot, with the highest stem counts observed in programs 1, 5, 6, and 7. No differences were observed in DI ($P > 0.05$), and incidence was overall low in the trial. Marketable yield did not differ among treatments, however, all programs except 1, 3, and 10 had numerically greater yields than the inoculated control.

No.	Treatment[z] (Rate[y]) Timing[x]	Stem Counts (29 Jun)[w]		Internal Leak Incidence (%)[v]	Marketable Yield (cwt/A)
1	Non-Inoculated Control	76.5	abc	0.5	271
2	Inoculated Control	66.5	cd	0.0	286
3	Revus 2.09 SC (0.4 fl oz) A	49.5	e	0.0	244
4	Revus 2.09 SC (8 fl oz) B	66.5	cd	0.6	328
5	Revus 2.09 SC (8 fl oz) B Orondis Gold DC (27.8 fl oz) B	83.3	ab	0.0	353
6	Orondis Gold DC (27.8 fl oz) B	86.5	a	0.6	357
7	Orondis Gold DC (48 fl oz) B	77.5	abc	0.0	298
8	Elumin (8 fl oz) B	75.3	abc	0.7	319
9	Ridomil Gold 465 SL (6.1 fl oz) B	69.5	bd	0.0	312
10	Phostrol (7 pt) CDE	61.0	de	0.0	271
11	Vibrance Ultra Potato (0.5 fl oz) A Cruiser 600 FS (0.128 fl oz) A Orondis Gold DC (27.8 fl oz) B	64.8	cd	0.0	293

[z] Programs 1-10 included a seed treatment of CruiserMaxx Vibrance Potato (0.5 fl oz/cwt) to manage off-target pests.
[y] Application rates for A=quantity/cwt and B, C, D, and E=quantity/A
[x] Application timings were: A (seed treatment) = 23 May; B (in-furrow) = 24 May; C = 4 Jul; D =11 Jul; E =18 Jul.
[w] Column values followed by the same letter were not significantly different based on Fisher's Protected LSD (α=0.05).
[v] Internal leak incidence for each plot was calculated from 50 arbitrarily selected tubers cut in half.

POTATO (*Solanum tuberosum* ‘Lamoka’)
Early Blight; *Alternaria solani*
Brown Spot; *Alternaria alternata*

C. Bloomingdale and J.F. Willbur
Dept. Plant, Soil and Microbial Sciences
Michigan State University
East Lansing, MI 48824

Evaluation of in-furrow and foliar fungicides to manage foliar diseases of potato in Michigan, 2023.

Experimental and commercially available fungicides were tested to determine their efficacy in managing potato early blight and brown spot. A field trial was established at the Montcalm Research Center in Stanton, MI. A randomized complete block design was used, and treatments were replicated four times. Soil type is a loamy sand. US#1 ‘Lamoka’ potatoes were cut into 2-oz seed pieces and left to suberize. Seed was treated 23 May via slurry (3.2 fl oz/cwt) in a cement mixer. The trial was hand planted 25 May, and in-furrow treatments were applied before closing rows. A CO_2-powered backpack sprayer, equipped with TJ2503E nozzles, was used to apply fungicides in-furrow at 6 gal/A (43 psi). Plots were two rows wide (34-in row spacing) by 20 ft long and seeded at 1.2 seed/row-ft. On 29 Jun, banded applications were made before re-hilling plots using a CO_2-powered backpack sprayer, equipped with TJ2504 nozzles (40 PSI) 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 Orondis Ultra (5.5 fl oz/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, six foliar applications (D, E, F, G, H, and I) were made across programs on 4 Jul, 11 Jul, 18 Jul, 25 Jul, 31 Jul, and 9 Aug. Foliar fungicides were applied at a rate of 20 gal/A (38 psi) via CO_2-powered backpack sprayer (TJ8004XR nozzles). Plots were inoculated on 19 Jul with an *A. solani* solution ($8x10^3$ conidia/mL) at 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 9 Oct, 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).

Differences were observed among the foliar DI ($P < 0.0001$) and foliar DS ($P < 0.0001$) values of programs. All treated programs had significantly lower DI (30.0-71.3%) and DS (3.5-7.0%) values than the control (DI=87.5%, DS=12.5%). The lowest DI and DS were both observed in program 11, but the values were not significantly different from many of the other programs. No significant differences were observed in yield or marketable yield. It is likely that the short infection duration due to late disease onset was not adequate time to observe differences among program yields.

No.	Treatment (Rate[z]) Timing[y]	Disease Incidence (%)[x,w]		Disease Severity (%)[w]		Total Yield (cwt/A)	Marketable Yield (cwt/A)
1	Treated Control	87.5	a	12.5	a	353.4	324.4
2	Exp[v] 1 (13 fl oz) B; Propulse (10 fl oz) E; Scala 60 SC (7 fl oz) G	55.0	c-e	7.0	b	313.7	291.1
3	Exp 1 (13 fl oz) B; Propulse (10 fl oz) E; Luna Tranquility (11.2 fl oz) G	53.8	c-e	5.0	b-e	334.9	310.7
4	Elatus (6.4 oz) B; Miravis Prime (10 fl oz) EG	71.3	b	5.8	b-d	378.3	351.5
5	Exp 1 (13 fl oz) B; Endura (5.5 oz) EG; Provysol (4 fl oz) EG	43.8	e-h	5.0	b-e	355.8	324.9
6	Exp 1 (13 fl oz) B; Delaro (8 fl oz) D; Luna Tranquility (11.2 fl oz) G	58.8	b-d	4.5	c-e	338.9	311.1
7	Exp 1 (13 fl oz) B; Quadris (9 fl oz) D; Miravis Prime (10 fl oz) G	46.3	c-g	5.0	b-e	361.7	334.6
8	Elatus (6.4oz) B; Quadris (9 fl oz) D; Omega (8 fl oz) E; Miravis Prime (10 fl oz) G	60.0	bc	6.5	bc	332.3	301.1
9	Exp 1 (13 fl oz) B; Headline (9 fl oz) D; Endura (5.5oz) EG; Provysol (4 fl oz) EG	37.5	f-h	4.0	de	333.6	303.0
10	Exp 1 (13 fl oz) B; Velum Prime (6.5oz) E; Scala 60 SC (7 fl oz) G	50.0	c-g	5.0	b-e	357.7	332.8
11	CruiserMaxx Vibrance Potato (0.5 fl oz/ cwt) A; Elatus (6.4oz) B; Omega (8 fl oz) E; Miravis Prime (11.4 fl oz) FH; Revus Top (7 fl oz) I	30.0	h	3.5	e	346.6	314.9
12	Emesto Silver (0.31 fl oz/ cwt) A; Velum Prime (6.5 fl oz) B; Luna Tranquility (11.2 fl oz) EFH; Scala (7 fl oz) I	46.3	c-g	4.5	c-e	348.1	315.9
13	EXP-2 (10 fl oz) B	45.0	d-g	5.0	b-e	301.8	283.3
14	Topguard (28 fl oz) B	36.3	gh	4.0	de	295.4	280.9
15	Adastrio (18 fl oz) C	51.3	c-f	5.0	b-e	342.3	314.1
16	Topguard (28 fl oz) C	53.8	c-e	5.0	b-e	335.9	312.2
17	Adastrio (9 fl oz) EG; Super Tin (5 fl oz) I; Endura (7oz) I	42.5	e-h	5.3	b-e	317.1	285.2
18	Luna Tranquility (11.2 fl oz) EG; Super Tin (5 fl oz) I; Endura (7oz) I	60.0	bc	5.0	b-e	312.1	286.3

[z] 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.

[y] Application letters code for the following dates: A=23 May (seed treatment), B=25 May (in-furrow), C=29 Jun (re-hill), D=4 Jul, E=11 Jul, F=18 Jul, G=25 Jul, H=31 Jul, and I=9 Aug.

[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.

[w] Final foliar disease incidence and severity ratings (combined early blight and brown spot) collected 7 Sep.

[v] Exp=Experimental compound.

Table of Contents

Investigate the effect of irrigation thresholds on potato yield, water use efficiency, and disease potential

Younsuk Dong[1], Jaime Willbur[2], Chris Long[2]
[1]Department of Biosystems and Agricultural Engineering
[2]Department of Plant, Soil and Microbial Science

Introduction

Climate change has impacted the agricultural industry in Michigan through variable temperatures and erratic precipitation. Irrigation can reduce the effects of inconsistent precipitation and prolonged dryness, increasing the resiliency of crop production to climate change. Potatoes benefit from irrigation management because of the significant effect of irrigation on both yield and quality. Not watering the potatoes sufficiently can result in yield loss and cause misshapen tubers, vascular necrosis, or hollow heart defects. Improper irrigation schedules or unnecessary irrigation can waste resources, but can also increase the potential risk of plant diseases. Plant disease can substantially reduce yield and quality of product. Even more importantly, they can impact potato storability, which negatively affects the sustainability and economics of production. Excessive soil moisture at critical points can drive foliar, vine, or root and tuber infections and promote pathogen development, reproduction, dispersal, and survival. Some of the most devastating foliar and vine rotting diseases are early blight, late blight, white mold, and bacterial stem rot or blackleg. In tubers, irrigation has been shown to influence black scurf, silver scurf, and common scab diseases. Therefore, precision irrigation is needed to minimize diseases, improve potato quality and yield, increase irrigation water use efficiency, and maximize return on investment. The irrigation trigger threshold is one of the critical factors in irrigation management. Currently, there is a lack of knowledge, data, and demonstration on the effect of irrigation thresholds on potato yields, growth, water use efficiency, and disease potential in common commercial potato varieties. The goal of this project was to understand the effect of irrigation thresholds on potato yield, water use efficiency, and disease potential.

Materials and Methods

This potato irrigation study was conducted at Michigan State University's Montcalm Research Center. The irrigation treatments were: **T1** (50% Available Water-holding Capacity (AWC)), **T2** (70% AWC), and **T3 (**90% AWC). Three replications of four common commercial potato varieties, including Mackinaw, Snowden, Lamoka, and Manistee, were used for each treatment. We used an overhead irrigation system to irrigate at different AWC thresholds. DC solenoid valves were connected to a motor controller to program irrigation system. Irrigation distribution uniformity evaluation was performed to ensure the irrigated areas receive the same amount of irrigation. We used LOCOMOS (low-cost sensor monitoring system) to collect in-field soil and environmental conditions. We monitored soil moisture levels at 6-, 12-, and 18-inch, soil temperature, ambient temperature, relative humidity, leaf wetness duration, canopy temperature, precipitation, and irrigation in each plot.

Table of Contents

Figure 1. Installed Irrigation system, controlled by solenoid valves (Left). Xcel-Wobbler sprinklers by Senninger were used in this study (Right).

Results and Conclusions

Figure 2 shows the available soil moisture levels of each treatment. As expected, the soil available water for 90% AWC irrigation treatment (Treatment 3) maintained a higher soil moisture content than other 70% (Treatment 2) and 50% (Treatment 1) AWC treatments throughout the growing season. Figure 3 shows the comparison of yields data with irrigation treatments and variety. A two-way ANOVA statistical analysis was utilized to understand the effect of the irrigation treatments and variety on potato yields. The results show there is a statistically significant difference between irrigation treatments and potato yields (P-value=0.007), but there is not a statistically significant interaction between Variety and potato yields (P-value=0.372). Tukey Test (Pairwise multiple comparison procedures) result showed that there is a statistically significant difference between Irrigation treatment 1 and 2 (P-value=0.018) and treatment 1 and 3 (P-value=0.016). However, there is not a statistically significant difference between irrigation treatment 2 and 3 (P-value=0.999). This indicates irrigating at 50% AWC resulted in higher yields than irrigating at 70% or 90% AWC. In addition to the yield impact, Treatment 1 (50% AWC) areas had less irrigation, resulting in increased irrigation water use efficiency. The 2023 precipitation at this demonstration site was 0.45, 1.24, 8.12, 3.56, and 1.49 inches in May, June, July, August, and September, respectively. Overall, there was more precipitation in July and August, compared to the last 10-year average precipitation of those months. Thus, more data through multiple years of demonstration are needed to fully confirm the effect of irrigation treatments.

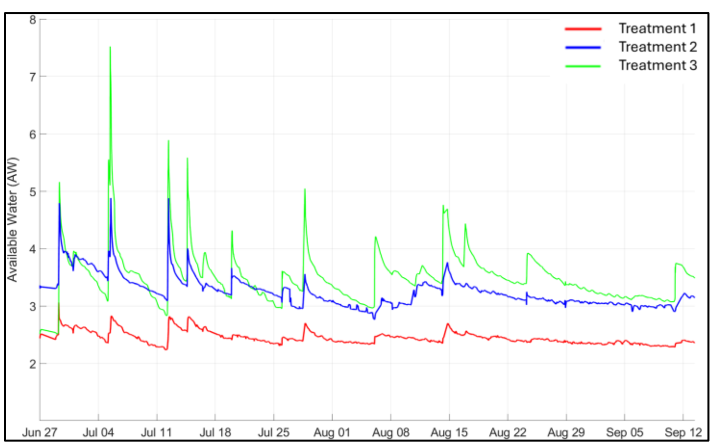


Figure 2. Available water content throughout the growing season for Treatments 1, 2, and 3.

Table of Contents

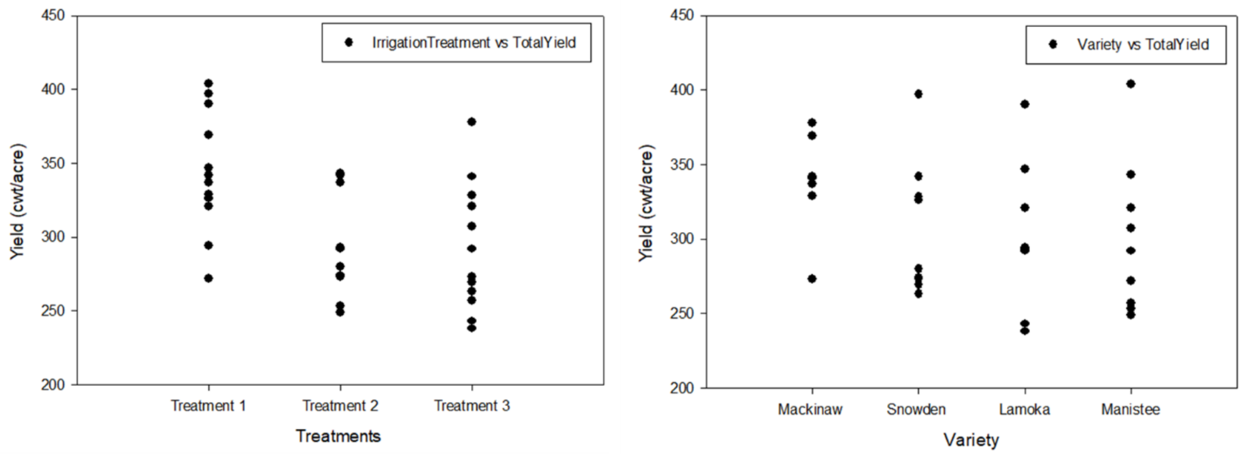


Figure 3. The comparison of yield with irrigation treatments (left) and variety (right).

A two-way ANOVA statistical technique was utilized to compare the effect of the irrigation treatments and variety on specific gravity. The statistical analysis results show that there are statistically significant differences between irrigation treatments and specific gravity (P-value=0.028), and between variety and specific gravity (P-value=0.020). Tukey Test (Pairwise multiple comparison procedures) result showed that there is a statistically significant difference between Irrigation treatment 2 and 3 (P-value=0.041), but it is weak correlation as the power of the performed test with alpha is 0.05. The analysis also indicates that specific gravity for Mackinaw was higher than Lamoka and is statistically significant difference (P-value=0.023).

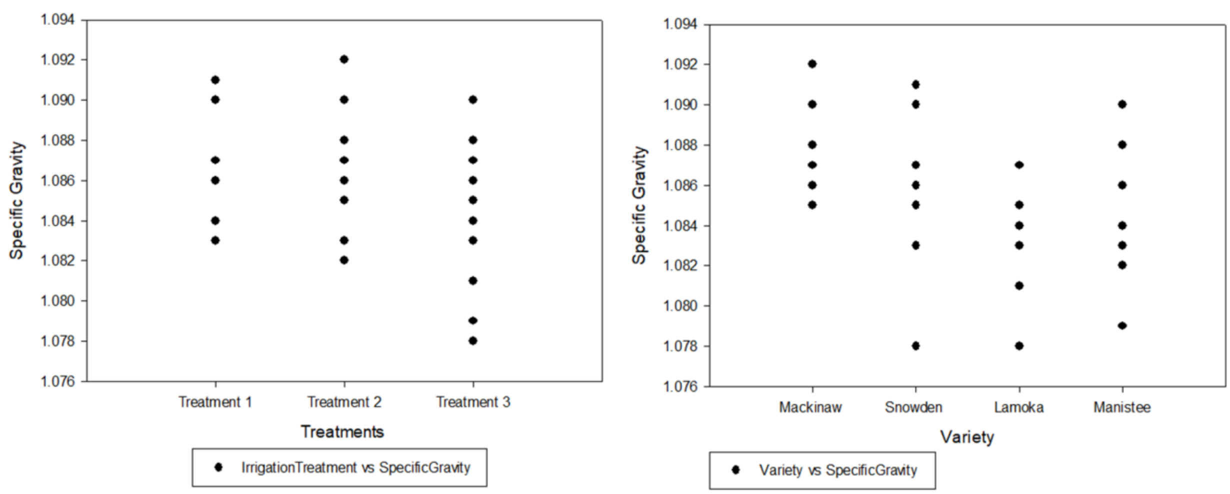


Figure 4. The comparison of specific gravity with irrigation treatments (left) and variety (right).

The team also collected multiple soil and root samples at each treatment area, for nematode and *Verticillium dahlia* analysis. All samples were submitted to Michigan State University Plant & Pest Diagnostics. We did not observe any statistically significant differences from the result (root-lesion and stunt) and all samples indicated low Potato Early Die risk. Overall, this 2023 irrigation study recommend irrigating at 50% AWC threshold to maximize water use efficiency and yields.

Table of Contents

Develop a Colorado potato beetle (CPB) degree day model on the MSU Enviroweather website.

Enviroweather programmers used the weekly sampling of CPB conducted by the MSU Vegetable Entomology lab to track the development of Colorado potato beetle (CPB) at 20 commercial potato fields in Michigan. Temperature data from the nearest Enviroweather station to each field were used to calculate GDD_{base52} for each sample date to determine and compare when the first, peak and end of emergence occurred for CPB adults, eggs, and larvae (Fig. 1). There was not clear agreement between previous research and the current observations. Among sites in Michigan observations and GDD_{base52} were also inconsistent due to different planting dates, amount of pest pressure, timing of control measures, etc. Due to this variability we used the data from seven fields near Entrican, MI with heavy CPB pressure to construct smoothed lines depicting the phenologies of CPB life stages (Fig. 1). Figure 1 shows how the model will function, and is a prototype for the model display that will appear on Enviroweather. The graphs represent the typical progression of different life stages of CPB based on degree days. The current relative abundance of a given stage is shown by solid red circles, and expected abundance based on the forecasted degree days totals are shown by green circles. Because this model predicts conditions using seven days of forecasted temperatures, growers can use this model to decide if management will be needed in the near future. The model will also be paired with a description page that will provide additional information on pest biology and management. Links in the model will take the user to recommendations for control of key developmental stages. In addition the model will show whether the first or second generation is occurring so growers will know when to switch insecticide classes for resistance management.

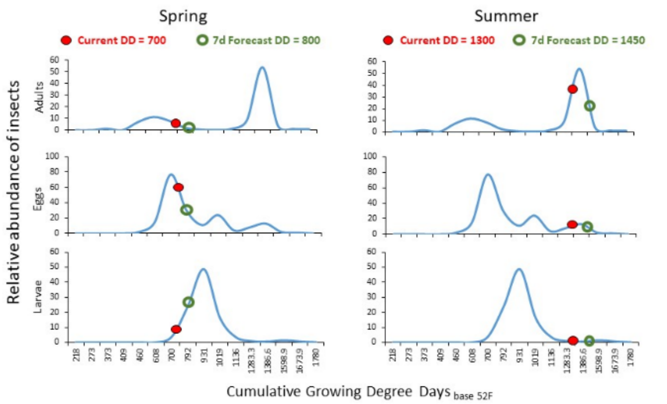


Figure 1.Relationship between GDD and abundance of CPB Adults (top row) Eggs (middle row) and Larvae (bottom row). Each graph shows a typical emergence pattern for each life stage through the growing season. These graphs demonstrate how the model will function during the season. The model will display the current level of abundance based on current GDD (red circles), while green circles show the estimated abundance based on 7 days of temperature forecasts. Example graphs of model displays during a typical Spring are shown in the left hand column and a Summer scenario is shown in the right hand column.

The CPB model will be similar to Enviroweather's Asparagus Miner model in its form and function. As it is being developed and revised, the model will be a part of Enviroweather's development website and will be made available to project collaborators through MSU's firewall, but will not be available to the general public. We expect to release the model to the public for the 2024 growing season.

Validate the Colorado potato beetle model in Michigan potato fields.

We collaborated with commercial growers, extension staff, pest scouts and pest managers to locate fields with known CPB pressure. Twenty commercial fields in the main potato growing areas of Michigan were used for scouting for CPB life stages. We visited weekly these commercial potato fields from the time that plants started emerging from the ground to senescence at the end of the growing season. In each field, we randomly picked 50 plants and counted the number of CPB life stages on the whole plant.

2023 MSU POTATO BREEDING AND GENETICS RESEARCH REPORT
January 2024

David S. Douches, J. Coombs, K. Zarka, G. Steere, M. Zuehlke, D. Zarka, Jess Norling, Madison Whyte and Will Behling

Department of Plant, Soil and Microbial Sciences
Michigan State University
East Lansing, MI 48824

Cooperators: Ray Hammerschmidt, 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 (compared to 8,303 SNPs in initial array). With the development of genome-wide markers we are able to link genetic markers to important traits (reducing sugars, starch, scab resistance, etc.) 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 4,000 entries). In addition, our program has been utilizing

Table of Contents

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 2024, we will continue to test our engineered potatoes for late blight resistance, drought tolerance, invertase silencing and gene editing for PPO silencing and self-compatibility. 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 (MSR061-1), Manistee (MSL292-A), Huron Chipper (MSW485-2), Mackinaw (MSX540-4), Petoskey (MSV030-4) and now Dundee (MSZ242-13). 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 have 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 grant. 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. Lastly, we have had NSF-funded grants to better understand the potato genome and study wound-healing in potato. 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.

Over the years, key infrastructure changes have been established for the breeding program to make sound assessments of the breeding selections moving through the program. In 2016, we constructed a greenhouse to expand our breeding and certified minituber seed production. This greenhouse is located at the MSU Agronomy Farm facility on south campus. Also in 2016, we began to upgrade the potato washing and grading line. which was completed with funding from MPIC and AgBioResearch. Variable speed control drives, a new lift; custom built barrel washer; grading table; and Kerian speed sizer are all part of the set up as of 2019. Incorporation of bar-coding and scales synchronized to computer hot keys, have improved the speed, accuracy, and efficiency of the grading process. All entities of the potato group: Potato Breeding and Genetics; Potato Outreach Program; pathologists and soil fertility researchers have access to this new equipment.

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 2023 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 2023 harvest, about 1,200 selections were made from the 40,000 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 2024 directly out of 45°F (7.2°C) storage. Atlantic, 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 90 selections were made, respectively; based on chip quality, specific gravity, scab resistance, late blight resistance and DNA markers for PVY and Golden nematode 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. We tested the removal of PLRV and PVX succeeded. Over 1200 different varieties and breeding lines are maintained in tissue culture for the breeding and genetics program.

Chip-Processing

Over 70% 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 MSAA217-3 (early bulking), MSBB058-1 (scab resistant) that are advanced in the NCPT trials. MSBB636-11, MSZ614-15, MSDD244-05, MSDD247-07, MSDD247-11, MSDD376-4, MSEE031-3 and MSEE182-3 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, 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

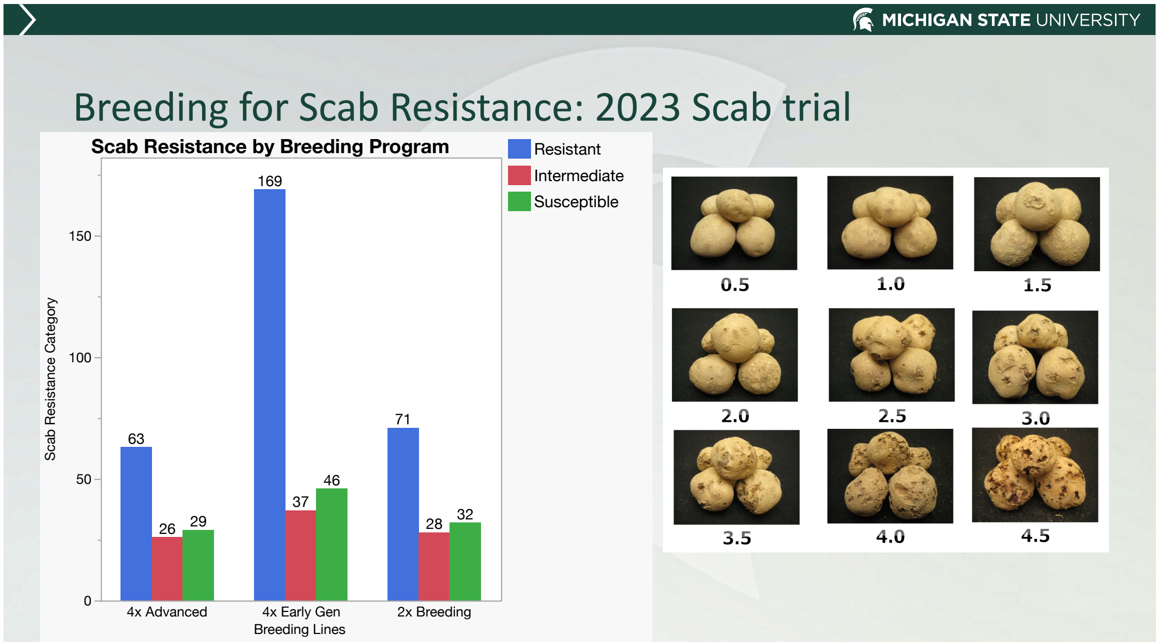
Efforts have been made to identify lines with good appearance with an attractive skin finish, low internal defects, good cooking quality, high marketable yield and resistance to scab, late blight and PVY. Our current tablestock development goals now are to continue to improve the frequency of scab and 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 2023, while others were tested under replicated conditions at the Montcalm Research Center. Promising tablestock lines include MSCC553-1R 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. We are currently collecting nutritional data on the antioxidants in Blackberry tubers and chips that may enhance the marketing of this variety. Higher antioxidants are found in Blackberry and we are testing other lines this winter.

Disease and Insect Resistance Breeding

Scab: In 2023, 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. 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 yellow and red. 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 and is summarized below (Figure 1). All susceptible check plots (Snowden and Atlantic) were scored as susceptible.

Based upon this data, scab resistance is strong in the breeding program. We lead the nation in scab resistant lines. This is evident in the NCPT. These data were 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. Many highly scab resistant lines (score < 1.0) coming from this effort are summarized in the variety report.

Fig. 1. Scab Disease Nursery Ratings 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 2023 we conducted late blight trials at the MSU campus. We inoculated with the US23 genotype and obtained infection. 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 (Fig. 2). In the past year we tested over 1,000 progeny for the PVY resistance marker. The marker positive selections were evaluated at Montcalm 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.

Table of Contents

Fig. 2 PVY resistant selections in the breeding program

MICHIGAN STATE UNIVERSITY

Breeding for PVY Resistance: 2023 status

Family	PVYR Advanced Selections
MSII	26
MSHH	38
MSGG	30
MSFF	18
MSEE	10
MSDD	11
MSCC	5
MSBB	10

- MSU Germplasm has incorporated PVY Resistance in many market classes: Round whites, Red skinned, Yellow flesh, Specialty (pigmented).

MICHIGAN STATE UNIVERSITY

2023 PVY Challenge Trial

							32 DAP	64 DAP	83 DAP
				%	N	N	7/14/23	8/11/23	8/30/23
Line	Female	Male	PVY R/S?	PVY	PVY+	Total	PVY+ N	PVY+ N	PVY+ N
Mackinaw			PVYR	0	0	18	0	0	0
MSAA174-1	MSU161-1	MSQ440-2	PVYR	0	0	18	0	0	0
MSBB630-2	Lady Liberty (NY152)	Kalkaska (MSJ036-A)	PVYR	0	0	22	0	0	0
MSCC553-1R	Red Marker #2	ND7132-1R	PVYR	0	0	18	0	0	0
MSDD244-15	Mackinaw (MSX540-4)	MSR127-2	PVYR	0	0	18	0	0	0
MSDD247-11	Mackinaw (MSX540-4)	MSV383-B	PVYR	0	0	18	0	0	0
MSDD376-4	NY148	MSV033-1	PVYR	6	1	18	0	0	1
MSEE016-10	NY148	MSR127-2	PVYR	0	0	18	0	0	0
MSEE031-3	MSZ219-14	Lamoka (NY139)	PVYR	0	0	18	0	0	0
Huron Chipper			S	0	0	18	0	0	0
MSAA127-01PP	Purple Heart	MSU200-5PP	S	67	4	6	0	2	2
MSAA127-7PP	Purple Heart	MSU200-5PP	S	50	9	18	0	4	5
MSAA182-3R	MSU200-5PP	MSS544-1R	S	11	2	18	0	1	1
MSDD039-1	Lamoka (NY139)	MSR127-2	S	56	10	18	0	6	4
MSEE115-1	MSV313-2	MSR127-2	S	17	3	18	0	2	1
MSFF007-2	Lamoka (NY139)	MSQ086-3	S	28	5	18	0	3	2
MSFF008-1	Lamoka (NY139)	MSR127-2	S	33	6	18	0	4	2
MSFF022-2	Huron Chipper (MSW485-2)	Lamoka (NY139)	S	22	4	18	0	2	2
MSFF134-1PP	MSZ107-1PP	MSX324-1P	S	39	7	18	0	5	2
MSZ416-8RY	MSN230-1RY	NDTX4271-5R	S	61	11	18	0	6	5
PA01N32-1			PALB	0	0	4	0	0	0
PALB03016-3			PALB	0	0	12	0	0	0
PALB0302-1			PALB	0	0	12	0	0	0
PALB03035-7			PALB	0	0	12	0	0	0

Table of Contents

MSU Lines with Commercial Tracking

MSV093-1Y (Bonafide)

Parentage: McBride x MSP408-14Y
Developers: Michigan State University and the MSU AgBioResearch.
Plant Variety Protection: To be applied for

Strengths: MSV093-1Y is a high yield potential yellow-flesh breeding line with an attractive, round tuber shape. This line has demonstrated excellent high yield potential in replicated trials at the MSU Montcalm Research Center and on grower field trials throughout Michigan. This yellow flesh line has excellent internal quality (few defects) and a low incidence of blackspot bruise. MSV093-1Y also has moderate scab tolerance. MSV093-1Y has a strong vine and a mid-early season maturity.

Incentives for production: High yield potential with an attractive tuber shape with good yellow flesh with excellent internal quality.

Mackinaw (MSX540-4)

Parentage: Saginaw Chipper x Lamoka
Developers: Michigan State University and the MSU AgBioResearch.
Plant Variety Protection: To Be Applied For.

Strengths: MSX540-4 is a chip-processing potato with resistance to potato virus Y (PVY), late blight (*Phytophthora infestans*), tolerance to common scab (*Streptomyces scabies*), and demonstrated tolerance to *Verticillium* wilt. This variety has average yield with a high specific gravity, and a high percentage of A-size tubers with an attractive, uniform shape. MSX540-4 has a strong vine and a mid- to late-season maturity and has demonstrated excellent long-term storage chip-processing quality.

Table of Contents

MSX540-4 has performed well in multiple locations in the PotatoesUSA National Chip Processing Trials (NCPT).
Incentives for production: Long-term chip-processing quality with resistance to PVY and late blight, and tolerance to common scab.

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

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

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:

Table of Contents

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.

Table of Contents

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*).

Table of Contents

***S. chacoense*-derived and other new sources for Colorado Potato Beetle 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. Selfing will then recover the homozygous condition of recessive loci contributing to beetle resistance. In 2023 we made selections in the families for tuber appearance on the survivors at the ed of the season. We will run detached leaf bioassays in the winter to screen the 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.

