

**Michigan State University
AgBioResearch**

**In Cooperation With
Michigan Potato
Industry Commission**



**Michigan Potato Research Report
Volume 57
2025**

December 11, 2025

Dear Members of the Michigan Potato Industry,

The Michigan Potato Industry Commission remains steadfast in its commitment to advancing potato production through dedicated research efforts. Over the past year, the Commission has provided over \$212,000 in direct funding to support research projects aimed at addressing critical challenges and opportunities in our industry. These projects have delivered significant insights into areas such as variety development, disease management, soil fertility, and storage innovations—ensuring that Michigan continues to lead as a competitive and respected force in the national potato industry.

The enclosed research report reflects the collective achievements of the 2025 potato research projects, carried out with the expertise and collaboration of Michigan State University AgBioResearch and Michigan State University Extension. We are proud to share these findings, which highlight our industry's resilience, innovation, and dedication to continuous improvement. We believe these research outcomes provide valuable tools and knowledge that can be directly applied to enhance your operations. Whether refining production techniques or improving resource efficiency, the insights from these projects aim to strengthen the profitability and sustainability of Michigan potato production.

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

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

Sincerely,



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

2025 MICHIGAN POTATO RESEARCH REPORT

C. M. Long, Coordinator

INTRODUCTION AND ACKNOWLEDGMENTS

The 2025 Potato Research Report contains reports of the many potato research projects conducted by Michigan State University (MSU) potato researchers at several locations. The 2025 report is the 57th 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 GREEN and numerous other sources. The principal source of funding for each project has been noted in each report.

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

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

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

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

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Prologue

The following sections of the 2025 Potato Research Report present research findings from MSU's core potato research programs, reflecting a coordinated and multidisciplinary effort to address the production challenges and opportunities facing Michigan's potato industry. These programs encompass outreach and extension, plant breeding and genetics, nematology, integrated potato disease management, soil health, crop physiology, and irrigation management.

Each report has been prepared by the respective principal investigator and summarizes objectives, methods, and key findings from research conducted during the 2025 season. Collectively, these studies provide science-based information to support sustainable potato production, improve yield and quality, enhance environmental stewardship, and strengthen the long-term competitiveness of Michigan's potato industry.

Together, these program reports form the foundation of this annual volume and highlight MSU's continued commitment to collaborative, industry-driven potato research.

Potato Outreach Program

Program Objectives

The primary objectives of this program are to: (1) identify and advance promising potato breeding lines for continued testing and evaluation; (2) conduct large-scale agronomic and processing evaluations under grower-managed, commercial production systems to assess field performance and processing potential; and (3) utilize trial-derived data to support and accelerate the commercialization of new potato varieties.

The program also does research on key priorities of the Michigan Potato Industry Commission, focusing on improving potato cropping systems.

On-farm Evaluation of Agronomic and Processing Traits of Potato Genotypes

Funding: Federal Grant, MPIC and Potatoes USA/SNAC

Chris Long, Phabian Makokha, Azamat Sardarbekov, Bernard M. Schroeter, Dave Douches, James DeDecker

Materials and Methods

A total of 121 potato genotypes were evaluated across multiple locations: 28 fresh chipping lines at three sites (Table 1), 38 storage chipping lines at seven sites (Table 2), eight storage SNAC lines at one site (<https://potatoesusa.medius.re/>), 24 tablestock yellow-fleshed genotypes (6 advanced lines and 18 European varieties) at seven sites, two tablestock white-fleshed lines at seven sites, and seven red-fleshed lines at seven sites (Table 3), and 20 tablestock russet lines at nine sites (Table 4). All trials were conducted as non-replicated single strips, except for three trials: a storage chip trial at Walthers, a tablestock russet trial at Walthers, and a tablestock red, white, and yellow trial at Walthers. Storage evaluations were performed at the MSU Montcalm Research Center in the Michigan Potato Industry Commission storage facility during 2024–2025.

Results

Site-specific trial results are available at <https://msupotato.medius.re/>. Storage evaluation results are summarized in the following pages.

Table 1: Statewide Fresh Chip Processing Trials: Summary Across Three Locations, MI, 2025

LINE	CWT/A		PERCENT OF TOTAL ¹				SP GR ²	OTF CHIP SCORE ³	RAW TUBER QUALITY ⁴ (%)				COMMON SCAB RATING ⁵	SED SCORE ⁶	VINE VIGOR ⁷	VINE MATURITY ⁸	COMMENTS	
	US#1	TOTAL	US#1	Bs	As	OV			PO	HH	VD	IBS						BC
AF5933-4 ^c	674	741	91	9	91	0	0	1.075	1.0	0	40	0	0	2.5	0.4	1.0	2.5	mishapes, uniform round oval blocky tubers, light skin appearance
MSFF038-3 ^{bc}	672	730	92	7	92	0	2	1.072	1.0	0	0	5	5	1.8	0.0	1.0	2.3	flat round oval, medium netted, slight skinning, sheep nose, uniform tuber type
MSHH018-3 ^{bc}	671	727	93	8	93	0	0	1.070	1.3	0	5	0	0	0.5	0.1	1.3	2.5	blocky uniform, medium netted, slight skinning, nice general appearance
Paige ^c	636	737	86	11	86	0	2	1.081	1.0	0	10	0	10	2.0	0.0	1.0	3.0	flat oval, dark uniform type, sticky stolons, medium netted, moderate skinning
Manistee^b	612	681	90	10	90	0	0	1.080	1.5	0	0	0	0	0.5	0.0	2.0	3.0	flat round, big tubers
MSGG426-2 ^c	607	657	92	7	92	0	1	1.073	1.5	0	20	0	0	0.5	0.3	1.0	2.5	blocky round oval, medium netted, slight points,
MSDD249-09 ^{ab}	590	612	96	3	96	0	1	1.078	1.3	0	3	0	0	1.2	0.0	1.0	2.7	blocky round oval, slight skinning, medium netted, sheep nose
NY174 ^b	587	688	85	13	85	0	2	1.083	1.5	0	0	0	0	0.5	0.0	2.0	3.5	blocky tubers
Snowden^{abc}	570	649	88	11	88	0	1	1.075	1.3	0	3	7	3	0.5	0.1	1.5	2.8	round blocky, moderate skinning, traces of points, misshapes
ND13220C-3 ^{abc}	537	801	66	31	66	0	3	1.086	1.5	0	7	0	0	1.2	0.0	1.7	3.5	heat sprouts, not uniform tuber shape, misshapes, moderate skinning
AF6200-7 ^{abc}	526	572	92	7	92	0	1	1.087	1.3	0	0	0	0	0.3	0.0	1.3	2.7	tuber rots, flat round oval, moderate skinning, minor growth cracks
MSGG276-4 ^a	515	561	92	7	92	0	1	1.073	1.5	0	0	0	0	2.0	0.0	1.0	2.5	round oval, typy tubers
NY177 ^{bc}	505	688	72	28	72	0	0	1.090	1.2	0	7	10	0	1.0	0.0	1.5	3.0	flat pear shaped, medium netted, moderate skinning, misshapes
MSDD247-11 ^{abc}	501	561	88	8	88	0	3	1.078	1.2	0	3	7	3	0.5	0.0	1.3	2.2	light skin appearance, few points, variable tuber shape
B3403-6^{abc}	499	602	82	17	82	0	1	1.086	1.5	3	0	7	0	1.3	0.0	1.3	2.8	moderate skinning, nice appearance, uniform tubers, points
Petoskey ^b	489	562	87	12	87	0	1	1.092	1.5	0	0	0	0	1.0	0.0	1.0	3.0	uniform tuber type
MSDD247-07 ^{abc}	485	549	88	9	88	0	3	1.090	1.3	0	3	13	3	1.0	0.0	1.3	2.7	variable tubers size, medium netted, some points, traces of skinning
MSEE035-4 ^{abc}	476	547	86	10	86	0	4	1.079	1.5	17	0	10	0	1.7	0.0	1.0	3.5	severe skinning, flat round oval blocky, misshapes, points
MSGG409-3 ^{abc}	472	577	82	17	82	0	1	1.072	1.2	0	0	3	0	0.3	0.0	1.2	3.3	moderate to severe skinning, misshapes, some points, sheep nose
Mackinaw ^{ab}	472	529	89	10	89	0	1	1.080	1.3	0	0	5	0	0.5	0.0	1.0	3.3	uniform tuber shape, sheep nose
MSBB617-02 ^{abc}	431	476	91	8	91	0	1	1.074	1.5	10	7	7	3	0.7	0.0	1.0	2.7	small uniform round tubers, moderate skinning, heavy netted, stem end, points
MSAA076-6 ^{abc}	427	538	72	25	72	0	4	1.080	1.5	0	3	27	0	1.0	0.1	1.5	2.8	dark uniform tubers, flat round oval, traces of sticky stolons. Severe heat necrosis, non uniform
AF6565-8 ^a	415	493	84	12	83	1	5	1.077	1.5	5	0	0	0	1.3	0.0	1.8	3.0	light skin appearance, uniform tubers, some stem end, points
Bliss ^{abc}	406	498	80	16	80	0	4	1.074	1.5	0	7	0	0	0.8	0.1	1.2	2.7	blocky round oval, not uniform, misshapes, typical purplish bud end, stem end, points
MSBB058-1 ^b	404	503	80	20	80	0	0	1.083	1.5	0	0	20	0	0.5	0.0	1.5	4.0	small round tubers
CMK2009-630-001 ^{abc}	400	579	67	29	67	0	4	1.076	1.5	10	13	0	0	2.0	0.0	1.5	3.0	variable tuber shape, moderate skinning, medium netted, knobs, mishapen
MSDD244-05 ^a	390	461	85	12	82	3	3	1.074	1.5	0	0	20	0	1.0	0.0	1.0	2.5	sheep nose, some points, greening
AF6671-10 ^{abc}	372	432	86	14	86	0	1	1.072	1.2	7	0	7	0	0.5	0.1	1.2	3.0	traces of rots, moderate skinning, large tubers, light skin appearance
MSEE031-3 ^{abc}	327	411	76	19	76	0	5	1.072	1.3	0	17	10	0	0.5	0.2	1.5	3.0	dark skin uniform tubers, flat round oval, misshapes, Points, some growth cracks
Atlantic^{abc}	308	380	80	17	80	0	2	1.077	1.7	13	7	17	3	1.0	0.1	1.5	2.5	not uniform tuber type, very long size profile, shiny appearance
MUI2014-011-023 ^{abc}	285	515	54	41	54	0	6	1.079	1.8	0	23	3	0	1.5	0.2	1.8	3.0	misshapes, small size, oval oblong. Some blistered chips, golden skin
MEAN	492	582	84	15	83	0	2	1.079	1.4	2	6	6	1	1.0	0.1	1.3	2.9	

2025 Chip Variety Trial Sites

Black Gold^a
Lennard Ag^b
Walther Farms^c

¹SIZE

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

²SPECIFIC GRAVITY

Total solids

³OUT OF THE FIELD CHIP COLOR SCORE

(Scale)
Ratings: 1 - 5
1: Excellent
5: Poor

⁴RAW TUBER QUALITY

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

⁵COMMON 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

⁶SED (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

⁷VINE VIGOR RATING

Date: Variable
Rating: 1-5
1: Slow emergence
5: Early emergence
(vigorous vines, some flowering)

⁸VINE MATURITY RATING

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

Table 2: Statewide Storage Chip Processing Trials: Summary Across Seven Locations, MI, 2025

LINE	CWT/A		PERCENT OF TOTAL ¹				SP GR ²	OTF CHIP SCORE ³	RAW TUBER QUALITY ⁴ (%)				COMMON SCAB RATING ⁵	SED SCORE ⁶	VINE VIGOR ⁷	VINE MATURITY ⁸	COMMENTS	
	US#1	TOTAL	US#1	Bs	As	OV			PO	HH	VD	IBS						BC
MSGG276-4 ^g	589	638	93	8	92	1	0	1.073	1.5	23	0	0	1	0.0	0.6	2.7	2.7	medium heavy netted, blocky oval
MSGG409-3 ^{abde} g	557	622	89	9	87	2	2	1.079	1.3	7	16	7	2	0.9	0.3	2.0	3.1	blocky round, heavy netted, slight skinning
MSGG409-2 ^{abce} g	518	576	88	10	84	4	2	1.079	1.4	22	7	25	0	1.3	0.2	1.7	3.0	medium netted, blocky round oval
AF6671-10 ^g	503	544	92	7	92	0	1	1.082	1.5	3	16	0	0	0.3	0.7	2.6	2.3	small round size, growth cracks, medium netted
W17AF6670-1 ^f	503	583	86	13	86	0	0	1.080	1.0	0	17	3	3	2.0	0.0	1.5	3.0	flat round oval, medium netted
ND13220C-3 ^{abde} fg	484	672	70	25	69	1	6	1.091	1.0	14	18	0	3	1.5	0.2	2.5	3.3	not uniform tuber type, light netted, not uniform size, points, mishapen
NY174 ^{abde} fg	478	535	88	10	88	0	1	1.086	1.2	1	13	1	0	1.3	0.4	2.1	2.8	flat blocky, round oval, medium netted, misshapen pickouts, slight skinning, nice general appearance
Petoskey ^{de} g	476	587	80	7	80	0	13	1.079	1.5	7	18	7	13	0.9	0.2	1.9	2.2	not uniform size, medium netted, misshapen, growth cracks, slight skinning, alligator hide
MSEE035-4 ^{abde} g	470	525	89	8	88	1	3	1.085	1.3	8	0	16	0	1.0	0.4	1.7	3.2	light netted, flat round tuber type, growth cracks, not uniform tuber type, sticky stolons
MSHH018-3 ^{abde} f	451	504	88	10	85	4	2	1.077	1.3	5	4	5	0	0.9	0.2	1.7	2.4	blocky round oval, light to medium netted, sticky stolons, skinning
MSBB058-1 ^{abde} fg	449	492	91	8	90	1	1	1.090	1.3	0	3	4	0	1.0	0.2	1.9	2.5	deep apical eye, medium netted, moderate skinning, uniform oval tuber type
Snowden^{abde}fg	438	492	87	12	86	2	1	1.078	1.2	16	21	6	7	1.5	0.2	1.9	2.5	medium netted, round oval, medium skinning, blocky round, uniform tuber type
NY177 ^{abde} fg	431	526	81	16	81	0	2	1.091	1.2	0	21	7	0	1.5	0.2	1.9	2.9	flat round to oval, light netted, moderate skinning, traces of pear shapes, growth cracks
W17066-34 ^f	424	508	83	16	83	0	1	1.079	1.0	0	20	0	0	1.0	0.1	1.5	3.0	round oval, med netted, trace of growth cracks
Paige ^{eg}	422	555	73	26	73	0	1	1.088	1.5	2	17	0	0	1.7	0.5	2.3	3.3	flat round oval, medium netted, moderate skinning, growth cracks, not uniform tuber type
MSDD249-09 ^{abde} g	415	444	93	4	90	4	3	1.081	1.3	3	12	2	0	1.3	0.3	1.7	2.6	flat blocky, growth cracks, medium netted, not uniform tuber type
MSGG426-2 ^{hg}	414	447	93	7	92	1	1	1.078	1.5	0	20	0	0	1.0	0.6	2.5	2.1	large blocky round, heavy netted, lots of growth cracks
MSFF037-17 ^{abeg}	408	468	87	11	87	0	2	1.079	1.4	3	16	18	0	1.7	0.1	1.8	2.6	flat round oblong, sticky stolons, misshapen, light netted, growth cracks
AF5933-4 ^{hg}	406	467	83	17	83	0	0	1.080	1.3	5	45	0	5	2.2	0.4	2.9	1.4	small uniform round, light netted, blocky
Mackinaw ^{acde} g	398	467	85	12	84	0	3	1.088	1.3	0	23	10	0	0.9	0.1	2.0	3.0	Round oval blocky, medium netted, medium skinning, sticky stolons, ok general appearance

2025 Chip Variety Trial Sites

4-L Farm^a
MRC Box Bin^b
Hampton Farms^c
Lennard Ag^d
Main Farms^e
Sandyland Farms^f
Walther Farms^g

¹SIZE

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

% of total: Values rounded to the nearest whole number

⁶SED (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

²SPECIFIC GRAVITY

Total solids

³OUT OF THE FIELD CHIP COLOR SCORE

(SNAC Scale)

Ratings: 1 - 5

1: Excellent

5: Poor

⁷VINE VIGOR RATING

Date: Variable
Rating 1-5
1: Slow emergence
5: Early emergence (vigorous vines, some flowering)

⁴RAW TUBER QUALITY

(percent of tubers out of 10)