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 can be used in diploid potato breeding. 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 introgress self-compatibility. From the crosses produced in the past 9 years from these dihaploid crosses with over 60 breeding lines or varieties, over 1,000 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 russets. Right now, we have more than 100 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 them 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

Table of Contents

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. We have over 40 populations that we have cycled 5 generations to improve for self-compatibility and tuber traits. We have also been crossing self-compatible donors to the dihaploids of Atlantic, Superior, MSZ219-14, Kalkaska, MSR127-2, MSS576-5SPL, Lady Liberty, NY148 and others so we can develop inbred chip-processing diploid lines. This new diploid potato breeding project is expanding to develop promising lines to use as parents in the future as well as to think about F1 hybrid varieties.
From 2021-23, we yield tested about over 200 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 data validates the results from the past years so we are confident that we can develop potato varieties with this new breeding approach.

Figure 3. Diploid selection MSHH1042-A2.

Certified NFT Minituber Production at Michigan State University

Since 2016, the MSU Potato Breeding program has operated its own certified NFT minituber production greenhouse. The ability to produce certified seed allows faster introduction of early generation material to the potato industry. It also helps position the program for participation in international trials. Our production numbers for 2023 are summarized below in Figure 4.

Table of Contents

Figure 4. 2023 Certified Seed Minituber Production

MICHIGAN STATE UNIVERSITY

2023 Certified Seed Production at MSU

- 23 Clones, 29,300 Minitubers

Line	Tubers	Remarks
AF5707-1	4325	
Blackberry	6425	
COTX15083-1R	529	
MSAA076-6	259	
MSAA182-3R	1278	
MSAA260-03	254	
MSBB058-1	261	PVYR
MSCC553-1R	2678	PVYR
MSDD244-05	241	PVYR
MSEE016-10	208	PVYR
MSFF182-1R	734	PVYR
Dundee (MSZ242-13)	131	
NDTX4271-5R	405	
Spartan Red #2	1336	PVYR

Line	Tubers	Remarks
Diamant	1118	USAID-Check
DIA-MSU-UB015	1080	USAID-LB
DIA-MSU-UB255	5615	USAID-LB
GRA-MSU-UG234	544	USAID-LB
GRA-MSU-UG265	441	USAID-LB
Granola	506	USAID-Check
Kal.91.03	306	Invertase Silencing
Kalkaska	303	Inv. Silence Check
YG.8.12	333	

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 been creating the plants for the target countries. Agronomic and late blight trials in Indonesia, Nigeria and Kenya (Figure 5) demonstrate their resistance to late blight and yield well under late blight pressure.

Figure 5. Field Trials in Kenya in 2023

Workstream I: 3 R-gene LBR potato field trials - Country Activities

- **Kenya**
  - ***CFT***: ML-CFT1 –short rain season; ML-CFT-2 –long rain season
  - ***Regulatory***: regulatory data cleaned and analyzed
  - ***Issue***: seed mixture (minor, detected)
  - ***Next***: regulatory studies/dossier on lead transgenic event(s), ML-CFT- 3 / demo plots

Victoria: Vic.172, Vic.185
Shangi: Sha.06, Sha.105
Tigoni: Tig.254

KALRO stations: Muguga Njabini Molo

Table of Contents

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 (Figure 6). 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. Field trials at MRC in 2023 continue to confirm this observation. 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 are currently petitioning the USDA for exemption from regulation.

Figure 6. Agronomic trials with XERICO events

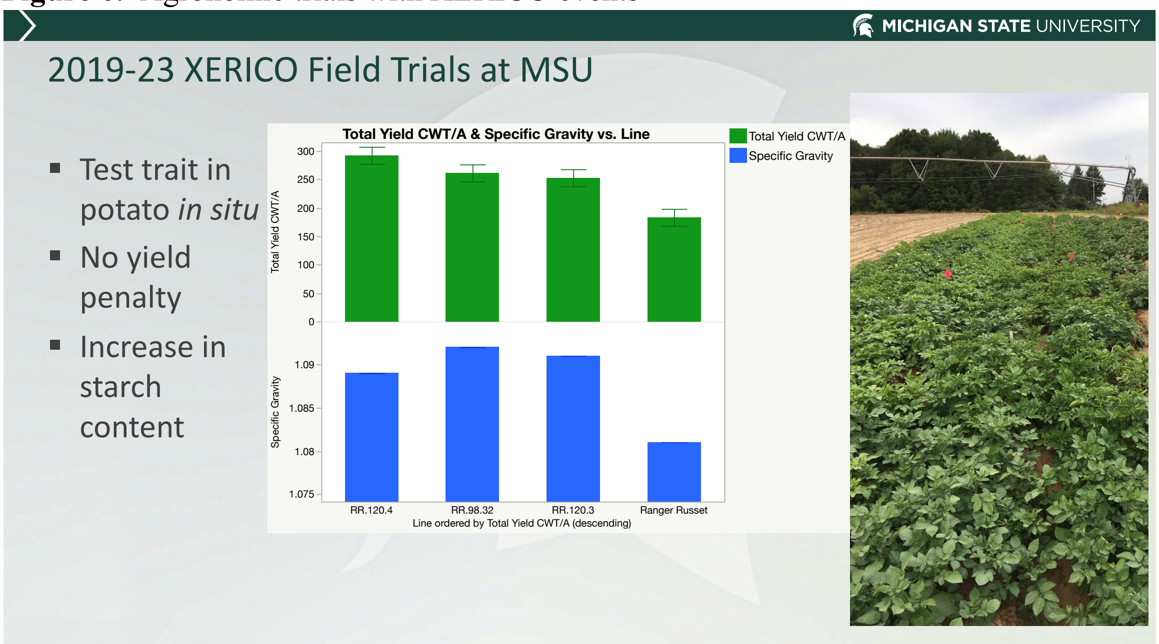


Table of Contents

Funding: Fed. Grant/MPIC/Potatoes USA

2023 POTATO VARIETY EVALUATIONS

D.S. Douches, J. Coombs, K. Zarka, G. Steere, M. Zuehlke, K. Shaw, J. Norling, C. Long, J. Wilbur and W. Behling

Department of Plant, Soil, and Microbial Sciences
Michigan State University
East Lansing, MI 48824

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 2023, we tested over 155 varieties and breeding lines in the replicated variety trials, 134 lines in the North Central Regional trial plus over 191 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 5 years. Oats were grown in 2022 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.

2023 was the thirteenth 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 134 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 we feel show promise in 2023 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 (257 lines) and the scab variety trial (134 lines) and diploid scab trial (131). In 2023, 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 2021-2023 scab ratings are based upon the Montcalm Research Center site. **Table 8** categorizes many of the varieties and advanced selections tested in 2023 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 2023 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 0.5 – 3.3 for the variety trial. A total of 92 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 257 early generation selections that were evaluated, 169 had scab resistance (scab rating of ≤ 1.5) (**Table 9**).

C. Late Blight Trial (Table 10)

In 2023, the late blight trial was planted at the East Lansing campus Plant Pathology farm. All entries were planted in early 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. Seventeen of 107 lines were classified as late blight resistant in the replicated trial, in addition to 36 classified as moderately resistant. Many of the lines were also PVY resistant. Select early generation lines were tested for late blight resistance. Twenty-one of 87 early generation 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 of Contents

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 2023, 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 1,000 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 40 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), MSW474-1, and MSZ242-13 (Dundee). Our newest graduates of the NCPT are MSBB058-1 and MSAA217-3. Minituber production and/or commercial seed have been produced of the newer lines and will be tested in Michigan in 2024.

Table 1

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

ADVANCED CHIP-PROCESSING TRIAL
MONTCALM RESEARCH CENTER
May 8 to September 26, 2023 (141 days)
DD Base 40°F 2952[9]

	PVY		CWT/A		PERCENT OF TOTAL[1]						CHIP	CHIP	PERCENT (%) TUBER QUALITY[4]								3-YR AVG US#1
LINE	Resistant	N	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	SCORE[2]	SED[3]	HH	VD	IBS	BC	SCAB[5]	MAT[6]	BRUISE[7]	LB[8]	CWT/A
MSBB630-2	PVYR	2	517	559	93	8	92	2	1	1.081	1.5	1.0	10	10	5	10	1.2	5.0	2.3	-	555
MSFF036-1	PVYR	2	511	535	96	5	92	4	0	1.077	1.5	1.0	0	20	0	0	1.7	4.5	1.9	-	622*
MSGG409-3	PVYR	2	500	546	92	8	92	0	1	1.078	1.5	1.0	0	55	0	0	1.7	5.0	2.0	MR	-
MSBB636-11	PVYR	2	498	516	97	2	92	5	1	1.075	1.5	0.0	5	10	0	0	0.7	4.0	1.6	MS	581*
MSDD376-4	PVYR	2	477	496	96	4	95	1	1	1.088	1.5	1.0	25	10	0	5	1.3	5.0	1.6	-	487*
MSDD553-1	PVYR	2	459	478	96	4	93	3	0	1.078	1.5	1.0	5	25	0	0	1.8	5.0	1.8	MR	542*
MSEE035-4	PVYR	2	446	485	92	8	91	2	0	1.091	1.5	2.0	0	0	10	5	0.5	4.0	2.6	R	-
MSEE171-2		2	425	448	95	5	93	2	0	1.080	2.0	1.0	0	15	0	0	0.8	5.0	1.7	-	-
MSGG194-3	PVYR	2	416	448	93	7	93	0	1	1.079	1.5	2.0	5	35	0	0	2.2	4.0	1.8	-	-
MSFF037-17	PVYR	2	412	451	91	9	91	1	1	1.090	1.0	0.0	0	25	0	0	1.7	4.0	2.0	MS	540*
MSDD372-07	PVYR	2	411	442	93	7	93	0	0	1.094	2.0	2.0	0	15	0	0	0.5	5.0	1.6	R	517*
MSFF038-3	PVYR	2	409	429	96	4	95	1	2	1.086	2.0	2.0	25	5	0	0	1.7	3.0	1.2	MS	-
MSBB635-14	PVYR	2	404	427	95	4	93	2	2	1.077	1.5	2.0	0	50	0	0	1.0	4.5	1.9	-	478
MSEE207-2	PVYR	2	398	423	94	6	94	1	1	1.083	2.0	1.0	0	25	0	0	0.3	5.0	1.8	MR	500*
MSFF007-2		2	398	432	92	8	91	1	1	1.085	1.5	2.0	0	25	5	0	1.0	4.5	2.0	MS	454*
MSDD249-9	PVYR	2	383	398	96	4	92	5	0	1.087	1.5	2.0	20	5	0	0	1.0	3.0	1.1	MR	462*
MSAA260-3		2	380	397	96	4	96	0	0	1.084	1.0	0.0	0	15	0	0	1.7	4.0	2.0	MS	436
MSBB060-1	PVYR	2	376	391	96	5	94	2	0	1.079	2.0	2.0	0	45	0	0	0.7	5.0	1.8	-	-
MSAA076-6		2	369	439	84	15	84	0	1	1.089	1.0	0.0	0	10	10	0	0.8	2.5	2.4	-	424
MSEE016-07		2	367	380	97	4	95	2	0	1.094	1.5	1.0	5	10	0	0	0.8	5.0	1.5	-	-
MSBB230-1		2	362	385	94	6	94	0	1	1.085	2.0	2.0	0	20	0	0	1.7	3.0	1.8	-	-
MSFF079-16	PVYR	2	362	382	95	3	91	4	3	1.083	2.0	0.0	5	10	10	0	0.5	4.0	2.0	MR	398*
MSAA240-5		2	354	385	93	5	92	1	3	1.086	1.0	0.0	0	20	5	0	2.5	3.5	2.3	MS	-
MSBB058-3	PVYR	2	352	374	94	6	92	2	0	1.085	1.0	1.0	5	20	0	0	1.3	5.0	1.7	R	389
MSFF077-4	PVYR	2	350	361	97	3	96	2	0	1.078	1.5	1.0	5	10	0	0	1.7	3.5	1.6	MS	-
MSBB614-15		2	348	365	96	5	92	4	0	1.081	1.0	1.0	25	5	0	0	0.7	5.0	1.1	R	381
MSFF097-6	PVYR	2	345	382	90	10	90	0	1	1.087	1.5	1.0	0	5	0	5	1.3	5.0	2.5	MR	375*
MSW474-1		2	315	362	88	13	88	0	0	1.082	1.0	1.0	5	0	0	5	0.5	5.0	2.0	MS	385
MSDD244-05	PVYR	2	308	337	92	6	90	2	4	1.084	1.5	1.0	0	20	0	0	0.7	3.5	1.8	MS	394*
MSDD247-07	PVYR	2	308	329	94	7	92	2	0	1.098	1.0	1.0	0	0	15	0	1.0	3.0	2.6	MR	363
MSBB058-1		2	306	336	91	9	91	0	0	1.095	2.0	1.0	0	0	0	0	1.3	3.5	1.2	S	418*
Lamoka		**2**	**306**	**329**	**93**	**6**	**92**	**1**	**2**	**1.084**	**1.5**	**1.0**	**0**	**40**	**5**	**0**	**1.3**	**3.0**	**2.0**	-	**327**
MSEE016-10	PVYR	2	304	362	84	16	84	0	1	1.095	1.0	2.0	0	0	0	0	1.3	3.0	1.2	-	-
MSEE031-3	PVYR	2	304	330	92	7	92	0	1	1.083	2.0	2.0	0	20	0	0	0.8	2.5	1.7	MR	-
MSEE182-3	PVYR	2	301	345	87	13	87	0	0	1.077	2.0	2.0	0	0	0	0	0.3	2.5	0.3	MS	-
MSAA217-3		2	297	309	96	4	93	3	1	1.093	1.0	1.0	20	25	5	0	1.0	4.5	1.7	-	-

LINE	PVY Resistant	N	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR	CHIP SCORE[2]	CHIP SED[3]	PERCENT (%) TUBER QUALITY[4] HH	VD	IBS	BC	SCAB[5]	MAT[6]	BRUISE[7]	LB[8]	3-YR AVG US#1 CWT/A
MSDD247-11	PVYR	2	295	346	85	9	85	0	6	1.090	1.5	0.0	0	0	0	5	0.5	2.5	2.8	MR	366
MSBB610-13	PVYR	2	294	306	96	3	94	2	1	1.082	1.0	1.0	0	10	5	0	1.2	2.5	2.1	-	396*
Dundee (MSZ242-13)		2	285	315	90	8	89	1	3	1.092	1.5	2.0	5	0	0	0	0.8	3.5	0.9	MS	355
Manistee		**2**	**272**	**308**	**88**	**12**	**88**	**0**	**0**	**1.077**	**1.5**	**1.0**	**10**	**10**	**0**	**0**	**2.5**	**2.0**	**1.6**	**-**	**251***
MSDD089-2		2	259	274	95	5	95	0	1	1.078	1.0	0.0	0	0	0	0	1.3	4.0	2.0	-	335*
MSZ025-2		2	256	273	94	6	93	1	0	1.076	2.0	2.0	0	10	5	0	1.2	2.0	1.9	-	-
MSGG263-1	PVYR	2	254	283	90	8	89	2	2	1.073	1.5	2.0	0	20	0	0	1.2	4.5	1.8	MS	-
MSGG349-3	PVYR	2	243	279	87	11	87	0	2	1.070	2.0	1.0	0	15	0	0	1.2	2.5	1.8	MR	-
Mackinaw	**PVYR**	**2**	**239**	**259**	**93**	**6**	**93**	**0**	**2**	**1.092**	**1.0**	**1.0**	**0**	**30**	**5**	**0**	**0.7**	**4.0**	**2.0**	**MR**	**402**
MSDD085-13	PVYR	2	235	259	91	10	91	0	0	1.081	1.0	1.0	0	20	0	0	0.7	2.0	1.8	-	263
MSDD039-01		2	231	265	88	13	88	0	1	1.078	2.0	2.0	0	20	0	0	1.2	3.0	1.7	-	-
MSDD244-15	PVYR	2	230	241	96	4	96	0	1	1.078	1.0	0.0	0	5	0	0	1.2	4.0	1.9	R	345
Petoskey		2	229	255	90	9	90	0	2	1.086	1.5	1.0	0	0	0	0	1.3	3.0	1.3	-	363
MSDD042-01		2	224	275	81	3	81	0	17	1.074	2.0	2.0	5	10	0	0	1.3	3.0	1.5	-	-
MSEE115-1		2	203	216	94	5	94	0	2	1.094	1.5	1.0	5	5	0	0	0.7	3.0	1.3	-	-
MSGG426-2	PVYR	2	203	224	91	9	91	0	0	1.080	1.5	1.0	0	30	0	0	0.7	3.5	1.8	MR	-
MSGG195-1	PVYR	2	197	234	85	15	85	0	1	1.075	1.5	1.0	0	5	0	0	1.7	2.5	1.8	-	-
MSFF292-1		2	185	228	81	18	81	0	1	1.086	1.5	1.0	0	5	0	0	1.7	3.0	1.8	-	279*
NY163	PVYR	2	154	197	79	21	79	0	0	1.083	1.0	1.0	0	25	0	0	1.7	2.5	2.0	S	286*
MSFF321-1		2	151	227	67	33	67	0	1	1.087	1.0	2.0	0	0	5	0	0.5	2.5	1.8	MS	-
Snowden		**2**	**124**	**164**	**76**	**24**	**76**	**0**	**1**	**1.080**	**1.0**	**1.0**	**5**	**25**	**0**	**0**	**3.0**	**2**	**1.9**	**MS**	**285**
Atlantic		**2**	**117**	**132**	**88**	**10**	**88**	**0**	**2**	**1.081**	**1.5**	**1.0**	**10**	**0**	**0**	**0**	**2.6**	**2.0**	**1.4**	**S**	**275**
MEAN			321	351						1.1							1.2	3.6	1.8		376

[1]SIZE: B: < 2 in.; A: 2-3.25 in.; OV: > 3.25 in.; PO: Pickouts.
[2]CHIP SCORE: SNAC Scale (Out of the field); Ratings: 1-5; 1: Excellent, 5: Poor.
[3]SED: Stem End Defect, Based on Paul Bethke's (USDA/UWisconsin - Madison) 0 - 5 scale. 0 = no SED; 3 = significant SED; 5 = severe SED
[4]QUALITY: HH: Hollow Heart; BC: Brown Center; VD: Vascular Discoloration; 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 17, 2023; 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: 5/8/23
Vine Kill: 9/1/23
Days from planting to vine kill: 116

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

Table 2

NORTH CENTRAL REGIONAL TRIAL
MONTCALM RESEARCH CENTER
May 09 to September 05, 2023 (119 days)
DD Base 40°F 2895[8]

	PVY		CWT/A		PERCENT OF TOTAL[1]						CHIP	OTF	PERCENT (%) TUBER QUALITY[4]					
LINE	RESISTANT	N	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	SCORE[2]	SED[3]	HH	VD	IBS	BC	SCAB[5]	MAT[6]
Chip																		
W19ND1810Y-10		1	488	577	84	10	84	0	6	1.077	-	-	0	0	0	0	4.0	4.0
MSHH119-1		1	482	498	97	3	97	0	0	1.086	1.0	0.0	0	20	0	10	0.5	3.0
MN20ND1810Y-297A		1	464	516	90	10	90	0	0	1.068	1.0	1.0	0	0	0	0	5.0	3.0
MSHH004-2	PVYR	1	462	511	90	10	90	0	0	1.081	2.0	2.0	0	20	0	10	1.5	3.0
ND1845B-1Y		1	455	536	85	7	85	0	8	1.076	1.0	1.0	30	0	0	0	4.0	4.0
MSHH018-4	PVYR	1	444	487	91	9	91	0	0	1.089	1.0	1.0	0	0	0	0	1.5	5.0
MSHH048-4	PVYR	1	429	478	90	10	87	3	0	1.081	1.0	1.0	0	0	0	0	3.0	4.0
MSHH069-3	PVYR	1	424	442	96	4	96	0	0	1.073	1.0	3.0	0	0	20	0	1.5	3.0
W19023-17		1	423	445	95	5	95	0	0	1.080	2.0	2.0	0	30	0	0	2.5	5.0
MSHH018-3	PVYR	1	414	436	95	5	95	0	0	1.086	-	-	0	0	0	0	2.0	3.0
MSHH063-2	PVYR	1	413	462	89	11	89	0	0	1.083	1.0	1.0	0	30	0	0	3.0	4.0
MN20W19022-005		1	392	418	94	4	94	0	2	1.076	1.0	1.0	0	0	30	0	1.0	3.0
MSHH066-6	PVYR	1	392	407	96	4	96	0	0	1.087	1.0	0.0	10	10	10	0	1.5	4.0
MSHH043-03	PVYR	1	391	493	79	21	79	0	0	1.080	1.0	1.0	0	0	0	0	0.5	5.0
MN20AF7174-001		1	390	433	90	9	90	0	1	1.074	2.0	2.0	10	0	0	0	2.0	2.0
W19007-4		1	388	467	83	8	83	0	9	1.082	1.0	2.0	20	0	10	0	3.0	5.0
MSHH130-1	PVYR	1	380	429	89	10	89	0	1	1.087	1.0	1.0	0	0	0	0	2.0	3.0
MN20TX015-001		1	379	409	93	7	93	0	0	1.081	1.0	0.0	0	20	10	0	2.0	5.0
MSHH206-11	PVYR	1	364	423	86	14	86	0	0	1.066	-	-	0	10	0	0	3.5	2.0
W19027-4		1	356	386	92	7	92	0	1	1.083	1.0	1.0	0	20	0	0	1.0	3.0
ND1852-10		1	347	393	88	9	88	0	2	1.088	2.0	0.0	0	10	0	0	2.0	3.0
MN20ND184Y-121		1	335	356	94	6	94	0	0	1.065	2.0	1.0	0	30	0	0	2.5	3.0
W19016-5		1	334	442	76	24	76	0	0	1.078	2.0	0.0	0	90	0	0	2.0	2.0
MSHH015-5	PVYR	1	316	339	93	7	93	0	0	1.088	1.0	0.0	0	30	0	0	1.0	3.0
MSHH043-10		1	306	340	90	10	87	3	0	1.089	1.0	1.0	0	20	0	10	2.0	5.0
Lamoka		**2**	**279**	**297**	**94**	**6**	**94**	**0**	**0**	**1.083**	**2.0**	**0.0**	**0**	**30**	**0**	**0**	**2.0**	**3.0**
MSHH056-19	PVYR	1	260	303	86	14	86	0	0	1.075	1.0	1.0	0	0	0	0	0.5	4.0
ND1848-1		1	257	282	91	9	91	0	0	1.068	2.0	1.0	10	50	0	0	1.5	2.0
W19013-4		1	254	283	90	10	90	0	0	1.085	1.0	1.0	10	0	10	0	0.5	5.0
W19024-18		1	250	310	81	19	81	0	0	1.087	1.0	1.0	0	40	0	0	3.0	2.0
MSHH137-1	PVYR	1	249	294	85	15	85	0	0	1.083	1.0	1.0	0	20	0	0	0.5	2.0
MN19AF6869-021		1	245	271	90	8	90	0	2	1.074	1.0	1.0	0	0	0	0	2.0	2.0
MSHH113-06	PVYR	1	245	306	80	20	80	0	0	1.080	1.0	1.0	0	0	0	0	1.0	3.0
MN20ND184Y-020		1	233	287	81	15	81	0	4	1.071	2.0	1.0	0	30	0	0	3.0	3.0
ND2032-2		1	227	276	82	18	82	0	0	1.071	1.0	1.0	0	0	0	0	3.0	3.0
ND20178-3		1	227	289	79	8	79	0	13	1.067	1.0	0.0	0	60	0	0	2.5	3.0
W19012-30		1	227	304	75	24	75	0	2	1.096	1.0	0.0	0	0	0	0	2.5	3.0
MN20ND184Y-120		1	225	276	82	15	82	0	3	1.064	-	-	0	0	0	0	2.5	3.0
Snowden		**2**	**217**	**303**	**72**	**28**	**72**	**0**	**0**	**1.081**	**1.0**	**1.0**	**0**	**70**	**0**	**0**	**3.0**	**1.0**
ND1853-24		1	191	241	79	17	79	0	4	1.089	2.0	2.0	0	50	0	0	1.0	3.0
MN20AF7131-002		1	189	302	63	27	63	0	11	1.079	1.0	1.0	0	0	20	0	3.0	3.0
W19012-12		1	175	306	57	43	57	0	0	1.094	2.0	0.0	0	0	0	0	1.0	3.0
W19028-23		1	163	185	88	12	88	0	0	1.098	1.0	1.0	0	20	0	0	1.0	5.0
MN19AF6866-004		1	162	240	68	25	68	0	7	1.075	1.0	2.0	0	30	10	0	2.0	3.0

	PVY		CWT/A		PERCENT OF TOTAL[1]						CHIP	OTF	PERCENT (%) TUBER QUALITY[4]					
LINE	RESISTANT	N	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	SCORE[2]	SED[3]	HH	VD	IBS	BC	SCAB[5]	MAT[6]
W19027-40		1	152	283	54	46	54	0	0	1.082	1.0	2.0	0	10	10	0	2.0	2.0
MN20ND1810Y-128		1	138	182	76	16	76	0	9	1.071	1.0	2.0	0	0	0	0	3.5	3.0
MSHH185-04	PVYR	1	133	160	83	17	83	0	0	1.069	-	-	0	0	0	0	2.0	3.0
MN18AF6648-010		1	114	247	46	54	46	0	0	1.076	1.0	1.0	0	0	0	0	2.0	3.0
W19018-3		1	114	171	67	28	67	0	6	1.078	1.0	0.0	10	0	0	0	2.5	2.0
ND1848-2		1	106	138	77	15	77	0	8	1.083	1.0	3.0	10	20	50	0	1.0	4.0
ND1846-6		1	88	132	67	33	67	0	0	1.077	1.0	2.0	0	30	0	0	3.5	3.0
MN20ND184Y-070		1	87	141	62	38	62	0	0	1.066	1.0	2.0	20	40	0	0	1.0	2.0
MN20W19027-074		1	69	126	55	45	55	0	0	1.071	1.0	1.0	0	20	0	0	1.0	1.0
MN20AF7145-002		1	62	144	43	43	43	0	14	1.065	1.0	0.0	0	30	10	0	2.0	1.0
W19012-9		1	48	81	59	41	59	0	0	1.073	1.0	1.0	0	30	0	0	4.5	2.0
ND2029-1		1	25	51	48	52	48	0	0	1.063	1.0	2.0	0	0	0	0	2.0	4.0
MEAN			275	327						1.079							2.1	3.1
Russet																		
W19036-5rus		1	375	507	74	17	74	0	9	1.083	-	-	0	20	10	0	3.0	4.0
W19035-17rus		1	373	436	85	10	85	0	5	1.072	-	-	10	0	0	0	2.5	2.0
MN20ND1833B-001		1	364	439	83	17	83	0	0	1.073	-	-	30	0	0	0	4.5	4.0
W19037-1rus		1	317	374	85	13	85	0	2	1.083	-	-	0	0	0	0	4.0	4.0
W19035-14rus		1	289	360	80	17	80	0	3	1.071	-	-	0	10	0	0	3.0	2.0
W19034-41rus		1	286	387	74	20	74	0	6	1.072	-	-	0	20	0	0	2.0	3.0
W19035-18rus		1	285	356	80	15	80	0	5	1.070	-	-	0	20	10	0	5.0	3.0
Gold Rush Russet		**2**	**274**	**331**	**83**	**13**	**83**	**0**	**4**	**1.063**	-	-	**0**	**20**	**0**	**0**	**0.5**	**1.0**
W19035-10rus		1	248	344	72	24	72	0	4	1.061	-	-	0	40	0	0	1.5	2.0
W19034-30rus		1	247	347	71	23	71	0	6	1.074	-	-	0	20	0	0	1.0	3.0
W19035-1rus		1	247	360	69	28	69	0	3	1.070	-	-	0	0	0	0	2.5	2.0
W19034-33rus		1	241	325	74	24	74	0	2	1.069	-	-	0	20	0	0	3.0	2.0
MN19AOR16034-002		1	232	336	69	24	69	0	7	1.072	-	-	0	0	0	0	2.0	2.0
W19037-11rus		1	206	353	59	35	59	0	6	1.068	-	-	0	0	0	0	1.0	2.0
MN20ND17105-001		1	195	337	58	42	58	0	0	1.079	1.0	1.0	10	10	0	0	1.0	2.0
W19039-6rus		1	189	235	80	20	80	0	0	1.065	-	-	0	0	0	0	0.5	2.0
Russet Norkotah		**2**	**187**	**292**	**64**	**27**	**64**	**0**	**9**	**1.071**	-	-	**20**	**0**	**0**	**0**	**3.0**	**3.0**
W19034-15rus		1	187	311	60	40	60	0	0	1.075	-	-	0	0	0	0	2.0	2.0
W19033-9rus		1	184	345	53	39	53	0	8	1.071	-	-	0	0	0	0	3.0	2.0
W19034-21rus		1	161	265	61	39	61	0	0	1.077	-	-	0	0	0	0	2.0	1.0
W19039-3Rus		1	150	178	84	16	84	0	0	1.057	-	-	0	10	0	0	1.5	1.0
MN20ND17100-001		1	137	220	62	28	62	0	10	1.070	-	-	0	20	0	0	4.0	4.0
W19038-3rus		1	102	168	60	36	60	0	4	1.073	-	-	0	50	0	0	1.5	2.0
ND195-3Russ		1	101	184	55	23	55	0	22	1.068	-	-	10	50	0	0	3.0	1.0
W19038-4rus		1	58	230	25	71	25	0	4	1.071	-	-	0	10	0	0	3.5	5.0
MN20CO17085-003		1	48	216	22	73	22	0	4	1.070	-	-	0	0	0	0	0.5	2.0
MEAN			219	317						1.071							2.3	2.4

	PVY		CWT/A		PERCENT OF TOTAL[1]						CHIP	OTF	PERCENT (%) TUBER QUALITY[4]					
LINE	RESISTANT	N	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	SCORE[2]	SED[3]	HH	VD	IBS	BC	SCAB[5]	MAT[6]
Red																		
MSHH157-4RR	PVYR	1	400	450	89	11	89	0	0	1.056	1.0	1.0	0	0	0	0	2.0	2.0
MN19ND1759-001		1	389	430	90	9	90	0	1	1.067	-	-	0	10	60	0	2.0	3.0
MSHH172-3PP	PVYR	1	382	417	92	8	92	0	0	1.068	2.0	1.0	0	0	0	0	2.0	2.0
MSHH160-05R	PVYR	1	377	411	92	8	92	0	0	1.086	-	-	0	0	0	0	2.5	5.0
MSHH149-17R	PVYR	1	357	395	90	10	90	0	0	1.071	-	-	0	0	0	0	2.5	4.0
MSHH155-6RY	PVYR	1	356	471	76	24	76	0	0	1.083	-	-	0	0	0	0	2.5	3.0
MSHH170-5RR	PVYR	1	332	428	78	22	78	0	1	1.069	3.0	2.0	0	0	0	0	1.0	3.0
MSHH164-03RY	PVYR	1	309	315	98	2	98	0	0	1.086	-	-	0	10	0	0	0.5	3.0
MSHH176-2R	PVYR	1	308	355	87	12	87	0	1	1.072	-	-	0	0	0	0	2.0	2.0
MSHH161-06R	PVYR	1	301	310	97	3	97	0	0	1.067	-	-	0	0	0	20	2.0	5.0
ND1870-3R		1	299	357	84	11	84	0	5	1.061	-	-	0	30	0	0	3.5	3.0
ND1940-1R		1	237	286	83	17	83	0	0	1.075	-	-	0	20	0	0	2.5	3.0
Dark Red Norland		**2**	**222**	**269**	**83**	**17**	**83**	**0**	**0**	**1.053**	-	-	**0**	**0**	**0**	**0**	**1.5**	**1.0**
ND1858Y-4R		1	218	284	77	23	77	0	0	1.069	-	-	30	50	10	0	3.0	2.0
MN19TX17751-005		1	208	238	88	12	88	0	1	1.077	2.0	2.0	0	20	0	0	2.0	2.0
ND1966-1pY		1	191	295	65	34	65	0	1	1.063	-	-	0	20	0	0	2.5	1.0
MSHH228-3PP	PVYR	1	176	196	90	10	90	0	0	1.063	2.0	2.0	0	0	0	0	2.0	5.0
MSHH161-04RY	PVYR	1	155	180	86	11	86	0	3	1.063	-	-	0	10	0	0	2.5	4.0
ND1979-1RR		1	145	166	88	12	88	0	0	1.066	1.0	1.0	0	0	10	0	3.0	2.0
MN19ND1759-002		1	134	194	69	24	69	0	7	1.059	-	-	0	0	0	0	1.5	2.0
ND1979-2Rp		1	115	197	58	42	58	0	0	1.068	-	-	0	0	0	0	3.5	3.0
ND2013-3R		1	106	123	86	9	86	0	5	1.060	-	-	0	0	0	0	3.0	1.0
ND2039-3R		1	93	132	70	30	70	0	0	1.060	-	-	10	0	0	0	3.5	1.0
ND2037-2R		1	88	106	83	17	83	0	0	1.058	-	-	0	10	0	0	1.0	2.0
ND2036-1R		1	77	261	30	70	30	0	0	1.054	-	-	0	0	0	0	2.5	1.0
ND1979-3Rp		1	73	146	50	46	50	0	4	1.068	2.0	1.0	0	50	0	0	3.0	2.0
ND1915-3R		1	67	71	93	7	93	0	0	1.068	-	-	0	10	0	0	4.0	2.0
ND1915-2R		1	66	140	47	8	47	0	44	1.072	-	-	0	0	0	0	4.0	3.0
MSHH180-04R		1	49	139	35	65	35	0	0	1.069	-	-	0	0	0	0	3.0	2.0
ND2037-3R		1	48	63	75	25	75	0	0	1.060	-	-	0	0	0	0	2.0	1.0
ND2056-11pY		1	37	100	37	63	37	0	0	1.045	-	-	0	0	0	0	3.5	1.0
ND2035-1R		1	27	99	27	55	27	0	18	1.056	-	-	0	20	0	0	3.0	1.0
ND1913-1R		1	24	50	47	53	47	0	0	1.071	-	-	0	0	0	0	1.5	1.0
MEAN			193	245						1.066							2.4	2.4

LINE	PVY RESISTANT	N	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR	CHIP SCORE[2]	OTF SED[3]	PERCENT (%) TUBER QUALITY[4] HH	VD	IBS	BC	SCAB[5]	MAT[6]
Table/Speciality																		
MN20CO18192-001		1	449	544	83	15	83	0	2	1.084	2.0	1.0	10	10	0	0	3.5	4.0
MN19TX18280-002		1	434	490	89	10	89	0	2	1.077	3.0	3.0	10	0	0	0	4.0	4.0
MSHH179-04Y	PVYR	1	409	427	96	4	92	4	0	1.074	-	-	0	10	0	0	3.0	4.0
ND1837B-3Y		1	347	413	84	16	84	0	0	1.075	-	-	40	20	0	0	4.0	4.0
MSHH224-4Y	nd	1	300	424	71	28	71	0	1	1.058	-	-	0	0	0	0	1.5	3.0
ND1840B-1R		1	263	317	83	17	83	0	0	1.067	-	-	0	0	0	0	2.5	3.0
MN20TX478-001		1	258	278	93	7	91	1	0	1.058	-	-	0	0	0	0	4.0	2.0
MN20ND1824Y-001		1	247	269	92	8	92	0	0	1.063	-	-	0	30	10	0	2.5	3.0
Columba		**1**	**223**	**316**	**71**	**27**	**71**	**0**	**2**	**1.051**	-	-	**0**	**20**	**0**	**0**	**1.0**	**1.0**
MN19TX18171-003		1	216	254	85	10	85	0	5	1.072	1.0	1.0	0	20	0	0	1.0	3.0
MN190011-002		1	174	271	64	16	64	0	20	1.061	-	-	0	0	0	0	2.5	3.0
MN18W17026-004		1	29	142	20	37	20	0	42	1.060	-	-	0	0	0	0	2.0	1.0
MEAN			279	346						1.067							2.6	2.9

[1]SIZE: B: < 2 in.; A: 2-3.25 in.; OV: > 3.25 in.; PO: Pickouts.
[2]CHIP SCORE: SNAC Scale (Out of the field); Ratings: 1-5; 1: Excellent, 5: Poor.
[3]SED: Stem End Defect, Based on Paul Bethke's (USDA/UWisconsin - Madison) 0 - 5 scale. 0 = no SED; 3 = significant SED; 5 = severe SED
[4]QUALITY: HH: Hollow Heart; BC: Brown Center; VD: Vascular Discoloration; IBS: Internal Brown Spot. Percent of 10 Oversize and/or A-size tubers cut.
[5]MATURITY RATING: August 17, 2023; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).
[6]SCAB DISEASE RATING: MSU Scab Nursery; 0: No Infection; 1: Low Infection <5%; 3: Intermediate; 5: Highly Susceptible.

Plant Date: 5/9/23
Vine Kill: 8/30/23
Days from planting to vine kill: 113

Table 3

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

ADAPTATION TRIAL, TABLESTOCK LINES
MONTCALM RESEARCH CENTER
May 9 to September 12, 2023 (126 days)
DD Base 40°F 2935[7]

LINE	PVY RESISTANT	N	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR	PERCENT (%) TUBER QUALITY[2] HH	VD	IBS	BC	SCAB[3]	MAT[4]	BRUISE[5]	LB[6]
MSCC282-2PP		2	690	733	94	5	92	3	1	1.071	0	0	0	0	1.8	4.0	-	-
MSFF353-1R		2	584	613	95	5	94	1	1	1.078	0	10	0	0	2.0	4.5	0.9	R
MSGG127-3R	PVYR	2	577	628	92	8	92	1	0	1.081	0	0	0	0	1.8	3.5	0.9	-
MSDD088-1		2	523	547	96	4	94	2	1	1.073	5	0	0	0	0.8	4.0	0.4	S
Blackberry		2	506	582	86	14	86	1	1	1.066	0	0	0	0	1.0	4.0	0.3	MS
MSGG039-08	PVYR	2	505	690	73	23	73	0	4	1.071	0	30	5	0	2.0	3.0	0.5	MS
MSGG135-1R	PVYR	2	478	660	73	27	72	1	1	1.076	0	0	0	0	1.0	3.5	0.4	MR
MSZ109-8PP		2	459	511	90	9	90	0	2	1.066	0	0	0	0	0.5	4.0	0.1	-
MSFF031-6	PVYR	2	454	482	94	6	94	0	0	1.067	0	0	0	0	0.8	3.5	1.6	MS
MSGG137-1R	PVYR	2	439	475	93	8	91	2	0	1.070	10	0	0	0	2.0	4.0	0.8	R
MSGG863-A2		2	436	471	93	6	90	3	2	1.086	5	5	0	10	1.0	4.0	-	-
Reba		**2**	**424**	**445**	**95**	**3**	**94**	**1**	**2**	**1.071**	**30**	**0**	**0**	**0**	**1.5**	**3.0**	**0.8**	**S**
MSFF182-1R	PVYR	2	416	523	80	21	80	0	0	1.086	35	0	0	5	0.8	4.0	0.9	R
MSCC553-1R	PVYR	2	407	454	90	7	90	0	4	1.074	0	0	0	0	1.0	4.0	0.1	MR
MSGG084-1	PVYR	2	397	436	91	8	91	0	1	1.070	5	35	0	0	1.0	3.0	0.5	MS
MSFF211-2	PVYR	2	392	444	88	4	87	2	8	1.064	0	15	0	20	1.8	4.0	-	R
MSFF120-2Y		2	388	421	92	8	91	2	1	1.070	0	0	5	0	1.3	3.0	0.8	S
MSFF335-2RR		2	379	445	85	15	85	0	1	1.066	0	5	0	0	0.5	5.0	1.9	MR
MSFF230-1		2	377	493	77	15	77	0	9	1.082	55	5	5	0	1.0	4.0	1.3	R
MSGG039-11	PVYR	2	374	436	86	9	84	2	7	1.071	0	0	0	0	1.3	3.0	0.3	MS
MSZ416-8RY		2	374	427	88	8	85	3	5	1.060	0	25	0	0	1.5	3.5	0.3	MS
Becca Rose		2	371	485	76	14	76	0	11	1.064	0	15	0	0	1.3	4.0	0.3	MS
MSAA182-3R		2	354	423	84	16	82	2	1	1.078	5	15	0	0	1.5	3.5	0.8	-
MSFF305-1RY	PVYR	2	348	403	86	14	86	0	0	1.071	0	15	0	0	1.3	5.0	0.2	R
MSAA101-01RR		2	347	395	88	12	88	0	0	1.077	30	10	0	0	0.5	3.0	1.2	S
MSAA174-1	PVYR	2	323	338	96	5	96	0	0	1.058	0	20	5	0	1.5	3.0	0.7	MR
Dark Red Norland		**2**	**321**	**356**	**90**	**9**	**87**	**3**	**2**	**1.057**	**10**	**0**	**5**	**5**	**1.5**	**3.0**	**0.3**	**S**
MSFF142-1P		2	318	420	76	25	76	0	0	1.071	0	5	0	0	1.3	5.0	0.3	MR
MSBB371-1YSPL		2	312	363	86	15	86	0	0	1.073	0	20	0	0	0.5	4.0	0.5	-
MSGG158-11PP	PVYR	2	281	383	74	26	74	0	1	1.062	0	0	0	0	1.0	3.5	-	-
Golden Globe		2	275	365	76	15	76	0	10	1.065	0	5	0	0	1.0	2.5	0.2	S
MSFF138-04R		2	264	303	87	12	84	3	1	1.077	0	5	5	0	1.5	4.0	1.8	R
MSFF134-1PP		2	263	318	83	12	83	0	6	1.070	0	0	0	0	1.5	3.5	-	MS
Yukon Gold		**2**	**253**	**287**	**88**	**12**	**88**	**0**	**1**	**1.071**	**40**	**10**	**5**	**10**	**2.0**	**2.5**	**0.9**	**S**

LINE	PVY RESISTANT	N	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR	PERCENT (%) TUBER QUALITY[2] HH	VD	IBS	BC	SCAB[3]	MAT[4]	BRUISE[5]	LB[6]
Colomba		2	246	303	79	21	79	0	1	1.051	0	10	0	0	0.8	3.5	0.1	MS
Jacqueline Lee		2	243	401	61	39	61	0	1	1.079	0	0	0	0	2.3	3.5	1.3	S
MSFF230-2PY		2	213	271	79	17	79	0	5	1.080	5	10	0	0	1.3	5.0	0.5	R
MSFF145-2R		2	190	324	59	41	59	0	1	1.066	0	0	0	0	0.8	1.5	0.0	S
MEAN		2	381	449						1.071					1.2	3.6	0.7	

[1]SIZE: B: < 2 in.; A: 2-3.25 in.; OV: > 3.25 in.; PO: Pickouts.
[2]QUALITY: HH: Hollow Heart; BC: Brown Center; VD: Vascular Discoloration; 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 17, 2023; 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: 5/9/23
Vine Kill: 9/1/23
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 9 to September 14, 2023 (128 days)
DD Base 40°F 2935[7]

	PVY		CWT/A		PERCENT OF TOTAL[1]						OTF	OTF	PERCENT (%) TUBER QUALITY[2]							
LINE	RESISTANT	N	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	SFA	SED	HH	VD	IBS	BC	SCAB[3]	MAT[4]	BRUISE[5]	LB[6]
MSBB626-11	PVYR	1	604	629	96	4	93	3	0	nd	nd	nd	0	0	0	0	nd	4.0	nd	MR
MSGG302-1	PVYR	1	511	516	99	1	88	11	0	1.090	1.0	2.0	10	0	0	0	0.5	5.0	2.3	MR
MSGG190-1	PVYR	1	478	508	94	6	93	1	0	1.078	1.0	1.0	0	0	0	0	0.5	3.0	1.0	MS
MSDD084-19	PVYR	1	469	509	92	6	92	0	2	1.080	1.0	0.0	0	0	0	0	1.5	4.0	0.7	MR
Mackinaw	**PVYR**	**1**	**433**	**469**	**92**	**6**	**92**	**0**	**1**	**1.091**	**1.0**	**0.0**	**0**	**10**	**0**	**0**	**1.5**	**4.0**	**1.8**	**MR**
MSEE149-2		1	409	419	98	2	87	10	0	1.084	1.0	0.0	0	0	0	0	1.5	5.0	2.5	-
MSGG242-1	PVYR	1	407	472	86	14	86	0	0	1.088	1.0	0.0	0	0	50	10	0.5	4.0	2.0	MR
MSFF029-10	PVYR	1	396	468	85	15	85	0	0	1.087	1.0	1.0	0	0	10	10	1.5	3.0	0.2	-
MSFF022-2		1	376	407	92	8	92	0	0	1.076	1.0	2.0	0	0	0	0	1.5	3.0	0.8	MS
Mystere		1	350	439	80	20	80	0	1	1.076	1.0	0.0	0	10	0	0	2.0	3.0	0.7	S
MSDD050-B		1	340	376	91	8	84	6	2	1.069	2.0	2.0	0	0	0	0	0.5	3.0	1.0	MR
MSFF088-1		1	337	362	93	7	93	0	0	1.083	1.0	0.0	0	0	0	0	0.5	3.0	2.6	MR
MSFF035-2	PVYR	1	329	365	90	3	88	2	7	1.080	1.0	0.0	10	0	0	0	1.0	3.0	1.4	-
MSEE025-1	PVYR	1	304	307	99	1	99	0	0	1.077	1.0	1.0	0	0	0	0	0.5	3.0	0.1	MR
Petoskey		1	298	331	90	9	90	0	1	1.095	2.0	1.0	0	0	0	0	2.0	3.0	2.4	-
MSFF008-1		1	297	327	91	9	91	0	0	1.078	2.0	1.0	10	0	0	0	1.0	5.0	1.4	-
MSEE052-5		1	293	379	77	6	76	1	17	1.076	1.0	0.0	0	10	10	0	1.0	4.0	0.4	MR
MSEE149-1		1	230	237	97	3	95	2	0	1.079	3.0	2.0	0	0	0	0	0.5	5.0	2.4	-
MSFF191-1Y	PVYR	1	221	253	88	9	88	0	3	1.064	1.0	2.0	0	0	0	0	1.5	3.0	0.1	MR
Snowden		**1**	**204**	**271**	**75**	**24**	**75**	**0**	**1**	**1.085**	**1.0**	**0.0**	**0**	**0**	**0**	**0**	**2.5**	**2.0**	**1.7**	**MS**
MSGG169-2	PVYR	1	173	177	98	2	91	7	0	1.068	1.0	1.0	0	0	0	0	1.0	3.0	0.2	S
MSEE063-6	PVYR	1	158	172	92	7	92	0	1	1.080	1.0	2.0	20	10	0	0	1.0	5.0	1.0	R
Atlantic		**1**	**131**	**150**	**87**	**10**	**87**	**0**	**3**	**1.083**	**1.0**	**2.0**	**20**	**10**	**20**	**10**	**3.0**	**2.0**	**1.5**	**S**
MEAN			337	371						1.080							1.2	3.6	1.3	

[1]SIZE: B: < 2 in.; A: 2-3.25 in.; OV: > 3.25 in.; PO: Pickouts.
[2]QUALITY: HH: Hollow Heart; BC: Brown Center; VD: Vascular Discoloration; 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 17, 2023; 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: 5/9/23
Vine Kill: 9/1/23
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 9 to September 14, 2023 (128 days)
DD Base 40°F 2935[7]

LINE	PVY RESISTANT	N	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR	PERCENT (%) TUBER QUALITY[2] HH	VD	IBS	BC	SCAB[3]	MAT[4]	BRUISE[5]	LB[6]
Allison		1	524	616	85	12	85	0	3	1.070	10	10	0	0	1.0	5.0	0.8	MS
MSFF301-3SPL		1	380	413	92	6	92	0	1	1.079	0	10	0	0	0.5	3.0	1.3	MR
MSFF149-01		1	321	357	90	7	90	0	4	1.081	0	30	0	0	1.0	3.0	1.5	MR
Sifra		1	278	398	70	30	70	0	1	1.061	0	20	10	0	3.0	2.0	0.2	MS
MSGG030-3Y		1	277	344	81	13	81	0	7	1.066	0	0	0	0	1.0	3.0	1.2	S
Jelly		1	270	297	91	6	91	0	3	1.074	20	50	0	0	1.0	4.0	0.4	MR
Spartan Splash		1	265	300	88	11	88	0	1	1.070	0	10	0	0	0.5	3.0	1.0	-
MSFF050-1		1	218	234	93	6	93	0	1	1.069	10	0	0	0	1.0	3.0	1.0	-
Dark Red Norland		**1**	**205**	**237**	**86**	**12**	**86**	**0**	**2**	**1.056**	**0**	**0**	**0**	**0**	**1.0**	**2.0**	**0.3**	**S**
MSAA127-01PP		1	200	252	79	19	79	0	2	1.059	0	0	0	0	0.5	4.0	0.9	MS
Camelia		1	184	244	75	19	75	0	6	1.060	0	20	0	0	2.0	2.0	0.2	MR
MEAN			284	336						1.068					1.1	3.1	0.8	

[1]SIZE: B: < 2 in.; A: 2-3.25 in.; OV: > 3.25 in.; PO: Pickouts.
[2]QUALITY: HH: Hollow Heart; BC: Brown Center; VD: Vascular Discoloration; 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 17, 2023; 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: 5/9/23
Vine Kill: 9/1/23
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 9 to September 14, 2023 (128 days)
DD Base 40°F 2935[7]

	PVY		CWT/A		PERCENT OF TOTAL[1]						PERCENT (%) TUBER QUALITY[2]							
LINE	RESISTANT	N	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	HH	VD	IBS	BC	SCAB[3]	MAT[4]	Bruise[5]	LB[6]
MSGG102-1RR			382	452	85	14	85	0	2	1.070	0	0	0	0	2.5	3.0	ND	R
MSFF338-1PP			355	453	78	20	78	0	1	1.061	0	0	0	0	0.5	4.0	0.5	MS
MSFF335-3Pinto			258	510	51	44	51	0	6	1.064	0	0	0	0	0.5	4.0	0.4	MS
Dark Red Norland			**194**	**243**	**80**	**20**	**80**	**0**	**0**	**1.054**	**0**	**0**	**0**	**0**	**1.5**	**1.0**	**0.3**	**S**
W16025-5R			160	212	76	22	76	0	2	1.055	0	0	0	0	2.5	2.0	0.3	S
MSFF030-1WR	PVYR		144	225	64	26	64	0	10	1.060	0	0	0	0	0.5	3.0	0.7	MS
W17005-3R			111	149	74	21	74	0	4	1.059	0	0	10	10	2.0	3.0	0.0	S
W17026-4R			89	187	47	52	47	0	1	1.054	0	0	0	0	1.5	2.0	0.1	-
MSFF334-1Pinto			85	184	46	43	46	0	11	1.059	0	0	0	0	1.0	5.0	0.7	R
MEAN			198	291						1.060					1.4	3.0	0.4	

[1]SIZE: B: < 2 in.; A: 2-3.25 in.; OV: > 3.25 in.; PO: Pickouts.
[2]QUALITY: HH: Hollow Heart; BC: Brown Center; VD: Vascular Discoloration; 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 17, 2023; 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: 5/9/23
Vine Kill: 9/1/23
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 8 to September 26, 2023 (141 days)
DD Base 40°F 2952[6]

		CWT/A		PERCENT OF TOTAL[1]						PERCENT (%) TUBER QUALITY[2]						
LINE	N	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	HH	VD	IBS	BC	SCAB[3]	MAT[4]	BRUISE[5]
MSHH618-01	2	345	368	94	6	94	0	1	1.068	90	5	0	0	1.5	4.0	0.0
MSHH1043-02	2	317	384	83	16	83	0	3	1.077	30	5	0	0	0.8	4.5	2.4
MSHH693-01	2	244	334	73	28	73	0	0	1.088	0	0	0	0	-	3.5	1.3
MSII1591-3	2	215	235	92	9	92	0	0	1.096	100	0	0	0	-	4.0	3.2
Atlantic	**2**	**202**	**224**	**90**	**10**	**90**	**0**	**1**	**1.086**	**15**	**10**	**5**	**0**	**3.5**	**2.0**	**2.1**
MSII1117-1	2	192	253	76	24	76	0	1	1.084	0	0	20	0	-	3.0	3.5
Lamoka	**2**	**169**	**186**	**91**	**10**	**91**	**0**	**0**	**1.081**	**0**	**25**	**5**	**0**	**1.0**	**2.5**	**0.8**
MSGG691-06	2	168	267	64	31	64	0	6	1.072	50	0	10	0	2.5	4.0	2.9
MSHH664-01	2	133	193	68	29	68	0	4	1.074	50	5	0	0	2.3	4.5	3.8
MSII1081-2	2	128	171	75	21	75	0	5	1.083	35	0	0	0	0.8	2.0	3.3
MSHH699-02	2	114	233	49	50	49	0	1	1.092	0	0	0	0	-	4.0	1.5
MSFF690-01	2	102	175	58	42	58	0	1	1.081	40	20	5	0	1.5	3.0	2.1
MSII1591-2	2	91	126	72	24	72	0	5	1.099	10	5	0	0	1.8	3.0	1.7
MSGG655-01	2	65	95	70	31	70	0	0	1.084	0	0	0	0	-	3.0	1.9
MSHH1041-4	2	42	87	48	48	48	0	5	1.068	0	0	5	0	-	2.0	3.3
MEAN		168	222						1.082					1.7	3.3	2.3

[1]SIZE: B: < 2 in.; A: 2-3.25 in.; OV: > 3.25 in.; PO: Pickouts.
[2]QUALITY: HH: Hollow Heart; BC: Brown Center; VD: Vascular Discoloration; 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 17, 2023; 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]Enviroweather: Entrican Station. Planting to vine kill

Plant Date: 5/8/23
Vine Kill: 9/1/23
Days from planting to vine kill: 116

Table 8

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

2021-23 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, MONTCALM RESEARCH CENTER , MI

LINE	3-YR* AVG.	2023 RATING	2023 WORST	2023 N	2022 RATING	2022 WORST	2022 N	2021 RATING	2021 WORST	2021 N
Sorted by ascending 2023 Average Rating;										
MSEE182-3	1.1	0.3	0.5	3	1.2	2.0	3	1.7	3.0	3
MSEE207-2	0.5	0.3	0.5	3	0.7	1.0	3	0.5	0.5	3
MSDD247-11	0.7	0.5	0.5	3	1.2	2.0	3	0.5	0.5	3
MSDD372-07	1.3	0.5	0.5	3	1.8	2.0	3	1.7	2.0	3
MSEE035-4	0.8	0.5	0.5	3	0.8	1.0	3	1.2	1.5	3
MSFF079-16	0.7*	0.5	1.0	3	0.8	1.0	3			
MSFF321-1		0.5	0.5	3						
MSGG242-1		0.5	0.5	3						
MSW474-1	0.7	0.5	0.5	3	1.0	1.5	3	0.5	0.5	3
Mackinaw[PVYR, LBR]	**1.4**	0.7	1.5	6	**1.8**	**2.5**	**6**	**1.8**	**2.5**	**3**
MSBB060-1		0.7	1.0	3						
MSBB614-15	0.6	0.7	1.0	3	0.7	1.0	3	0.3	0.5	3
MSBB636-11	0.9*	0.7	1.0	3	1.2	1.5	3			
MSDD050-B		0.7	1.0	3						
MSDD085-13	0.8	0.7	1.0	3	1.2	1.5	3	0.5	0.5	3
MSDD244-05	1.0	0.7	1.0	3	1.0	1.0	3	1.3	2.0	3
MSEE115-1	0.9*	0.7	1.0	3	1.2	1.5	3			
MSFF035-2	1.1	0.7	1.0	3	1.2	1.5	3	1.5	2.0	3
MSGG426-2		0.7	1.0	3						
MSZ109-8PP	0.9	0.7	1.0	3	0.8	1.0	3	1.3	1.5	3
MSEE149-1		0.8	1.0	2						
MSAA076-6	1.0	0.8	1.0	3	1.3	2.0	3	0.8	1.0	3
MSAA101-1RR	1.0	0.8	1.0	3	1.0	1.0	3	1.2	1.5	3
MSBB626-11	1.0	0.8	1.0	3	1.0	1.0	3	1.2	1.5	3
MSEE016-07	1.4	0.8	1.0	3	1.5	2.5	3	1.8	2.5	3
MSEE031-3	1.2	0.8	1.0	3	1.3	1.5	3	1.3	2.0	3
MSEE052-5		0.8	1.0	3						
MSEE149-2		0.8	1.5	3						
MSEE171-2		0.8	1.0	3						
MSFF050-1	1.3*	0.8	1.0	3	1.7	3.0	3			
MSFF088-1		0.8	1.0	3						
MSFF142-1P	1.1	0.8	1.0	3	0.8	1.0	3	1.5	2.0	3
MSFF145-2R		0.8	1.0	3						
MSFF182-1R	1.3*	0.8	1.5	3	1.7	2.0	3			
MSZ242-13	1.2	0.8	1.0	3	0.8	1.0	3	2.0	2.0	3
MSZ416-8RY		0.8	1.0	3						
Dark Red Norland	1.1	0.9	1.5	9	1.3	2.0	6	1.2	2.0	3
MSAA127-01PP		1.0	1.5	3						
MSAA217-3		1.0	1.5	3						
MSBB635-14	1.1	1.0	1.0	2	1.0	1.5	3	1.2	1.5	3
MSDD247-07	1.3	1.0	1.0	3	1.7	2.0	3	1.2	1.5	3
MSDD249-9	1.6	1.0	1.5	3	2.0	2.0	3	1.8	2.0	3
MSEE025-1		1.0	1.5	3						
MSEE063-6		1.0	1.5	3						
MSFF007-2	1.1*	1.0	1.5	3	1.2	1.5	3			
MSFF008-1		1.0	1.0	3						
MSFF031-6	1.1	1.0	1.5	3	1.3	1.5	3	1.0	1.5	3
MSFF138-04R		1.0	1.5	3						
MSGG302-1		1.0	1.5	2						
Blackberry	1.7	1.2	2.0	3	1.7	2.5	3	2.2	3.0	3

Table of Contents

LINE	3-YR* AVG.	2023 RATING	2023 WORST	2023 N	2022 RATING	2022 WORST	2022 N	2021 RATING	2021 WORST	2021 N
Sorted by ascending 2023 Average Rating;										
MSAA174-1	1.6	1.2	2.0	3	1.7	2.0	3	1.8	2.5	3
MSBB371-1YSPL	1.2	1.2	2.0	3	1.2	2.0	3	1.3	2.0	3
MSBB610-13	1.5*	1.2	1.5	3	1.8	2.5	3			
MSBB630-2	1.3	1.2	1.5	3	1.0	1.5	3	1.7	2.0	3
MSDD039-01	1.4*	1.2	1.5	3	1.7	2.0	3			
MSDD244-15	1.0	1.2	2.0	3	1.0	1.5	3	0.8	1.0	3
MSFF211-2	1.2	1.2	1.5	3	1.2	1.5	3	1.3	1.5	3
MSFF335-2RR	1.2*	1.2	1.5	3	1.2	2.0	3			
MSGG084-1		1.2	1.5	3						
MSGG263-1		1.2	1.5	3						
MSGG349-3		1.2	1.5	3						
MSZ025-2		1.2	2.0	3						
MSBB058-1	1.2*	1.3	1.5	2	1.2	1.5	3			
MSBB058-3	1.4	1.3	1.5	2	1.2	1.5	3	1.7	2.0	3
Petoskey	1.4	1.3	1.5	6	1.7	2.0	3	1.3	2.0	6
Lamoka	**1.6**	1.3	1.5	3	**2.0**	**2.5**	**3**	**1.5**	**2.0**	**3**
MSDD042-01		1.3	2.0	3						
MSDD089-2	1.2*	1.3	2.5	3	1.0	1.5	3			
MSDD376-4	1.5	1.3	2.0	3	1.7	2.0	3	1.5	2.5	3
MSEE016-10	1.6	1.3	2.0	3	1.3	2.0	3	2.0	2.0	3
MSFF097-6	1.1*	1.3	2.0	3	0.8	1.5	3			
MSFF120-2Y	1.1	1.3	1.5	3	1.0	1.0	3	1.0	1.5	3
MSFF149-01		1.3	2.0	3						
MSFF301-3SPL		1.3	1.5	3						
MSFF305-1RY	1.4	1.3	2.0	3	1.3	1.5	3	1.7	2.0	3
MSDD088-1	1.3	1.5	2.0	3	0.8	1.0	3	1.7	2.0	3
MSFF022-2	1.4*	1.5	2.0	3	1.3	1.5	3			
MSFF334-1Pinto	1.1	1.5	2.0	3	1.2	1.5	3	0.7	1.0	3
MSGG158-11PP		1.5	3.0	3						
MSAA260-3	1.6	1.7	2.0	3	1.5	1.5	3	1.7	2.0	3
MSBB230-1		1.7	2.0	3						
MSFF036-1	2*	1.7	2.0	3	2.3	3.0	3			
MSFF037-17	1.8*	1.7	2.0	3	2.0	2.0	3			
MSFF038-3	1.8*	1.7	2.5	3	1.8	2.0	3			
MSFF077-4		1.7	2.0	3						
MSFF134-1PP	1.6	1.7	2.5	3	1.3	1.5	3	1.8	2.0	3
MSFF292-1	1.4*	1.7	2.0	3	1.2	2.0	3			
MSGG195-1		1.7	3.0	3						
MSGG409-3		1.7	2.5	3						
NY163	1.8*	1.7	2.0	3	2.0	2.5	3			
Spartan Splash	2*	1.7	2.5	3	2.3	2.5	3			
W17005-3R		1.7	2.0	3						
MSGG135-1R		1.8	2.0	2						
Colomba		1.8	3.0	3						
FL2137		1.8	2.5	3						
MSAA182-3R	1.4*	1.8	2.5	3	1.0	1.5	3			
MSDD553-1	1.9	1.8	2.0	3	1.8	2.0	3	2.2	2.5	3
MSFF030-1WR		1.8	2.0	3						
MSFF335-3Pinto	2.3*	1.8	2.5	3	2.8	3.5	3			
MSFF338-1PP	2.1*	1.8	2.5	3	2.3	3.0	3			
MSGG863-A2		1.8	3.0	3						
MSFF029-10	2.2	2.0	2.0	3	2.7	3.0	3	1.8	2.0	3
MSGG030-3Y		2.0	3.0	3						
Reba	2.2	2.0	2.5	3	2.5	3.0	3	2.2	2.5	3

Table of Contents

LINE	3-YR* AVG.	2023 RATING	2023 WORST	2023 N	2022 RATING	2022 WORST	2022 N	2021 RATING	2021 WORST	2021 N
Sorted by ascending 2023 Average Rating;										
Allison		2.2	2.5	3						
Becca Rose		2.2	2.5	3						
Jelly		2.2	2.5	3						
MSCC553-1R	1.9	2.2	2.5	3	1.2	1.5	3	2.5	3.0	3
MSDD084-19	1.8*	2.2	2.5	3	1.3	1.5	3			
MSFF191-1Y		2.2	3.0	3						
MSGG194-3		2.2	2.5	3						
MSGG169-2		2.3	3.0	3						
Manistee	2.7	2.5	3.0	3	2.8	3.5	3	2.8	3.0	3
MSAA240-5		2.5	3.0	3						
MSCC282-2PP	2.3*	2.5	3.0	3	2.2	2.5	3			
MSFF230-2PY		2.5	3.0	3						
MSGG039-11		2.5	3.0	3						
MSGG190-1		2.5	3.0	3						
Mystere		2.5	2.5	3						
W16025-5R		2.5	3.0	3						
W17026-4R		2.5	2.5	3						
Atlantic	2.8	2.6	3.0	6	3.1	3.5	6	2.8	3.5	3
Golden Globe		2.7	3.5	3						
Jacqueline Lee	2.8*	2.7	3.5	3	2.8	3.5	3			
MSGG137-1R		2.7	3.5	3						
Yukon Gold	2.4	2.7	3.0	3	2.7	3.0	3	1.8	2.5	3
MSFF230-1		2.8	3.0	3						
Sifra		2.8	3.5	3						
Camelia		3.0	3.5	3						
MSGG039-08		3.0	3.5	3						
MSGG127-3R		3.0	3.5	3						
Snowden	3.1	3.0	3.5	6	3.3	3.5	6	3.0	3.5	3
MSFF353-1R	2.6*	3.2	3.5	3	2.0	2.5	3			
MSGG102-1RR		3.8	4.0	3						