HH: Hollow Heart

VD: Vascular Discoloration

IBS: Internal Brown Spot

BC: Brown Center

⁸VINE MATURITY RATING

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

⁵COMMON 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

LINE	CWT/A		PERCENT OF TOTAL ¹						OTF CHIP SCORE ³	RAW TUBER QUALITY ² (%)				COMMON SCAB RATING ⁵	SED SCORE ⁶	VINE VIGOR ⁷	VINE MATURITY ⁸	COMMENTS
	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR ²		HH	VD	IBS	BC					
AF6200-7 ^{abcdeg}	397	439	90	7	89	1	4	1.088	1.4	7	6	2	0	1.0	0.5	1.7	2.4	medium netted, flat round oval blocky, points, growth cracks, medium netted
MSFF038-3 ^{abcdeg}	392	473	83	15	81	1	2	1.079	1.3	10	3	11	0	1.3	0.3	2.3	2.5	beautiful round tuber type, medium netted, growth cracks, misshapen pick outs, slight hide skin
AF6206-5 ^{fg}	389	460	84	12	84	0	4	1.086	1.2	0	19	0	0	2.2	0.4	2.3	2.3	blocky tuber not uniform tuber type, poor general appearance, medium netted, skinning
MSDD247-07 ^{abcdeg}	377	418	89	9	88	1	3	1.092	1.2	2	10	32	0	0.9	0.2	1.9	2.4	blocky round, medium netted, mishapen pickouts, trace of growth cracks, slight skinning
MSDD247-11 ^{abcdeg}	365	413	88	10	88	0	2	1.084	1.2	2	11	1	1	0.6	0.2	2.0	2.2	not uniform tuber type, medium netted, deep eyes, poor yield
MSGC20-16 ^b	362	415	87	8	87	0	5	1.080	1.0	0	0	10	0	1.0	0.1	4.0	1.5	growth cracks, misshapen pickouts, round blocky tuber type, heavy netted
AF6671-10 ^{abcde}	350	400	86	12	86	0	2	1.082	1.2	2	22	0	0	0.9	0.2	1.7	2.3	small flat round, light netted, not uniform tuber type, skinning
AF6565-8 ^{bcdefg}	349	411	83	15	83	0	2	1.079	1.3	1	8	1	0	1.3	0.2	1.6	2.9	small round size, medium netted, growth cracks, misshapen pick outs
MCAA076-6 ^{bdeg}	349	410	83	14	83	0	3	1.083	1.2	0	21	28	6	1.1	0.2	2.5	2.4	medium netted, pear shaped, medium netted, oval pear shape, sticky stolons
MSGB02-02 ^b	348	397	88	11	88	0	1	1.084	1.0	20	0	0	0	1.5	0.1	2.5	2.0	small to medium tuber type, medium netted, growth cracks, heat sprouts
Bliss ^{abcdeg}	347	411	82	14	82	1	4	1.079	1.3	0	22	1	2	1.0	0.3	1.7	2.5	small round, uniform tuber type, light netted, trace of purple on apical end, growth cracks, knobby
MSEE031-3 ^{abcdeg}	346	402	84	13	84	0	2	1.076	1.3	3	22	15	0	0.8	0.5	2.4	2.5	misshapen, growth cracks, skin cracks, skinning, pear shape, deep apical eye
MSGA24-02 ^b	328	374	88	8	88	0	4	1.084	1.0	0	20	0	0	1.0	0.4	3.5	3.5	flat round tuber type, light to medium netted, uniform general appearance, growth cracks
Manistee ^{edc}	297	359	82	17	82	0	0	1.073	1.3	0	13	13	0	1.8	0.4	1.7	2.5	misshapen, non uniform tuber type, points, knobby, medium netted
Lamoka ^{abedef}	290	349	82	12	81	1	6	1.076	1.2	2	26	7	0	1.5	0.2	1.9	2.3	flat oval tuber type, medium light netted skin, trace pear shapes, pear shaped
Kal 91.3 ^b	284	346	82	16	82	0	2	1.078	1.0	30	0	0	0	1.5	0.3	3.0	2.0	light medium netted, not uniform tuber type
MSBB617-02 ^{abcdeg}	270	301	89	7	88	1	4	1.074	1.3	15	22	5	2	0.5	0.3	1.7	2.4	blocky round, medium size tuber type, light netted, skinning
CMK2009-630-001 ^{abcdeg}	269	430	57	37	57	0	6	1.078	1.3	10	15	0	2	2.0	0.2	2.6	2.1	smaller oval to oblong, medium netted, not uniform, points, heat sprouts
Elevate ^b	201	255	79	21	79	0	0	1.072	1.0	10	90	0	0	2.5	0.2	3.5	1.5	light medium netted, not uniform tuber type
B3403-6 ^b	192	228	84	11	84	0	5	1.088	1.0	0	10	0	0	2.0	0.2	2.5	2.5	light medium netted, not uniform tuber type
MUI2014-011-023 ^{acdeg}	187	409	43	43	43	0	13	1.080	1.1	6	11	11	0	1.5	0.3	2.2	2.4	heavy netted, not uniform tuber type, poor general appearance, round to oval
MEAN	388	457	84	13	83	1	3	1.081	1.2	6	16	6	1	1.3	0.3	2.2	2.5	

2025 Chip Variety Trial Sites

4-L Farm^a
MRC Box Bin^b
Hampton Farms^c
Lenard Ag^d
Main Farms^e
Sandyland Farms^f
Walther Farms^g

¹**SIZE**

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

²**SPECIFIC GRAVITY**

Total solids

³**OUT OF THE FIELD CHIP COLOR SCORE**

(SNAC Scale)
Ratings: 1 - 5
1: Excellent
5: Poor

⁴**RAW TUBER QUALITY**

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

⁵**COMMON SCAB RATING**

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

⁶**SED (STEM END DEFECT) SCORE**

0: No stem end defect
1: Trace stem end defect
2: Slight stem end defect
3: Moderate stem end defect
4: Severe stem end defect
5: Extreme stem end defect

⁷**VINE VIGOR RATING**

Date: Variable
Rating 1-5
1: Slow emergence
5: Early emergence
(vigorous vines, some flowering)

⁸**VINE MATURITY RATING**

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

Table 3. Statewide Tablestock (Non-Russet) Variety Trials: Summary Across Seven Locations, MI, 2025

SKIN COLOR	LINE	CWT/A		PERCENT OF TOTAL ¹				RAW TUBER QUALITY ² (%)				COMMON SCAB RATING ²	VINE VIGOR ²	VINE MATURITY ⁴	YELLOW FLESH		RED SKIN			COMMENTS			
		US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR ²	HH	VD				IBS	BC	WAXINESS ⁷	FLESH COLOR ⁴	WAXINESS ⁷		SKIN COLOR ²	UNIFORMITY ^{4*}	SILVER SCURF ^{1†}
Yellow	MSGG039-11Y ^{abcdefg}	516	598	63	26	63	0	11	1.070	0	3	0	0	1.2	1.7	3.7	3.5	3.2					small round oval, fairly uniform tuber type, trace of pink eye and growth cracks
	Colomba^{abcdefg}	458	557	66	24	65	1	10	1.056	7	26	12	0	0.5	2.5	2.5	3.0	3.6					severe heat sprouts, round oval, uniform tuber type, knobby, growth cracks
	Saphia ^{abcdef}	457	691	73	16	73	0	11	1.067	0	10	0	0	1.0	1.0	3.0	2.8	4.2					bottlenecking, oblong to long, light netted, misshapen pick outs, points, growth cracks
	MSHH224-1Y ^{abcdefg}	450	571	83	12	82	2	5	1.065	4	9	0	6	1.1	2.5	2.9	2.8	3.0					large round uniform tuber type, trace of misshapen, trace heat sprouts
	Jelly ^{bcdefg}	422	513	73	24	73	0	3	1.063	0	0	0	0	0.5	3.2	3.0	3.0	4.2					knobby, points, blocky, sticky stolons, misshapen pick outs, medium netted
	Chas ^{bcdefg}	397	523	60	26	60	0	13	1.087	30	0	0	0	1.2	1.3	4.2	2.8	2.7					growth cracks, knobs, not uniform tuber type, misshapen, light netted
	Alaska Gold ^{abcdefg}	386	555	75	14	75	0	11	1.056	7	25	0	0	0.9	2.2	2.5	2.8	2.8					points, growth cracks, sticky stolons, points, misshapen
	MUZ015-004-003 ^{abcdef}	385	526	89	9	85	4	2	1.050	0	20	0	0	0.7	1.0	2.7	2.5	2.5					round oval blocky, medium netted
	Stella Gold ^{bcdefg}	379	470	50	33	49	1	16	1.064	0	15	5	1	1.1	2.7	2.7	3.1	2.6					uniform round tuber type, traces of heat sprouts, nice general appearance, some points
	Mikado ^{abcdef}	340	448	72	18	72	0	10	1.067	18	17	2	0	1.5	2.3	2.6	3.2	2.9					flat oblong to long, points, growth cracks, bottle necking
	Isabella ^{def}	317	432	70	27	70	0	3	1.058	1	13	10	0	0.7	2.4	2.4	3.0	2.7					not uniform tuber type, medium netted
	Gala ^{bcdefg}	315	442	84	9	82	2	7	1.051	0	15	0	0	0.7	3.0	2.5	3.4	3.0					severe heat sprout, uniform round oval tuber, points, light skin
	Acoustic ^{abcdef}	314	423	70	22	69	1	9	1.063	2	13	3	1	1.0	2.4	2.8	3.0	3.1					misshapen pick out, round oval, non uniform tuber type, trace of rots, knobs
	W15240-2Y ^{abc}	298	398	60	31	59	0	10	1.063	0	7	3	3	1.2	2.5	2.7	2.7	3.1					round oval, trace of pear shapes, not uniform, bright general appearance
	Queen Anne^{abcdefg}	297	476	39	48	38	0	13	1.069	1	18	0	0	0.6	2.0	3.2	3.6	4.1					severe heat sprout, points, uniform elongated tubers, growth cracks
	Samoa ^{def}	297	409	65	30	64	1	5	1.075	1	5	8	0	0.9	2.6	3.0	3.0	2.8					large blocky, light skin, misshapen, growth cracks, not uniform tuber type, pineconing
	Rock ^{bcdefg}	278	425	63	30	63	0	7	1.056	0	6	0	0	1.4	2.3	2.9	3.4	3.8					not uniform tuber type, poor general appearance, light skin, trace of misshapen pick outs, sticky stolons
	Christel ^{bcdefg}	276	419	76	14	74	2	10	1.049	0	20	0	1	0.5	2.5	3.0	3.1	2.2					flat round oval, medium netted, sticky stolons
	MSH320-04Y ^b	271	304	80	14	78	1	7	1.061	0	11	1	0	1.1	2.7	2.6	3.0	3.0					oblong to long, misshapen pickouts, growth cracks, light netted
	Souna ^{bcdefg}	266	552	65	16	65	0	18	1.061	0	7	3	1	0.9	2.2	3.0	2.9	2.4					misshapen, flat elongated, poor appearance, not uniform tuber type, knobs
	Jola ^{def}	253	398	82	9	80	2	9	1.068	0	12	0	0	0.9	2.1	3.6	2.7	3.5					misshapen pick outs, blocky oblong tuber type, trace of growth cracks, not uniform tuber type
	IPB8343-2WY ^{abc}	239	347	70	24	69	1	6	1.061	0	12	0	1	0.6	2.9	2.1	3.1	3.9					round blocky, deep eyes, sheep nose, deformed tuber type
	Tessa ^{bcdefg}	223	367	62	38	62	0	0	1.057	0	0	20	0	0.5	1.0	2.5	2.5	1.0					very oblong to long, tubular, not uniform tuber type, misshapen, elongated
	Arthus ^{def}	179	272	68	14	68	0	17	1.071	1	11	15	3	1.4	2.7	3.2	2.8	2.8					poor tuber type, medium netted, misshapen pick out, prominent lenticels
Odett ^{bcdefg}	174	430	73	26	73	0	1	1.058	0	20	2	3	1.5	2.6	2.2	3.2	3.3					not uniform skin color and tuber type, points, heat sprouts, round oval light skin	
T1 ^{1†}	105	169	81	15	80	1	4	1.062	0	12	0	0	0.6	2.5	3.1	3.1	3.6						
MEAN	319	451	74	22	74	0	3	1.060	0	7	11	0	0.8	2.1	2.7	2.7	2.7						
White	Reba ^{defg}	488	512	95	4	94	1	1	1.066	6	10	0	4	0.6	3.0	2.8	2.3	1.0					blocky oval, light netted, sheep nose, uniform tuber type, deep apical eye
	08 6840-1 ^{abcdfg}	480	605	80	9	79	1	11	1.063	3	18	2	3	1.0	2.7	3.5	2.6	1.1					blocky flat round oval, bright general appearance, not uniform, misshapen pick outs
	MSFF031-6 ^{bcdfg}	466	515	89	10	86	4	1	1.062	0	12	2	0	0.6	3.0	2.7	2.1	1.0					moderate prominent lenticels, light netted, OK general appearance, deep apical eye, sheep nose
	Superior^{def}	321	405	80	9	80	0	11	1.069	3	38	5	0	0.3	2.3	2.0	1.8	1.0					misshapen, flat, poor tuber type
	MEAN	439	509	86	8	85	1	6	1.065	3	20	2	2	0.6	2.7	2.8	2.2	1.0					
Red	Spartan Red ^{abcdefg}	496	554	89	8	87	3	3	1.068	7	10	0	7	1.3	3.0	3.1			2.6	2.9	2.5	1.3	flat round, moderate skinning, sticky stolons, black scurf, misshapen, poor general appearance
	MSHH161-06R ^{bcdefg}	445	470	95	3	89	5	2	1.060	6	7	5	26	1.4	1.8	3.5			3.2	4.8	4.9	2.6	large blocky round, moderate skinning, trace of growth cracks, sticky stolons
	AC11596-1R ^{abcdefg}	368	453	81	18	80	1	2	1.057	0	10	0	0	0.7	2.4	2.7			3.2	3.4	3.3	1.6	uniform round oval tuber type, acceptable general appearance
	MSHH176-2R ^{bcdefg}	360	420	86	11	85	1	3	1.066	1	6	0	0	0.8	3.0	3.6			2.9	2.8	3.3	1.1	severe emerging heat sprouts, sticky stolons, uniform round tuber type, mild silver scurf
	MSHH164-03R Y ^{bcdef}	313	359	87	9	85	2	4	1.071	0	7	15	7	0.4	1.6	2.9			2.7	3.4	3.7	1.5	growth cracks, misshapen, mod skinning, uniform round tuber type
	Dark Red Norland^{abcdefg}	294	368	80	17	80	0	3	1.060	4	14	0	0	0.4	2.7	1.5			2.9	2.6	2.5	2.2	mod skinning, flat round, misshapen pickouts, growth cracks, OK general appearance
	BNC981-1 ^{def}	241	298	80	17	80	0	3	1.071	0	10	0	0	0.7	3.0	3.2			2.8	3.5	3.3	1.2	round uniform tuber type, severe silver scurf, heat sprouts
MEAN	360	417	85	12	84	2	3	1.065	3	9	3	6	0.8	2.5	2.9			2.9	3.3	3.3	1.6		

2025 Russet Variety Trial Sites

Site	SIZE	SPECIFIC GRAVITY	RAW TUBER QUALITY	COMMON SCAB RATING	VINE VIGOR RATING	VINE MATURITY RATING
4-1 Farms, Inc ^a	Non-russet tablestock	Total solids	(percent of tubers out of 10)	0.0: Complete absence of surface or pitted lesions	Date: Variable	Date: Variable
Walker Farms ^a	Bc = 1.78"		HH: Hollow Heart	1.0: Presence of surface lesions	Rating: 1-5	Rating: 1-5
Horley Brothers Farms ^a	As: 1.78" - 3.14"		VD: Vascular Diskoloration	2.0: Pitted lesions on tubers, though coverage is low	1: Slow emergence	1: Early (times completely dead)
Jenkins Potato Farm ^a	OV: > 3.14"		IBS: Internal Brown Spot	3.0: Pitted lesions common on tubers	5: Early emergence	5: Late (vigorant vines, some flowering)
Kitchen Farms, Inc ^a	PO: Pickouts		BC: Brown Center	4.0: Pitted lesions severe on tubers		
Styma Potato Farm ^a	% of total: Values rounded to the nearest whole number			5.0: More than 50% of tuber surface area covered in pitted lesions		

WAXINESS RATING	FLESH COLOR	SKIN COLOR	UNIFORMITY OF SKIN COLOR	SILVER SCURF
1: Heavy netting, buff	1: White	1: Light pink	1: Highly variable, non-uniform	0: No incidence of silver scurf
5: Waxy, smooth	5: Dark yellow	5: Dark red	5: Highly uniform, color throughout	5: High incidence of silver scurf

Table 4: Statewide Tablestock Russet Variety Trials: Summary Across Nine Locations, MI, 2025

LINE	CWT/A		PERCENT OF TOTAL ¹					SP GR ²	RAW TUBER QUALITY ³ (%)				COMMON SCAB RATING ⁴	VINE VIGOR ⁵	VINE MATURITY ⁶	COMMENTS
	US#1	TOTAL	US#1	Bs	As	OV	PO		HH	VD	IBS	BC				
MUI2015-004-003 ^b	591	750	78	11	64	14	10	1.068	10	0	0	0	2.0	1.0	3.5	dark russetting, misshapen pickouts, growth cracks, oblong tuber type
AOR15166-2 ^{abcdefgi}	562	616	91	7	75	16	2	1.087	0	10	0	0	0.8	2.1	3.2	light russetting, oblong to long flat, good general appearance, growth cracks
TI1 ¹	526	684	77	22	71	6	1	1.069	0	10	0	0	1.5	2.5	2.5	medium russetting, trace of alligator skin, points, misshapen, flat oval oblong
Silverton Russet^{abcdefgi}	461	580	77	12	62	15	10	1.067	14	11	1	6	0.3	2.1	3.5	moderate alligator hide, misshapen, knobs, medium russetting, growth cracks
A12327-5VR ^{abcdefghi}	457	616	75	10	51	24	16	1.069	14	9	3	0	0.4	2.6	3.3	dark russet, growth cracks, good general appearance, alligator hide, oblong, some misshapen
Reveille Russet^{abcdefghi}	442	583	75	9	56	18	17	1.065	0	14	6	0	0.2	1.8	3.1	light russetting, heat sprouts, not uniform
AF5736-16 ^{abcdefgi}	412	479	85	9	70	15	6	1.081	22	11	10	2	0.5	1.7	3.8	medium russet, blocky oblong to long, slight deep eyes
AAF15096-1 ⁸	411	487	84	11	75	9	4	1.085	0	10	0	0	1.0	4.0	4.0	light medium russetting, poor general appearance, misshapen pick outs
AAF10596-1 ¹ ^{abcdefgi}	409	505	80	14	68	13	6	1.080	26	13	0	1	1.4	1.9	2.5	medium to dark russetting, not uniform tuber type, oblong, points
A18077-11TE ^{abcdefgi}	408	537	75	12	68	8	13	1.078	8	20	3	2	0.5	2.2	2.9	light russetting, growth cracks pickouts, misshapen, blocky to oblong
AF6377-10 ^{abcdefgi}	407	478	84	8	60	24	8	1.071	29	14	1	0	0.3	2.0	2.6	light to medium russet, flat blocky oblong, OK general appearance, some misshapen
A18476-3adg ^{abcdefgi}	395	540	73	16	66	7	10	1.077	4	12	0	0	0.7	1.7	3.4	dark russetting, not uniform, moderate alligator skin, misshapen, growth cracks
AF7001-5 ^{abcdefgi}	395	500	79	15	71	8	7	1.079	16	18	0	0	0.5	1.9	2.9	growth cracks pickouts, medium russet, slight skinning, elongated, alligator hide
AF6377-12 ^{abcdefgi}	386	449	85	8	68	18	7	1.076	36	13	1	3	0.6	1.8	2.6	medium dark russetting, nice general appearance, oblong to long, trace of growth cracks, misshapen
Vanguard^{abcdefgi}	386	474	78	15	72	6	7	1.059	0	6	0	0	0.5	2.1	2.2	medium russetting, oval to oblong, medium tuber size, nice tuber type but scaby
W20059-12RUS ^{abcdefghi}	374	529	71	15	59	12	15	1.064	5	10	4	0	0.5	2.2	3.7	growth cracks, misshapen, med russetting, not uniform tuber type, oblong
Russet Norkotah^{abcdefghi}	370	506	71	17	54	17	12	1.066	24	21	1	0	0.8	2.3	2.9	knobby, medium russet, misshapen, pine coning, growth cracks, alligator hide
W20039-15RUS ^{abcdefgi}	362	460	79	13	69	10	8	1.060	0	14	2	7	0.7	2.3	2.5	dark russetting, OK general appearance, misshapen pick outs, growth cracks
A13091-5 ^{abcdefgi}	353	444	79	16	72	6	4	1.076	9	28	1	0	0.8	2.4	3.0	poor general appearance, moderate alligator skin, medium to dark russetting, elongated
A15077-9TE ^{abcdefgi}	347	427	75	10	57	18	17	1.076	53	10	0	0	0.5	1.9	3.6	moderate growth cracks, alligator hide, bottlenecks, not uniform, dark russetting
A18057-2TE ^{abcdefgi}	332	466	71	14	63	8	15	1.069	0	19	0	0	1.4	2.1	2.9	slight alligator hide, trace of rots, blocky oblong to long, medium russet, severe growth cracks, misshapen
Gold Rush^{abcdeg}	297	403	70	15	59	11	15	1.063	6	4	0	0	0.1	2.2	2.9	medium russetting, oblong, small tubers, pine coning, very tubular
A18224-2 ¹	278	482	53	30	50	3	17	1.054	0	30	0	0	0.5	2.3	4.0	tubular, knobby, point, medium russetting, misshapen, oblong to long
OR11222-4 ¹	185	451	41	41	41	0	18	1.064	0	80	0	0	0.5	1.5	2.5	medium dark russet, flat oblong, misshapen pick outs
CO15070-4RUS ^{abcdefgi}	164	334	48	45	48	0	6	1.064	0	7	0	0	0.0	2.2	2.2	medium russetting, blocky oval oblong, good general appearance, not uniform tuber type
MEAN	388	511	74	16	63	11	10	1.071	11	16	1	1	0.7	2.1	3.0	

2025 Table Russet Variety Trial Sites

- 4-L Farms, Inc^a
- Elmaple Farms LLC^b
- Horkey Brothers Farms^c
- Jenkins Potato Farm^d
- Kitchen Farms, Inc^e
- Lennard Ag Co.^f
- Slyma Potato Farm^g
- Verbrigghe Potato Farms^h
- Walther Farmsⁱ

¹SIZE

Russets

Bs: < 4 oz

As: 4 - 10 oz

OV: > 10 oz

PO: Pickouts

% of total: Values are rounded to the nearest whole number

²SPECIFIC GRAVITY

Total solids

³RAW TUBER QUALITY

(percent of tubers out of 10)

HH: Hollow Heart

VD: Vascular Discoloration

IBS: Internal Brown Spot

BC: Brown Center

⁴COMMON 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

⁵VINE VIGOR RATING

Date: 6/10/2025

Rating 1-5

1: Slow emergence

5: Early emergence (vigorous vine, some flowering)

⁶VINE MATURITY RATING

Date:

Rating 1-5

1: Early (vines completely dead)

5: Late (vigorous vines, some flowering)

Potato Storage Studies

Study 1: Effect of sprout inhibitor treatments and bin inlet airflow timing on chip quality in Bliss and Mackinaw

Introduction

Chip quality deterioration in stored processing potatoes is often linked to changes in tuber physiology that elevate sugar levels, promote sprouting, and increase internal and external defects, ultimately reducing chip quality. This study evaluated the effects of sprout inhibitors and bin inlet closure period after sprout inhibitor application on chip quality in two processing cultivars, Bliss and Mackinaw. Potatoes were piled up in storage bins and treated with 1,4-dimethylnaphthalene (1,4Sight[®]) and Isopropyl 3-chlorocarbanilate (Chlorpropham[®]) (CIPC) and 1,4Zap[®] in Michigan Potato Industry Commission (MPIC) storage facilities during 2024-2025 located adjacent to the Michigan State University Montcalm Research Center (MRC). Tubers were sampled biweekly and chip quality assessed.

Study a: Air inlet closure duration effects on chip quality of early-harvested Bliss potatoes treated with 1,4Sight[®] in bulk bin storage

Potatoes were harvested on September 30, 2024, from Sandyland Farms and piled into two storage bins (Bins 1 and 2) on the same date. Bin dimensions measured 10 ft × 12 ft × 20 ft, and the bin load weighed about 570 cwt. Pulp temperature at loading were 63.5 °F for both bins. A 0.03 fl oz cwt⁻¹ dose of 1,4Sight was applied to both bins on October 1, 2024. Following 1,4Sight[®] application, Bin 1 air inlet was closed for 12 hours before ventilation was initiated on October 2, while Bin 2 air inlet remained closed for 48 hours before fan activation on October 3. A 0.1 oz cwt⁻¹ dose of CIPC[®] and 0.03 fl oz cwt⁻¹ of 1,4Zap[®] were applied to both bins on October 29, 2024. The average storage pulp temperatures were 52°F (Bin 1) and 51°F (Bin 2). Tubers were unloaded on February 24, 2025. During storage period, a sample of 40 tubers were collected biweekly and submitted to Techmark Inc. for assessment of glucose, sucrose, SFA color, and chip defects (external, internal, and greening).

Results

Air inlet closure duration had no significant effect on any trait. Days in storage significantly affected the sucrose content but not the other quality parameters (Table 1). Sucrose levels peaked early in storage, with the highest at 35 days (0.91 (%×10)) and 21 days (0.86 (%×10)), then gradually declined to the lowest at 147 days (0.48 (%×10)) (Table 2). The SFA color score was comparable across treatments, while internal defects and undesirable chips were minimal and not subjected to further analysis (data not shown).

Study 1: *p*-values for chip quality traits of early harvested Bliss treated with 1,4Sight[®], under air inlet closure duration prior to fan activation in MPIC storage bins, MRC, 2024–2025.

Sources of variation	Glucose content	Sucrose content	External defects	Greening effects	Total defects
Air inlet closure duration	0.9694	0.1828	0.0986	0.6408	0.1623
Days in storage	0.2026	0.0172	0.2421	0.3105	0.4437

Table 2: Mean sucrose content of early harvested Bliss treated with 1,4Sight[®], under air inlet closure durations prior to fan activation in MPIC storage bins, MRC, 2024-2025, data pooled across bins.

Days in storage	Sucrose content (%×10)
0	0.6812 abc
21	0.8590 ab
35	0.9071 a
49	0.6096 abc
65	0.5796 abc
77	0.6739 abc
98	0.6590 abc
119	0.4982 bc
133	0.5912 abc
147	0.4770 c

Study b: Air inlet closure duration effects on chip quality of early-harvested Bliss potatoes treated with 1,4Sight[®] in bulk bin storage

The crop was harvested on October 08, 2024, from Sandyland Farms and piled into two storage bins (bins 3 & 4) on the same date. Bin dimensions measured 10 ft × 12 ft × 20 ft, and the bin load weighed about 570 cwt. The temperature at loading was 62 °F for both bins. A 0.03 fl oz cwt⁻¹ dose of 1,4Sight[®] was applied to both bins on October 13, 2024. After 1,4Sight[®] application, Bin 3 was closed for 12 hours while Bin 4 was closed for 24 hours before initiating bin ventilation. A 0.1 oz cwt⁻¹ dose of CIPC[®] and 0.03 fl oz cwt⁻¹ of 1,4Zap[®] were applied to both bins on November 11, 2024. The average storage pulp temperature for both bins was 50°F. Tubers were unloaded on March 24, 2025. During storage, a sample of 40 tubers were collected biweekly and submitted to Techmark Inc. for analysis of glucose, sucrose, SFA color, and chip defects (external, internal, and greening).

Results

Air inlet closure duration had a significant effect only on sucrose content (Table 3). Bin 3 (12 h closure) had 0.034 %×10 higher sucrose content than Bin 4 (24 h closure) (Table 4). Days in storage significantly affected glucose, sucrose, and total defects (Table 3). Storage time significantly affected glucose and total defects overall, but no single time point differed significantly after multiple comparison adjustments, indicating gradual changes over time (Table 5 and 6). Sucrose content declined by half from day 0 to 166, with a significant decrease after day 40 (Table 5). The SFA color score was comparable across treatments, while internal defects, greening, and undesirable chips were minimal and not subjected to further analysis (data not shown).

Table 3: *p*-values for chip quality traits in late harvested Bliss treated with 1,4Sight[®] under air inlet closure durations prior to fan activation in MPIC storage bins, MRC, 2024-2025.

Sources of variation	Glucose content	Sucrose content	Total defects
Air inlet closure duration	0.1098	0.0180	0.2509
Days in storage	0.0105	<.0001	0.0172

Table 4: Mean sucrose content over time in late harvested Bliss treated with 1,4Sight[®] under bin closure durations prior to fan activation in MPIC storage bins, MRC, 2024-2025, data pooled across bins.

Bin	Sucrose content (%×10)
3 (12 h air inlet closure)	0.4623 a
4 (24 h air inlet closure)	0.4283 b

Table 5. Mean glucose and sucrose content of late harvested Bliss treated with 1,4Sight[®] under air inlet closure durations prior to fan activation in MPIC storage bins, MRC, 2024-2025, data pooled across bins.

Bin	Glucose content %	Sucrose content %×10
0	0.0025 a	0.7255 a
12	0.0020 a	0.6055 ab
26	0.0025 a	0.6006 ab
40	0.0020 a	0.4743 cb
56	0.0010 a	0.3937 cd
68	0.0010 a	0.4056 cd
89	0.0010 a	0.4182 cd
110	0.0015 a	0.3656 cd
124	0.0010 a	0.4007 cd
138	0.0010 a	0.3258 d
152	0.0000 a	0.4299 cd
166	0.0011 a	0.3508 d

Table 6: Mean total defects over time in late harvested Bliss treated with 1,4Sight[®] under air inlet closure durations prior to fan activation in MPIC storage bins, MRC, 2024-2025, data pooled across bins.

Days in storage	Total defects (%)
0	3.7360 a
12	8.1460 a
26	17.580 a
40	11.950 a
56	5.8410 a
68	16.790 a
89	0.0000 a
110	4.5790 a
124	3.3840 a
138	6.7520 a
152	5.2550 a
166	5.7780 a

Study c: Air inlet closure duration effects on chip quality of Mackinaw potatoes treated with 1,4Sight® in bulk bin storage

Potatoes were harvested on October 08, 2024, from Sandyland Farms and piled into two storage bins (bins 5 & 6) on the same date. Bin dimensions measured 10 ft × 12 ft × 20 ft, and the bin load weighed about 570 cwt. The pulp temperatures at loading were 58 °F (Bin 5), and 57 °F (Bin 6). A 0.03 fl oz cwt⁻¹ dose of 1,4Sight® formulation was applied to both bins on October 13, 2024. Following 1,4Sight® application, Bin 5 was closed for 12 hours and Bin 6 for 48 hours before fan activation for air inlet. A 0.1 oz cwt⁻¹ dose of CIPC® and 0.03 fl oz cwt⁻¹ of 1,4Zap® were applied to both bins on November 14, 2024. The average pulp temperatures during storage were 50 °F (Bin 5) and 49°F (Bin 6). Potatoes were unloaded on March 24, 2025. During storage, tuber samples were collected biweekly and taken to Techmark Inc. for chip quality assessment on glucose, sucrose, SFA color, and chip defects (external, internal, and greening).

Results

Days in storage significantly affected glucose, sucrose, external and total defects, while air inlet closure duration effects were not significant except for total defects (Table 7). Glucose content peaked at 0.006% (12-26 days), declined to 0.001% (124-208 days), slightly rose at 222 days, and overall decreased with storage time (Table 8). Sucrose peaked at 1 %×10 (26 days), then dropped to 0.5 %×10 (138 days), showing an overall decline during storage (Table 8). Bin 5 (24 h closure) had 5% more mean total defects than Bin 6 (48 h closure) (Table 9). External defects fluctuated, peaking at 26% (68 days) and reaching a minimum of 1% (138 days). Total defects remained consistently high, with peaks near 27% (236 days) and occasional declines at 40, 124, and 166 days (Table 10). The SFA color score was comparable across treatments, while internal defects, greening, and undesirable chips were minimal and not subjected to analysis (data not shown).

Table 7: *p*-values for chip quality traits in Mackinaw treated with 1,4Sight® under air inlet closure durations prior to fan activation in MPIC storage bins, MRC, 2024-2025.

Sources of variation	Glucose content	Sucrose content	External defects	Total defects
Air inlet closure duration	0.6630	0.2352	0.1663	0.0474
Days in storage	0.0008	0.0006	0.0047	0.0019

Table 8: Mean glucose content over time in Mackinaw treated with 1,4Sight[®] under bin closure durations prior to fan activation in MPIC storage bins, MRC, 2024-2025, data pooled across bins.

Days in storage	Glucose content	Sucrose content
	%	%×10
0	0.0041 ab	0.9650 abc
12	0.0056 a	1.0447 ab
26	0.0056 a	1.1091 a
40	0.0041 ab	1.0096 abc
56	0.0026 ab	0.8285 abcd
68	0.0026 ab	0.9940 abc
89	0.0021 ab	0.8146 abcd
110	0.0015 ab	0.7376 abcd
124	0.0011 b	0.6750 bcd
138	0.0018 ab	0.5398 d
152	0.0011 b	0.7637 abcd
166	0.0016 ab	0.6728 bcd
187	0.0011 b	0.5850 dc
208	0.0011 b	0.7100 abcd
222	0.0031 a	0.9828 abcd
236	0.0021 ab	0.7982 abcd

Table 9: Mean total defects in Mackinaw treated with 1,4Sight[®] under air inlet closure durations prior to fan activation in MPIC storage bins, MRC, 2024-2025, data pooled across days in storage.

Bin	Mean total defects (%)
Bin 5 (24 h air inlet closure)	14.860 a
Bin 6 (48 h air inlet closure)	11.450 b

Table 10: Mean external and total defects over time in Mackinaw treated with 1,4Sight[®] under air inlet closure durations prior to fan activation in MPIC storage bins, MRC, 2024-2025, data pooled across bins.

Days in storage	External defects	Total defects
		%
0	1.822 abc	9.944 a
12	14.160 abc	13.460 a
26	22.430 ab	23.050 a
40	6.833 abc	6.012 b
56	21.020 ab	20.450 a
68	25.770 a	26.920 a
89	11.720 abc	10.970 a
110	20.040 ab	21.450 a
124	7.722 abc	6.916 b
138	1.037 c	3.266 a
152	14.600 abc	13.900 a
166	6.372 abc	5.550 b
187	1.418 bc	22.920 a
208	8.698 abc	7.904 a
222	17.840 abc	22.340 a
236	25.200 a	27.000 a

Study d: Effects of 1,4Sight[®] on Mackinaw potatoes in bulk bin long-term storage

Potatoes were harvested on September 20, 2024, from Main Farms and piled into two storage bins (Bins 8 & 9) on the same date. Bin dimensions measured 10 ft × 12 ft × 20 ft, and the bin load weighed about 625 cwt. A 0.03 fl oz cwt⁻¹ dose of 1,4Sight[®] formulation was applied to bin 8 on September 24, 2024, and air inlet was closed for 24 hours before ventilation was initiated. Bin 9 was the untreated control, receiving no 1,4Sight[®] application, with continuous air inlet operation under conventional management. On October 24, 2024, both bins were treated with 0.1 oz cwt⁻¹ CIPC[®] and 0.03 fl oz cwt⁻¹ 1,4Zap[®]. The average pulp temperature during storage was 50 °F in both bins. Tubers were unloaded on June 2, 2025. During storage, tuber samples were collected biweekly and shipped to Techmark Inc. for chip quality assessment on glucose, sucrose, SFA color, and chip defects (external, internal, and greening).