$HSD_{0.05}$ =

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 of Contents

Table 9

MICHIGAN STATE UNIVERSITY

POTATO BREEDING and GENETICS

2023 SCAB DISEASE EARLY GENERATION TRIAL SUMMARY
SCAB NURSERY, MONTCALM RESEARCH CENTER, MI

LINE	2023 RATING	2023 N	LINE	2023 RATING	2023 N
Sorted by ascending 2023 Rating:					
MSII1593-2	0.0	1	MSII147-9	0.5	1
MSFF725-3	0.5	1	MSII150-3	0.5	1
MSHH015-5	0.5	1	MSII154-1	0.5	1
MSHH034-12	0.5	1	MSII168-1	0.5	1
MSHH043-03	0.5	1	MSII172-3	0.5	1
MSHH043-10	0.5	1	MSII195-1	0.5	1
MSHH046-1	0.5	1	MSII199-2	0.5	1
MSHH053-19	0.5	1	MSII210-6	0.5	1
MSHH069-3	0.5	1	MSII211-3	0.5	1
MSHH091-03	0.5	1	MSII212-1	0.5	1
MSHH119-1	0.5	1	MSII214-1	0.5	1
MSHH134-20	0.5	2	MSII224-1	0.5	1
MSHH137-1	0.5	1	MSII243-2	0.5	1
MSHH170-5RR	0.5	1	MSII311-1Y	0.5	1
MSHH600-A2	0.5	1	MSII400-1RR	0.5	1
MSHH601-A2	0.5	1	MSII415-1R	0.5	1
MSHH1042-A1	0.5	1	MSII416-6R	0.5	1
MSHH1042-A2	0.5	1	MSII423-06R	0.5	1
MSII046-7	0.5	1	MSII1022-1	0.5	1
MSII049-1	0.5	1	MSII1051-4	0.5	1
MSII050-3	0.5	1	MSII1054-2	0.5	1
MSII050-4	0.5	1	MSII1075-1	0.5	1
MSII052-2	0.5	1	MSII1189-1	0.5	1
MSII057-2	0.5	1	MSII1592-2Y	0.5	1
MSII063-2	0.5	1	MSII1593-1RY	0.5	1
MSII075-1	0.5	1	MSII1594-1Y	0.5	1
MSII090-4	0.5	1	MSII1598-1Y	0.5	1
MSII093-1	0.5	1	MSII1606-1	0.5	1
MSII098-1	0.5	1	MSII1631-1	0.5	1
MSII105-1	0.5	1	WI3-6	0.5	1
MSII107-1	0.5	1	MSHH056-03	0.8	2
MSII108-6	0.5	1	MSHH004-2	1.0	1
MSII112-3	0.5	1	MSHH053-04	1.0	1
MSII117-15	0.5	1	MSHH066-6	1.0	1
MSII120-4	0.5	1	MSHH113-06	1.0	1
MSII128-1	0.5	1	MSHH172-3PP	1.0	1
MSII133-1	0.5	1	MSHH224-4Y	1.0	1
MSII133-2	0.5	1	MSHH606-A2	1.0	1
MSII142-1	0.5	1	MSHH970-A1	1.0	1
MSII146-1	0.5	1	MSHH1500-A7	1.0	1
MSII147-3	0.5	1	MSII040-1	1.0	1

Table of Contents

LINE	2023 RATING	2023 N	LINE	2023 RATING	2023 N
Sorted by ascending 2023 Rating:					
MSII052-1	1.0	1	MSII1653-1	1.0	1
MSII067-1	1.0	1	MSHH018-4	1.5	1
MSII076-1	1.0	1	MSHH185-4	1.5	1
MSII090-2	1.0	1	MSHH796-A2	1.5	1
MSII107-5	1.0	1	MSII042-1	1.5	1
MSII117-1	1.0	1	MSII042-2	1.5	1
MSII117-10	1.0	1	MSII046-1	1.5	1
MSII117-12	1.0	1	MSII078-10	1.5	1
MSII117-13	1.0	1	MSII081-1	1.5	1
MSII119-2	1.0	1	MSII084-1	1.5	1
MSII126-4	1.0	1	MSII107-7	1.5	1
MSII135-1	1.0	1	MSII108-4	1.5	1
MSII147-8	1.0	1	MSII115-2	1.5	1
MSII169-1	1.0	1	MSII120-5	1.5	1
MSII171-1	1.0	1	MSII122-2	1.5	1
MSII184-1	1.0	1	MSII128-4	1.5	1
MSII186-2	1.0	1	MSII132-1	1.5	1
MSII190-1	1.0	1	MSII134-1	1.5	1
MSII210-2	1.0	1	MSII135-2	1.5	1
MSII212-2	1.0	1	MSII149-1	1.5	1
MSII213-1	1.0	1	MSII164-1	1.5	1
MSII214-2	1.0	1	MSII177-1	1.5	1
MSII226-1	1.0	1	MSII186-1	1.5	1
MSII227-1	1.0	1	MSII198-1	1.5	1
MSII233-1	1.0	1	MSII231-1	1.5	1
MSII233-2	1.0	1	MSII233-3	1.5	1
MSII239-1	1.0	1	MSII238-1	1.5	1
MSII241-1	1.0	1	MSII243-1	1.5	1
MSII241-2	1.0	1	MSII301-4	1.5	1
MSII242-1	1.0	1	MSII306-5Y	1.5	1
MSII325-1Y	1.0	1	MSII344-4Y	1.5	1
MSII328-6Y	1.0	1	MSII353-1Y	1.5	1
MSII336-2	1.0	1	MSII409-05R	1.5	1
MSII338-1Y	1.0	1	MSII418-03R	1.5	1
MSII339-1Y	1.0	1	MSII418-10	1.5	1
MSII413-2R	1.0	1	MSII419-10	1.5	1
MSII415-2P	1.0	1	MSII1505-1	1.5	1
MSII416-2RR	1.0	1	MSII1518-1	1.5	1
MSII432-2R	1.0	1	MSII1519-1	1.5	1
MSII1054-1	1.0	1	MSII1604-1	1.5	1
MSII1073-1	1.0	1	ND2-7	1.5	1
MSII1148-1	1.0	1	WI1-16	1.5	1
MSII1151-1	1.0	1	MI2-24	2.0	1
MSII1172-1	1.0	1	MSBB764-1	2.0	1
MSII1198-1	1.0	1	MSBB791-1	2.0	1

Table of Contents

LINE	2023 RATING	2023 N	LINE	2023 RATING	2023 N
Sorted by ascending 2023 Rating:					
MSBB829-1	2.0	1	MSII163-1	2.5	1
MSEE824-04	2.0	1	MSII176-3	2.5	1
MSHH018-3	2.0	1	MSII305-1	2.5	1
MSHH063-2	2.0	1	MSII309-2Y	2.5	1
MSHH064-2	2.0	1	MSII311-5Y	2.5	1
MSHH157-4RR	2.0	1	MSII326-1	2.5	1
MSHH614-A4	2.0	1	MSII353-2Y	2.5	1
MSHH685-A1	2.0	1	MSII1201-1	2.5	1
MSHH685-A6	2.0	1	MSII1503-2RP	2.5	1
MSHH1040-A4	2.0	1	MSII1505-2	2.5	1
MSHH1040-A5	2.0	1	MSII1512-1	2.5	1
MSII039-1	2.0	1	ND1-3	2.5	1
MSII050-1	2.0	1	MSHH130-1	3.0	1
MSII060-5	2.0	1	MSHH206-11	3.0	1
MSII091-1	2.0	1	MSHH228-3PP	3.0	1
MSII106-1	2.0	1	MSHH614-A5	3.0	1
MSII122-4	2.0	1	MSHH614-A6	3.0	1
MSII129-1	2.0	1	MSHH614-A7	3.0	1
MSII311-4Y	2.0	1	MSHH710-A2	3.0	1
MSII323-5Y	2.0	1	MSHH970-A6	3.0	1
MSII414-2PP	2.0	1	MSII088-1	3.0	1
MSII414-6PP	2.0	1	MSII125-1	3.0	1
MSII415-3R	2.0	1	MSII155-1	3.0	1
MSII418-04R	2.0	1	MSII160-1	3.0	1
MSII418-07R	2.0	1	MSII225-1	3.0	1
MSII419-07R	2.0	1	MSII237-1	3.0	1
MSII432-7R	2.0	1	MSII1046-01	3.0	1
MSII445-1	2.0	1	MSII1167-1	3.0	1
MSII1001-1	2.0	1	MSII1503-1PP	3.0	1
MSII1044-1	2.0	1	MSII076-2	3.5	1
MSII1111-1	2.0	1	MSII102-1	3.5	1
MSII1511-1PP	2.0	1	MSII132-2	3.5	1
MSII1594-3Y	2.0	1	MSII1199-1	3.5	1
MSII1659-1	2.0	1	MSII1505-3	3.0	1
MSHH068-10	2.5	1	MI2-20	3.5	1
MSHH614-A1	2.5	1	MSGG563-A4	3.5	1
MSHH1040-A6	2.5	1	MSHH048-4	3.5	1
MSII046-8	2.5	1	MSII327-1Y	3.5	1
MSII048-1	2.5	1	MSII336-1	3.5	1
MSII126-1	2.5	1			
MSII143-1	2.5	1			

Table of Contents

Table 10

2023 MSU LATE BLIGHT VARIETY TRIAL
PLANT PATHOLOGY FARM, LANSING, MI

Line Sort:

LINE	N	RAUDPC[1] MEAN	LB RESISTANCE[2]
Allison	3	6.6	MS
Atlantic Guard	**45**	**13.9**	**S**
Atlantic	**3**	**12.3**	**S**
Becca Rose	3	8.4	MS
Camelia	3	4.2	MR
Colomba	3	10.7	MS
COTX08063-2Ru	2	10.7	MS
COTX10080-2Ru	3	9.4	MS
Dark Red Norland	**6**	**24.0**	**S**
Golden Globe	1	13.4	S
Jacqueline Lee	**2**	**12.7**	**S**
Jelly	3	5.1	MR
Mackinaw	**6**	**6.2**	**MR**
MSAA101-01RR	3	12.3	S
MSAA127-01PP	3	10.2	MS
MSAA174-1	3	4.1	MR
MSAA240-5	3	7.0	MS
MSAA260-3	3	9.4	MS
MSBB351-1	3	11.2	MS
MSBB614-15	3	0.7	R
MSBB626-11	3	5.7	MR
MSBB636-11	3	6.9	MS
MSCC553-1R	3	4.4	MR
MSCC725-232	3	9.7	MS
MSDD050-B	3	5.0	MR
MSDD084-19	3	3.3	MR
MSDD088-1	3	15.8	S
MSDD244-05	3	7.6	MS
MSDD244-15	3	0.5	R
MSDD247-07	3	5.9	MR
MSDD247-11	3	5.3	MR
MSDD249-9	3	3.6	MR
MSDD370-2	3	4.5	MR
MSDD372-07	3	0.6	R
MSDD483-1	3	10.6	MS
MSDD553-1	3	5.6	MR
MSEE025-1	3	4.4	MR
MSEE031-3	3	5.9	MR
MSEE035-4	3	2.7	R
MSEE048-2Y	3	0.1	R
MSEE052-5	3	5.8	MR
MSEE063-6	3	1.5	R
MSEE180-3P	3	3.5	MR
MSEE182-3	3	6.5	MS
MSEE191-3Y	2	3.2	MR
MSEE207-2	3	4.3	MR
MSFF007-2	3	7.6	MS
MSFF022-2	3	7.8	MS
MSFF030-1WR	3	8.0	MS
MSFF031-3SPL	2	3.9	MR
MSFF031-6	3	6.5	MS

RAUDPC Sort:

LINE	N	RAUDPC[1] MEAN	LB RESISTANCE[2]
MSFF230-2PY	3	0.1	R
MSEE048-2Y	3	0.1	R
MSFF334-1Pinto	3	0.3	R
MSFF072-1Y	3	0.4	R
MSDD244-15	3	0.5	R
MSDD372-07	3	0.6	R
MSFF305-1RY	3	0.6	R
MSBB614-15	3	0.7	R
MSFF182-1R	3	0.7	R
MSFF353-1R	3	1.4	R
MSEE063-6	3	1.5	R
MSFF230-1	3	2.1	R
MSGG137-1R	2	2.4	R
MSFF138-04R	3	2.5	R
MSGG102-1RR	3	2.5	R
MSFF211-2	3	2.6	R
MSEE035-4	3	2.7	R
MSEE191-3Y	2	3.2	MR
MSDD084-19	3	3.3	MR
MSFF149-01	3	3.5	MR
MSEE180-3P	3	3.5	MR
MSDD249-9	3	3.6	MR
MSZ219-13	3	3.6	MR
MSFF097-6	3	3.7	MR
MSFF079-16	3	3.8	MR
MSFF031-3SPL	2	3.9	MR
MSFF191-1Y	3	4.1	MR
MSAA174-1	3	4.1	MR
MSGG242-1	3	4.1	MR
Camelia	3	4.2	MR
MSEE207-2	3	4.3	MR
MSCC553-1R	3	4.4	MR
MSEE025-1	3	4.4	MR
MSDD370-2	3	4.5	MR
MSFF088-1	3	4.6	MR
MSFF301-3SPL	3	4.6	MR
MSFF335-2RR	3	4.8	MR
MSGG349-3	3	5.0	MR
MSDD050-B	3	5.0	MR
MSGG426-2	3	5.1	MR
Jelly	3	5.1	MR
MSFF142-1P	3	5.2	MR
MSDD247-11	3	5.3	MR
MSGG302-1	3	5.5	MR
MSDD553-1	3	5.6	MR
MSBB626-11	3	5.7	MR
MSEE052-5	3	5.8	MR
MSGG409-3	4	5.9	MR
MSDD247-07	3	5.9	MR
MSEE031-3	3	5.9	MR
MSGG135-1R	3	6.0	MR

Table of Contents

Line Sort:				*RAUDPC Sort:*			
LINE	N	RAUDPC[1] MEAN	LB RESISTANCE[2]	LINE	N	RAUDPC[1] MEAN	LB RESISTANCE[2]
MSFF034-4P	3	11.5	MS	MSFF206-1	3	6.1	MR
MSFF037-17	3	7.5	MS	**Mackinaw**	**6**	**6.2**	**MR**
MSFF038-3	3	10.7	MS	MSEE182-3	3	6.5	MS
MSFF072-1Y	3	0.4	R	MSFF031-6	3	6.5	MS
MSFF077-4	3	11.0	MS	Allison	3	6.6	MS
MSFF079-16	3	3.8	MR	**Snowden**	**3**	**6.8**	**MS**
MSFF088-1	3	4.6	MR	MSFF335-3Pinto	3	6.9	MS
MSFF097-6	3	3.7	MR	MSBB636-11	3	6.9	MS
MSFF120-2Y	3	13.3	S	MSAA240-5	3	7.0	MS
MSFF134-1PP	3	11.2	MS	MSGG039-11	2	7.1	MS
MSFF138-04R	3	2.5	R	MSGG084-1	3	7.3	MS
MSFF142-1P	3	5.2	MR	MSFF037-17	3	7.5	MS
MSFF145-2R	2	23.2	S	MSDD244-05	3	7.6	MS
MSFF149-01	3	3.5	MR	MSFF007-2	3	7.6	MS
MSFF182-1R	3	0.7	R	MSFF338-1PP	3	7.7	MS
MSFF191-1Y	3	4.1	MR	MSFF022-2	3	7.8	MS
MSFF206-1	3	6.1	MR	MSFF030-1WR	3	8.0	MS
MSFF211-2	3	2.6	R	Becca Rose	3	8.4	MS
MSFF230-1	3	2.1	R	MSGG263-1	3	8.4	MS
MSFF230-2PY	3	0.1	R	MSGG039-08	3	8.7	MS
MSFF301-3SPL	3	4.6	MR	MSFF321-1	3	8.8	MS
MSFF305-1RY	3	0.6	R	MSZ416-8RY	3	9.2	MS
MSFF321-1	3	8.8	MS	MSW474-1	3	9.3	MS
MSFF334-1Pinto	3	0.3	R	MSAA260-3	3	9.4	MS
MSFF335-2RR	3	4.8	MR	COTX10080-2Ru	3	9.4	MS
MSFF335-3Pinto	3	6.9	MS	MSCC725-232	3	9.7	MS
MSFF338-1PP	3	7.7	MS	Sifra	3	9.8	MS
MSFF353-1R	3	1.4	R	MSGG190-1	3	10.2	MS
MSGG030-3Y	3	14.6	S	MSZ242-13	3	10.2	MS
MSGG039-08	3	8.7	MS	MSAA127-01PP	3	10.2	MS
MSGG039-11	2	7.1	MS	MSDD483-1	3	10.6	MS
MSGG084-1	3	7.3	MS	Colomba	3	10.7	MS
MSGG102-1RR	3	2.5	R	COTX08063-2Ru	2	10.7	MS
MSGG135-1R	3	6.0	MR	MSFF038-3	3	10.7	MS
MSGG137-1R	2	2.4	R	MSFF077-4	3	11.0	MS
MSGG169-2	3	15.2	S	MSBB351-1	3	11.2	MS
MSGG190-1	3	10.2	MS	MSFF134-1PP	3	11.2	MS
MSGG242-1	3	4.1	MR	MSFF034-4P	3	11.5	MS
MSGG263-1	3	8.4	MS	MSAA101-01RR	3	12.3	S
MSGG302-1	3	5.5	MR	**Atlantic**	**3**	**12.3**	**S**
MSGG349-3	3	5.0	MR	**Jacqueline Lee**	**2**	**12.7**	**S**
MSGG409-3	4	5.9	MR	MSZ598-2	3	12.8	S
MSGG426-2	3	5.1	MR	MSFF120-2Y	3	13.3	S
MSW474-1	3	9.3	MS	Golden Globe	1	13.4	S
MSZ219-13	3	3.6	MR	MSZ513-2	3	13.6	S
MSZ242-13	3	10.2	MS	**Reba**	**3**	**13.8**	**S**
MSZ416-8RY	3	9.2	MS	**Atlantic Guard**	**45**	**13.9**	**S**
MSZ513-2	3	13.6	S	NY163	3	14.2	S
MSZ598-2	3	12.8	S	Mystere	3	14.5	S
Mystere	3	14.5	S	MSGG030-3Y	3	14.6	S
NY163	3	14.2	S	W16025-5R	2	14.9	S
Reba	**3**	**13.8**	**S**	MSGG169-2	3	15.2	S
Sifra	3	9.8	MS	W17005-3R	3	15.5	S
Snowden	**3**	**6.8**	**MS**	MSDD088-1	3	15.8	S

Table of Contents

Line Sort:				*RAUDPC Sort:*			
LINE	N	RAUDPC[1] MEAN	LB RESISTANCE[2]	LINE	N	RAUDPC[1] MEAN	LB RESISTANCE[2]
W16025-5R	2	14.9	S	MSFF145-2R	2	23.2	S
W17005-3R	3	15.5	S	**Dark Red Norland**	**6**	**24.0**	**S**

[1]Ratings indicate the average plot RAUDPC (Relative Area Under the Disease Progress Curve).

[2]LB Resistance: R=Resistant, MR=Moderate Resistance, MS=Moderate Susceptibility, S=Susceptible

LB Isolate used: US-23

Table of Contents

Table 11

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

2023 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 2023 RAUDPC							
MSFF230-2PY	0.1	R	1	MSHH113-06	7.9	MS	1
MSII414-6PP	0.2	R	1	MSHH137-1	7.9	MS	1
MSSFF230-1	0.4	R	1	MSII199-2	7.9	MS	1
MSII233-2	0.5	R	1	MSII212-2	7.9	MS	1
MI2-20	0.6	R	1	MSII416-6R	7.9	MS	1
MSHH056-19	0.6	R	1	WI1-16	7.9	MS	1
MSII414-2PP	0.6	R	1	ND2-7	8.2	MS	1
MSII416-2RR	0.6	R	1	MSII106-1	8.3	MS	1
MSII186-2	1.3	R	1	MSII076-2	8.4	MS	1
MSII120-5	1.4	R	1	MSHH048-4	8.6	MS	1
MSHH043-03	1.4	R	1	MSII135-2	8.7	MS	1
MSHH053-04	1.9	R	1	MSII120-4	8.8	MS	1
MSHH134-20	1.9	R	2	MSII125-1	9.0	MS	1
MSII149-1	2.1	R	1	MSII060-5	9.1	MS	1
MSII305-1	2.2	R	1	MSII042-1	9.3	MS	1
MSII198-1	2.4	R	1	MSII093-1	10.0	MS	1
MSII233-1	2.5	R	1	MSII112-3	10.0	MS	1
MSII306-5Y	2.5	R	1	MSII212-1	10.0	MS	1
MSII147-9	2.6	R	1	MSII226-1	10.1	MS	1
MSII147-8	2.8	R	1	MSII186-1	10.4	MS	1
MSHH056-03	2.9	R	2	MSII119-2	10.4	MS	1
MSHH004-2	3.9	MR	1	MSHH206-11	10.7	MS	1
MSII213-1	3.9	MR	1	MSII042-2	10.7	MS	1
MSHH018-3	4.3	MR	1	MSII076-1	10.7	MS	1
MSHH063-2	4.3	MR	1	MSHH224-4Y	10.9	MS	1
MSHH069-3	4.3	MR	1	MSII231-1	11.1	MS	1
MSII233-3	4.4	MR	1	MSHH119-1	11.4	MS	1
MI2-24	4.7	MR	1	MSII338-1Y	11.4	MS	1
MSHH018-4	4.7	MR	1	MSII184-1	12.1	S	1
MSII150-3	4.7	MR	1	MSII445-1	12.4	S	1
MSII242-1	4.7	MR	1	**Atlantic Guard**	**12.5**	**S**	**15**
MSII126-4	5.0	MR	1	MSII126-1	12.9	S	1
MSII057-2	5.1	MR	1	ND1-3	13.1	S	1
MSHH043-10	5.4	MR	1	MSII040-1	13.6	S	1
MSHH015-5	5.4	MR	1	MSII301-4	15.0	S	1
MSII237-1	5.4	MR	1	WI3-6	15.4	S	1
MSII147-3	6.0	MR	1	MSII309-2Y	16.4	S	1
MSHH053-19	6.1	MR	1				
MSII049-1	6.1	MR	1				
MSHH066-6	7.1	MS	1				
MSHH091-03	7.1	MS	1				
MSHH130-1	7.3	MS	1				
MSII176-3	7.3	MS	1				
MSII135-1	7.4	MS	1				
MSHH185-4	7.4	MS	1				
MSII115-2	7.5	MS	1				
MSII328-6Y	7.5	MS	1				
MSII048-1	7.6	MS	1				
MSII105-1	7.6	MS	1				
MSII134-1	7.6	MS	1				

[1]Ratings indicate the average plot RAUDPC (Relative Area Under the Disease Progress Curve).
[2]LB Resistance: R=Resistant, MR=Moderate Resistance, MS=Moderate Susceptibility, S=Susceptible

Table of Contents

2023 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									
NY163	1.083	21	4	0	0	0	0	84	0.2
MSGG426-2	1.080	19	6	0	0	0	0	76	0.2
MSBB636-11	1.075	19	4	2	0	0	0	76	**0.3**
MSDD042-01	1.074	15	10	0	0	0	0	60	**0.4**
MSDD089-2	1.078	16	7	2	0	0	0	64	**0.4**
MSGG349-3	1.070	13	7	3	0	0	0	57	0.6
MSEE182-3	1.077	11	11	3	0	0	0	44	0.7
MSFF077-4	1.078	11	10	4	0	0	0	44	0.7
MSZ025-2	1.076	12	7	3	0	1	0	52	0.7
MSAA260-3	1.084	11	8	4	1	0	0	46	**0.8**
Atlantic	**1.081**	**11**	**9**	**4**	**1**	**0**	**0**	**44**	**0.8**
FL2137	**1.080**	**11**	**10**	**0**	**2**	**1**	**0**	**46**	**0.8**
MSZ242-13	1.092	10	9	6	0	0	0	40	0.8
Snowden	**1.080**	**9**	**10**	**6**	**0**	**0**	**0**	**36**	**0.9**
MSFF292-1	1.086	6	12	5	0	0	0	26	1.0
MSFF321-1	1.087	10	5	7	0	1	0	43	1.0
MSGG263-1	1.073	10	7	6	1	1	0	40	1.0
MSGG195-1	1.075	8	7	5	2	0	0	36	1.0
MSBB610-13	1.082	7	6	3	4	0	0	35	**1.2**
MSDD247-11	1.090	6	10	9	1	1	0	22	**1.3**
MSDD039-01	1.078	5	9	8	2	1	0	20	**1.4**
MSAA240-5	1.086	3	11	4	5	1	0	13	**1.6**
MSFF097-6	1.087	1	13	7	1	2	0	4	1.6
Manistee	**1.077**	**5**	**9**	**5**	**4**	**1**	**1**	**20**	**1.6**
Lamoka	**1.084**	**2**	**11**	**6**	**4**	**1**	**0**	**8**	**1.6**
MSDD085-13	1.081	1	10	9	3	1	0	4	**1.7**
MSBB230-1	1.085	5	6	9	1	4	0	20	**1.7**
MSFF036-1	1.077	3	10	3	6	2	0	13	1.8
Petoskey	1.086	6	5	6	3	3	1	25	1.8
MSEE115-1	1.094	3	7	3	7	1	0	14	**1.8**
MSEE031-3	1.083	2	6	11	6	0	0	8	1.8
MSEE207-2	1.083	6	4	8	4	1	2	24	1.8
MSFF037-17	1.090	4	5	8	6	2	0	16	1.9
MSDD244-05	1.084	2	8	7	6	2	0	8	**1.9**
MSDD376-4	1.088	4	6	8	4	1	2	16	**1.9**
MSDD247-07	1.098	4	7	5	3	4	1	17	**2.0**
MSBB060-1	1.079	3	8	6	4	4	1	12	**2.0**
MSBB058-3	1.085	6	2	9	2	5	1	24	**2.0**
MSFF079-16	1.083	2	7	9	4	1	2	8	2.0
MSBB614-15	1.081	4	4	6	6	2	1	17	**2.0**
MSAA217-3	1.093	3	5	8	5	4	0	12	**2.1**
MSFF038-3	1.086	6	3	6	5	3	2	24	2.1
MSBB635-14	1.077	5	5	3	8	2	2	20	**2.1**
MSEE171-2	1.080	3	6	6	4	6	0	12	2.2
MSFF007-2	1.085	4	7	6	1	3	4	16	2.2
MSGG409-3	1.078	1	11	9	3	1	5	3	2.2
MSDD249-9	1.087	2	5	6	8	2	1	8	**2.3**
Mackinaw	**1.092**	**2**	**4**	**8**	**7**	**1**	**2**	**8**	**2.3**
MSDD244-15	1.078	2	6	7	4	2	3	8	**2.3**
MSBB058-1	1.095	1	4	8	9	3	0	4	**2.4**
MSEE016-07	1.094	1	7	7	2	3	5	4	**2.6**
MSDD553-1	1.078	2	3	5	7	8	0	8	**2.6**
MSAA076-6	1.089	0	6	8	5	0	6	0	**2.7**
MSBB630-2	1.081	2	6	4	2	4	6	8	**2.8**
MSDD372-07	1.094	1	2	10	2	5	5	4	**2.9**
MSGG194-3	1.079	0	2	9	6	5	3	0	2.9
MSW474-1	1.082	0	3	4	5	7	6	0	3.4

Table of Contents

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 (contd.)									
MSEE035-4	1.091	1	1	2	6	10	5	4	3.5
MSEE016-10	1.095	0	2	0	3	9	8	0	4.0
ADAPTATION TRIAL, TABLESTOCK LINES									
MSFF145-2R	1.066	26	1	0	0	0	0	**96**	**0.0**
Colomba	1.051	22	3	0	0	0	0	88	0.1
MSZ109-8PP	1.066	22	3	0	0	0	0	88	0.1
MSCC553-1R	1.074	21	3	0	0	0	0	88	0.1
Golden Globe	1.065	20	4	1	0	0	0	80	0.2
MSFF305-1RY	1.071	19	6	0	0	0	0	76	0.2
MSFF142-1P	1.071	17	6	0	0	0	0	74	0.3
Becca Rose	1.064	19	5	1	0	0	0	76	0.3
Dark Red Norland	**1.057**	**17**	**7**	**0**	**0**	**0**	**0**	**71**	**0.3**
Blackberry	1.066	17	8	0	0	0	0	68	0.3
MSGG039-11	1.071	17	8	0	0	0	0	68	0.3
MSZ416-8RY	1.060	19	4	2	0	0	0	76	0.3
MSGG135-1R	1.076	17	7	1	0	0	0	68	0.4
MSDD088-1	1.073	15	8	1	0	0	0	63	0.4
MSFF230-2PY	1.080	18	5	2	1	0	0	69	0.5
MSGG039-08	1.071	16	6	3	0	0	0	64	0.5
MSGG084-1	1.070	15	7	1	1	0	0	63	0.5
MSBB371-1YSPL	1.073	13	11	1	0	0	0	52	0.5
MSAA174-1	1.058	12	10	2	0	1	0	48	0.7
MSAA182-3R	1.078	11	9	4	1	0	0	44	0.8
MSFF120-2Y	1.070	10	10	5	0	0	0	40	0.8
Reba	**1.071**	**8**	**10**	**4**	**0**	**0**	**0**	**36**	**0.8**
MSGG137-1R	1.070	9	12	3	1	0	0	36	0.8
MSFF182-1R	1.086	6	16	3	0	0	0	24	0.9
MSFF353-1R	1.078	11	7	6	1	0	0	44	0.9
MSGG127-3R	1.081	11	8	4	2	0	0	44	0.9
Yukon Gold	**1.071**	**9**	**10**	**6**	**0**	**0**	**0**	**36**	**0.9**
MSAA101-01RR	1.077	6	11	8	1	0	0	23	1.2
Jacqueline Lee	1.079	3	12	6	2	0	0	13	1.3
MSFF230-1	1.082	8	6	5	4	1	0	33	1.3
MSFF031-6	1.067	6	8	4	3	2	1	25	1.6
MSFF138-04R	1.077	5	6	7	6	1	1	19	1.8
MSFF335-2RR	1.066	2	4	7	5	1	0	11	1.9
PRELLIMINARY CHIP									
MSEE025-1	1.077	21	2	0	0	0	0	91	0.1
MSFF191-1Y	1.064	22	3	0	0	0	0	88	0.1
MSFF029-10	1.087	21	4	0	0	0	0	84	0.2
MSGG169-2	1.068	9	0	1	0	0	0	90	0.2
MSEE052-5	1.076	16	8	1	0	0	0	64	0.4
MSDD084-19	1.080	13	8	3	1	0	0	52	0.7
Mystere	1.076	12	9	4	0	0	0	48	0.7
MSFF022-2	1.076	12	8	3	1	1	0	48	0.8
MSDD050-B	1.069	12	4	5	2	1	0	50	1.0
MSEE063-6	1.080	3	6	3	0	0	0	25	1.0
MSGG190-1	1.078	10	8	4	2	1	0	40	1.0
MSFF008-1	1.078	5	6	4	4	0	0	26	1.4
MSFF035-2	1.080	3	10	11	0	1	0	12	1.4
Atlantic	**1.083**	**1**	**6**	**5**	**0**	**1**	**0**	**8**	**1.5**
Snowden	**1.085**	**2**	**8**	**10**	**5**	**0**	**0**	**8**	**1.7**
Mackinaw	**1.091**	**4**	**7**	**7**	**3**	**3**	**0**	**17**	**1.8**
MSGG242-1	1.088	1	8	7	5	3	0	4	2.0
MSGG302-1	1.090	1	1	5	5	1	0	8	2.3
Petoskey	1.095	0	3	12	8	2	0	0	2.4
MSEE149-1	1.079	2	2	3	2	3	1	15	2.4
MSEE149-2	1.084	3	4	6	4	6	2	12	2.5
MSFF088-1	1.083	3	1	3	4	4	2	18	2.6

Table of Contents

ENTRY	SP GR	NUMBER OF SPOTS PER TUBER 0	1	2	3	4	5+	PERCENT (%) BRUISE FREE	AVERAGE SPOTS/TUBER
PRELIMINARY PIGMENTED									
W17005-3R	1.059	21	1	0	0	0	0	95	0.0
W17026-4R	1.054	12	1	0	0	0	0	92	0.1
Dark Red Norland	**1.054**	**18**	**6**	**1**	**0**	**0**	**0**	**72**	**0.3**
W16025-5R	1.055	18	6	1				72	0.3
MSFF335-3Pinto	1.064	15	9	1	0	0	0	60	0.4
MSFF338-1PP	1.061	15	8	2	0	0	0	60	0.5
MSFF030-1WR	1.060	7	4	1	1	0	0	54	0.7
MSFF334-1Pinto	1.059	7	3	3	0	0	0	54	0.7
PRELIMINARY TABLE									
Sifra	1.061	21	2	1	0	0	0	88	0.2
Dark Red Norland	**1.056**	**13**	**1**	**1**	**0**	**0**	**0**	**87**	**0.2**
Camelia	1.060	19	6	0	0	0	0	76	0.2
Jelly	1.074	18	5	2	0	0	0	72	0.4
Allison	1.070	13	4	4	2	0	0	57	0.8
MSAA127-01PP	1.059	6	16	3	0	0	0	24	0.9
Spartan Splash	1.070	10	8	4	1	1	0	42	1.0
MSFF050-1	1.069	5	4	3	1	0	0	38	1.0
MSGG030-3Y	1.066	6	10	7	1	1	0	24	1.2
MSFF301-3SPL	1.079	8	4	10	3	0	0	32	1.3
MSFF149-01	1.081	6	9	3	5	2	0	24	1.5
USPB/SFA TRIAL CHECK SAMPLES (Not bruised)									
Lamoka	**1.083**	**15**	**7**	**2**	**1**	**0**	**0**	**60**	**0.6**
AF6165-9	1.085	11	10	4	0	0	0	44	0.7
Snowden	**1.085**	**11**	**10**	**2**	**2**	**0**	**0**	**44**	**0.8**
MSAFB635-15	1.087	11	9	2	3	0	0	44	0.9
NY174	1.079	7	11	6	0	1	0	28	1.1
AF6200-4	1.080	5	9	5	3	2	1	20	1.6
NY177	1.095	1	8	7	7	0	2	4	2.1
USPB/SFA TRIAL BRUISE SAMPLES									
NY174	1.079	5	7	9	3	0	1	20	1.6
MSAFB635-15	1.087	8	7	3	2	3	2	32	1.6
Lamoka	**1.083**	**2**	**8**	**6**	**7**	**1**	**1**	**8**	**2.0**
AF6165-9	1.085	2	7	6	4	5	1	8	2.2
Snowden	**1.085**	**3**	**6**	**7**	**3**	**3**	**3**	**12**	**2.2**
NY177	1.095	1	3	6	4	9	2	4	2.9
AF6200-4	1.080	1	4	2	3	2	13	4	3.6
DIPLOID TRIAL (replicated trial)									
MSHH618-01	1.068	25	0	0	0	0	0	100	0.0
Lamoka	**1.081**	**9**	**12**	**4**	**0**	**0**	**0**	**36**	**0.8**
MSHH693-01	1.088	7	9	5	2	2	0	28	1.3
MSHH699-02	1.092	6	6	3	5	0	1	29	1.5
MSII1591-2	1.099	5	6	6	3	3	0	22	1.7
MSGG655-01	1.084	3	6	9	5	1	1	12	1.9
Atlantic	**1.086**	**3**	**4**	**9**	**6**	**3**	**0**	**12**	**2.1**
MSFF690-01	1.081	6	3	5	7	2	2	24	2.1
MSHH1043-02	1.077	0	3	9	12	1	0	0	2.4
MSGG691-06	1.072	1	4	3	6	6	3	4	2.9
MSII1591-3	1.096	0	1	4	10	9	1	0	3.2
MSHH1041-4	1.068	0	2	2	7	3	4	0	3.3
MSII1081-2	1.083	0	1	3	2	3	3	0	3.3
MSII1117-1	1.084	0	1	3	7	8	5	0	3.5
MSHH664-01	1.074	0	1	1	5	12	6	0	3.8

* 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 10/27/2023.
The table is presented in ascending order of average number of spots per tuber.