Results

Bin effects were non-significant for all traits. Storage duration significantly affected sucrose and total defects (Table 11). Sucrose content rose to a peak of 1.4 %×10 at 46 days, then generally declined (Table 12, Fig. 1). Total defects fluctuated, peaking at 28% by 88 days (Table 12, Fig. 2). Overall, sucrose showed a rise followed by a decline, and total defects varied without a clear trend.

Table 11: *p*-values for chip quality traits in Mackinaw treated 1,4Sight[®] in MPIC storage bins, MRC, 2024-2025.

Sources of Variation	Glucose content	Sucrose content	External defects	Total defects
Bin	0.1094	0.0714	0.4533	0.1557
Days in storage	0.5293	0.0044	0.6892	0.0059

Table 12: Mean sucrose content and total defects over time in Mackinaw treated with 1,4Sight[®] in MPIC storage bins, MRC, 2024-2025, data pooled across bins.

Days in storage	Sucrose content %×10	Total defects %
0	0.8833 abc	7.359 ab
11	1.0292 abc	15.68 ab
32	1.1673 abc	4.496 b
46	1.3671 a	15.270 ab
60	1.1896 abc	14.340 ab
76	1.1779 abc	8.763 ab
88	1.2428 ab	27.680 a
109	1.1245 abc	13.480 ab
130	1.0898 abc	12.780 ab
144	0.7946 abc	15.000 ab
158	0.7946 bc	11.810 ab
172	0.9884 abc	9.380 ab
186	0.8891 abc	4.781 b
207	0.7684 c	10.480 ab
228	0.8146 bc	3.109 b
242	0.9587 abc	8.788 b
252	1.0370 abc	18.390 ab

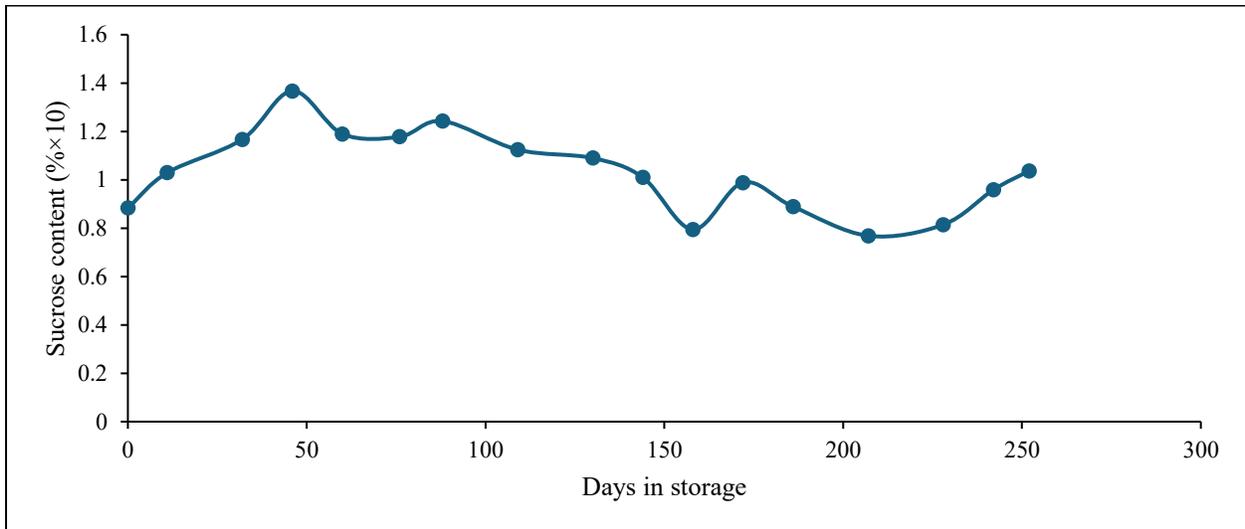


Fig. 1. Mean sucrose content over time in Mackinaw treated 1,4Sight[®] in MPIC storage bins, MRC, 2024-2025, data pooled across bins.

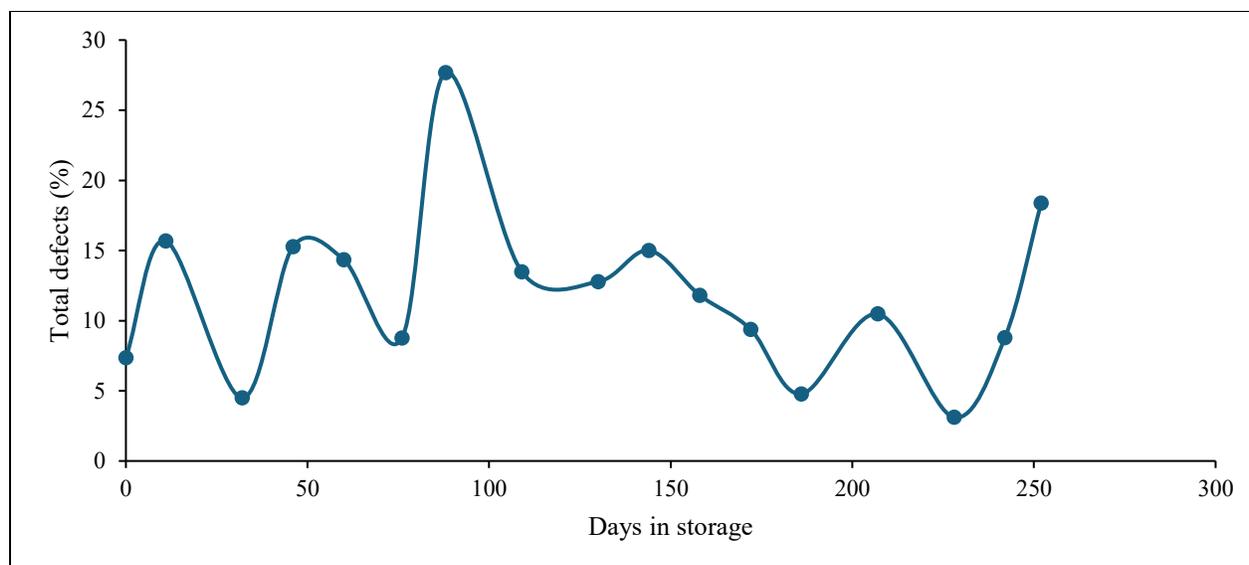


Fig. 2. Mean total defects over time in Mackinaw treated with 1,4Sight® in MPIC storage bins, MRC, 2024-2025, data pooled across bins.

Findings

For Bins 1 through 6, duration of storage demonstrated a stronger and more consistent influence on chip quality traits, significantly affecting sucrose content and, in some cases, glucose content and total defects.

In contrast, air inlet closure duration prior to fan activation generally showed minimal influence, with isolated effects on external defects and sucrose content. However, longer air inlet closure reduced mean total defects in Mackinaw, indicating a limited, trait-specific influence.

For Bins 8 and 9, 1,4Sight® treatment did not enhance the long-term storage performance of Mackinaw potatoes for chip processing compared to the non-treated control, but duration of storage affected sucrose content and total defects.

Study 2: Chip quality evaluation of advanced potato breeding lines in long-term box bin storage

Objective: To assess the chip-processing quality of potato lines from public and private breeding programs following long-term box bin storage.

Materials and methods

Field trials

Forty-five entries were evaluated with Snowden as a check (Table 13). Seed potatoes (120 cwt) were planted in single 34-inch rows with 10-inch seed spacing on May 10, 2024, at the Michigan State University Montcalm Research Center, Entrican, MI. Crops were vine-killed on September 3 and harvested on September 24, 2024. A 23-foot section of the row was harvested for yield evaluation, while the remaining portion was harvested for postharvest storage studies. Preharvest and yield data are provided in the 2024 farmer packet (<https://www.canr.msu.edu/potatooutreach>).

Storage trials

The study was conducted from September 23, 2024, to June 2, 2025, evaluating 45 potato entries (Table 13). For each entry, 10 cwt of tubers were placed in a ventilated plastic box bin, stacked in Bulk Bin 7 to ensure airflow via forklift openings and a plenum recirculation system. On October 24, 2024, the bin (Bin 7) was treated with CIPC[®] (0.1 oz cwt⁻¹) and 1,4Zap[®] (0.03 fl oz cwt⁻¹). The average pulp temperature was 55 °F during storage. Box bins were equipped with access doors for biweekly sampling.

An initial out of field sample was collected directly from the field on September 23, 2024, immediately after harvest and prior to binning, followed by a biweekly sampling of 40 tubers per entry for chip quality analysis at Techmark Inc. Entries with unacceptable chip quality were discontinued from subsequent sampling.

Chip quality was evaluated using a rank summation method. Entries were scored across key traits including chip color, glucose, sucrose, and total defects, all measured as percentages. Rankings were based on both mean performance and maximum values, representing the worst case during the storage period. Ranks for each trait were summed to generate a total rank score, with lower scores indicating superior performance.

Results

Chip color and individual defects (internal, external, and greening) were similar across most entries (data not shown). Therefore, the ranking was primarily based on glucose and sucrose content, and total defects. Summary of results is presented in Table 13.

×10

Table 13: Glucose and sucrose content, total defects, and rank summaries of 45 potato breeding lines in box bins stacked in Bin 7 at MPIC, MRC, MI (Sept 23, 2024 – June 2, 2025).

Line	Mean glucose (%)	Rank (mean glucose)	Maximum glucose (%)	Rank (maximum glucose)	Mean sucrose (%×10)	Rank (mean sucrose)	Maximum sucrose (%×10)	Rank (maximum sucrose)	Mean total defects (%)	Rank (mean defects)	Maximum total defects (%)	Rank (maximum defects)	¹ Total rank score (summation)	² N
MSBB058-1	0.0014	15	0.0029	21	0.5436	6	0.7789	6	2.69	3	5.63	7	58	16
MSDD244-15	0.0011	5	0.0021	11	0.5724	7	0.8182	9	3.76	12	10.24	19	63	15
MSEE016-10	0.0016	18	0.0019	7	0.7494	26	0.8504	10	0.66	1	2.72	1	63	9
Bliss (Late Sandyland)	0.0012	8	0.0026	17	0.3996	1	0.5606	2	9.15	30	12.25	24	82	11
MSDD249-9	0.0012	9	0.0021	10	0.6308	9	1.0438	26	4.96	15	9.71	16	85	16
MSBB230-1	0.0008	1	0.0014	1	0.7363	23	0.9261	16	6.65	24	12.25	23	88	4
MSBB060-1	0.0022	30	0.0027	20	0.7286	21	0.8714	13	2.07	2	4.35	3	89	9
Elevate	0.0010	3	0.0014	2	0.6480	2	0.7809	7	11.51	40	15.10	29	94	9
MSDD247-07	0.0008	2	0.0019	8	0.8891	36	1.3806	37	3.12	6	4.90	6	95	16
MSEE031-3	0.0014	13	0.0022	13	0.7472	25	0.8562	11	5.05	16	11.43	21	99	10
NY177	0.0011	7	0.0018	4	0.7515	27	1.0196	24	7.51	27	9.24	14	103	16
MSBB630-2	0.0015	17	0.0021	12	0.5015	3	0.6247	3	10.88	39	15.48	30	104	4
MSGG302-1	0.0014	14	0.0018	5	0.7544	28	0.9043	15	7.02	25	9.84	17	104	5
Bliss BB	0.0013	10	0.0046	26	0.5841	8	0.9955	21	4.30	13	14.68	27	105	16
MSDD372-07 (Low N)	0.0013	10	0.0026	18	0.9461	38	1.1618	32	3.14	7	4.32	2	107	8
NY174	0.0011	6	0.0023	14	0.6599	14	0.7701	5	12.42	41	19.89	33	113	16
MSDD247-11	0.0017	20	0.0027	19	0.8653	35	1.0885	28	3.66	11	4.71	4	117	16
AF6671-10	0.0019	24	0.0048	27	0.6672	16	1.0365	25	5.63	17	7.41	9	118	16
MSDD244-05	0.0017	21	0.0056	31	0.6380	11	1.2288	34	2.76	4	10.29	20	121	14
MSGA24-02	0.0010	4	0.0019	6	1.0563	42	2.8263	44	3.47	10	9.30	15	121	16
MSFF029-10	0.0017	19	0.0018	3	0.8378	32	0.9540	17	7.18	26	14.20	26	123	9
Dundee	0.0018	22	0.0033	24	0.8644	34	1.4626	38	3.34	9	4.88	5	132	16
Kal.91.03	0.00144	15	0.0024	16	1.4711	45	4.0466	45	3.06	5	7.36	8	134	16
Mackinaw (Main Farms)	0.0013	12	0.0023	15	0.9196	37	1.3435	35	6.51	23	8.87	13	135	15
Bliss (Early Sandyland)	0.0021	26	0.0032	23	0.5016	4	0.9820	20	9.19	32	18.71	32	137	11
CMK2009-630-001	0.0022	29	0.0052	29	0.7407	24	1.1341	30	4.92	14	8.25	12	138	15
AC13126-1Wadg	0.0039	40	0.0154	44	0.5326	5	0.7017	4	6.01	20	16.76	31	144	13
MSAA076-6	0.0039	41	0.0114	42	0.6475	12	1.1895	33	3.25	8	8.22	11	147	13
AF5933-4	0.0027	34	0.0057	32	0.7346	22	1.0191	23	6.18	21	10.24	18	150	16
MSBB630-2 (Low N)	0.0030	36	0.0030	22	0.4770	2	0.4770	1	63.70	45	63.70	45	151	1
MSFF037-17	0.0023	31	0.0086	37	0.7771	29	1.1214	29	5.64	18	8.19	10	154	16
MSBB230-1 (Low N)	0.0020	25	0.0020	9	0.7870	30	0.7870	8	59.00	44	59.00	44	160	1
NYU34-6	0.0018	22	0.0049	28	0.6894	18	1.5393	39	7.52	28	12.84	25	160	16
Snowden	0.0031	37	0.0090	38	0.6616	15	0.8977	14	10.70	38	15.06	28	170	11
MSEE035-4	0.0027	35	0.0059	33	0.7193	19	0.9554	18	10.27	35	20.55	35	175	15
AC13125-5W	0.0045	43	0.0103	41	0.6349	10	0.8647	12	9.81	34	27.72	40	180	13
Mackinaw (Sandyland)	0.0024	32	0.0052	30	0.7283	20	1.0734	27	10.40	37	20.19	34	180	15
B3403-6	0.0031	38	0.0038	25	0.9524	39	1.3579	36	9.54	33	12.24	22	193	8
MSFF038-3	0.0035	39	0.0137	43	0.6677	17	1.0041	22	9.15	31	38.41	41	193	13
ND13220C-3	0.0025	33	0.0083	36	1.0198	41	1.8531	40	5.79	19	22.77	36	205	13
MSDD376-4 (Low N)	0.0021	27	0.0065	34	1.2613	43	2.3715	43	8.78	29	27.06	39	215	8
AF6896-1	0.0091	45	0.0098	39	0.8239	31	0.9817	19	33.91	43	44.50	42	219	7
MSDD376-4	0.0021	28	0.0080	35	0.9897	40	2.0065	41	10.28	36	50.24	43	223	15
MSGG409-3	0.0039	42	0.0103	40	0.8615	33	1.1527	31	15.11	42	23.63	38	226	16
Sinatra	0.0056	44	0.0219	45	1.2896	44	2.1568	42	6.18	22	23.25	37	234	8

¹Lower values indicate better performance (ranking assigns lowest rank to ties).

²Number of times sampled

Study 3: Evaluation of pressure bruise susceptibility in advanced potato breeding lines after long-term storage at varying pile heights

Pressure bruising, characterized by sunken discoloration and tuber weight loss, poses a major challenge in chip potato storage due to its effect on quality and marketability. This study evaluated the effects of pile height on pressure bruise incidence, internal discoloration, and weight loss in advanced potato breeding lines during the 2024-2025 storage season at the MRC, MI. Tubers were stored at pile heights of 3, 8, and 14 ft in MPIC bins (10 ft × 12 ft × 20 ft), loaded with 570 cwt (Bins 1-6) or 625 cwt (Bins 8 and 9). Each breeding line (20 lbs. per replicate, three replicates per pile height) was placed during bin loading; lines were not replicated across bins. Breeding lines, pile heights, bin loading and unloading dates are presented in Table 14. Bins were unloaded on different dates based on the quality retention of the piled variety.

Tuber weight was recorded at loading, while weight loss, pressure bruise incidence, and internal discoloration of bruised tubers were assessed at unloading. Mean separations for effects of breeding line, pile height, and their interaction on weight loss, pressure bruise incidence, and internal discoloration are presented in Tables 15-35.

Table 14: Storage bins, pressure bruise test lines, and loading and unloading dates at MRC, Michigan, 2024-2025.

Bin	Load variety	Pressure bruise test lines	Loading date	Unloading date
1	Bliss (Sandyland early)	Bliss (Sandyland early), Elevate, Kal.91-03, MSDD247-07, MSGA24-02	9.30.2024	2.24.2025
2	Bliss (Sandyland early)	Bliss (Sandyland early), MSBB058-1, MSDD249-9, MSEE016-10, MSFF038-3	9.30.2024	2.24.2025
3	Bliss (Sandyland late)	Bliss (MRC), Bliss (Sandyland late), MSDD247-11, MSDD376-4, NY177	10.08.2024	3.24.2025
4	Bliss (Sandyland late)	Bliss (Sandyland late), CMK2009-630-1, MSAA076-6, ND13220C-3, NYU34-6	10.08.2024	3.24.2025
5	Mackinaw (Sandyland)	MSDD244-05, MSGG409-3, Mackinaw (Sandyland), NY174, Snowden	10.08.2024	6.02.2025
6	Mackinaw (Sandyland)	MSDD244-05, MSGG409-3, Mackinaw (Sandyland), NY174, Snowden	10.08.2024	6.02.2025
8	Mackinaw (Main Farms)	Mackinaw	9.20.2024	5.29.2025
9	Mackinaw (Main Farms)	Mackinaw	9.20.2024	5.29.2025

Table 15: Mean weight loss, pressure bruise incidence, and bruise without discoloration for five potato entries at three pile heights in MPIC Bulk Bin 1 at MRC, MI, 2024. Data averaged across pile heights.

Entry	Weight loss	Tubers with bruise	Tubers with bruise and no color
		%	
Bliss (Sandyland early)	4.45 c	93.54 a	63.59 a
Elevate	7.27 a	0.01 c	0.01 c
Kal.91-03	4.43 c	0.01 c	0.01 c
MSDD247-07	5.32 b	5.11 b	2.04 b
MSG24-02	4.85 cb	18.51 b	9.17 b
<i>p</i> value	<.0001	<.0001	<.0001

Table 16: Mean weight loss, pressure bruise incidence, and bruise without discoloration for potatoes stored at different pile heights in MPIC Bulk Bin 1 at MRC, MI, 2024. Data averaged across entries.

Pile height ft	Weight loss	Tubers with bruise	Tubers with bruise and no color
		%	
3	5.63 a	2.79 a	0.645 a
8	4.79 ab	1.68 a	1.189 a
14	5.16 b	1.13 a	0.698 a
<i>p</i> value	0.0019	0.4588	0.6671

Table 17: Mean number of tubers without pressure bruise for five potato entries at three pile heights in MPIC Bulk Bin 1 at MRC, MI, 2024.

Entry	Pile height	Mean tuber number without pressure bruise
	ft	%
Bliss (Sandyland early)	3	0 c
Bliss (Sandyland early)	8	25 bc
Bliss (Sandyland early)	14	51 b
Elevate	3	100 a
Elevate	8	100 a
Elevate	14	100 a
Kal.91.03	3	100 a
Kal.91.03	8	100 a
Kal.91.03	14	100 a
MSDD247-07	3	94 b
MSDD247-07	8	82 b
MSDD247-07	14	99 ab
MSG24-02	3	97 ab
MSG24-02	8	82 b
MSG24-02	14	84 b
<i>p</i> value		0.0168

Table 18: Mean weight loss of five potato entries in MPIC Bulk Bin 2 at MRC, MI, 2024, averaged across three pile heights.

Entry	Weight loss %
Bliss (Sandyland early)	3.88 ab
MSBB058-1	3.13 b
MSDD249-9	5.40 a
MSEE016-10	2.88 b
MSFF038-3	3.48 b
<i>p</i> value	0.0004

Table 19: Mean number of tubers without pressure bruise and bruise without discoloration for five potato entries at three pile heights in MPIC Bulk Bin 2 at MRC, MI, 2024.

Entry	Pile height	Tuber number without bruise	Tubers with bruise and without discoloration
	ft		%
Bliss (Sandyland early)	3	2.11 c	63.27 a
Bliss (Sandyland early)	8	37.17 b	32.30 a
Bliss (Sandyland early)	14	58.24 b	36.73 a
MSBB058-1	3	53.05 b	42.09 a
MSBB058-1	8	63.96 b	35.94 a
MSBB058-1	14	75.15 b	24.67 a
MSDD249-9	3	48.18 b	50.00 a
MSDD249-9	8	75.24 b	23.60 ab
MSDD249-9	14	97.89 a	1.99 c
MSEE016-10	3	51.82 b	42.03 a
MSEE016-10	8	49.46 b	49.29 a
MSEE016-10	14	97.89 a	2.450 bc
MSFF038-3	3	51.82 b	48.17 a
MSFF038-3	8	65.69 b	34.19 a
MSFF038-3	14	54.52 b	36.09 a
<i>p</i> value		<.0001	0.0007

Table 20: Mean weight loss of five potato entries in MPIC Bulk Bin 3 averaged across three pile heights, MRC, MI, 2024.

Entry	Weight loss %
Bliss (MRC)	3.40 b
Bliss (Sandyland late)	4.01 ab
MSDD247-11	5.15 a
MSDD376-4	5.15 a
NY177	3.66 b
<i>p</i> value	<.0001

Table 21: Mean weight loss for potatoes stored at three pile heights in MPIC Bulk Bin 3 at MRC, MI, 2024. Data averaged across entries.

Pile height	Weight loss
ft	%
3	4.23 ab
8	4.63 a
14	3.82 b
<i>p</i> value	0.0452

Table 22: Mean number of tubers without pressure bruise and bruise without discoloration for five potato entries at three pile heights in MPIC Bulk Bin 3 at MRC, MI, 2024.

Entry	Pile height	Tuber number without bruise	Tubers with bruise and without discoloration
	ft		%
Bliss (MRC)	3	3.524 g	63.51 abcd
Bliss (MRC)	8	28.16 bcdef	51.95 bcde
Bliss (MRC)	14	63.73 ab	31.98 ef
Bliss (Sandyland late)	3	10.87 egf	84.64 a
Bliss (Sandyland late)	8	23.96 cdefg	68.68 abc
Bliss (Sandyland late)	14	63.07 abc	35.19 def
MSDD247-11	3	4.538 gf	78.68 ab
MSDD247-11	8	35.48 bcde	59.71 abcde
MSDD247-11	14	78.23 a	20.84 f
MSDD376-4	3	34.16 bcde	55.86 bcde
MSDD376-4	8	46.82 abcd	50.64 bcde
MSDD376-4	14	49.40 abcd	49.33 cdef
NY177	3	22.96 defg	70.50 abc
NY177	8	41.94 abcde	54.55 bcde
NY177	14	64.02 ab	32.41 ef
<i>p</i> value		0.0019	0.0038

Table 23: Mean weight loss of five potato entries in MPIC Bulk Bin 4 across three pile heights, MRC, MI, 2024.

Entry	Pile height	Weight loss	Tuber number without bruise
	ft		%
Bliss (Sandyland late)	3	4.81 abcde	12.96 de
Bliss (Sandyland late)	8	3.38 f	20.57 de
Bliss (Sandyland late)	14	3.58 def	49.77 bcd
CMK2009-630-1	3	3.57 ef	36.54 cde
CMK2009-630-1	8	3.79 cdef	52.42 abcd
CMK2009-630-1	14	3.88 cdef	80.80 abc
MSAA076-6	3	5.25 ab	5.981 e
MSAA076-6	8	5.38 ab	44.07 cde
MSAA076-6	14	4.87 abcd	78.67 abc
ND13220C-3	3	4.65 abcde	92.73 ab
ND13220C-3	8	4.14 bcdef	93.53 a
ND13220C-3	14	4.94 abc	86.01 abc
NYU34-6	3	5.40 ab	38.12 cde
NYU34-6	8	5.70 a	47.07 cde
NYU34-6	14	5.89 a	47.82 cd
<i>p</i> value		0.0066	0.0107

Table 24: Mean tubers with bruise and without discoloration of five potato entries in MPIC Bulk Bin 4 averaged across three pile heights, MRC, MI, 2024.

Entry	Tubers with bruise and without discoloration
	%
Bliss (Sandyland late)	66.63 a
CMK2009-630-1	40.24 b
MSAA076-6	40.27 b
ND13220C-3	4.95 c
NYU34-6	42.37 b
<i>p</i> value	<.0001

Table 25: Mean tubers with bruise and without discoloration for potatoes stored at three pile heights in MPIC Bulk Bin 4 at MRC, MI, 2024. Data averaged across entries.

Pile height	Tubers with bruise and without discoloration
ft	%
3	47.64 a
8	36.72 a
14	20.14 b
<i>p</i> value	0.0002

Table 26: Mean weight loss of five potato entries in MPIC Bulk Bin 5 across three pile heights, MRC, MI, 2024.

Entry	Weight loss %
MSDD244-05	6.80 b
MSGG409-3	5.34 c
Mackinaw (Sandyland)	5.59 c
NY174	7.02 ab
Snowden	7.72 a
<i>p</i> value	<.0001

Table 27: Mean weight loss for potatoes stored at three pile heights in MPIC Bulk Bin 5 at MRC, MI, 2024. Data averaged across entries.

Pile height ft	Weight loss %
3	6.67 a
8	6.03 b
14	6.62 a
<i>p</i> value	0.0111

Table 28: Mean number of tubers without pressure bruise for five potato entries at three pile heights in MPIC Bulk Bin 5 at MRC, MI, 2024.

Variety	Pile height	Tuber number without bruise
	ft	%
MSDD244-05	3	1.453 def
MSDD244-05	8	11.40 bc
MSDD244-05	14	26.70 ab
MSGG409-3	3	6.06 cde
MSGG409-3	8	6.06 cde
MSGG409-3	14	28.03 ab
Mackinaw (Sandyland)	3	11.89 bc
Mackinaw (Sandyland)	8	16.75 bc
Mackinaw (Sandyland)	14	45.40 a
NY174	3	0.45 f
NY174	8	0.71 ef
NY174	14	45.44 a
Snowden	3	14.07 bc
Snowden	8	10.39 bcd
Snowden	14	45.19 a
<i>p</i> value		<.0001

Table 29: Mean tubers with bruise and without discoloration of five potato entries in MPIC Bulk Bin 6 across three pile heights, MRC, MI, 2024.

Entry	Tubers with bruise and without discoloration
	%
MSDD244-05	75.29 a
MSGG409-3	79.14 a
Mackinaw (Sandyland)	64.23 b
NY174	64.26 b
Snowden	57.54 b
<i>p</i> value	<.0001

Table 30: Mean tubers with bruise and without discoloration for potatoes stored at three pile heights in MPIC Bulk Bin 5 at MRC, MI, 2024. Data averaged across entries.

Pile height	tubers with bruise and without discoloration
ft	%
3	73.36 a
8	73.75 a
14	57.64 b
<i>p</i> value	<.0001

Table 31: Mean weight loss of five potato entries in MPIC Bulk Bin 6 across three pile heights, MRC, MI, 2024.

Entry	Weight loss
	%
AC13125-5W	9.63 a
AC13126-1wadg	5.89 bc
AF5933-4	7.89 abc
Dundee	8.02 ab
Mackinaw (Sandyland)	5.78 c
<i>p</i> value	<.0001

Table 32: Mean number of tubers without pressure bruise and bruise without discoloration for five potato entries at three pile heights in MPIC Bulk Bin 6 at MRC, MI, 2024.

Variety	Pile height	Tuber number without bruise	Tubers with bruise and without discoloration
	ft		%
AC13125-5W	3	1.57 e	97.99 a
AC13125-5W	8	1.57 e	69.87 b
AC13125-5W	14	13.88 abcde	64.44 cb
AC13126-1wadg	3	3.89 ed	50.70 cb
AC13126-1wadg	8	3.89 ed	45.49 cb
AC13126-1wadg	14	3.61 ed	51.87 cb
AF5933-4	3	34.19 abc	50.99 cb
AF5933-4	8	6.63 cde	62.40 cb
AF5933-4	14	45.57 ab	44.29 cb
Dundee	3	10.33 bcde	55.81 cb
Dundee	8	4.09 cde	66.18 cb
Dundee	14	21.43 abcd	55.81 cb
Mackinaw (Sandyland)	3	12.01 bcde	59.47 cb
Mackinaw (Sandyland)	8	26.58 abcd	51.87 cb
Mackinaw (Sandyland)	14	58.07 a	29.62 c
<i>p</i> value		0.0430	0.0034

Table 33: Mean weight loss of Mackinaw potatoes stored in MPIC Bulk Bins 8 and 9 across three pile heights, MRC, MI, 2024.

Bin	Weight loss
	%
8	4.97 b
9	5.96 a
<i>p</i> value	0.0134

Table 34: Mean weight loss of Mackinaw potatoes at three pile heights, averaged across MPIC Bulk Bins 8 and 9, MRC, MI, 2024.

Pile height	Weight loss
ft	%
3	6.29 a
8	5.30 ab
14	4.83 b
<i>p</i> value	0.0140

Table 35: Mean number of tubers without pressure bruise and bruise without discoloration for five potato entries at three pile heights in MPIC Bulk Bin 6 at MRC, MI, 2024.

Pile height	Tuber number without bruise	Tubers with bruise and without discoloration
ft		%
3	12.39 b	52.68 a
8	16.19 b	58.94 a
14	51.33 a	44.47 a
<i>p</i> value	<.0001	0.1577

Assessment of variety resistance to four postharvest diseases of potato in Michigan, 2025

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

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

Materials and Methods

1) Postharvest disease variety screening. During 2024-25, harvested and stored tubers from nine chipping lines comprising commercial varieties and research germplasm were obtained from the MSU Potato Outreach Program box bin trial conducted at the MSU Montcalm Research Center (Montcalm County). All materials were tested at three replicate timepoints (5 tubers/timepoint/disease).

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

2) Residual effects of dimethylnaphthalene. We assessed the residual effects of a 20 ppm dimethylnaphthalene (DMN) (1,4Sight®) post-bin loading treatment on dry rot, pink rot, *Pythium* leak, and soft rot development in Mackinaw tubers. Mackinaw tubers were harvested from a MSU Potato Outreach Program field location (Main Farms) on 20 Sep 2024, stored in MPIC storage facilities, and treated with and without 0.03 fl oz/cwt (20 ppm) of 1,4-dimethylnaphthalene (DMN) (1,4Sight®) on 24 Sep 2024. Treated and non-treated tuber samples were collected from both top and bottom these bins and inoculated for disease testing in three minimum replicate timepoints. Tubers were inoculated with each disease and assessed as described above.

3) Pathogenicity of *Plectosphaerella* in tubers. We investigated the potential pathogenicity of a *Fusarium*-like fungal organism commonly observed from tubers with dry rot symptoms in 2024 samples. This organism was morphologically and molecularly characterized as *Plectosphaerella*

cucumerina, which has been previously found to cause stunting, root, and crown rot in pepper and tomato (Raimondo and Carlucci 2018). Eight *Plectosphaerella* isolates (LJ8 to 1B5B-1) as well as isolates of *Fusarium* sp. (Fus25), *F. oxysporum* (Oxy25), and *F. graminearum* (Gra25) from dry rot symptomatic tubers in 2025 were selected and tested for pathogenicity and virulence on Lamoka tuber slices. These were compared with known virulent *Fusarium sambucinum* (Samb) and *F. graminearum* (Gra) isolates and a potato dextrose (PDA) negative control.

Overall Summary

1) Postharvest disease variety screening. Postharvest resistance to four diseases was screened in chipping (Figure 1 and 3) potato entries using Michigan pathogen isolates. No clear relationship was observed between resistance responses to different diseases; however, as observed in 2025, Bliss and NY177 possessed at least moderate resistance to three or four diseases.

From 2025 testing, Bliss exhibited greater resistance to pink rot, Pythium leak and dry rot, Snowden also had greater resistance to dry rot and soft rot, but tended to be more susceptible to pink rot and Pythium leak, and Mackinaw exhibited susceptibility to soft rot, dry rot, and Pythium leak this year. MSBB058-1 exhibited moderate resistance to dry rot and pink rot.

While dry rot responses to *F. graminearum* and *F. sambucinum* generally followed similar trends, several varieties may have seemed more or less resistant depending on the species used, such as Bliss and MSDD247-07 (Figure 2). For example, using only the *F. sambucinum* standard isolate, Bliss dry rot susceptibility caused by *F. graminearum* may have been missed.

2) Residual effects of dimethylnaphthalene. We also assessed the effects of a 20 ppm DMN treatment on dry rot, pink rot, Pythium leak, and soft rot using Mackinaw, however there were not significant differences for most diseases (Figure 4). A slight reduction in Pythium leak symptoms was observed in treated bottom of the bin tubers ($P < 0.01$).

3) Pathogenicity of *Plectosphaerella* in tubers. From this preliminary assay, all *Plectosphaerella* isolates were comparable to the mock-inoculated media control and considered likely not pathogenic (Figure 5). While *Fusarium* isolates Oxy25 and Gra25 were also not significantly different from the PDA media control, minimal symptoms were formed on tuber slices though 80% less than than the virulent *F. sambucinum* and *F. graminearum* positive controls (Figure 5A). The whole tuber assay showed similar results as the slice assay, but *Plectosphaerella* isolates did cause significant though very minor infection (Figure 5B); repetitions of this assay will be conducted in the future. From these preliminary assays with Lamoka tubers, *Plectosphaerella* isolates were considered to exhibit low virulence.