2022-2023 MICHIGAN POTATO DEMONSTRATION STORAGE ANNUAL REPORT MICHIGAN POTATO INDUSTRY COMMISSION

Chris Long, Coordinator, Trina VanAtta, and Azamat Sardarbekov

Introduction and Acknowledgements

Round white potato production for chip processing continues to lead the potato market in Michigan. Michigan growers continually look for promising new round white varieties that meet necessary production and processing criteria. There are many variety trials underway in Michigan that evaluate chipping varieties for yield, solids, disease resistance, desired tuber size profile, and chipping quality with the hope of exhibiting the positive attributes of these lines to growers and processors. Extended storage chip quality and tuber storability are highly important in round white potato production. Therefore, any new chip processing varieties with commercialization potential will have storage profiles developed. Examining new varieties for long-term storage and processing quality keeps the Michigan chip industry at the leading edge of the snack food industry. The information in this report allows the industry to make informed decisions about the value of adopting these varieties into commercial production.

The Michigan Potato Industry Commission (MPIC) Potato Demonstration Storage Facility consists of two structures. The first building, the Dr. B. F. (Burt) Cargill Building, constructed in 1999, allows the Michigan potato industry to generate storage and chip quality data on newly identified chip processing clones. This information helps to establish the commercial potential of new varieties. This demonstration storage facility utilizes six 550 cwt. bulk bins (Bins 1-6) that have independent ventilation systems. The Ben Kudwa Building, built in 2008, has three independently ventilated 600 cwt. bulk bins. The first of these bulk bins, Bin 7, was converted to box bin storage that holds 36, 10 cwt. box bins to provide storage profiles on earlier generation potato varieties. The box bin is an entry point into storage profiling that allows the industry to learn about a variety's physical and chemical storability before advancing to the bulk bin level. A variety is evaluated for 4-6 years before entering box bin testing. In the variety development process, little information has been collected about a varieties' physical storability or chemical storage profile prior to being included in the box bin trial. A storage profile consists of monthly or bi-weekly sampling of potatoes to obtain sucrose and glucose

Table of Contents

levels, chip color, and defect values. In addition, we evaluate each variety for weight loss or shrinkage and pressure bruise. With this information we create the storage profile of a variety, providing the industry with a clearer picture of where a line can or cannot be utilized in the snack food industry. The Michigan potato industry hopes to use these storage profiles to improve long-term storage quality, deliverability of product and, ultimately, sustained market share.

The two remaining 600 cwt. bulk bins in the second structure are used to evaluate the post-harvest physiology of potatoes. The facility can be used to evaluate storage pathology or sprout inhibitor products. The Michigan potato industry recognizes the importance of controlling disease and sprout development in storage and is committed to doing research in these areas.

This sixteenth annual Demonstration Storage Report contains the results of the storage work conducted in the facility during the 2022-2023 storage season. Section I, "2022-2023 New Chip Processing Variety Box Bin Report", contains the results and highlights from our 10-cwt. box bin study. Section II, "2022-2023 Bulk Bin (500 cwt. bin) Report," shows bulk bin results, including information from commercial processors regarding these new varieties.

The storage facility, and the work done within it, is directed by the Michigan Potato Industry Commission (MPIC) Storage and Handling Committee and Michigan State University (MSU) faculty. The funding and financial support for this facility, and the research conducted within it, is largely derived from the MPIC. The committee occasionally receives support for a given project from private and/or public interests.

We wish to acknowledge all the support and investment we receive to operate and conduct storage research. First, we express our gratitude for the partnership we enjoy between the MPIC and MSU. Thank you to the MPIC Storage & Handling Committee for their investment of time, guiding the decisions and direction of the facility. Brice Stein, Walther Farms Cass City; Todd Young, and Chase Young, Sandyland Farms; Karl Ritchie, Walther Farms Three Rivers, Jeff Thorlund, Thorlund Brothers Farm, and Kyle Lennard, Lennard Ag. Co. for providing the material to fill the bulk bins this year; without their willingness to be involved, we could not have accomplished our objectives. Equal in importance are the processors who invested in this research. They are Mitch Keeney, Jim Fitzgerald, and Jack Corriere of UTZ Quality Foods, Inc., Hanover, PA, and Al Lee and Phil Gusmano of Better Made Snack Foods Inc., Detroit, MI. It has been a great pleasure to work with all of you. Special thanks to Butch Riley (Gun Valley Ag. & Industrial Services, Inc.) for his annual investment in the sprout treatment of the storage facility. We would also like to acknowledge a long list of additional contributors who invested much time to help foster a quality storage program: Dr. Dave Douches and the MSU Potato Breeding and Genetics Program, Todd Forbush (Techmark, Inc), Mathew Klein (Farm Manager, MSU Montcalm Research Center), and Tim and Matt Wilkes (Potato Services of Michigan). All played a role in making this facility useful to the Michigan potato industry.

Overview of the 2022 Production Season

The overall 6-month average maximum and minimum temperatures during the 2022 growing season in central Michigan was consistent with the 15-year average temperatures. April and September had cooler maximum temperatures than average while the other months were consistent with the average (Table 1). Minimum temperatures were consistent with the 15-year average. Extreme heat events were also average in 2022, with 11 hours over two days exceeding 90ºF during the summer (Table 2). High nighttime temperatures (over 70ºF) were consistent with the average, 123 hours over 26 days in 2022.

Rainfall for April through September was 19.82 inches, 1.34 inches above the 15-year average (Table 3). April, July, and, most significantly, August were rainier than average. August had almost three inches of additional rainfall compared to the 15-year average. May, June, and September were drier than average.

Table of Contents

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

Year	April		May		June		July		August		September		Average	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
2008	61	33	67	40	77	56	80	58	80	54	73	50	73	49
2009	56	33	67	45	76	54	75	53	76	56	74	49	71	48
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**
15-Year Average	56	33	70	45	78	55	82	60	80	57	74	50	73	50

Table 2. Six-year heat stress summary (from May 1st – Sept. 30th)*

Year	Temperatures > 90°F		Night (10pm-8am) Temperatures > 70°F	
	Hours	Days	Hours	Days
2017	14	3	80	18
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**
Average	8	2	120	27

Table of Contents

Table 3. 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
2008	1.59	1.69	2.95	3.07	3.03	5.03	17.36
2009	3.94	2.15	2.43	2.07	4.74	1.49	16.82
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	21.50
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	3.90	19.50
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	0.70	15.78
2018	2.04	5.51	3.64	1.19	7.73	2.65	22.76
2019	2.64	5.46	2.90	2.04	3.31	5.72	22.07
2020	3.49	4.75	1.40	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**
15-Year Average	3.26	3.33	3.00	2.61	3.64	2.65	18.48

*Weather data collected at the MSU Montcalm Research Center, Entrican, MI.

Table of Contents

I. 2022-2023 New Chip Processing Variety Box Bin Report

(Chris Long, Trina VanAtta, Azamat Sardarbekov, and Brian Sackett)

Introduction

This project evaluated new chip processing varieties from public and private breeding programs for processing quality after storage. We evaluated a variety's response to pile temperature, as reflected in sucrose and glucose levels, as well as weight loss and pressure bruise susceptibility. Bin 7 contains 36 10 cwt. boxes. We organized the 36 boxes into six stacks of six. The box design allows air to travel in from a header, or plenum wall, through the forklift holes of each box and up through the potatoes within it. The air continues to flow up through the next box until it reaches the top and is drawn off the top of the chamber. The air is then reconditioned and forced back through the header wall plenums and up through the boxes again. Each box contains a sample door facing the center aisle from which we sampled tubers for bi-weekly or monthly quality evaluations.

Procedure

In 2022, we evaluated and compared 32 new varieties to the check variety Snowden. Once the varieties were chosen, 1 cwt. of most varieties were planted in a single 34-inch wide row. Some varieties were planted on one half of a row for monthly sampling. Planting occurred on May 20th at the MSU Montcalm Research Center, Entrican, MI. We planted the varieties at a 10" in-row seed spacing. All varieties received the following fertilizer: 284 lb. N/A, 92 lb. P_2O_5/A and 299 lb. K_2O/A. The varieties were vine killed after 110 days and allowed to set skins for 23 days before harvest on September 20th and October 4th, which was 133 days after planting. We did not account for variety maturity in harvest timing due to storage and handling restrictions.

We placed approximately 10 cwt. of each variety in a box bin and stacked the boxes in Bin 7. The average storage temperature for all the box bins was 54.0ºF for the 2022-2023 season. At harvest, we collected nine 20 lb. samples from selected full row variety for weight loss and pressure bruise evaluation. We describe the varieties, their pedigree, and scab ratings in Table 4. We also recorded yield, size distribution, chip quality, and specific gravity at harvest in Table 5. We graded the varieties to remove all "B" size tubers and pickouts, ensuring that the tubers began storage in good physical condition.

Table of Contents

The storage season began October 4th, 2022, and ended June 5th, 2023. Bin 7 was gassed with DMN and CIPC on November 4th, 2022 and March 14th, 2023. We began variety evaluations on October 4th, followed by a bi-weekly or monthly sampling schedule until early June. We randomly selected forty tubers from each box biweekly or monthly and sent them to Techmark, Inc. for sucrose, glucose, chip color, and defect evaluation. We also evaluated pressure bruising by placing nine pressure sample bags for select varieties in one of the bulk bins at the storage facility. We placed three bags at each of 3', 8', and 14' from the pile floor. When that bin was unloaded, we weighed the sample bags and calculated percent weight loss. We evaluated a 25-tuber sample from each of the nine bags for the presence or absence of pressure bruise. We recorded the number of tubers and severity of bruise. All pressure bruises were evaluated for discoloration.

This report is not an archive of all the data that we generated for the box bin trial, but rather a summary of the data from the most promising lines. This report presents a summary of information from the best performing lines from this trial that will be moved forward in the commercialization process. For more information, please contact Chris Long at Michigan State University in the Department of Plant, Soil and Microbial Sciences at (517) 256-6529 or longch@msu.edu. Additional data is available on the program website, canr.msu.edu/potatooutreach and database, msupotato.medius.re.

Table 4. 2022-2023 MPIC Demonstration Chip Box Bin Variety Descriptions

Entry	Pedigree	2022 Scab Rating*	Characteristics
AF6526-7	Pike x AF5040-8	2.3	Below average yield, common scab susceptible, flat oval tuber type, thin skin
AF6603-5	NY121 x MSR127-2	1.4	Below average yield, average specific gravity, common scab susceptibility, blocky round type
Bliss (NY163)	NYE50-8 x NYE48-2	0.7	Very low yield, smaller tuber size profile, low specific gravity, some purple skin pigmentation
CO12293-1W	CO02024-9W x ND7519-1	1.1	Above average yield, common scab susceptibility, blocky round type, thin skin
Dundee (MSW474-1)	MSN190-2 x MSP516-A	0.6	Low yield, significantly smaller tuber size, uniform round type
Mackinaw	Saginaw Chipper x Lamoka	0.5	Above average yield, high vascular discoloration, very low scab susceptibility, non-uniform type
MSAA076-6	MSR127-2 x MSS297-3	0.7	Above average yield, above average defects, poor appearance
MSAA260-03	MSQ086-3 x Atlantic	1.1	Low scab susceptibility, trace stem end defects, blocky round tuber type
MSAFB609-12	NY148 x MSQ086-3	1.1	Very low average yield, common scab susceptibility, smaller flat round to oval tuber type
MSAFB635-15	NYH15-5 x MSS297-3	1.3	Good internal quality, smaller uniform round type, common scab susceptible
MSBB008-3	Atlantic x MSR127-2	0.9	Average specific gravity, above average vascular discoloration, flat round to oval tuber type
MSBB058-1	NY148 x MSR127-2	0.9	Average internal defects, average yield, blocky round type
MSBB610-13	NY148 x MST096-2Y	0.4	Average yield, above average internal defects, flat blocky round to oval type

Table of Contents

Entry	Pedigree	2022 Scab Rating*	Characteristics
MSBB614-15	Saginaw Chipper x MSR127-2	0.4	Moderate to large size profile, average yield, significant vascular discoloration, high proportion pick outs
MSBB630-2	Lady Liberty x Kalkaska	0.5	High yield, low scab susceptibility, medium round type
MSBB636-11	Lady Liberty x MST096-2Y	0.6	Very high yield, large blocky type, high proportion pick outs, pit rot
MSDD084-19	NY148 x M5	0.6	Severe hollow heart and vascular discoloration, large flat blocky type
MSDD088-1	NY154 x MSQ086-3	0.4	Very high yield, low specific gravity, high vascular discoloration
MSDD089-2	NY154 x MSR127-2	0.5	Low specific gravity, round to oval type, low scab susceptibility
MSDD244-05	Mackinaw x MSR127-2	0.5	Low yield, blocky round type, deep apical eyes
MSDD376-4	NY148 x MSV033-1	0.4	High vascular discoloration, low scab susceptibility, flat round type
MSDD553-01	Mackinaw x MSQ086-3	0.7	Average yield, no defects, significantly smaller tuber size profile
MSEE031-3	MSZ219-14 x Lamoka	0.2	Low vascular discoloration, average defect susceptibility, light netted skin
MSFF097-6	MSR127-2 x MSCC725-174	0.4	Low yield, significantly smaller tuber size profile, high vascular discoloration
Dundee (MSZ242-13)	MSR169-8Y x MSU383-A	0.5	High yield, many defects, high specific gravity, less uniform shape
NY168	NY148 x E48-2	1.1	Low scab susceptibility, flat round to oval type, not uniform

Table of Contents

Entry	Pedigree	2022 Scab Rating*	Characteristics
NY174	NY148 x E48-2	0.3	High yield, high vascular discoloration, large flat blocky type
NY175	Lady Liberty x NYF31-1	0.8	Low yield, excellent internal quality, high scab susceptibility
NY179 (NYR1-7)	Andover x Lady Liberty	1.0	Average yield , high vascular discoloration, flat round to oval type
NYS37-2	K31-4 x F31-3	0.7	Very low yield, moderate size, average specific gravity
Sinatra	Hanse Seed	1.5	Low yield, many defects, high scab susceptibility
Snowden	**B5141-6 x Wischip**	**1.9**	**High hollow heart susceptibility, high vascular discoloration, flat, round type**
W15NYR11-13	NY158 x NYF31-3	1.3	High yield, high vascular discoloration, high scab susceptibility

*Scab rating based on 0-5 scale; 0 = most resistant and 5 = most susceptible across all locations in 2022. Common scab data and qualitative descriptions provided by the Potato Outreach Program.

Table 5. 2022 Storage Chip Processing Potato Variety Trial
Montcalm Research Center Box Bin

Planting: 5/20/22 Vine Kill: 9/7/22 Harvest: 9/30/22 and 10/4/22

GDD_{40}: 3045

LINE	CWT/A		PERCENT OF TOTAL[1]							RAW TUBER QUALITY[4] (%)								
	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR[2]	OTF CHIP SCORE[3]	HH	VD	IBS	BC	COMMON SCAB RATING[5]	SED SCORE[6]	VINE VIGOR[7]	VINE MATURITY[8]	COMMENTS
MSDD088-1	602	646	93	7	93	0	0	1.075	1.0	0	30	0	0	0.5	0.3	3.0	3.0	flat round to oval type, light netted skin, slight alligator hide and pink eye
NY174	573	602	95	5	95	0	0	1.091	1.0	10	20	0	0	0.5	0.4	3.5	3.5	large flat blocky tuber type, thin netted skin
Mackinaw	529	558	95	5	94	1	0	1.091	1.0	0	30	0	0	0.0	0.2	2.0	2.0	non uniform type, moderate rhizoctonia, heavy netted skin
MSBB636-11	528	572	92	4	85	7	4	1.078	1.0	0	20	0	0	1.0	0.1	1.5	3.0	large blocky round type, light skin, skinning, poor shape, moderate pit rot
MSAA076-6	499	574	87	10	87	0	3	1.091	1.0	0	20	0	0	1.0	0.4	2.5	2.5	poor appearance, deeper apical eyes, light netted skin
MSAA260-03	498	529	94	5	93	1	1	1.093	1.5	0	20	0	0	0.5	0.9	3.0	3.0	blocky round tuber type, thin skin, deep apical eyes
W15NYR11-13	474	550	86	14	86	0	0	1.085	1.0	0	30	0	0	1.5	0.2	3.0	3.0	nice tuber size profile, medium netted skin
MSBB630-2	461	525	88	9	88	0	3	1.083	1.5	0	0	0	0	0.5	0.3	2.0	2.0	medium round tuber type, light netted skin, nice appearance
Dundee (MSZ242-13)	458	509	90	5	90	0	5	1.098	1.0	0	0	0	0	1.0	0.3	2.5	2.5	blocky flat round to oval type, less uniform shape
MSBB058-1	444	495	90	9	90	0	1	1.097	1.0	0	0	0	0	0.5	0.2	2.5	2.5	blocky round type, light netted skin, trace skinning
MSBB008-3	423	448	94	6	94	0	0	1.083	1.0	0	20	0	0	1.0	0.6	2.5	2.5	flat round to oval tuber type, medium netted skin
Snowden	**417**	**463**	**90**	**10**	**90**	**0**	**0**	**1.091**	**1.0**	**40**	**30**	**0**	**0**	**2.0**	**0.3**	**2.5**	**2.5**	**flat round tuber type, medium to heavy netted skin**
MSDD084-19	410	467	88	11	88	0	1	1.077	1.0	40	20	0	0	0.5	0.1	2.0	2.0	large flat blocky tuber type
MSBB614-15	407	430	95	2	90	5	3	1.083	1.0	0	20	0	0	0.5	0.0	2.5	2.5	large flat oval type, growth crack in pickouts, sheep nose in large tubers
MSBB610-13	402	443	91	7	89	2	2	1.081	1.0	0	0	0	0	0.5	0.4	2.0	2.0	flat blocky round to oval type, medium netted skin
MSEE031-3	386	418	92	7	92	0	1	1.088	1.0	0	0	0	0	0.5	0.7	2.5	2.5	flat round to oval tuber type, light netted skin
MSDD089-2	382	400	96	3	94	2	1	1.078	1.0	0	0	0	0	0.5	0.1	1.5	1.5	round to oval tuber type, medium netted skin
NY179 (NYR1-7)	375	419	90	10	90	0	0	1.088	1.0	0	30	0	0	1.0	0.4	3.5	3.5	flat round to oval type, think skin
CO12293-1W	370	403	92	7	92	0	1	1.074	1.0	0	20	0	0	1.5	0.3	3.0	3.0	blocky round type, thin skin, trace growth crack in pickouts
MSDD244-05	367	391	94	6	94	0	0	1.089	1.0	0	0	0	0	1.0	0.1	2.5	2.5	blocky round tuber type, medium netted skin, deeper apical eyes
MSDD376-4	359	390	92	7	92	0	1	1.085	1.5	0	20	0	0	0.5	0.0	2.5	2.5	flat round tuber type, medium to heavy netted skin
MSDD553-01	359	435	83	17	81	2	0	1.092	1.0	0	10	0	0	0.5	0.7	2.0	2.0	flat round type, medium netted skin
NY168	351	413	85	14	85	0	1	1.091	1.0	0	0	0	0	0.0	0.8	2.5	2.5	flat round to oval type, not uniform, thin skin, purple skin pigmentation
AF6603-5	343	392	88	12	88	0	0	1.087	1.0	0	20	0	0	2.0	0.0	2.5	2.5	blocky round type, light netted skin
MSFF097-6	295	368	80	20	80	0	0	1.088	1.0	0	30	0	0	0.5	0.0	2.0	2.0	small round uniform type, medium to heavy netted skin
MSW474-1	280	353	79	21	79	0	0	1.083	1.0	0	10	0	0	0.5	0.1	2.5	3.5	uniform round tuber type, medium netted skin
NY175	270	328	82	18	82	0	0	1.080	1.0	0	0	0	0	1.5	0.6	3.0	3.0	blocky round tuber type, thin skin
MSAFB635-15	266	403	66	34	66	0	0	1.094	1.0	0	10	0	0	1.5	0.1	2.5	2.5	smaller uniform round type, medium netted skin
AF6526-7	226	274	83	15	83	0	2	1.083	1.0	0	0	0	0	2.5	0.1	3.0	3.0	flat oval tuber type, thin skin
NYS37-2	218	226	96	4	96	0	0	1.088	1.0	0	0	0	0	0.5	0.0	2.0	2.0	flat round type, light netted skin
MSAFB609-12	204	257	79	21	79	0	0	1.081	1.0	0	0	0	0	2.0	0.5	2.0	2.0	smaller flat round to oval tuber type, thin skin
Bliss (NY163)	141	258	55	45	55	0	0	1.077	1.0	0	0	0	0	0.0	0.2	2.0	2.0	small round uniform type, thin skin, moderate purple skin pigmentation
Sinatra	132	308	43	53	43	0	4	1.089	1.0	0	0	0	0	1.5	0.1	3.5	3.5	flat oval to oblong tuber type, thin skin
MEAN	**377**	**432**	**86**	**13**	**86**	**1**	**1**	**1.086**	**1.0**	**3**	**12**	**0**	**0**	**0.9**	**0.3**	**2.5**	**2.6**	

[1]**SIZE**
Bs: < 1 7/8"
As: 1 7/8" - 3 1/4"
OV: > 3 1/4"
PO: Pickouts

[2]**SPECIFIC GRAVITY**
Data not replicated

[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: 6/23/22
Rating 1-5
1: Slow emergence
5: Early emergence (vigorous vines, some flowering)

[8]**VINE MATURITY RATING**
Date: 8/11/22
Rating 1-5
1: Early (vines completely dead)
5: Late (vigorous vines, some flowering)

FIELD DATA

Planting date	5/20/22
Vine Kill Date	9/7/22
Harvest Date	9/30/22 and 10/4/22
Days (planting to vine kill)	110
Days (planting to harvest)	133
GDD_{40} MAWN Station	Entrican
GDD_{40} (planting to vine kill)	3045
Seed Spacing	10"

Results: 2022-2023 Chip Processing Box Bin Highlights

MSBB058-1

This variety has been evaluated by the Potato Outreach Program since 2019. At harvest, the specific gravity was 1.097, one of the highest in the trial. The US#1 yield was 444 cwt/A, above average in 2022 (Table 5). Two pre-harvest samples were taken on August 14^{th} and August 28^{th} in which rising glucose and sucrose indicated potential chemical immaturity. This variety exhibited mid-season maturity, below average common scab incidence, and a higher percentage of US#1 tubers than the trial average. It had good out of the field chip quality with a 1.0 chip score and slightly less stem end defect than the trial average. Sucrose concentrations were initially high but generally decreased through February. Concentrations rose to a high of 0.462%X10 at the last sample. Glucose concentrations were more stable. After a high initial value of 0.005 in the second sample due to the elevated sucrose, the remaining samples all had concentrations between 0.001% and 0.002% through bin unloading. No undesirable color was present during storage. There were two instances of internal color, both below 10%. Total defects were initially high due to bruising, but chip quality improved over time with 9.9% total defects in the final sample. This variety maintains good chip quality through early June and continues to demonstrate long term storage potential in Michigan. It remains under evaluation in Michigan.

Figure 1. MSBB058-1 chip samples at the first processing date on 10/4/22 (left) and last processing date on 6/5/23 (right).

Table of Contents

MSDD244-05

This Michigan State University variety was first evaluated by the Potato Outreach Program in 2022. It had a slightly below average yield potential of 367 cwt/A US#1 tubers but a high proportion of A-sized tubers. The specific gravity was slightly above average and internal quality was excellent. Vine size and maturity were average for the trial. Chip quality after harvest was good, with stem end defect and chip scores consistent with the trial average (Table 5). Between the two pre-harvest samples, increasing glucose and decreasing sucrose indicated chemical maturity. MSDD244-05 was sampled monthly instead of biweekly. The sucrose concentration decreased until it reached a low of 0.260%X10 in March. The concentration then rose and reached the highest level at bin unloading in June, 1.305%X10. Glucose was stable until the final storage sample, when it rose to 0.004%. All previous samples had glucose levels between 0.001% and 0.002%. Only one sample had internal color, and no samples had undesirable color. Total defects were highest during early storage and generally decreased through February. The final sample in June had 17.3% total defects. Good agronomic characteristics and excellent chip quality though May indicate this variety may be suitable for Michigan production. It will be further evaluated in the 2023-2024 box bin with biweekly sampling.

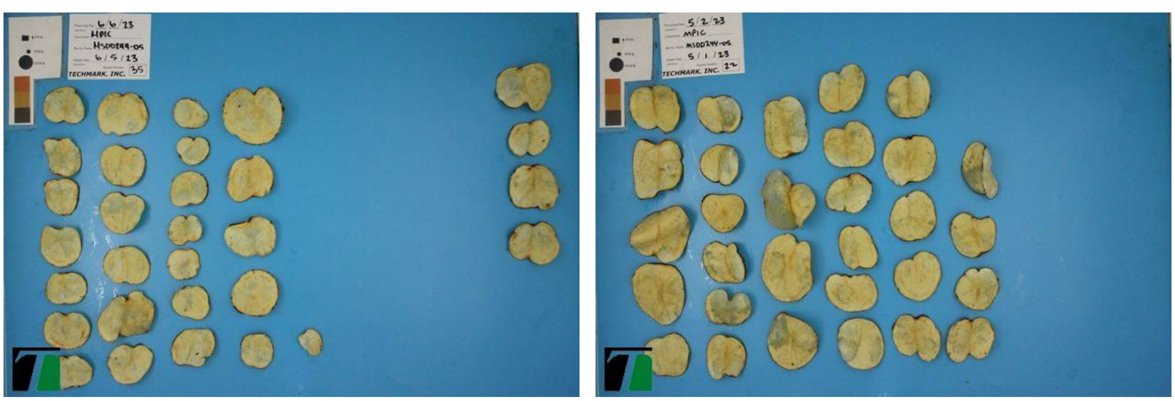


Figure 2. MSDD244-05 chip quality on last acceptable sample date, 5/1/23 (left) and last storage sample, 6/5/23 (right).

Table of Contents

NY174

This Cornell University variety was first evaluated by the Potato Outreach Program in 2021. It had an above average US#1 yield of 573wt/A, the second highest in the trial in 2022. It also had a very high total yield of 602 cwt/A. NY174 had 95% A-sized tubers, 5% B-sized tubers, and no pickouts or oversized tubers. The specific gravity of 1.086 was above average in 2022. Internal quality was below average, with 10% hollow heart and 20% vascular discoloration observed. NY174 was slightly less susceptible to common scab than average and had a scab score of 0.5. Out of the field chip quality was consistent with the trial average. This variety has a larger vine size and later maturity, but decreasing glucose and sucrose indicated chemical maturity at harvest (Table 5). The sucrose concentration followed a U-shaped trend, decreasing through January, remaining stable through March, then increasing through the end of storage. Glucose concentrations were slightly higher during early storage but were stable until the end of storage. Concentrations rose slightly in June, ending at 0.003%. Chip quality was variable during storage. While there were no instances of undesirable color, total defects were all over 30% from October to December. Chip quality improved through May, when there were no defects present in the second to last sample. The final chip sample had 10.3% defects. Most unacceptable chips were due to stem end color in early storage and bruising in the middle of storage. While not suitable for short term storage, NY174 produces excellent chips in May and June. It will be further evaluated in Michigan.

Figure 3. NY174 chip quality on the first (10/4/22, left) and last sample dates (6/5/23, right).

Table of Contents

Snowden

This variety was the commercial standard for the 2022-2023 Box Bin trial. It had an above average US#1 and total yield. With 90% A-sized tubers and ten percent B-sized tubers, the tuber size profile was consistent with the average. The specific gravity of 1.091 was higher than the trial average of 1.086 in 2022. Internal quality at harvest was marginal with 40% hollow heart and 30% vascular discoloration. Chip quality was good with a SNAC color score of 1.0 and a stem end score of 0.3, consistent with the average. In 2022 this variety had a both a vine type and vine maturity average for the trial (Table 5). In storage, sucrose concentrations followed a U-shaped trend, generally decreasing from the beginning of storage until February, then rising until bin unloading in June. The final sucrose concentration was 1.0608%X10. Glucose concentrations were stable for most of storage, and ranged between 0.001% and 0.005% until May. The final three samples were the highest in the season, ending at 0.029% in June. Snowden had good chip quality though most of storage, with one instance of undesirable color, and internal color defects at or below 13% in all samples. Total defects were highest during early storage, the second storage sample had almost 70% defects. Chip quality improved through winter, and the final chip sample had no defects. Chip defects were caused by stem end color during early storage, but the tubers reconditioned in storage and stem end defects were not present in any samples from January to June. Hollow heart was present in seven chip samples. Snowden continues to be grown and stored in Michigan and remains the standard for the Box Bin trials.

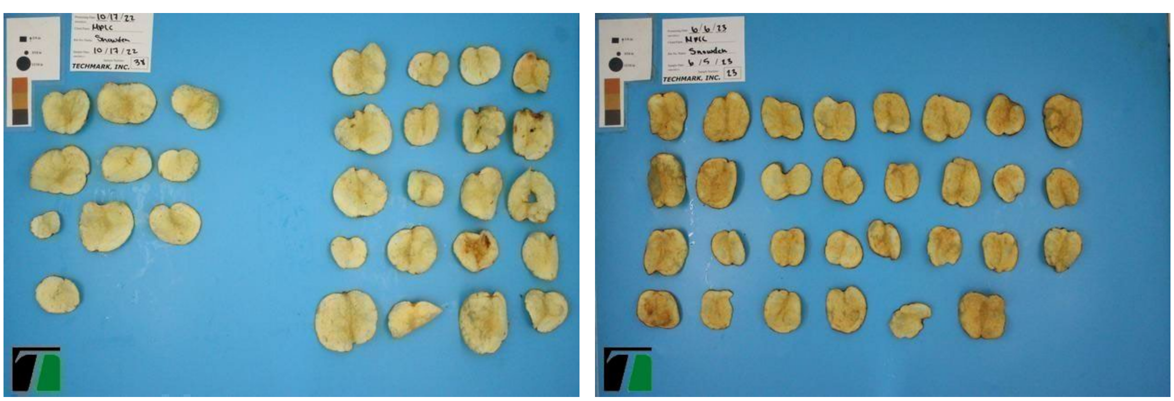


Figure 6. Snowden chip quality prior to reconditioning in storage on 10/17/22 (left) and last sample date, 6/5/23 (right).

Table of Contents

II. 2022 - 2023 Bulk Bin (500 cwt. Bin) Report

(Chris Long, Trina VanAtta, Azamat Sardarbekov, and Brian Sackett)

Overview and Objectives

The goals of the MPIC Storage and Handling Committee for the 2022-2023 bulk bin storage season were: (1) To refine optimal storage profiles for MSW474-1 given variable locations and growing degree days, determining if storage quality merits further variety evaluation (2) To refine optimal storage profiles for Bliss, specifically to determine optimal target temperature and storage duration (3) To evaluate storage pathogen susceptibility, storage profile, and skin color of NDA050237B-1R, a red skinned variety (4) To evaluate storage pathogen development and sprouting in Dundee prior to replanting.

Procedure

Each bin was filled under contract with potato producers in the state of Michigan. The MPIC paid field contract price for the potatoes to be delivered to the demonstration storage. Pressure bruise samples were collected for each bulk bin and designated bulk bins were filled. The varieties and their storage management strategies were established by the MPIC Storage and Handling Committee. For each bulk bin filled, a corresponding box bin containing 10 cwt. was filled and placed into Bin 7. Bin 7 was held at 54ºF, which was warmer than the corresponding bulk bin of the same variety. This allowed the committee to see if the warmer storage temperature in the box bin would reduce storage life and provided information on how the bulk bin tubers might physiologically age. All bulk bins were treated with DMN and CIPC at different times in the storage season, depending on goals for each bin.

2022-2023 Bulk Bin assignments:
1: MSW474-1 (Walther Farms Cass City)
2: Bliss (Sandyland Farms)
3 and 4: MSW474-1 (Walther Farms Three Rivers)
5 and 6: MSW474-1 (Thorlund Brothers)
7: Box Bins

8: NDA050237B-1R (Walther Farms Cass City)
9: Dundee (Lennard Ag. Co.)

We began sugar monitoring the day tubers were loaded into storage and sampled tubers on a two-week schedule thereafter. Forty tubers were removed from the sample door in each bin every two weeks and sent to Techmark, Inc. for sucrose, glucose, chip color, and defect evaluation. The sample door is located in the center back side of each storage bin and allows us to take samples three feet above the bottom of the pile. Pressure bruise evaluation began by collecting nine 20 to 25 lb. tuber samples as each bin was filled. Three samples were placed at each of three different levels within the bulk bin pile at 3, 8, and 14 feet from the storage floor.

We evaluated the pressure bruise samples 3 to 5 days after the bin was unloaded. We randomly selected a set of 25 tubers from each bag and visually inspected for pressure bruising. By removing the tuber skin with a knife, we evaluated the discoloration for each flat spot. A visual rating established presence or absence of flesh color (blackening of flesh). We calculated percent weight loss in each tuber sample as it was removed from the storage.

Bin 1: MSW474-1 Storage Trial (GDD$_{40}$ 3593, 51ºF)

MSW474-1, a Michigan State University variety, has been evaluated by the Potato Outreach Program since 2015. In the past seven years it has consistently displayed an average to above average yield, good internal quality, high specific gravity, and a high proportion of A-sized tubers. The smaller tuber size profile makes it appealing to processors, while the resistance to common scab and storage rot tolerance makes it attractive for long-term storage. Notably, it is resistant to both pink rot and Fusarium dry rot, and moderately tolerant to bacterial soft rot. Unlike Snowden and Lamoka, it is moderately susceptible to Pythium leak. While there are several strong agronomic and storage characteristics, fresh chip quality is generally poor and must recondition in storage, the maturity is later than that of Snowden, and the tubers can be susceptible to cold

Table of Contents

induced sweetening. Due to the full season maturity, late season nitrogen applications can result in chemically immature tubers at harvest which do not store well through spring. This bulk bin trial evaluated the variety as a Snowden or Lamoka replacement in storage locations.

The initial pulp temperature was 49.0ºF during loading on 9/30/22. The bin temperature was maintained around 52ºF for the duration of storage. In November of 2022, the Storage and Handling Committee chose to stop evaluations of MSW474-1 in all bins due to late vine maturity and its effects on chip quality. The original target temperature was not met, as the storage and handling committee chose to hold the bin at 52ºF and ship to a processor when the tubers reached acceptable quality.

The seed was planted in Cass City, MI on 5/7/22 and vine killed on 9/10/22 (126 DAP, GDD_{40} 3593). This field was harvested on 9/30/22, 146 days after planting. At loading, the were 45.1% bruise free with an average of 1.9 bruises per tuber.

Results

MSW474-1 was grown at Walther Farms, Cass City Michigan. The Potato Outreach Program conducted a test dig prior to vine kill, in which ten feet of potatoes were harvested and graded. A US#1 yield of 361 cwt/A and total yield of 450 cwt/A were calculated from this test dig. Specific gravity was 1.081. There were 18.3 tubers per plant, 4.1 tubers per stem, and an average tuber weight of 4.3 ounces. There were 71% A-sized tubers, 10% B-sized tubers, 10% oversize tubers, and 9% pickouts (Table 6). One preharvest panel was done on 8/31/22, just before vine kill (Table 7).

The sucrose concentration in tubers sampled shortly after bin loading was 0.624%X10, and rose though mid-November. After this sample, concentration decreased through February, ending at a low of 0.342%X10 on February 6th. Concentrations generally rose through the end of storage, with a final sucrose concentration of 0.473%X10 on April 3rd. The glucose concentrations were more variable and ranged between a high of 0.009% on December 5th and a low below the detection threshold of Techmark, Inc. equipment on January 16th. At bin unloading, the final concentration was 0.003%. Total chip defects were initially high, as MSW474-1 must recondition during early storage. The October 31st sample had the highest defect incidence of 73.1% total defects. Chip quality improved with each sample until January 16th sample with 15.3% defects. The final sample had 11.3% defects on April 3rd (Figure 7).

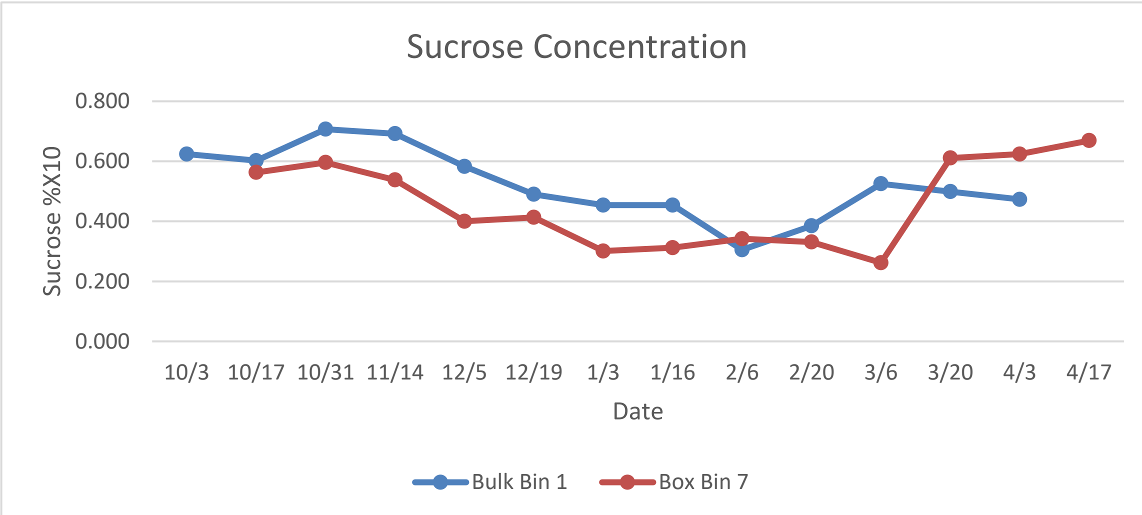
The Storage and Handling Committee had planned to cool the bin to 48ºF if the sucrose and glucose concentrations began to decrease. This would indicate that the tubers could tolerate a colder temperature. Unfortunately, the glucose remained variable, and this goal was not met. The bin was unloaded on April 11th with a pulp temperature of 51.0ºF (Figure 8). Chips images from three points in the storage season are included in Figure 9. The tubers were sent to Better Made Snack Foods, Inc., Detroit MI and were processed on April 12th. Pressure bruise data was not collected.

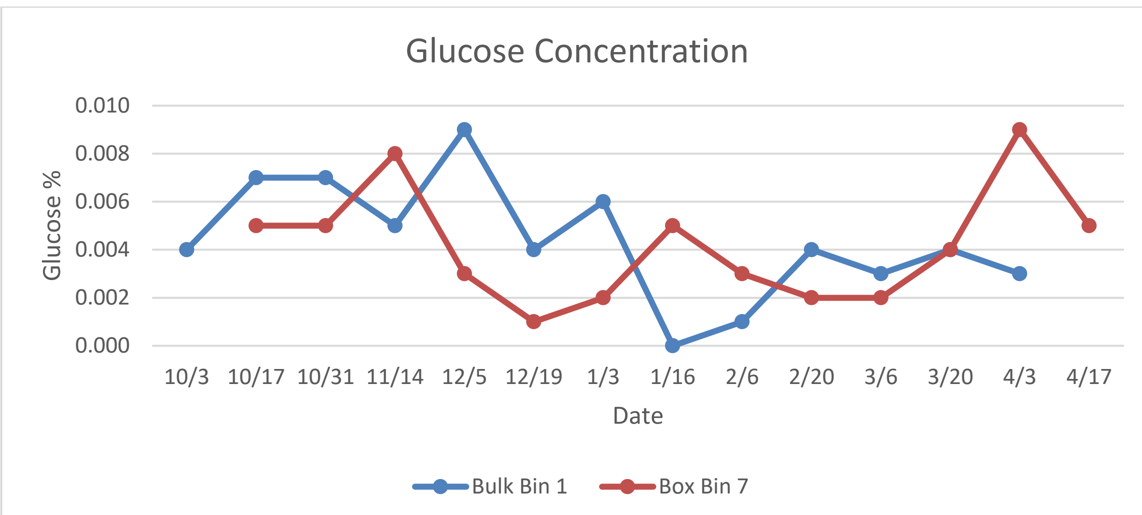
Better Made chipped the MSW474-1 tubers and observed 20.44% total defects, mostly due to sugar browning and external defects. The Agtron color of 64.9 was acceptable, but the defect incidence was too high. Better Made accepts loads with defects less than 17%. The specific gravity was 1.082. Better Made provided two chip samples to the Potato Outreach Program: one sample collected prior to Opti-Sort and one after Opti-Sort. POP staff sorted the chips into acceptable, internal defects, external defects, and sugar defects. Before Opti-Sort, the chips were 87% acceptable, 2% sugar defects, 4% internal defects, and 7% external defects (Figure 10). After the chips were sorted, POP staff found 94% acceptable, 1% sugar defects, 2% internal defects, and 3% external defects (Figure 11).

MSW474-1 may be successful in western states with longer day length and growing season due to the full-season maturity. Only one pre-harvest sample was collected in 2022 so a determination on variety maturity could not be made for this bin, but MSW474-1 was likely chemically immature at harvest. This variety is no longer under evaluation in Michigan, as the agronomic qualities were not strong enough to motivate further study on storage management.

Table of Contents

Figure 7. Sucrose concentration, glucose concentration, and total defects in Bin 1, Walther Cass City MSW474-1 compared to the same box bin variety.





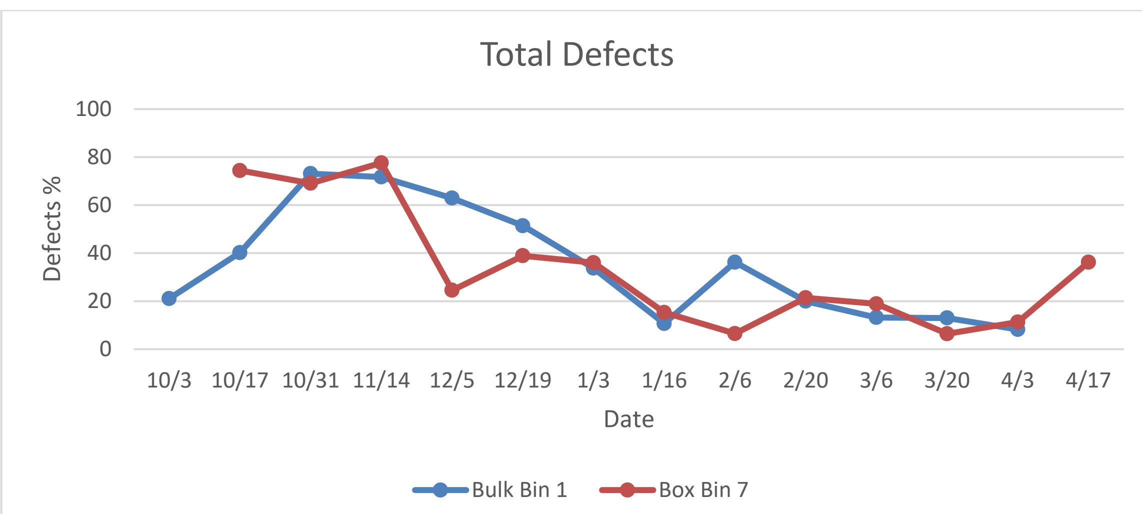


Table of Contents

Figure 8. MSW474-1 tubers at bin unloading on 4/11/23.

Figure 9. Bulk Bin 1 chips on the first sample date (10/3/22, left), sample with highest defect incidence (10/31/22, middle), and final sample date (4/3/23, right).

Figure 10. Tubers chipped by Better Made on 4/12/23 sorted at Michigan State University be defect type. These chips were collected prior to Opti-Sort. Acceptable chips are on the left, internal (top), external (middle) and sugar browning defects (bottom) are on the right.

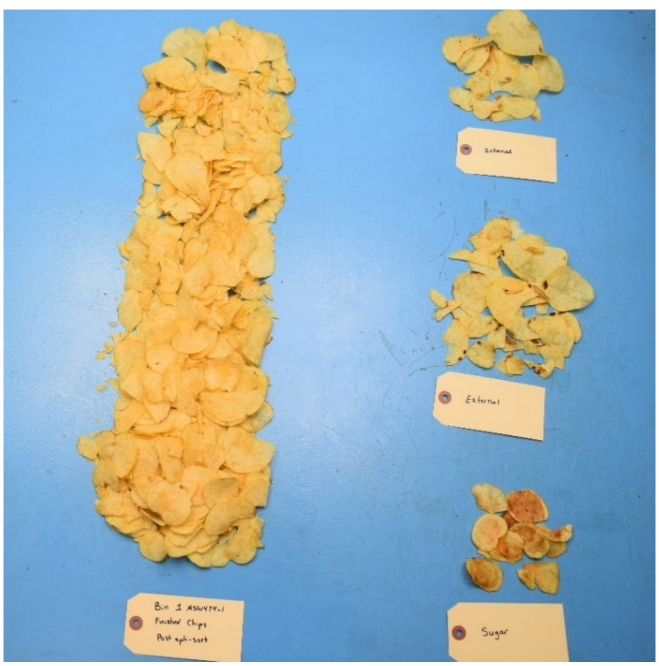


Figure 11. Tubers chipped by Better Made on 4/12/23 sorted at Michigan State University be defect type. These chips were collected after Opti-Sort. Categories are the same as those described in Figure 10.

Table of Contents

Table 6. 2022 Montcalm Research Center Bulk Bins
Bulk Planting Test Digs

LINE	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR[2]	Stand Count	Stem Count	Bs	As	OV	PO	Total Tubers	Tubers per Plant	Tubers per Stem	Average Tuber Weight (oz)	RAW TUBER QUALITY[3] (%) HH	VD	IBS	BC
Bin 1 MSW474-1 Walther Farms, Cass City	361	450	81	10	71	10	9	1.081	6	27	32	59	4	15	110	18.3	4.1	4.3	0	20	0	0
Bin 2 NY163 Sandyland Farms	384	457	84	15	78	6	1	1.080	10	36	49	95	4	1	149	14.9	4.1	3.3	0	0	0	0
Bin 3 and 4 MSW474-1 Walther Farms, Three Rivers	433	502	86	13	84	2	1	1.090	9	39	38	94	1	1	134	14.9	3.4	3.9	0	0	0	0
Bin 5 and 6 MSW474-1 Thorlund Bros.	339	418	81	19	79	2	0	1.088	9	31	48	49	1	0	98	10.9	3.2	3.4	0	10	0	0
Bin 9 MSZ242-13 Lennard Ag. Co.	388	426	91	4	76	15	5	1.080	7	13	14	58	6	2	80	11.4	6.2	5.5	0	0	0	0
Lamoka Walther Farms, Cass City	272	363	75	17	69	6	8	1.079	7	32	39	56	2	9	106	15.1	3.3	3.6	0	10	0	0
Mackinaw Walther Farms, Three Rivers	385	456	85	5	44	41	11	1.091	8	17	14	34	14	8	70	8.8	4.1	6.8	10	0	0	0
MEAN	**366**	**439**	**83**	**12**	**72**	**12**	**5**	**1.084**	**8**	**28**	**33**	**64**	**5**	**5**	**107**	**13.5**	**4.1**	**4.4**	**1**	**6**	**0**	**0**

[1]**SIZE**
Bs: < 3 oz
As: 3 - 10 oz
OV: > 10 oz
PO: Pickouts

[2]**SPECIFIC GRAVITY**
Data not replicated

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

Table 7. 2022 Chip Process Potatoes
Bulk Planting Pre-Harvest Panels

LINE	Sugar Profile: Glucose %	Sugar Profile: Sucrose %X10	Specific Gravity	Frito Lay Solids	Date
MSW474-1 Walther Farms, Bin 1	0.010	0.387	1.102	20.70	8/31/22
Bliss Sandyland Farms, Bin 2	0.004	0.750	1.090	18.56	8/15/22
Bliss Sandyland Farms, Bin 2	0.000*	0.884	1.078	16.42	8/29/22
MSW474-1 Walther Farms, Bins 3 and 4	0.001	0.262	1.088	18.03	9/6/22
MSW474-1 Thorlund Bros., Bins 5 and 6	0.005	0.725	1.097	19.81	8/15/22
MSW474-1 Thorlund Bros., Bins 5 and 6	0.002	0.860	1.086	17.85	8/29/22

*Glucose was present in this sample, but was below the detection threshold of Techmark, Inc.

Table of Contents

Bin 2, Bliss Storage Trial (GDD_{40} 2919, 48ºF)

Bliss (NY163) was developed at Cornell University and has been evaluated by the Potato Outreach Program since 2016. While the yield is typically average to below average, it has a high tuber set and a smaller tuber size profile, both of which are appealing to the current needs of chip processors. Bliss is tolerant to both common scab and stem end defects and has an earlier vine maturity than Snowden. The thin skin makes it attractive to chip processors but does increase the potential for storage rot. It has good fresh chip quality and medium-term storage potential. It has been evaluated for long term storage, but pathogen susceptibility and earlier vine maturity usually causes chip quality to decline prior to June. Some chip blistering has occurred in the 2020 crop, but not in the 2021 or 2022 seasons. Regardless, using the variety for wavy or kettle chips prevents the defect from impacting processing quality. At bin loading the tubers were 51.2% bruise free with an average of 1.5 bruises per tuber. The tubers were planted at Sandyland Farms, Howard City, Michigan on 5/20/22, and were vine killed on 9/1/22, 104 days after planting. The potatoes were harvested on 10/7/22, 140 days after planting. The pulp temperature was 56ºF at bin loading. The Bliss seed was planted in a field with Manistee.

Results

The Potato Outreach Program conducted a ten-foot test dig of NY163 in August 2022. US#1 yield was 384 cwt/A and total yield was 457 cwt/A. There were 78% A-sized tubers and 15% B-sized tubers. The specific gravity was 1.083. The internal quality was good with no defects observed (Table 6). Pre-harvest panels were taken on August 15th and 29th. Between samples, the specific gravity decreased, sucrose increased, and glucose decreased (Table 7). This indicated potential chemical immaturity in the tubers prior to vine kill. The bin was initially cooled to 49ºF at 0.4ºF per day and was further cooled to 48ºF at 0.2ºF per day. This temperature was maintained from December to bin unloading on 4/11/23.

The sucrose concentrations in Bliss followed a generally decreasing trend. Concentrations were highest at 0.748%X10 on October 7th, the first storage sample. The final sucrose

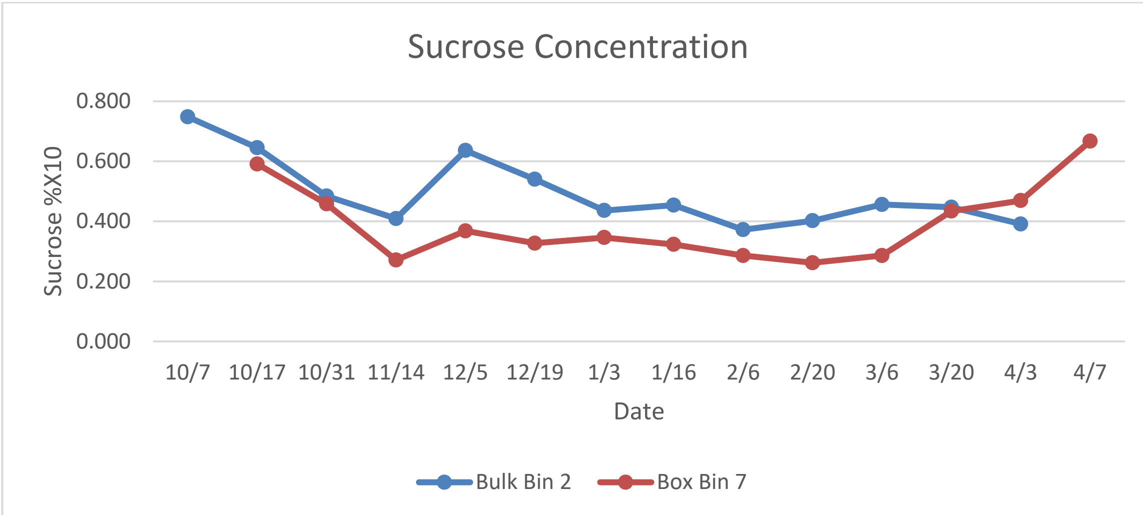
Table of Contents

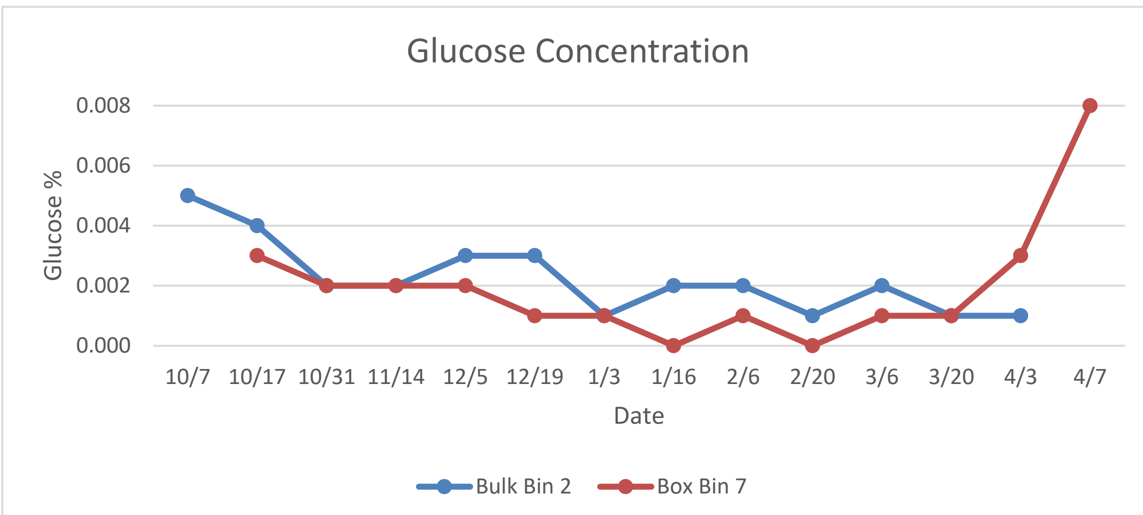
concentration was 0.391%X10 on April 3rd. The glucose concentration also generally decreased during storage, beginning at 0.005% and ending at 0.001%. The same tubers held in the box bin at 54ºF had lower sucrose and glucose concentrations but followed the same trend of decreasing over time. However, the final sample in the box bin had 0.667%X10 sucrose and 0.008% glucose, suggesting that continuing to hold Bliss at 48ºF for longer would result in increased sucrose and therefore poorer chip quality. Chip defects were initially high, almost 60% in the October 31st sample, but the last four samples had defects below 8% (Figure 12).

The bin was unloaded on 4/11/23 and the potatoes were shipped to Utz Quality Foods, Hanover PA (Figure 13). On the day of bin unloading, a sample of tubers was chipped at Sackett Potatoes (Figure 14). The specific gravity was 1.079 and the Frito Lay solids were 16.47. Staff at Utz Quality Foods photographed the tubers and chips (Figures 15 and 16). They calculated a specific gravity of 1.078 and 3% total defects, both of which are excellent. A sample of chips produced at Utz was sent to Michigan State University and the chips were sorted by Potato Outreach Program staff. In this evaluation, there were 94% acceptable chips, 3% internal defects, 3% external defects, and less than one percent sugar browning defects (Figure 17). The first and last samples chipped by Techmark, Inc display the consistent chip quality (Figure 18).

Bliss continues to display many beneficial agronomic and processing traits to replace Atlantic and Pike for fresh chipping and for mid-season storage in Michigan. It will be further evaluated in 2023-2024 storage.

Figure 12. Sucrose concentrations, glucose concentrations, and total defects in Bin 2, Sandyland Bliss compared to the same box bin variety





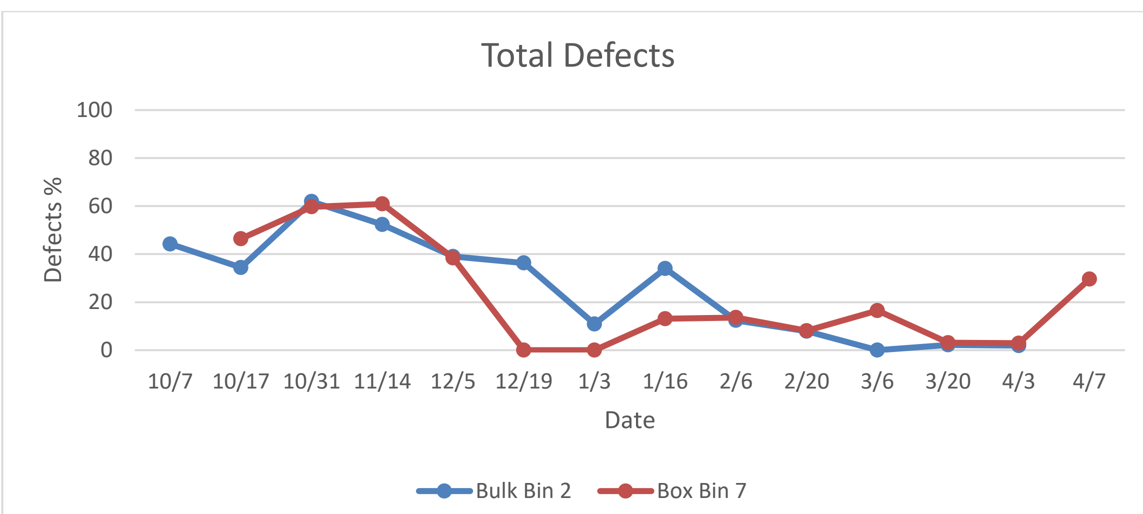


Table of Contents

Figure 13. Bliss tubers at bin unloading on 4/11/23.

Figure 14. Chips produced at Sackett Potatoes on 4/11/23 from Bliss tubers in Bin 2.

Table of Contents

Figure 15. Tubers prior to chipping at Utz Quality foods on 4/12/23.

Figure 16. Chips produced from Bliss tubers at Utz Quality Foods on 4/12/23.

Table of Contents

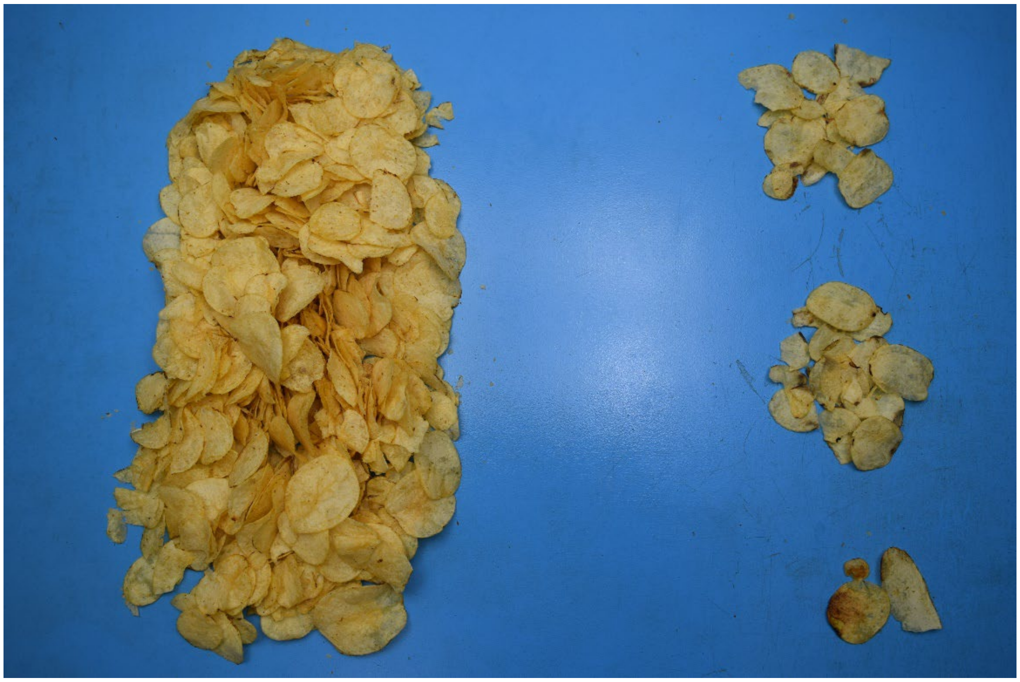


Figure 17. Utz chips sorted by Potato Outreach Program staff. Acceptable chips are on the left, defects are (from top to bottom) internal, external, and sugar.

Figure 18. Chips at the first sample on 10/7/22 (left) and last sample on 4/3/23 (right).

Table of Contents

Bins 3 and 4: MSW474-1 Storage Trial (GDD_{40} 3520, 48ºF)

The past agronomic and storage traits of MSW474-1 are discussed in the narrative on Bin 1. These two bulk bins were filled with potatoes grown by Walther Farms in Three Rivers, MI. The Potato Outreach Program conducted a ten-foot test dig prior to vine kill and calculated 433 cwt/A US#1 yield and 502 cwt/A total yield. The specific gravity was 1.081 and no internal defects were observed. There were 14.9 tubers per plant and 3.4 tubers per stem. The average tuber weight was 3.9 ounces. The tuber size profile was 84% A-sized tubers, 13% B-sized tubers, two percent oversize tubers, and one percent pickouts (Table 6). The potatoes in both bins were planted on May 12th and vines were killed on September 6th (117 DAP, GDD_{40} 3520). Harvest occurred on October 7th, 148 days after planting. At harvest the pulp temperature was 51.4ºF for both bins. The tubers were already bruised at bin loading, with five percent bruise free tubers in Bin 3 and 27.5% bruise free tubers in Bin 4. There was an average of 2.8 bruises per tuber in Bin 3 and 2.7 bruises per tuber in Bin 4. One pre-harvest sample was taken on September 6th, so no determination on chemical maturity can be made (Table 7). The bins were loaded on October 7th. Bin 3 was treated with DMN and CIPC on November 4th and February 8th. Bin 4 was treated with DMN and CIPC on those two dates and on November 21st.