Acknowledgements

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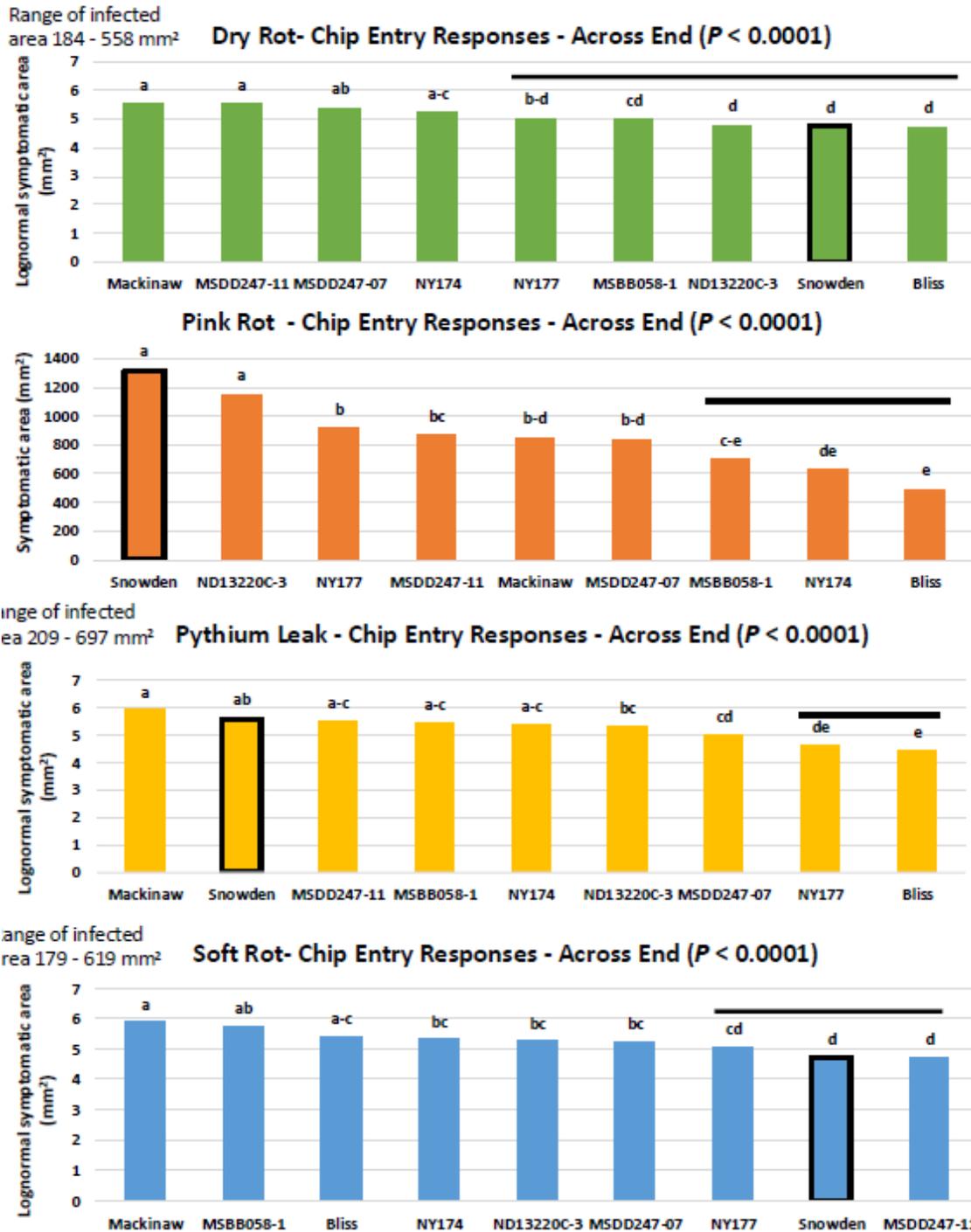


Figure 1. Responses of nine chipping potato lines to dry rot, pink rot, Pythium leak, and soft rot. Bars with the same letter not significantly different based on Fisher's protected LSD ($\alpha=0.05$). Means are across apical and basal end responses ($P < 0.0001$) for dry rot, pink rot, soft rot, and Pythium leak ($P < 0.001$) in tubers from MSU Potato Outreach Program field locations (Montcalm Research Center) tested in three minimum replicate timepoints.

Dry Rot - Chip Entry Responses - Across End ($P < 0.0001$)

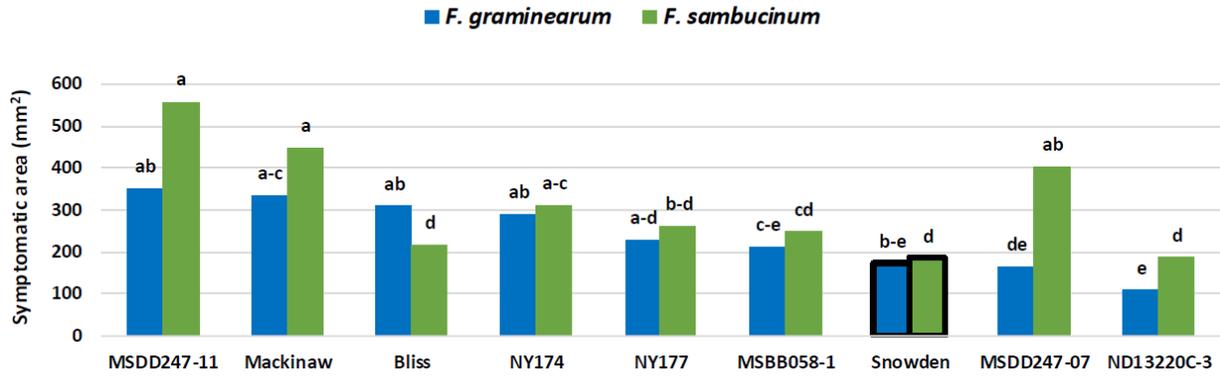


Figure 2. Responses of nine chipping potato lines to dry rot caused by two species of *Fusarium* prevalent in Michigan potato samples. *F. graminearum* (blue), *F. sambucinum* (green). Bars with the same letter not significantly different based on Fisher's protected LSD ($\alpha=0.05$). Significant variable responses were observed across apical and basal ends ($P < 0.0001$).

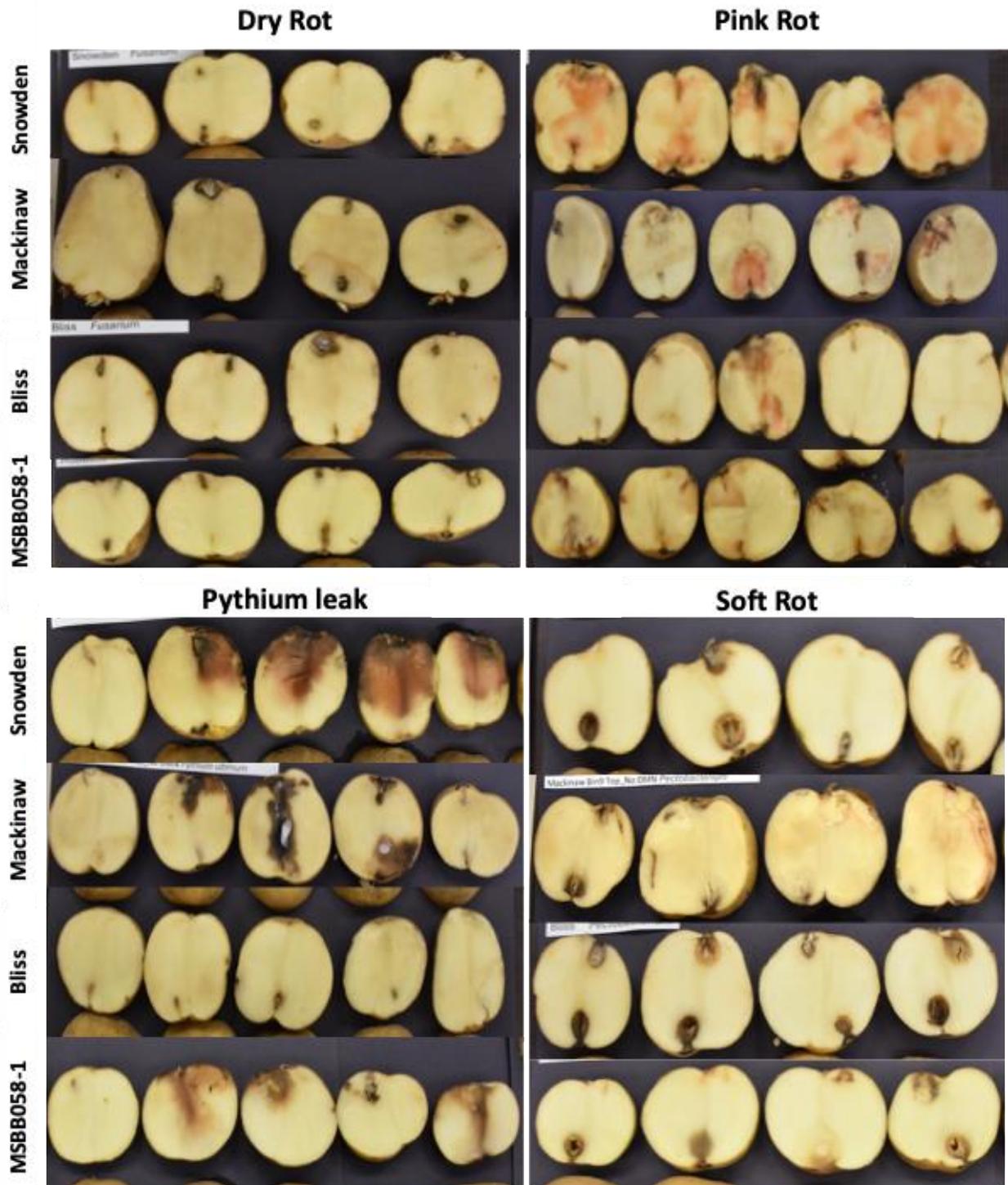


Figure 3. Examples of typical symptoms for each of the four tested postharvest diseases. Bliss had greater resistance to pink rot, Pythium leak and dry rot, Snowden also had greater resistance to dry rot and soft rot, but tended to be more susceptible to pink rot and Pythium leak, and Mackinaw exhibited susceptibility to soft rot, dry rot, and Pythium leak this year. MSBB058-1 exhibited moderate resistance to dry rot and pink rot.

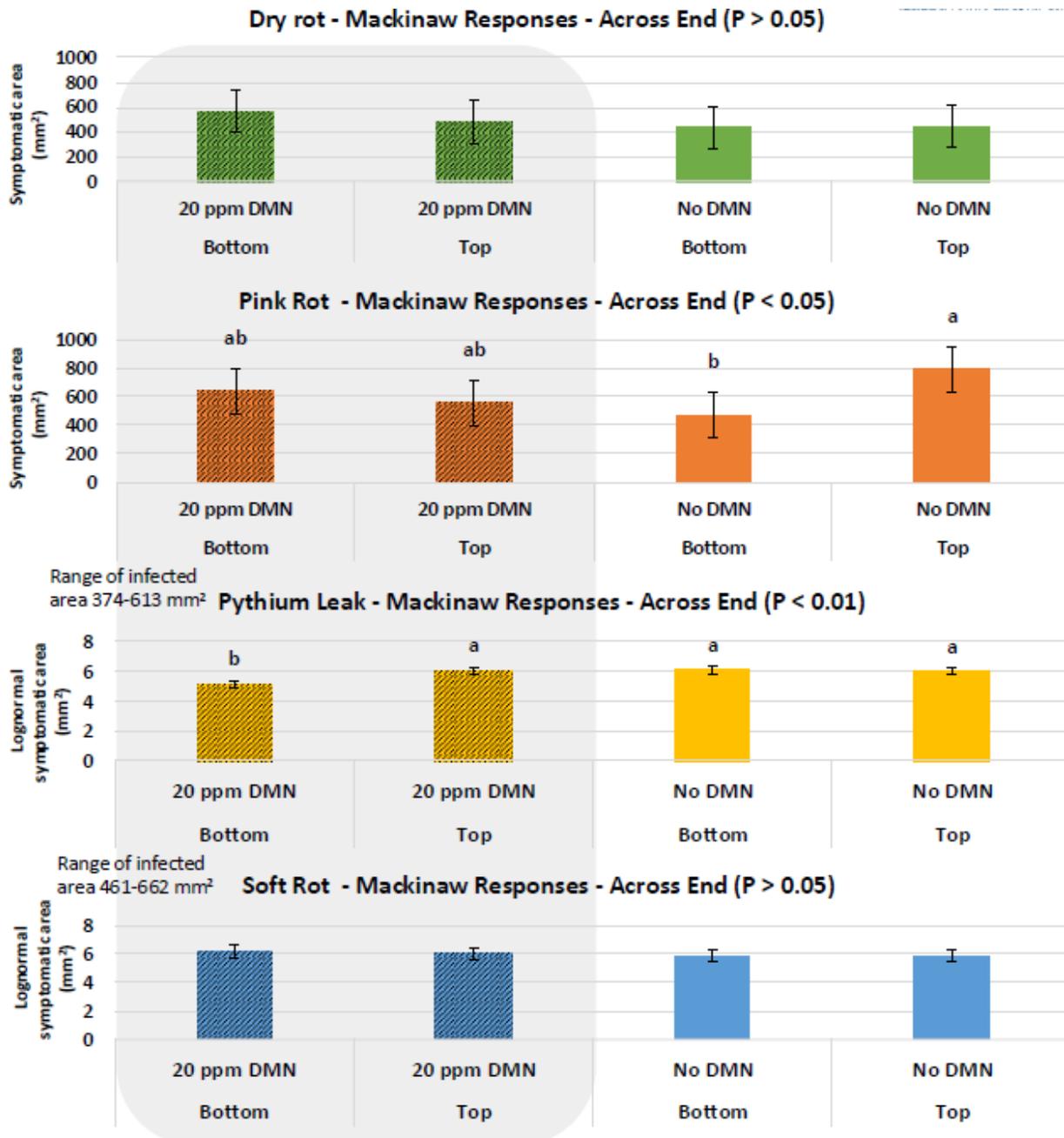


Figure 4. Effect of 20ppm DMN treatment to dry rot, pink rot, Pythium leak, and soft rot. Mackinaw were harvested from a MSU Potato Outreach Program field location (Main Farms) on 20 Sep 2024, stored in MPIC storage facilities, and treated with and without 0.03 fl oz/cwt (20 ppm) of 1,4-dimethylnaphthalene (DMN) (1,4Sight®) on 24 Sep 2024. Treated and non-treated tuber samples were collected from both top and bottom these bins and inoculated for disease testing in three minimum replicate timepoints. Bars with the same letter not significantly different based on Fisher's protected LSD ($\alpha=0.05$). There were no consistent significant differences between treatment for any disease, except a slight reduction in Pythium leak symptoms observed in treated bottom of the bin tubers ($P < 0.01$).

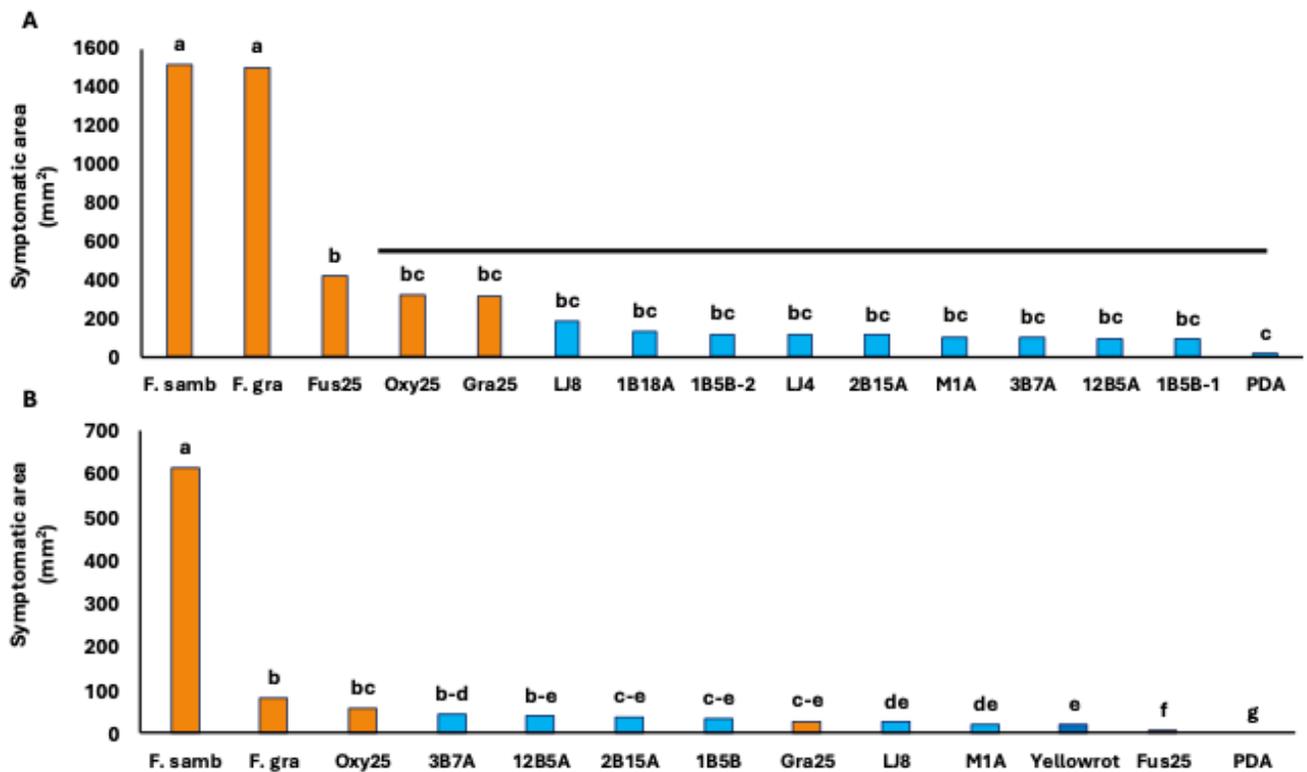


Figure 5. *Fusarium* (blue bars) and *Plectosphaerella* (orange bars) isolate virulence and pathogenicity assay conducted on A) tuber slices measured at four days post-inoculation (DPI4) ($P < 0.0001$) and B) in whole tubers measured at 28 days post-inoculation (DPI28) ($P < 0.0001$). *Plectosphaerella* sp. isolates were observed frequently in submitted dry rot samples in 2024. Eight *Plectosphaerella* isolates (LJ8 to 1B5B-1) as well as isolates of *Fusarium* sp. (Fus25), *F. oxysporum* (Oxy25), and *F. graminearum* (Gra25) from dry rot symptomatic tubers in 2025 were selected and tested for pathogenicity and virulence on Lamoka tuber slices and whole tubers. These were compared with known virulent *Fusarium sambucinum* (F. samb) and *F. graminearum* (F. gra) isolates and a potato dextrose (PDA) negative control. From these preliminary assays with Lamoka tubers, *Plectosphaerella* isolates were considered to exhibit low virulence.