Results

Bulk Bin 3: MSW474-1

The initial target temperature for this bin was 52ºF, which was reached in early December by cooling at a rate of 0.2ºF per day. The Storage and Handling committee chose to maintain the bin at this temperature and watch for signs of reconditioning since all samples displayed elevated sucrose and poor chip quality. The tubers did not recondition, so sugar sampling ceased after the 12/19/22 sample. All glucose concentrations were elevated in Bin 3 during storage. A concentration of 0.005% or lower is preferred in storage potatoes, but all samples had concentrations above this level, most notably the 12/5/22 sample with

0.038% glucose. The sucrose was also elevated during storage with all but the first sample above 0.56%X10. The elevated sucrose and glucose, failure to recondition, and black spot bruise severity at bin loading caused very poor chip quality, even at temperatures over 50ºF. All samples had defects over 83%, and two samples had only unacceptable chips (Figures 19 and 20). The box bin of the same variety was held at 54ºF, but also had a high proportion of defects even in the warmer temperature. After the first sample, all box bin samples of Walther Farms Three Rivers MSW474-1 had defects over 82% (Figure 20).

Bin 3 was unloaded on February 28th and the potatoes were sold to Campbell's Soup. No processing data is available. At bin unloading, the average tuber weight loss was 5.47%. There were 45% of tubers without pressure bruise, 31% bruised without color, and 24% bruised with color (Table 8). As stated in the narrative for Bin 1, MSW474-1 is no longer under evaluation in Michigan.

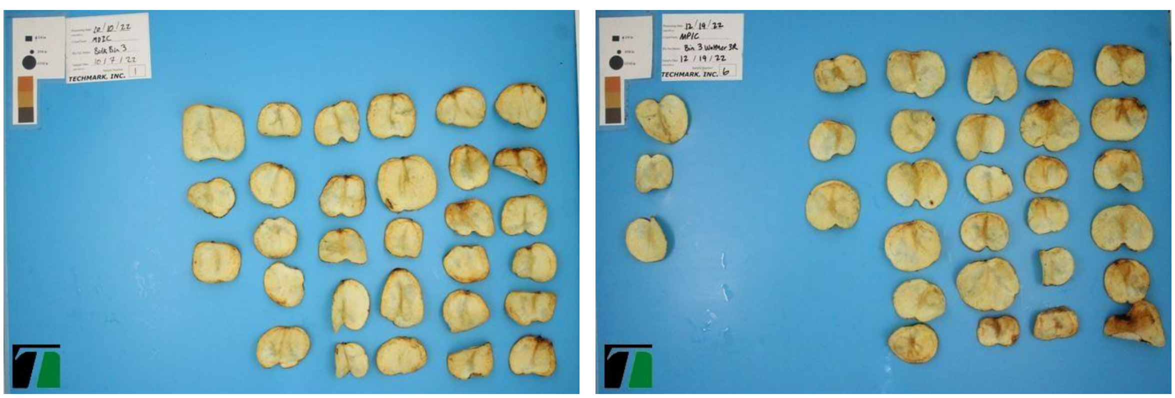
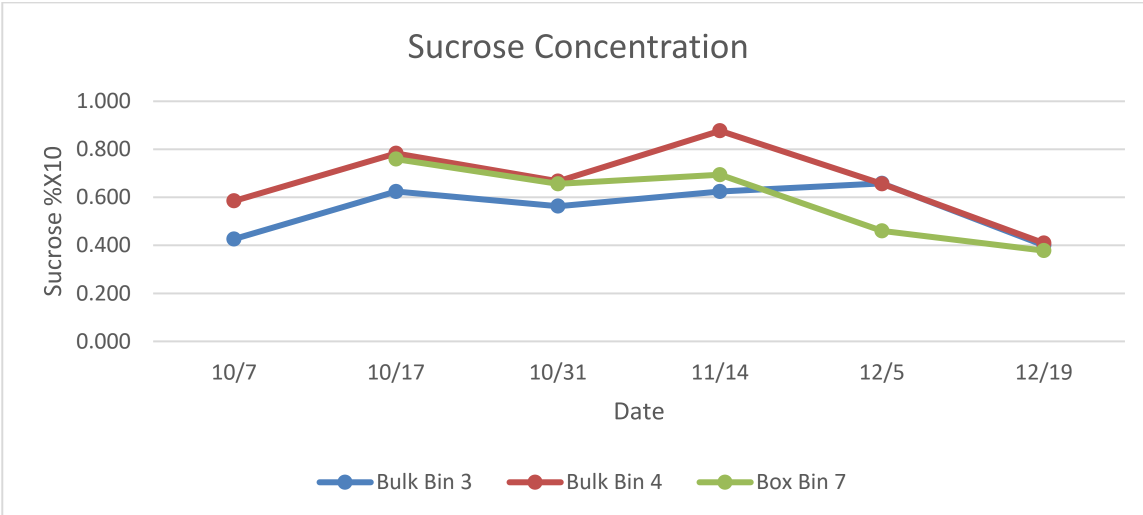
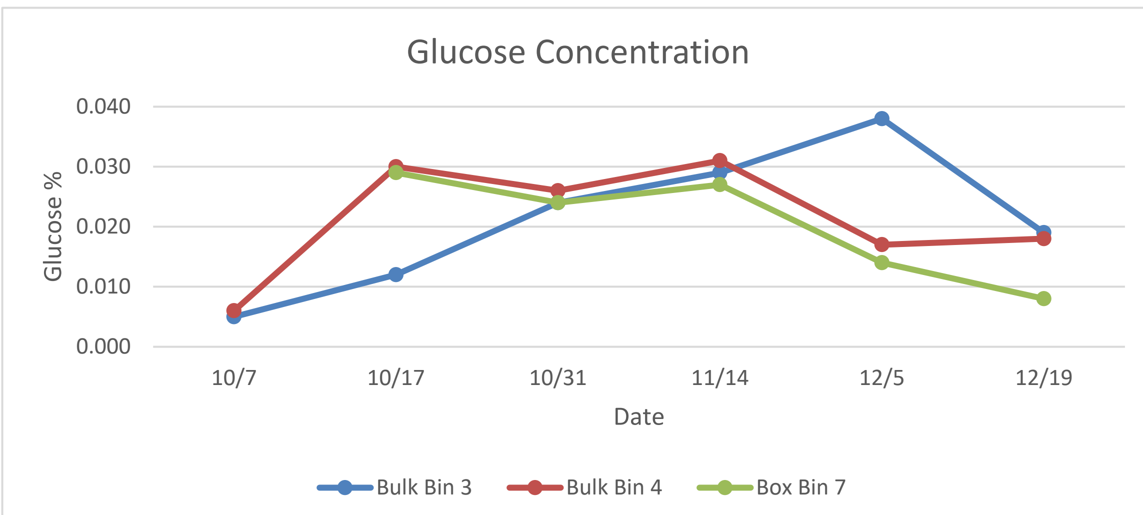


Figure 19. Images from the first chip sample on 10/7/22 and final sample on 12/19/22 from Bin 3.

Table of Contents

Figure 20. Sucrose concentrations, glucose concentrations, and total defects in Bins 3 and 4 Walther Farms Three Rivers MSW474-1 compared to the same box bin variety.





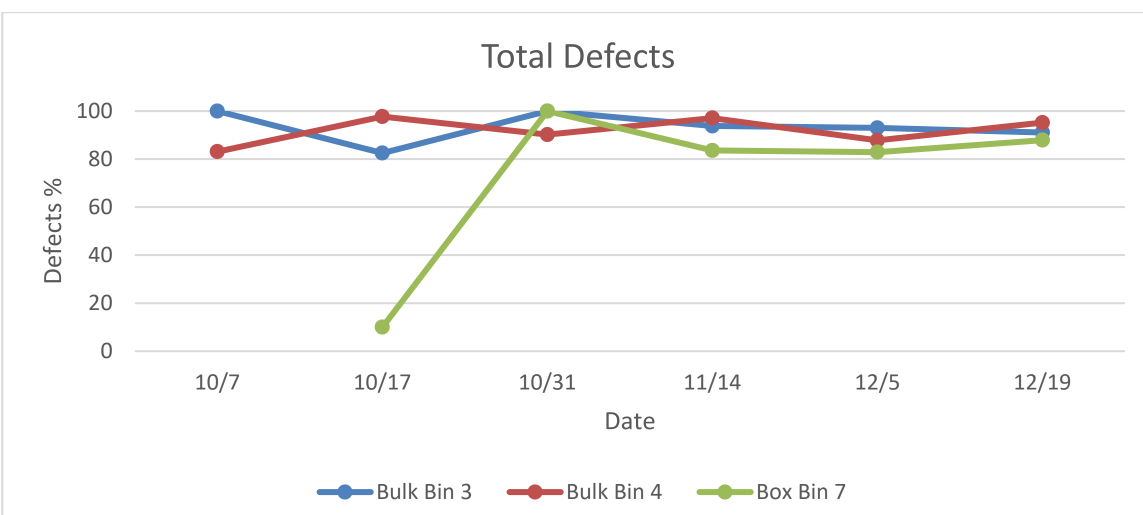


Table of Contents

Bulk Bin 4, MSW474-1

The Storage and Handling Committee initially planned to use the potatoes in Bin 3 and Bin 4 to study the effect of cooling rate or final target temperature and the effects on chip quality. The potatoes were grown in the same field, so chip quality differences between the two bins would be a result of storage management practices. Unfortunately, this was not possible due to early chip quality assessments, so Bin 4 was treated almost identically to Bin 3 due to the artificially shortened storage season.

As in Bin 3, glucose concentrations rose in Bin 4 in the initial samples, and only decreased slightly in the last sample on 12/19/22. The final concentration of 0.018% was still over three times higher than the standard maximum desirable level of 0.005%. The sucrose concentrations remained elevated during storage and ended at a concentration almost identical to that of Bin 3. Finally, total defects were very high in Bin 4. All six samples had over 83% total defects (Figures 20 and 21).

Bin 4 was also unloaded on February 28th and sold to Campbell's Soup. The tubers had an average 5.63% weight loss in storage. Forty three percent of the tubers had no pressure bruise at bin unloading, 41% were bruised with color, and 16% were bruised without color (Table 8). MSW474-1 will no longer be evaluated in Michigan.

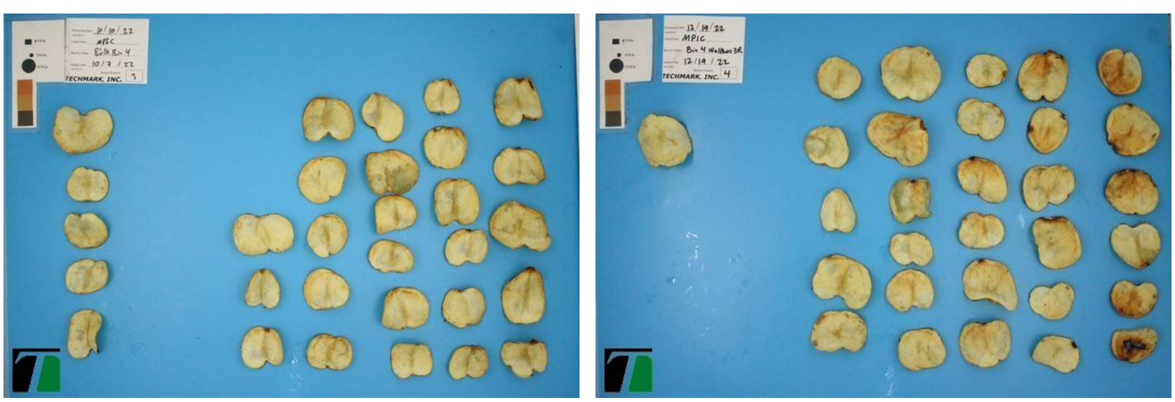


Figure 21. Images from the first chip sample on 10/7/22 and final sample on 12/19/22 from Bin 4.

Table of Contents

Table 8. 2022-2023 PRESSURE BRUISE DATA Bulk Bin #3 and #4 MSW474-1 (Three Rivers, MI)								
Location[1]	Average Weight Loss (%)	Average Number of External Pressure Bruises Per Tuber[2]				Average % of Total Tuber Number		
		0	1	2	3+	Without Bruise	Bruised (No Color)	Bruised with Color[3]
14' Bin 3	5.00	11	9	3	2	44	35	21
8' Bin 3	5.14	14	9	2	0	57	21	21
3' Bin 3	6.26	8	10	4	3	33	37	29
OVERALL AVERAGES	**5.47**					**45**	**31**	**24**
14’ Bin 4	5.14	15	7	3	1	59	33	8
8’ Bin 4	4.76	12	8	4	2	47	39	15
3’ Bin 4	7.01	6	10	7	2	24	52	24
OVERALL AVERAGES	**5.63**					**43**	**41**	**16**

[1]Feet above the bin floor.
[2]A Sample of 25 tubers randomly selected. Each tuber was first evaluated for the number of visual pressure bruises 0, 1, 2, 3+.
[3]A cut slice was removed just below the skin of each bruised area. If any flesh was darkened, it was scored as a tuber "with color".

Loaded	10/27/22(both)	Pulp Temp. (at Filling)	51.4ºF (both)		
Unloaded	2/28/23 (both)	Target Storage Temp.	52.0ºF (both)	End Temp.	47.8ºF (3) 48.0ºF (4)

Table of Contents

Bins 5 and 6: MSW474-1 (GDD_{40} 3312, 53ºF)

The evaluation history, agronomic and storage data of MSW474-1 have been discussed previously in this report. Bulk Bins 5 and 6 were filled with Potatoes from Thorlund Brothers Farm, Greenville, MI. This field was planted on May 15th and vine kill occurred on September 10th (118 DAP, 3312 GDD_{40}). A ten-foot test dig prior to vine kill calculated a US#1 yield of 339 cwt/A and a total yield of 418 cwt/A. The specific gravity was 1.088, and ten percent vascular discoloration was observed. There were 10.9 tubers per plant, 3.2 tubers per stem, and the average tuber weight was 3.4 ounces (Table 6). The potatoes were harvested on October 21st, 159 days after planting. At bin loading the pulp temperature was 46.0ºF in Bin 5 and 47.0ºF in Bin 6. Tubers were 2.5% and 2.6% bruise free, respectively.

Two pre-harvest samples were taken for this variety on August 15th and August 29th. The decreasing specific gravity and increasing sucrose indicated potential chemical immaturity (Table 7). Both bins were gassed with DMN and CIPC on November 21st and February 8th. Different target temperatures or rates of cooling between the bins were not realized due to high sucrose and glucose without evidence of early recondition. The Storage and Handling Committee shifted its priorities to keeping the bins warm and maintaining chip quality to sell and ship the potatoes in the spring. Both bins were held near 53ºF in service of this goal.

The main goal of the multiple bins of MSW474-1 from three locations was to determine if a region, number of growing degree days, or a fertility management strategy is best suited for long term storage of this variety. In bin pairs 3 and 4 and 5 and 6, there were plans to study the rate of cooling and target temperature difference and this effect on chip quality and storability.

Table of Contents

Results

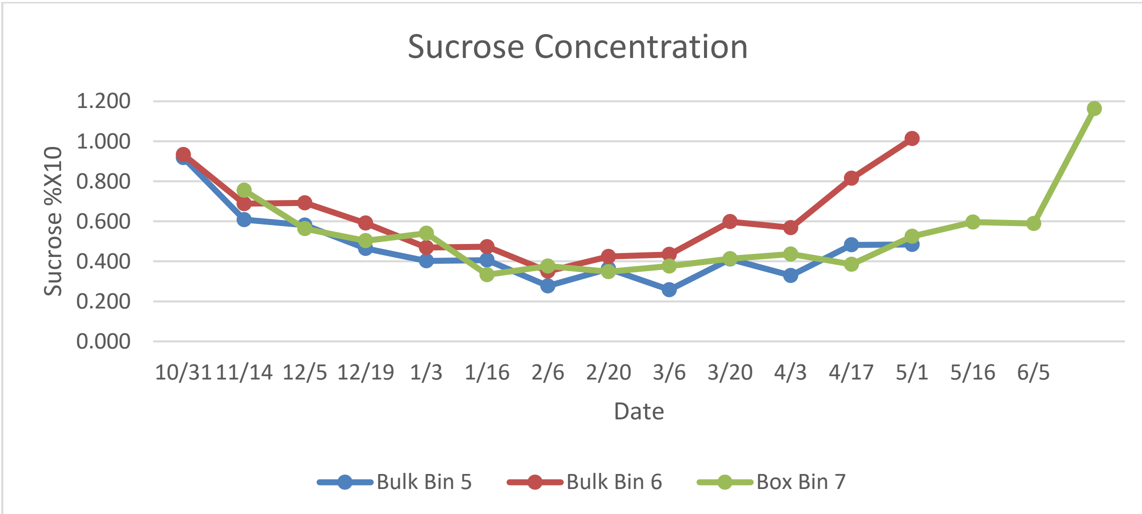
Bulk Bin 5: MSW474-1

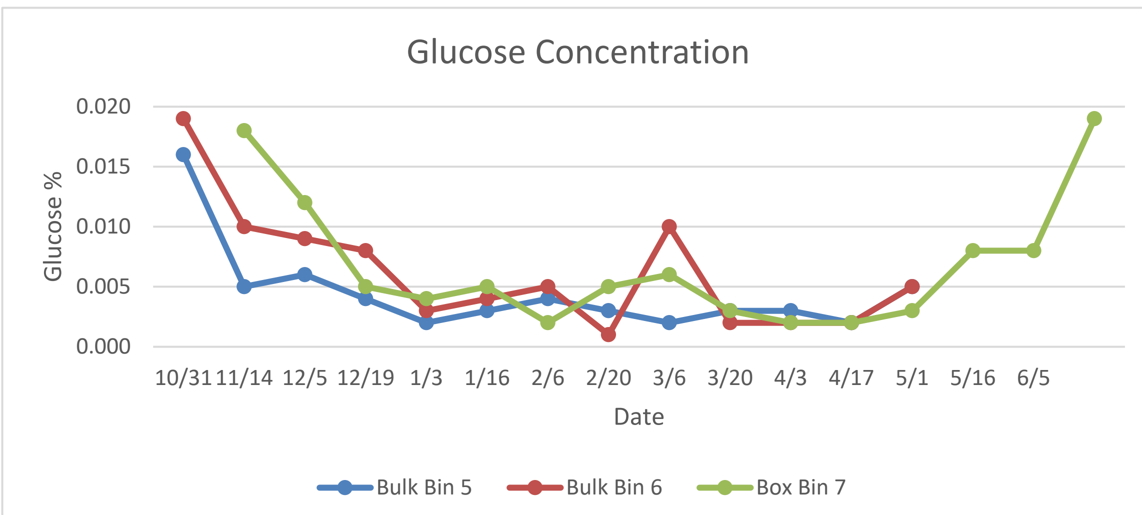
The temperature in Bulk Bin 5 was maintained near 53ºF for the duration of storage. The sucrose concentration followed a U-shaped trend, generally decreasing from a high of 0.918%X10 on 10/31/22 to the lowest point in the season on 0.258%X10 on 3/6/23. After this sample, concentrations increased though the end of storage on May 1st when the final concentration was 0.484%X10. The glucose concentration was initially elevated and was 0.016% in the first storage sample. Concentrations then followed a decreasing trend until the penultimate sample on 4/17/23. Concentrations rose slightly on the last sample taken May 1st to 0.484% (Figure 22). Decreasing chip defects early in storage show that MSW474-1 can move sucrose and glucose, improving chip color and reducing chip defects. While defects decreased from bin loading until the 1/16/23 sample, further bin cooling below 53ºF would have exacerbated chip defects and was not attempted. The most desirable chip sample with the fewest defects was the 4/3/23 sample with only 5.4% total defects (Figure 23). Defect incidence rose after this sample and ended at 31.5% (Figure 22).

Bin 5 was last sampled on May 1st and unloaded shortly after along with Bin 6. Both bins were sent to Better Made Snack Foods Inc., Detroit MI for processing. The potatoes were chipped on May 8th (Figure 24). Better Made found the chipped tubers to have 33.98% total defects, well over their 17% threshold for accepting a load of potatoes. They identified 1.11% greening defects, 14.76% internal defects, and 18.11% external defects.

The average tuber weight loss was 6.97% at bin unloading. 76% of tubers were pressure bruise free, 16% were bruised with no color, and eight percent were bruised with color (Table 9).

Figure 22. Sucrose concentrations, glucose concentrations, and total defects in Bins 5 and 6 Thorlund MSW474-1 compared to the same box bin variety.





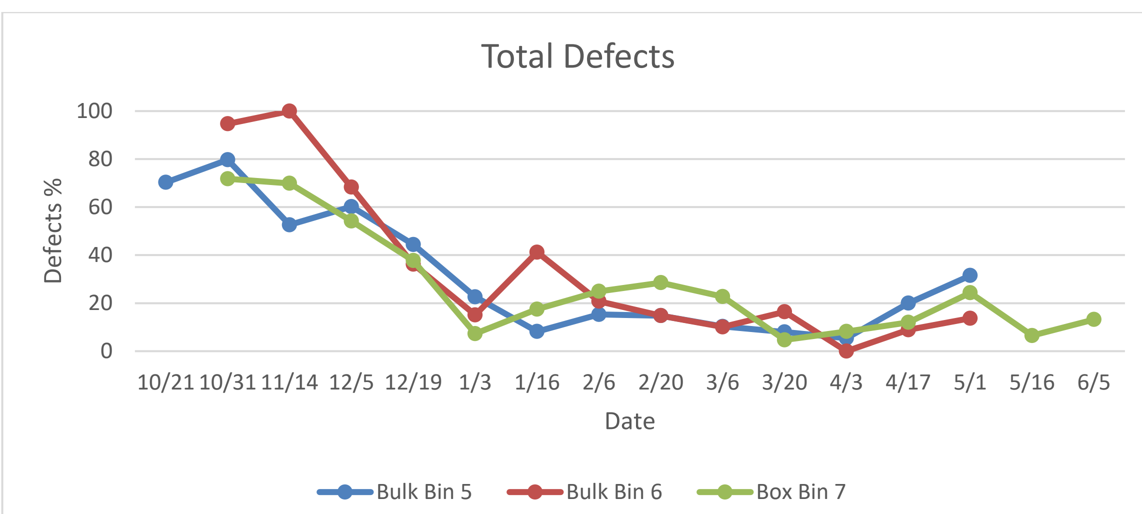


Table of Contents

Figure 23. Bulk bin 5 first chip sample on 10/21/22 (left), and best quality chip sample on 4/3/23 (right).

Figure 24. Potatoes chipped at Better Made Snack Foods from Bin 5 on 5/8/23.

Table of Contents

Bulk Bin 6: MSW474-1

This bin performed like Bin 5 in terms of total chip defects and glucose concentrations. The sucrose concentrations also followed a U-shaped trend, decreasing from 0.933%X10 on 10/31/22 to 0.350%X10 on 2/6/23, the lowest value during storage. After this time, the concentrations rose, exceeding those of Bin 5 and ending at 1.013%X10. This is almost twice the final sucrose concentration of Bin 5, which ended at 0.525%X10 on 5/1/23. As in Bin 5, the total defects were highest at the beginning of storage and the 11/14/22 sample had no acceptable chips. Chip quality improved over time, especially the 4/3/23 sample which had no chip defects (Figure 25). At the final sample on 5/1/23 there were 13.7% chip defects. The final glucose concentration was 0.005% (Figure 22).

Bin 6 was unloaded with Bin 5 and was also sent to Better Made Snack Foods, Inc. The chipped potatoes had 32.75% total defects, well above the 17% threshold at Better Made (Figure 26). Of the defects, 2.39% were browning, 1.94% greening, 4.84% internal, and 23.58% external. Average weight loss in Bin 6 was 9.66%. 42% of tubers were bruise free, 56% were bruised with no color, and two percent were bruised with color (Table 9).

Based on chip quality in Bin 6 as well as other bins of MSW474-1, this variety is no longer under evaluation in Michigan.

Figure 25. Bulk Bin 6 first chip sample on 10/31/22 (left), and best quality chip sample on 4/3/23 (right).

Figure 26. Chips processed from Bin 6 at Better Made Snack Foods on 5/8/23.

Table 9. 2021-2022 PRESSURE BRUISE DATA
Bulk Bin #5 and #6 MSW474-1 (Greenville, MI)

Location[1]	Average Weight Loss (%)	Average Number of External Pressure Bruises Per Tuber[2] 0	1	2	3+	Average % of Total Tuber Number: Without Bruise	Bruised (No Color)	Bruised with Color[3]
14' Bin 5	8.60	21	3	0	0	85	12	3
8' Bin 5	5.64	20	4	1	0	80	16	4
3' Bin 5	6.65	16	7	2	0	63	19	19
OVERALL AVERAGES	**6.97**					**76**	**16**	**8**
14’ Bin 6	10.39	19	5	1	0	77	15	8
8’ Bin 6	9.90	9	12	3	1	35	52	13
3’ Bin 6	8.69	8	10	5	2	32	39	29
OVERALL AVERAGES	**9.66**					**42**	**56**	**2**

[1]Feet above the bin floor.
[2]A Sample of 25 tubers randomly selected. Each tuber was first evaluated for the number of visual pressure bruises 0, 1, 2, 3+.
[3]Acut slice was removed just below the skin of each bruised area. If any flesh was darkened, it was scored as a tuber "with color".

Loaded	10/21/22(both)	Pulp Temp. (at Filling)	46.0ºF (5) 47.0ºF (6)		
Unloaded	5/1/23 (both)	Target Storage Temp.	53.0ºF (both)	End Temp.	52.8ºF (5) 53.0ºF (6)

Table of Contents

Bin 8: Becca Rose Storage Pathology Trial

Dr. Jaime Willbur used Bin 8 to study storage pathology susceptibility of Becca Rose (NDA050237B-1R), a red skinned white flesh potato from a cross made at North Dakota State University. The Potato Outreach Program evaluated this variety in tablestock trials for two years prior to the storage pathology study. It has an above average yield potential, good internal quality, a uniform round tuber type, and consistent bright red skin. It is tolerant to common and powdery scab and late blight. However, the variety has late tuber bulking and a later vine maturity.

The Willbur lab used the bin to address the questions below:

1. Which storage pathogens is this variety susceptible to?
2. For how long and at what temperature can this variety be stored?
3. How susceptible to silver scurf is this variety?
4. How well does this variety set skin and maintain skin color?
5. Do treatments with DMN or Stadium fungicide influence the outcomes to questions one through four?
6. Can DMN and temperature alone be used to prevent the tubers from sprouting?

For further information on the pathology results from this study, please see the research report from the Willbur lab. This report deals with storage and chip quality.

Results

Bulk Bin 8 was loaded on October 10th and was cooled to 42ºF at 0.6ºF per day (Figure 27). DMN was applied on October 12th at a rate of 20 ppm. In February, staff at Walther Farms evaluated a sample of tubers collected from the bulk bin. They concluded that due to skinning from harvest, the tubers were not suitable for fresh pack. While the internal quality was good, there was concern that the size profile was too small with too many tubers smaller than 8 ounces. Larger tubers are preferred for processing. While the tubers

Table of Contents

were in good physiological condition after storage, the red skin color and tuber skinning made them less desirable than other commercially available red skin tubers stored in western states (Figure 28). The tubers on the left side of the image, an unknown red skin variety, scored more favorably in the four qualitative scales used to evaluate and compare red skin potatoes. The North Dakota tubers are waxier, with a shinier finish, and have less visual silver scurf than Becca Rose. The color is also a darker red and a more uniform color within and across tubers. The bin was unloaded on June 5th, 2023. At bin unloading, there was an average of 6.03% tuber weight loss. Of the potatoes evaluated, 22% were without bruising, 74% were bruised with no color, and 4% were bruised with color (Table 10).

Figure 27. Becca Rose tubers in Bin 8 on 10/10/22.

Figure 28. Becca Rose tubers (right) compared to a North Dakota red skinned variety (left).

Table 10. 2022-2023 PRESSURE BRUISE DATA
Bulk Bin #8 NDA050237B-1R (Howard City, MI)

Location[1]	Average Weight Loss (%)	Average Number of External Pressure Bruises Per Tuber[2]				Average % of Total Tuber Number		
		0	1	2	3+	Without Bruise	Bruised (No Color)	Bruised with Color[3]
14' Bin 1	4.12	13	10	2	0	51	48	1
8' Bin 1	5.41	3	11	9	4	11	85	4
3' Bin 1	8.55	1	6	8	10	4	89	7
OVERALL AVERAGES	**6.03**					**22**	**74**	**4**

[1]Feet above the bin floor.
[2]A Sample of 25 tubers randomly selected. Each tuber was first evaluated for the number of visual pressure bruises 0, 1, 2, 3+.
[3]A cut slice was removed just below the skin of each bruised area. If any flesh was darkened, it was scored as a tuber "with color".

Loaded	10/10/22	Pulp Temp. (at Filling)	53.4ºF		
Unloaded	6/5/23	Target Storage Temp.	N/A	End Temp.	N/A

Table of Contents

Bin 9: Dundee Storage Pathology Trial (GDD_{40} 3661, 38ºF)

Dundee (MSZ242-13) has been evaluated by the Potato Outreach Program since 2016. It has potential as a Snowden and Lamoka replacement in storage locations with several promising agronomic and storage characteristics. It has average to above average specific gravity across trial locations, an above average percent of US#1 tubers, good internal quality, and is tolerant to common scab. In storage, it is tolerant to cold induced sweetening, and has good chip quality both out of the field and into the spring after storage.

However, managing the tuber size profile has been challenging. When planted at 10” in row spacing it has a below average yield potential with fewer mid-sized tubers and a below average tuber set with fewer, larger tubers. Planting seed pieces closer together may reduce oversized tubers and increase yield but does increase seed costs. Dundee is tolerant to Fusarium Dry Rot, but susceptible to pink rot and moderately susceptible to Pythium leak and bacterial soft rot.

The Potato Outreach Program conducted a ten-foot test dig of Dundee and calculated a US#1 yield of 388cwt/A and total yield of 426 cwt/A. There were 76% A-sized tubers, 15% oversized, 4% undersize, and 5% pickouts. The specific gravity was 1.080 and no internal defects were observed. Dundee had 11.4 tubers per plant, 6.2 tubers per stem, and an average tuber weight of 5.5 ounces (Table 6). No pre-harvest panels were collected.