Diagnostic optimization of viral detection and characterization of Potato virus Y for the Michigan seed potato certification program, 2025

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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 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 2024, we shifted to using immunocapture-reverse transcription-polymerase chain reaction (IC-RT-PCR) (Chikh-Ali and Karasev, 2015) methods for faster and more cost-effective methods to screen for PVY in seed tubers. In 2025, IC-RT-PCR method is well adapted in Michigan. We will be continuing further research comparison for accuracy, efficiency, and cost effectiveness.

In 2025-26, an MDARD-MSPA awarded specialty crop block grant will support direct tuber testing and growout comparison in 80 seed lots from growers. In general, samples of 400 tubers were collected from each lot. Direct tuber testing with IC-RT-PCR was conducted in 10-tuber subsamples at least two weeks postharvest. Cored samples were then suberized and sent to Hawaii for planting and winter grow-out. Results from direct tuber and leaflet ELISA methods will be compared. Subsets of positive samples will be subject to PVY strain confirmation by RT-PCR (Chikh-Ali et al. 2013; Lorenzen et al. 2006, 2010; Mackenzie et al. 2015).

We also are repeating assays to assess PVY strain by variety responses (Gundersen et al. 2019). Based on Michigan survey observations, three chipping lines and varieties of interest were selected for repeat greenhouse experiments (Lamoka, NY163, and Manistee) and screened using three prevalent PVY strains (N-Wi, NTN, N:O) in a greenhouse assay. These experiments are currently in progress for 2025-26.

In 2023-24, a survey was conducted of PVY strain types from positive seed certification samples as well as of two other tuber necrotic viruses, Potato mop-top virus (PMTV) and Tobacco rattle virus (TRV) in Michigan using qPCR methods from Mumford et al. (2000).

Results & Conclusions:

- In 2024-25, PVY strain NTN was most prevalent, exceeding frequencies of strain N-Wi for the first time since our surveys began in 2019 (Figure 1A). Furthermore, 23% of samples were mixtures of NTN and N-Wi (Figure 1B).
- From two years of survey for PMTV and TRV in Michigan seed lots, only one positive sample was detected in 2023; however, positive tuber samples were asymptomatic and did not exhibit typical internal necrosis (Figure 2). This result suggests these viruses are not a major concern at this time but support continued monitoring in the future.

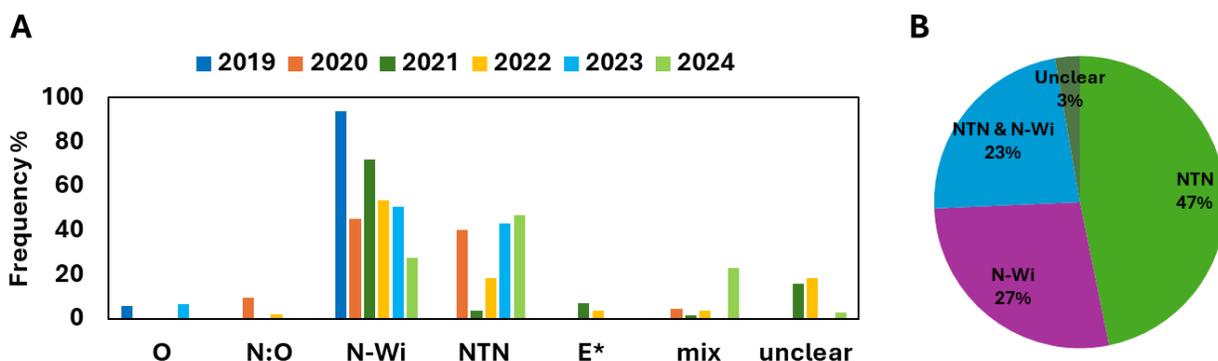


Figure 1. A) Representative PVY strains collected from Michigan potato seed certification program postharvest tests and B) breakdown of strains and strain mixtures in 2024-25. In 2020-21, N = 212 positives in 17,752 total samples. In 2021-22, N = 57 positives in 21,600 total samples. In 2022-23, N= 54 positives in 7,150 total samples. In 2023-24, N= 62 positives in 10,200 total samples. In 2024-25, N= 216 positives in 12,764 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.

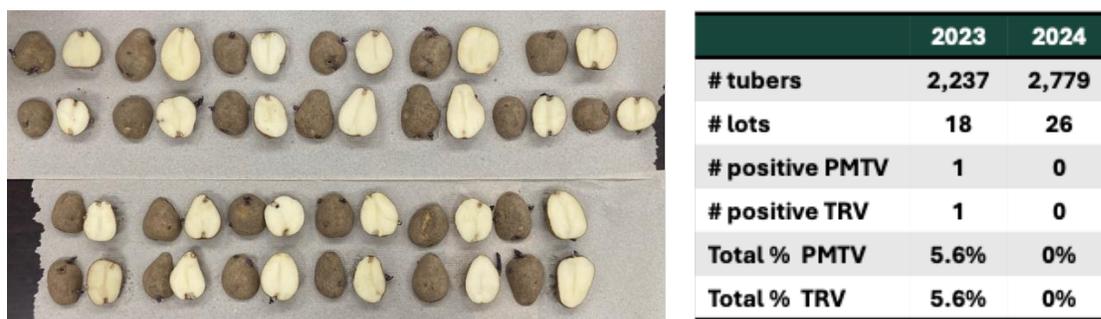


Figure 2. Survey of potato mop top virus (PMTV) and Tobacco rattle virus (TRV) in Michigan seed growing regions in 2023-2024. From 2023 and 2024, a total of 5,016 tubers representing 44 lots were screened for PMTV and TRV. In 2023, we detected one positive lot for both PMTV and TRV, however, this PMTV-positive sample was asymptomatic as shown above.

Acknowledgements:

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

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

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Keywords: Endura Pro, Lucento, Luna Tranquility, Scala SC, Topguard

Experimental and commercially available fungicides were tested to determine their efficacy in managing potato early blight (*Alternaria solani*) and brown spot (*Alternaria alternata*). A field trial was established at the Montcalm Research Center in Stanton, MI. Soil type at the station is loamy sand. A randomized complete block design was used with four replicates. US#1 'Lamoka' potatoes were cut into 2-oz seed piece and left to suberize before planting. The trial was planted 28 May. Plots were two rows wide (34-in row spacing) by 18 ft long and seeded at 1.2 seed/row-ft. Banded treatments were applied at re-hilling on 2 July. A CO₂-powered backpack sprayer, equipped with TJ2504 nozzles, was used to apply fungicides at 20 gal/A. Due to the trial's proximity to commercial potato fields, a blanket application of Echo 720 was applied weekly after row-closure to the entire trial to reduce the risk of late blight developing near commercially grown potatoes. Beginning at early flower, three foliar applications (B, C, and D) were made across programs. Application dates were B=15 July, C=31 July, and D=14 Aug. The previously mentioned sprayer was used to make applications, except TJ8004XR nozzles were used. Plots were inoculated 23 July and 30 July with *A. solani* solution (8×10^3 conidia/mL) at a volume of 20 gal/A. Foliar disease data (combined early blight and brown spot observations) were collected regularly throughout the growing season. Plots were harvested 25 September; both rows were dug and later graded. The final disease incidence (DI) and disease severity (DS) collected 18 August, estimated yield, and estimated marketable yield were compared among treatments. A generalized linear mixed model procedure was used to conduct the ANOVA and mean separations at the $\alpha=0.05$ significance level (SAS version 9.4).

Disease pressure was moderate, and differences were observed among the foliar DI ($P < 0.0001$) but not DS ($P > 0.05$). All tested programs had significantly lower incidence (15-23.3%) than the control (DI=48.8%); severity was numerically lower in all tested programs than in the control but was not significantly lower. No significant differences were observed in yield or marketable yield.

No.	Treatment (Rate ^a) Timing ^b	Disease Incidence (%) ^c		Disease Severity (%)	Total Yield (cwt/A)	Marketable Yield (cwt/A)
1	Treated control	48.8	a	15.8	348.5	313.3
2	Luna Tranquility (11.2 fl oz) B + Luna Tranquility (11.2 fl oz) C + Scala SC (7 fl oz) D	23.0	bc	15.0	307.7	276.7
3	Endura Pro (18.5 fl oz) B + Endura Pro (18.5 fl oz) C + Scala SC (7 fl oz) D	15.0	c	15.0	319.2	284.6
4	Experimental (22.8 fl oz) B + Experimental (22.8 fl oz) C + Scala SC (7 fl oz) D	16.5	bc	13.8	331.7	300.8
5	Lucento (11 fl oz) A	18.8	bc	15.0	317.2	281.4
6	Topguard (28 fl oz) A	23.3	b	14.5	329.1	293.3
7	Topguard (28 fl oz) A + Luna Tranquility (11.2 fl oz) C	20.5	bc	15.0	306.8	274.3
8	Lucento (5.5 fl oz) B + Lucento (5.5 fl oz) C + Scala SC (7 fl oz) D	17.0	bc	13.0	335.7	297.9
	<i>SE</i>	2.7		0.9	14.6	15.6
	<i>P-value</i>	<0.0001		0.4709	0.5603	0.5586
	<i>LSD</i>	8.0		-	-	-

^a All rates are listed as amount of product applied per acre.

^b Application letters code for the following dates: A=Jul 2 (at hill), B=Jul 15 (flower), C=Jul 31 (flower + 2 weeks), D=Aug 14 (flower + 4 weeks). MasterLock 0.25% V/V was added to all treatments.

^c Column values followed by the same letter are not significantly different based on Fisher's Protected LSD ($\alpha=0.05$).

Michigan Potato Industry Commission Grant Proposal 2025 Report

Project Title: Development of suppressive soils for sustainable management of the Potato Early Die complex

Investigator: Marisol Quintanilla

Introduction

Potato early die (PED), caused by the combined activity of *Pratylenchus penetrans* and *Verticillium dahliae*, can reduce potato yields by 30–50%. Current PED management strategies, including fumigation, may negatively impact the soil microbiome, limiting the activity of natural biological control systems. Previous research has shown that poultry manure and a compost blend (cattle and poultry manure + wood ash) can significantly reduce *P. penetrans* populations while improving potato yield. Although the mechanisms behind the pesticidal effects of these amendments are not fully understood, microbial communities are thought to play a key role. In recent decades, compost and manure have gained attention as alternatives to chemical fumigants, showing promise for managing plant-parasitic nematodes. The objective of this study was to evaluate the effects of compost compared with other common management strategies, including chemical and fumigation treatments, on plant-parasitic and free-living nematodes in potato fields.

Materials and Methods

Experimental site and design

The study was conducted at the Lennard Fumigation & Compost Trial (GPS: 41.75967, -85.50634) over the 2024 and 2025 growing seasons. A randomized complete block design with six treatments and four replicates per treatment (24 blocks total) was used. Each block consisted of 10 rows, with a row width of 2.83 ft, block width of 28.3 ft, and block length of 150 ft, covering 4,245 ft² per block (total area: 101,880 ft²). Treatments are described in Table 1.

Nematode sampling and population assessment

Soil samples were collected from each plot at three stages: early season, mid-season, and harvest. Soil cores (~175 cm³ each) were collected in a zigzag pattern across each plot and combined into a bulk sample (~7 L), which was thoroughly homogenized before subsampling. Nematodes were extracted using a modified centrifugal flotation method, identified to genus or species, and counted under a stereomicroscope. Nematode population changes were expressed as a reproduction factor (RF), calculated as the ratio of final population density to initial population density.

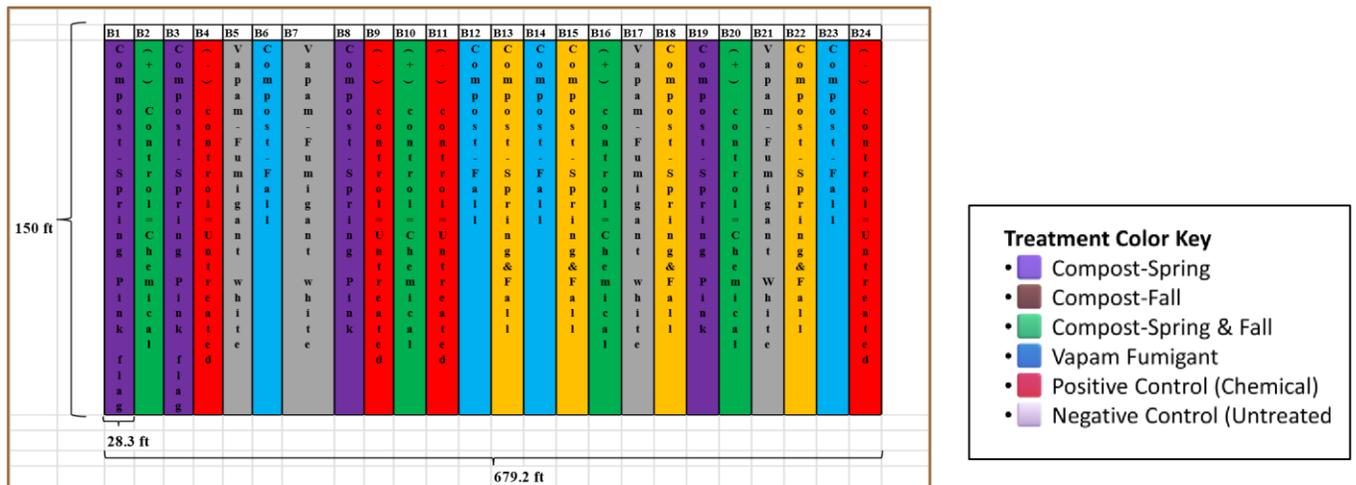


Table 1. Treatments and layout of the study field trial, 2024-2025.

Results

Compost-treated soils generally showed higher free-living nematode reproduction compared with non-compost treatments; however, these differences were not statistically significant (Fig. 1).

Vapam-Fumigant White and compost treatments reduced total plant-parasitic nematode reproduction by 63% and 7–26%, respectively, compared with the untreated control (Fig. 2).

Vapam-Fumigant White and compost treatments reduced root-lesion nematode (*Pratylenchus penetrans*) reproduction by 90% and 52–65%, respectively, compared with the untreated control (Fig. 3).

Applications of Vapam fumigant and compost treatments reduced spiral nematode (*Helicotylenchus* spp.) reproduction by 51% and 5–13%, respectively, compared with the chemical control. In contrast, compost-fall and untreated control plots showed smaller reductions, ranging from 0% to 26% (Fig. 4).