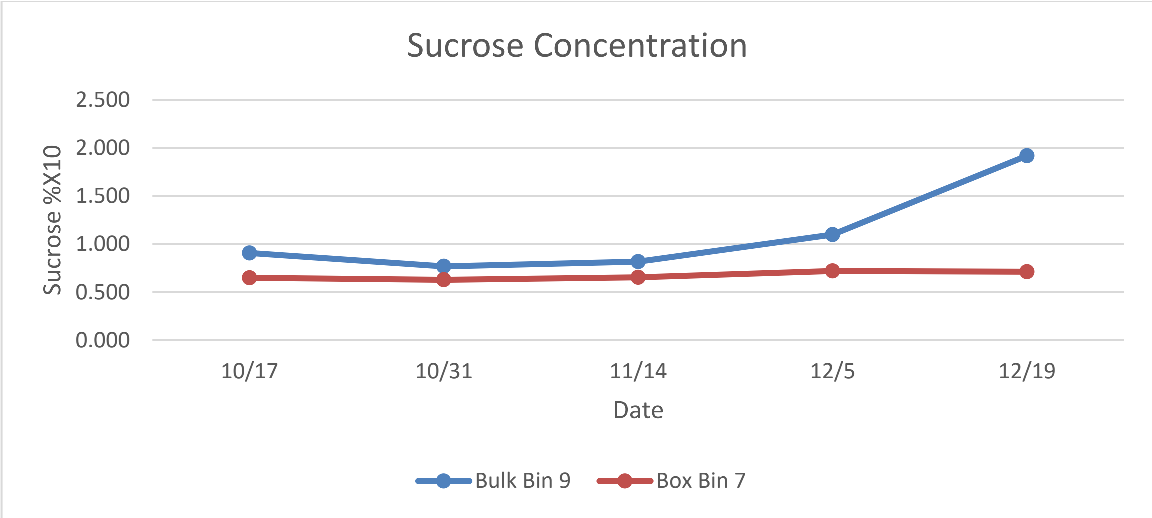
Bulk Bin 9 was loaded on October 6th with a pulp temperature of 57ºF. The tubers were in good condition at bin loading with 67.6% bruise free tubers and an average of 1.3 bruises per tuber. The bin was gassed with 20 ppm DMN on 10/7/22. Only five sugar panels samples were conducted for this variety when the purpose of the bin was changed. Sucrose, glucose, and defect prevalence graphs are included for the abbreviated season (Figure 29). The Storage and Handling Committee agreed that there was little benefit to the Michigan potato industry in continuing to test the storage traits of this variety, and instead used the bin to answer the following questions:

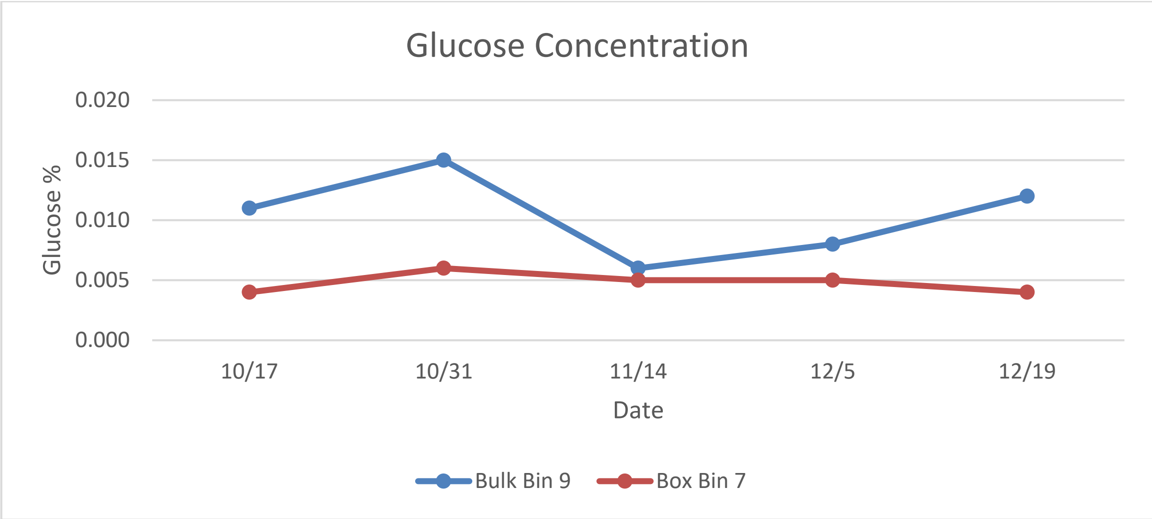
Table of Contents

1. Will DMN control tuber maturation and sprout development effectively so that this lot of potatoes could be replanted as seed in 2023?
2. Will DMN application reduce or prevent pathogen degradation in these potatoes by storage rot pathogens?
3. Will DMN application increase skin set of this variety?
4. Will the application of DMN to Dundee tubers increase stem number and tuber set in the potatoes upon replanting?

To maintain quality as seed potatoes, the bin was cooled from 53ºF to 38ºF at 0.4ºF per day. After storage, the Dundee seed was replanted at Lennard Ag. Co. Tuber pathogen development and sprout presence was monitored every two weeks by the Potato Pathology program.

Figure 29. Sucrose concentrations, glucose concentrations, and total defects in Bin 9 Lennard Ag. Co. Dundee compared to the same box bin variety.





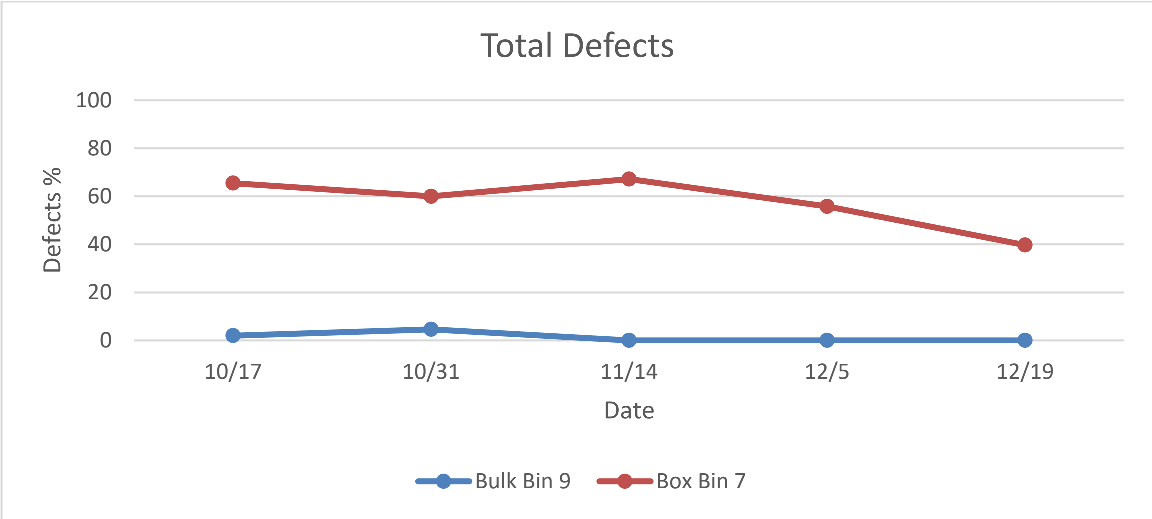


Table of Contents

Linking the Health of Plants and Soil: Integrating Data into a Systems Approach to Improve Potato Production and Environmental Sustainability
Second Year Continuation

2023 Michigan Potato Industry Commission

Bruno Basso, PhD.
Department of Earth and Environmental Sciences
Michigan State University

Rationale
Potato production is a major component of the high value commodity crops in Michigan. Though much of the research on potatoes is focused on the status of the seeds, plants, and soils during the potato growing system, research that considers the complete system is necessary to understand the various implications on the soil's health. To provide a solution for improving overall soil health in these systems has proven to be a challenging endeavor. Traditional methods of using small plots to test various treatment effects have been successful for trials of pesticides, varieties, other agronomic principles. More recently, a comprehensive method for visualizing the inherent spatial and temporal variability at the field-scale has been published and used by the Basso group to show the relationship that historical yields are the best predictor of future yields (Maestrini and Basso, 2018). However, in potato production, the availability and use of yield monitors is rare due to being very expensive and therefore uncommon. The potential to use remote sensing technologies to capture in-season variability and relate the imagery to soil health is an advancement that can likely allow these concepts to be scaled across much larger regions making them accessible to many farms and across lots of acres.

Objectives
The objectives of this proposal were to determine the relationship between plant and soil health in potatoes and their rotations using a systems approach. The unification of remotely sensed imagery, yield stability maps derived from combine grain yield monitors, and soil health metrics allow for a wide-ranging and comprehensive analysis. Point-based sampling of soils proves challenging to scale the construct of soil health practices. Many of the soil metrics collected, like pH, cation exchange capacity (CEC), organic matter (OM), phosphorus (P), potassium (K), are standard in most soil sampling packages, but there aren't consistent recommendations or understandings on how these values relate to "healthy soil". The overall objective of this project was to relate soil health metrics, along with additional geospatial layers, to quantify soil health practices. Specific research objectives include:

1) Determine the relationship between thermal and yield stability maps
2) Quantify soil health metrics and link to yield and thermal stability
3) Relate these findings to soil health recommendations

Methodology
Combine grain yield monitors provide high-resolution maps of grain yields that reveal patterns of spatial variability. These crop data layers are processed through a series of cleaning (e.g. removing outliers) and normalization steps before all layers of yield information are combined to create a yield stability map (Maestrini and Basso, 2018) revealing both the spatial and temporal

Table of Contents

variability. This in-depth analysis reveals distinctive patterns of high-yielding and stable (HS), medium-yielding and stable (MS), low-yielding and stable (LS), and unstable (UN) zones. The results indicate distinctive spatial zones which can be used by growers for reduced or intensified management strategies. Given that few growers have yield monitor sensors on their potato harvesters, this process relies on corn, soybean, and wheat yield data.

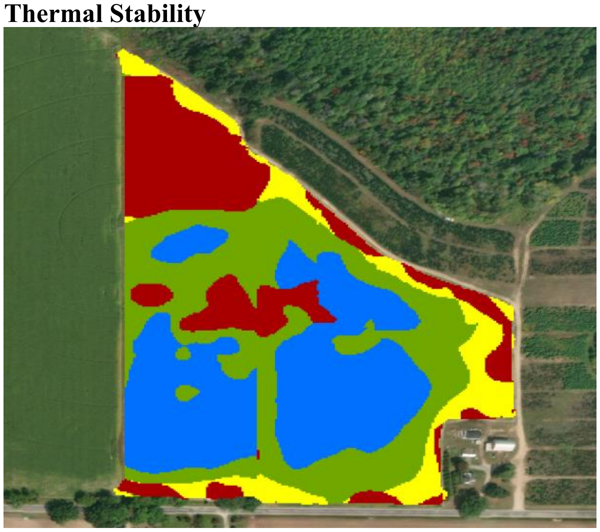
For each of these fields, remotely sensed imagery was gathered for multiple image types. From both airplane and unmanned aerial vehicles (UAVs) visual and thermal images were collected throughout the season. To encompass the pattern of growth over time, we used a time series of thermal images to track parts of the field which were consistently warmer or cooler than other parts of the field. Similar to the yield stability approach, areas of hot and stable, medium and stable, cold and stable, and unstable temperature were delineated.

Finally, a Solvita ® Soil Health Test was completed by collecting soil samples at 2 depths (0-15cm and 15-30cm) and in 2 different locations per yield stability zone. These analyses included bulk density, color, soil ammonia N, active carbon, NO^{-3} content, VAST (Volumetric Aggregate Stability Test), and a soil health score which measures biological activity in the soils to get an overall indication of healthiness.

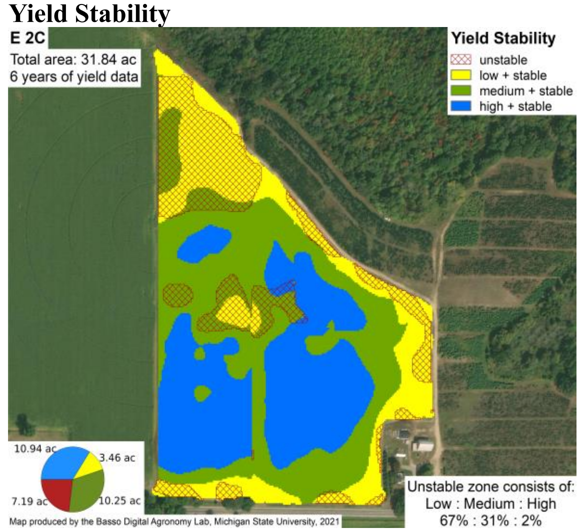
Results

Recent research from the Basso lab funded by the Michigan Potato Industry Commission has shown that thermal stability can reveal positive correlations with yield stability. In 2022, the field of observation showed a trend that matched previous findings. In fields where plants are consistently cold, high yields are expected. Yields were slightly lower in the hot and unstable thermal zones (Figure 1).

Thermal Stability



Yield Stability



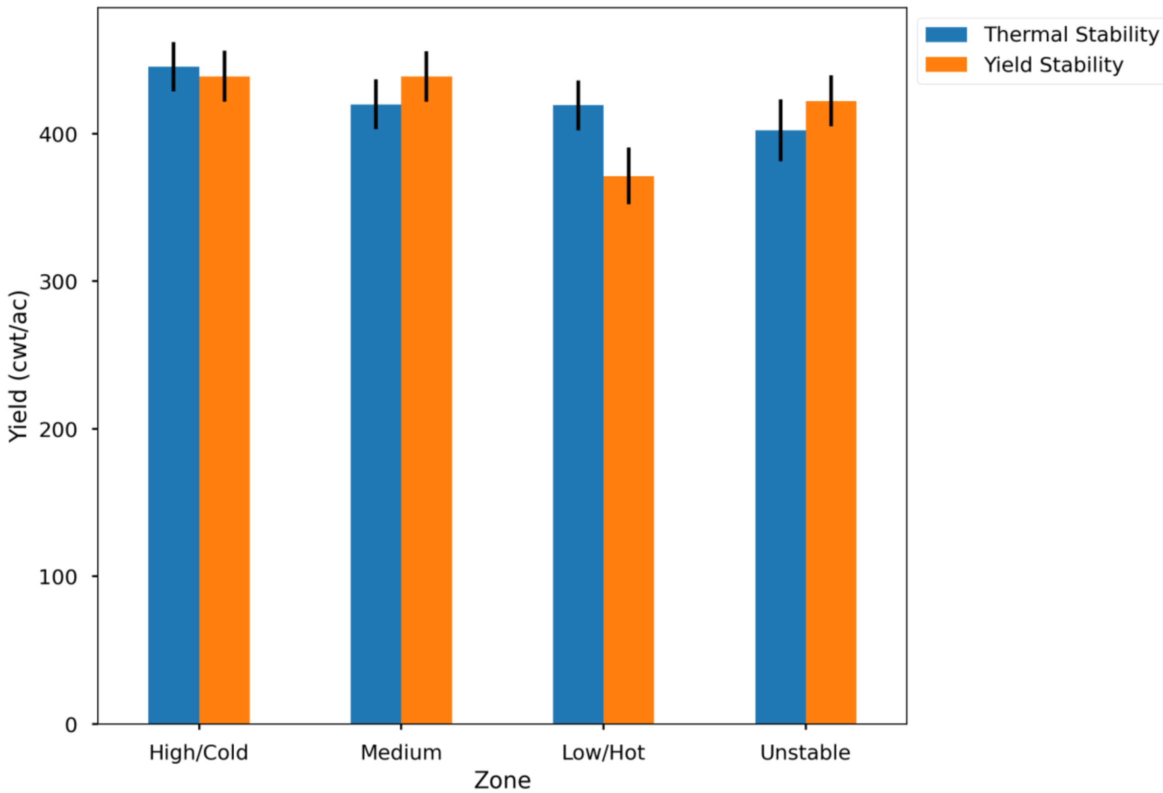
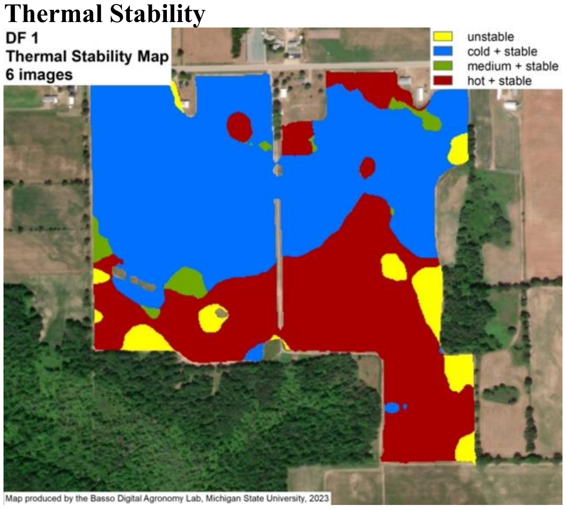


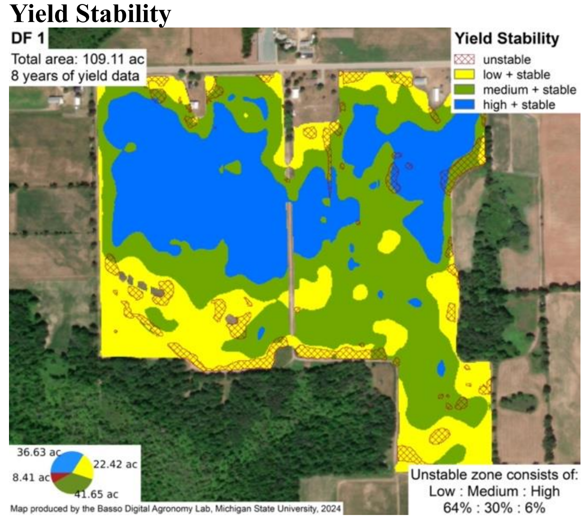
Figure 1. Thermal stability of images during potato growing season (upper left), yield stability from 6 years of grain yield data (upper right), and the relationship of potato yields within each zone (bottom) from a field in potato production in 2022.

In 2023, we observed a similar relationship between potato yield and thermal/yield stability in an additional potato field (Figure 2).

Thermal Stability



Yield Stability



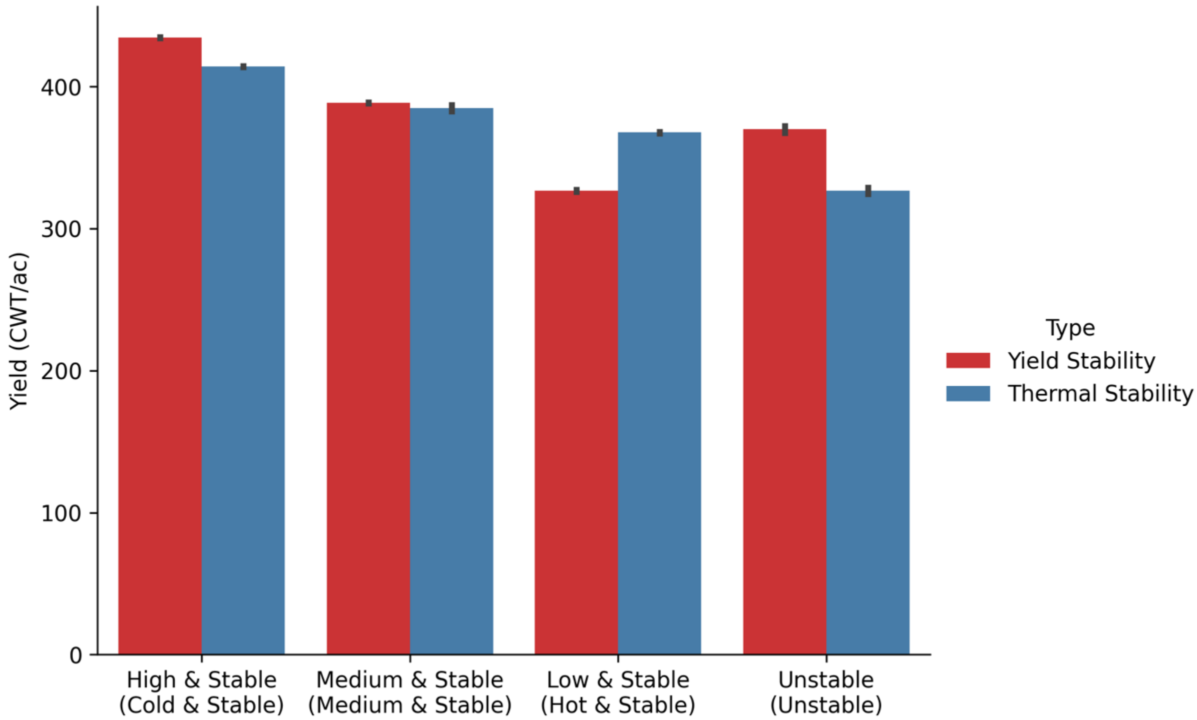


Figure 2. Thermal stability of images during potato growing season (upper left), yield stability from 6 years of grain yield data (upper right), and the relationship of potato yields within each zone (bottom) from a field in potato production in 2023.

However, analyses of additional fields in 2022 and 2023 did not always come to the same conclusion. A confusion matrix (Figure 3) shows the percentage of pixels that fell into the same zone for each category. For fields DF1 and MV3, there is a high correlation of pixels in both high and stable (yield stability) and cold and stable (thermal stability). Pivot irrigation dominates the potato production landscape, and these matrices confirm the positive influence of irrigation. In addition, there is a high correlation of low and stable (yield stability) and cold and stable (thermal stability) for these fields. Field MV3 shows another strong correlation between the medium yield stability and the medium thermal stability zones. The unstable thermal stability zones in Fields MV2 and MV3 fall mostly in the unstable yield and the low and stable yielding zones. Most of the pixels in field MM2 were cold and stable, which could be the effect of irrigation creating a uniform soil water profile during this growing season.

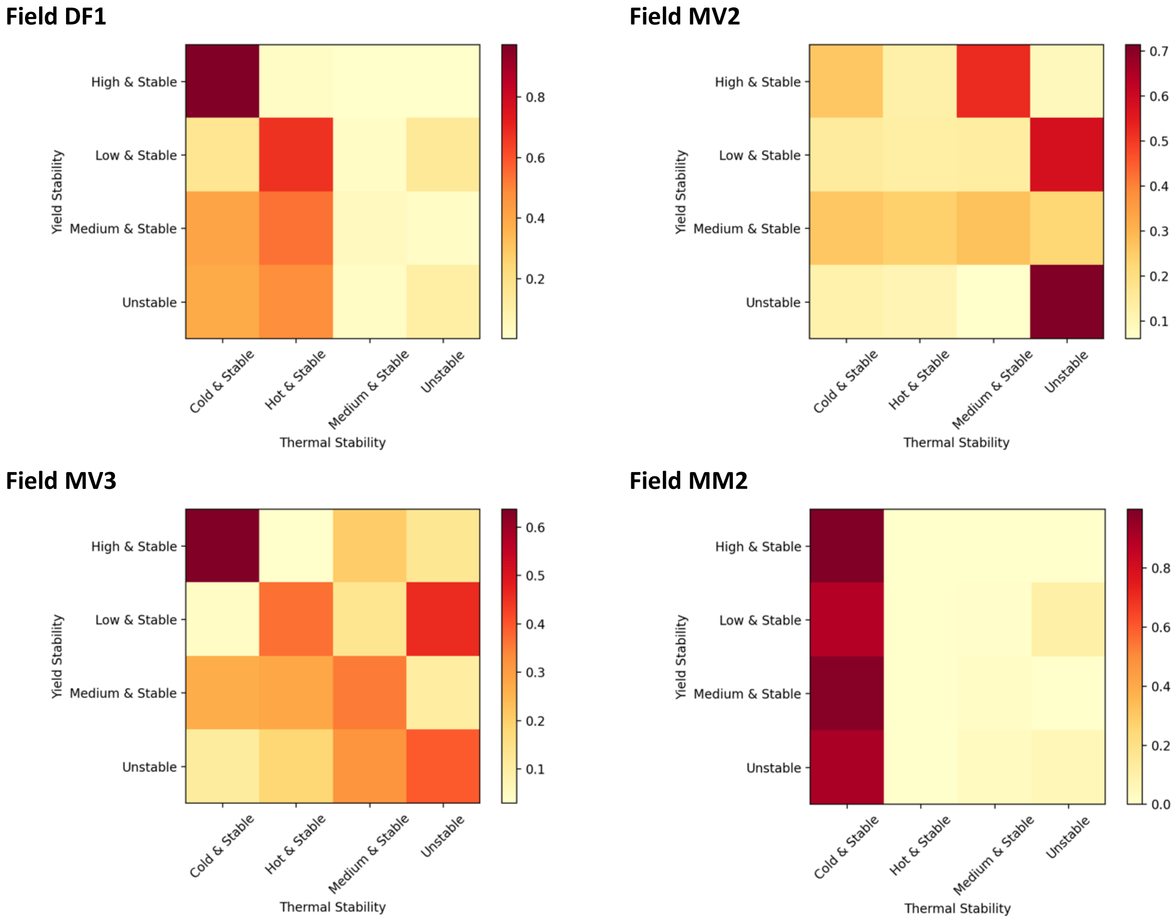
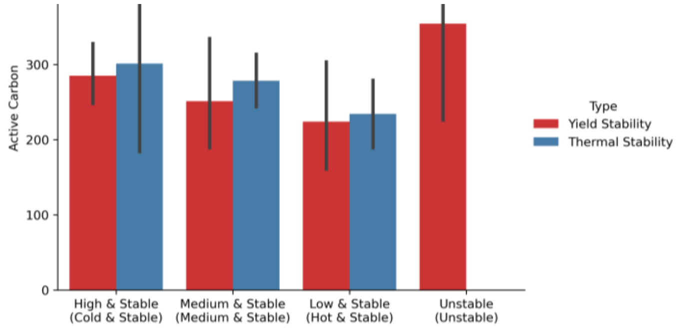


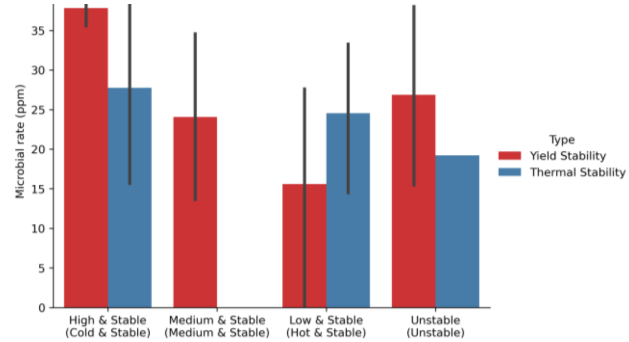
Figure 3. Correlation matrices analyzing pixel values for yield and thermal stability for 4 separate fields of study in 2022 and 2023 (DF1 upper left, MV2 upper right, MV3 bottom left, MM2 bottom right).

An analysis of the soil health samples by zone showed varying results. Results from these various scores or metrics did not show a consistent pattern of comparable values within yield and thermal stability zones. In the soil health metric figures (Figure 4), certain soil health analyses, such as active carbon, do show a pattern with yield stability zone and/or thermal stability zone; however, these patterns were not consistent across all fields. Interestingly, for NO^{-3}, thermal stability shows a large difference in values by thermal stability, but not yield stability, and again this pattern was not consistent across the fields. The color test results showed differences by yield stability zone, but only for the single field shown. Further targeting or stratifying the sampling pattern can potentially deliver results with consistent trends, yet in this case the comparisons are not consistent enough to discern thermal stability as a substitute for yield stability.

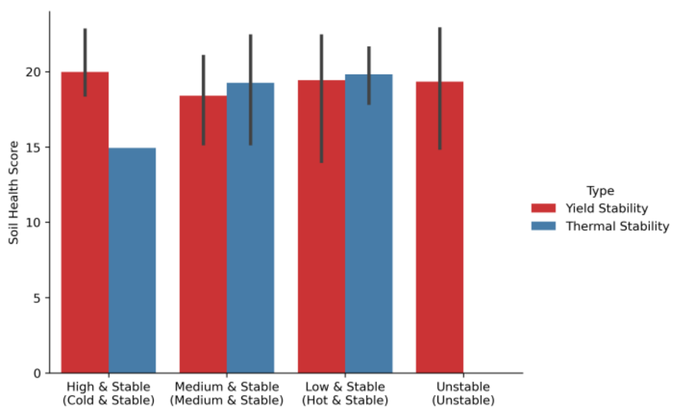
Active Carbon



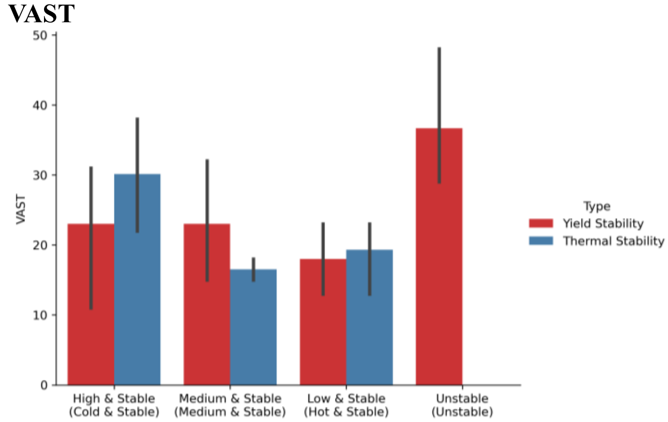
Microbial Rate



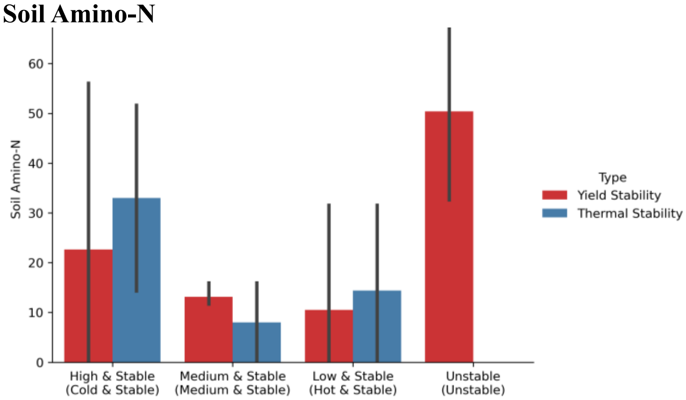
Soil Health Score



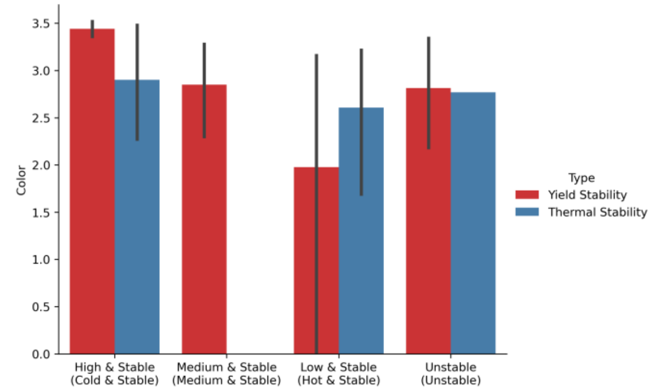
VAST



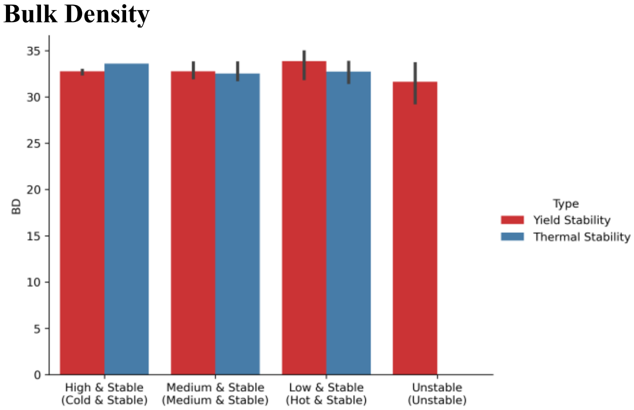
Soil Amino-N



Color



Bulk Density



NO^{-3}

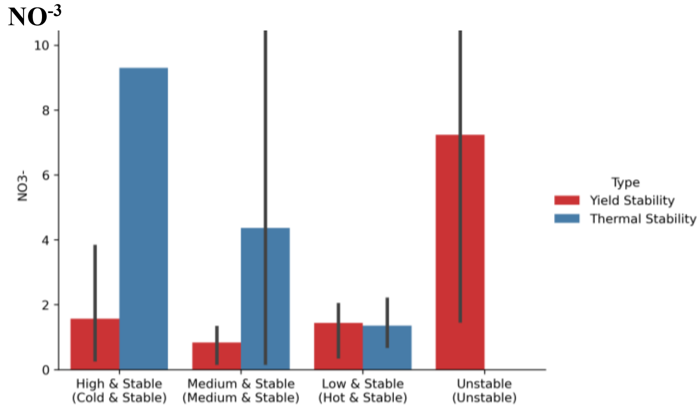


Table of Contents

Figure 4. Varying soil health test analyses included active carbon, microbial rate, soil health score, VAST, soil amino-N, color, bulk density, and NO^{-3}, with values by yield stability zones (red) and thermal stability zones (blue).

Conclusions

Measuring soil health is a considerable challenge. Various scores and metrics like those found in the Solvita® test scores provide point-based indications of important biological processes. However, the interactions of these processes on our cropping systems causes inconsistent trends and the inherent variability of these fields makes it even more difficult to discern the true driving factor in these observed yield gaps. Further analysis on the specific management for these fields can provide some indications of how these values can be improved upon. It has been indicated that the addition of cover crops, various types of manure, reducing pesticide and fumigation applications, and other conservation practices will help build soil health. Precision technologies like yield monitoring and remote sensing are reliable tools that can help understand these complex geophysical processes.

References

Maestrini, B., & Basso, B. (2018). Predicting spatial patterns of within-field crop yield variability. *Field Crops Research*, 219, 106-112. doi: 10.1016/j.fcr.2018.01.028