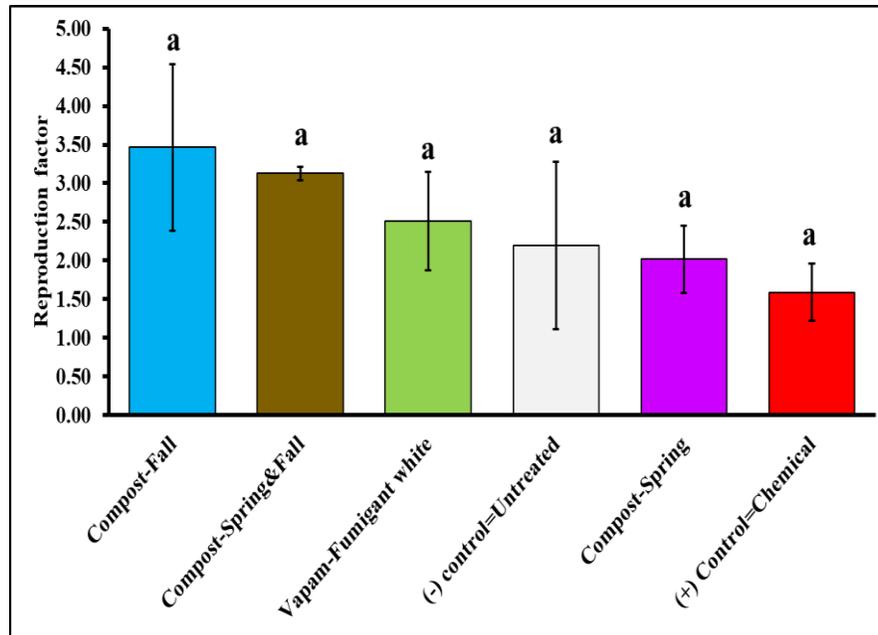


Figure 1. Impact of six soil treatments on free-living nematode reproduction factor in potato. Bars show mean \pm SE (n = 3–4). Different letters indicate significant differences ($P < 0.05$); lack of letters = no significant difference. Field trial, 2024.

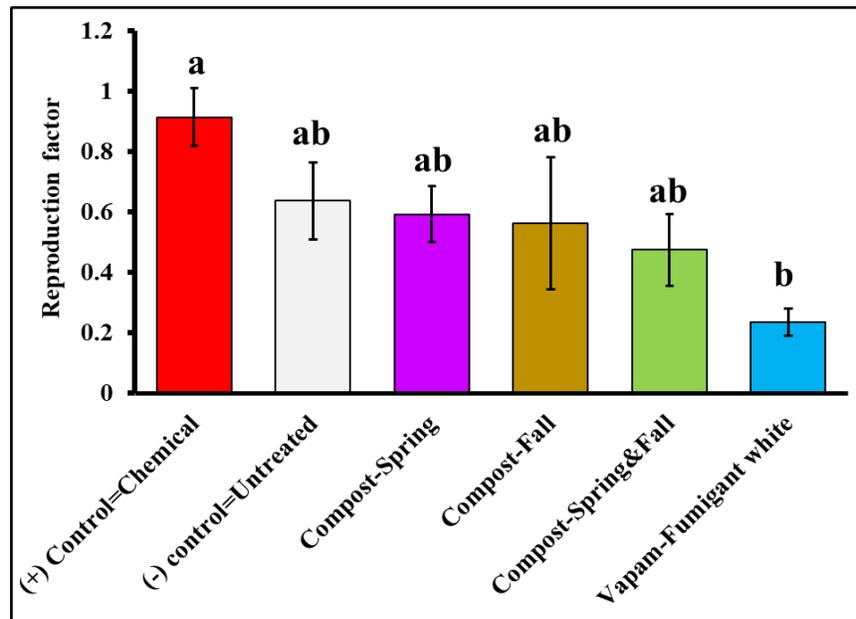


Figure 2. Plant-parasitic nematode reproduction factor under six soil treatments in potato. Bars = mean \pm SE (n = 3–4). Different letters indicate significant differences ($P < 0.05$). Field trial, 2024.

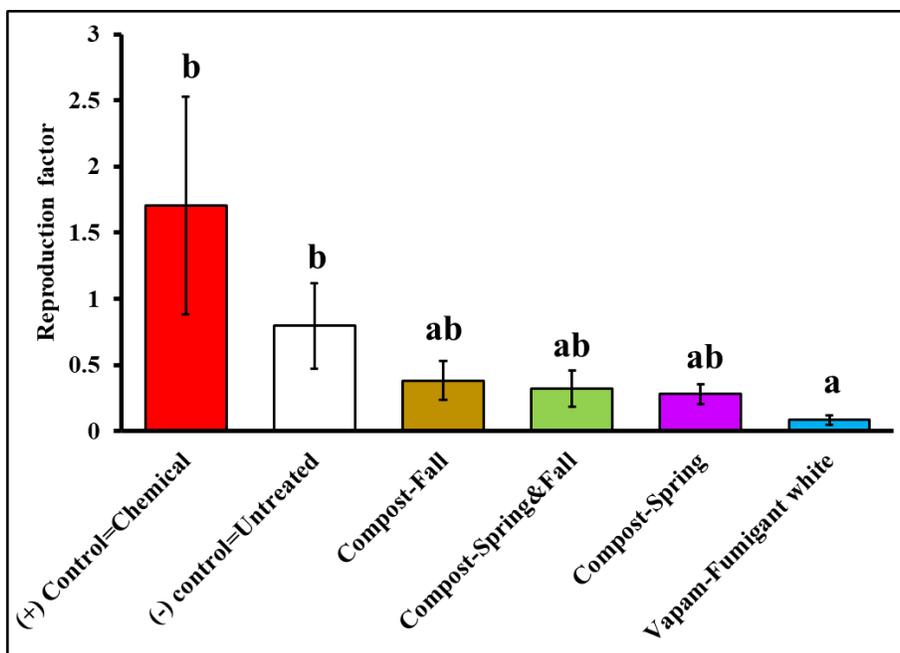


Figure 3. Root-lesion nematode (*Pratylenchus penetrans*) reproduction factor under six soil treatments in potato. Bars = mean ± SE (n = 3–4). Different letters indicate significant differences (P < 0.05). Field trial, 2024.

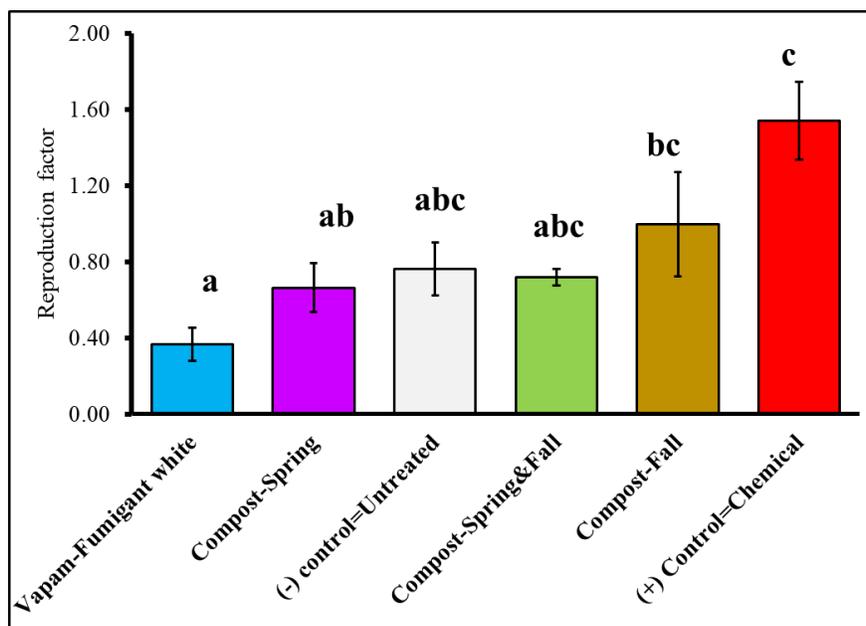


Figure 4. Reproduction factor (RF) of spiral nematodes (*Helicotylenchus* spp.) in potato under six soil treatments; bars show mean ± SE (n = 3–4). Different letters (A, B, C) indicate significant differences among treatments (P < 0.05). Field trial, 2024.

Conclusions

In conclusion, compost amendments resulted in moderate suppression of plant-parasitic nematodes while maintaining or enhancing populations of beneficial free-living nematodes, indicating a potential role in improving soil biological health in potato fields. Although fumigation provided the highest level of nematode control across treatments, compost-based approaches may contribute to integrated nematode management strategies aimed at balancing pest suppression and soil health.

Future Work

Data analysis from the 2025 season is ongoing and will further clarify the effects of compost, chemical, and fumigation treatments on plant-parasitic and free-living nematodes in potato fields. These additional analyses will help strengthen conclusions regarding the role of compost amendments in nematode suppression and soil health enhancement.

Acknowledgments

We thank the Michigan Potato Industry Commission for funding this project and the Christy Long laboratory team for their assistance with field sampling.

A state-wide assessment to better understand soil health and sustainability in potato-based cropping systems in Michigan

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Introduction

Maintaining soil health is one of the major challenges for farmers across the United States. Potato farming is particularly detrimental to soil health because of intensive tillage, frequent physical soil disturbance, and use of external chemical inputs (Hills et al., 2020). There are a number of management strategies that can improve soil health in potato systems. This includes reducing tillage and implementing cover crops, having a high diversity crop rotation and incorporating organic amendments (Carter et al., 2009; Hills et al., 2020). That said, to date we have a poor understanding of how to efficiently improve soil health across Michigan potato farms which have very sandy, coarse textured soils. Additionally, potato growers still have to contend with disease and plant parasitic nematodes which often require the use of pesticides to manage. Fumigants, specifically, can be even more detrimental to soil health in potatoes. The goal of this study is three-fold: 1) assess soil health characteristics on potato farms across the state of Michigan 2) identify which management practices are most effective at improving soil health across the state of Michigan and 3) identify how soil health metrics change over the growing season.

Method

Site Selection and Soil Sampling

In 2025, we sampled 50 fields from Michigan (Figure 1). Farm fields were selected based on management style, geographical location, and soil type. Emphasis was placed on selecting a range of farms using a range of different management styles. For example, farms using lower than average tillage, cover cropping and diverse crop rotations were considered low intensity and farms using average or higher than tillage, no cover crops and short rotations were considered more intensive. Farmers were asked for management surveys in 2025, these are still incoming.

Soil samples were collected from one location within each field using a grid sampling approach. Samples were taken at 20 cm in depth using a 1.91 cm diameter soil probe. There were two sampling timepoints, pre-plant and 60 days after planting (60DAP). Pre-plant samples were taken approximately 1 week to 1 day before planting. Each farmer received a soil health report for each field (Appendix 1).

Soil processing for soil health metrics

Before analyses, soils were sieved at 2 mm and air dried. Soil texture was measured by treating the soil with sodium hexametaphosphate and using a hydrometer to measure the density of soil particles in suspension (Gee and Bauder, 1986). Soil health indicators included soil protein, POXC and mineralizable C (Table 1). POXC was quantified by methods adapted from Weil et al. (2003) and Culman et al. (2012). Soil protein was quantified by methods adapted from Hurisso et al. (2018) and Moebius-Clune et al. (2016). Lastly, mineralizable C was quantified via a 24-h assay measuring CO₂ respired from rewetted (Franzluebbers et al., 2022; Hurisso et al., 2016).

Nematode quantification and identification

Nematodes were extracted from 50 g of soil using the Baermann funnel extraction method (Baermann, 1917). Extracted nematodes were fixed in 4% formalin. Nematode abundance was quantified using an inverted microscope. For each sample the first 100 nematodes were identified to the trophic group and genus. Nematode indices were calculated using Nematode Indicator Joint Analysis (NINJA), a software program that calculates nematode indices based on colonizer-persister values of each nematode family group (Table 1) (Sieriebriennikov et al., 2014). Metabolic footprint was created by plotting the structure index against the enrichment index.

Statistical Analyses

All analyses were performed using R software (R Core Team, 2021). Mean and standard deviation of soil nutrient levels for each farm was reported in Table 2.

We have yet to receive management surveys, yield, and quality metrics from every farm involved in the study. That said, once those metrics are received, those metrics will be further incorporated into our analysis. Most farmers used the same management for every field. To reflect management and determine if soil health parameters vary, we will use farm as a proxy. General linear mixed models (glmmTMB) were used to determine if soil health parameters and nematode indices differed by farm management (main factor), time (subfactor), soil texture (subfactor) or the relationship between time and farm (subfactor). DHARMA and Shapiro tests were used for model verification. ANOVA and emmeans using Tukey's HSD were used for post-hoc analyses. For all models, county was nested within region and treated as a random effect. Significance was set at $P < 0.05$.

Non-metric multidimensional scaling (NMDS) using Bray-Curtis dissimilarity matrices were used to determine compositional differences for nematode communities at the genus level. Permutational analysis of variance (PERMANOVA) was used to identify how farm, timepoint, and the interaction affect composition. All plots were created in ggplot.

Results and Conclusions

Soil Health Metrics

Soil protein, organic matter percentage, POXC and mineralizable C were all significantly influenced by farm management (Figure 2; Table 3). All farms had relatively low levels of organic matter. However, these rates were not affected by time or the interaction of time and farm. On average, pre plant soils were 1.26% and post plant were 1.24% organic matter. This may indicate that management does not decrease organic matter during the growing season. UP2, a less intensive farm, had consistently high soil protein, POXC and mineralizable C. Farms from the central region, which tend to be more intensive, had consistently low values of these metrics. POXC and mineralizable C decreased in most farms. This indicates a decline in organic carbon over the potato growing season. At most farms, soil protein slightly increased within the growing season. This is likely a result of fertilizer application and efficiency of the microbial community in cycling N. Soil texture only affected measures of soil organic carbon (i.e., POXC and mineralizable C).

Generally, soil health metrics appeared to vary depending on farm management. Based on conversations with farmers, the more intensive farms tended to have slightly lower soil health while those using less intensive management had higher soil health. However, this was variable depending on the specific metric. Certain management practices, such as fertilizer application and time, can significantly affect soil health metrics during the growing season but may not reflect long term gains in soil health. After receiving the management surveys, we will determine which strategies correlate to high soil health, yield and potato quality.

Energy was affected by farm ($\chi^2=56.22$, $P<0.0001$), time ($\chi^2=10.71$, $P=0.001$), and the interaction of time and farm ($\chi^2=24.62$, $P=0.026$) but not soil texture ($\chi^2=1.99$, $P=0.37$) (Figure 3). However, most values of total C:N ranged from ~10 to 18. These fall within the normal range for agricultural fields.

Nematode Community

All community indices were affected by farm management and time or the interaction of farm and time (Figure 4, Table 4). Only the channel and basal indices were affected by soil texture. Maturity and structure indices were most negatively affected by time with values decreasing over the growing season. Nematode-based soil health indices did not correlate to soil protein, organic matter percentage, POXC, and mineralizable C. There was a high degree of variability within the farms and regions. UP2 (less intensive) had average values for all indices, whereas some of the central farms (more intensive) had the highest values of certain indices. Nematodes can be more sensitive to physical disturbance and have a slower regeneration time than bacteria and fungi. These indices likely represent longer term soil health.

Almost all nematode communities had a metabolic footprint that fell into the bottom left quadrat (Figure 5). This indicates that the community is disturbed and conducive to plant parasitic

nematodes. Two farms from central and NW had matured communities' pre-plant that deteriorated over the season. One farm from the UP moved from disturbed to maturing, which is highly unusual given the physical disturbance in potato farming. Management surveys are needed to identify further patterns in nematode indices and the metabolic footprint.

Compositionally, farm, time and the interaction of the two structured nematode communities (Figure 6). Most soil samples consisted predominantly of bacterivore nematodes at both time points (Figure 7). Bacterivores accounted for ~50% of most communities. Fungivores accounted for ~5-10% and omnivore/predator nematodes for ~1-5% of communities. Herbivores typically comprised 5-30% of communities. There were no herbivores in the UP3 post plant community. The most common plant parasitic nematode genus identified within soil was *Pratylenchus* spp. (Figure 8A). There was a high degree of variability in the number of *Pratylenchus* spp. in each farm and over time (Figure 8B). Several farms' populations decreased or increased with most remaining consistent. Interestingly, UP2 (less intensive) had a low number of *Pratylenchus* spp. and many central farms (more intensive) had high numbers. Most of the other highly abundant herbivores were from the family Tylenchidae (i.e., *Filenchus*, *Tylenchus*, *Malenchus*) which are often referred to as root-associates that do not typically cause plant disease in potatoes. These nematodes are important for carbon and nitrogen cycling and plant growth. Other plant parasitic nematodes that are known to cause disease in potatoes were found in low numbers (Figure 8A). These include *Heterodera*, *Trichodorus*, *Paratrichodorus*, *Melodogyne*, and *Xiphenema*. There was one farm, Thumb1, that had a high number of *Heterodera* spp. post plant.

Conclusion:

Generally, soil health decreased over time. Farm management and time were the major factors driving soil health variables. Most farms had a decrease in soil carbon (i.e., POXC and mineralizable carbon) over the course of the growing season. Soil nitrogen was more variable but may have been influenced by fertilization rates and timing. Energy (i.e., total C:N) and organic matter was consistent. Nematode indices were variable, but tended to decrease over time. Indices and the metabolic footprint indicated depleted and disturbed nematode communities across most farms. This was further supported by composition, where nematode communities were largely bacterivores and herbivores. There were often low percentages of higher trophic level taxa. Plant parasitic nematodes were present in most farms, but the population sizes were variable. The most common plant parasite was *Pratylenchus* spp. followed by *Heterodera* spp. Future work will use management surveys to identify which management practices were most effective in retaining soil health over the growing season and which soil health variables correlated most highly to yield and quality. Lastly, individual farms have received soil health test reports for each field (Appendix 1). Our team is more than happy to provide consultations to any farmer wanting further information on their soil health test reports.

Figure 1: Potato fields sampled in 2025. Each dot represents one field for a total of 50 fields. Soils were sampled prior to planting and 60 days after planting for a total of 100 soil samples. Each color of the dot represents the region. Abbreviations: NW = Northwest; SW = Southwest; UP = Upper Peninsula.

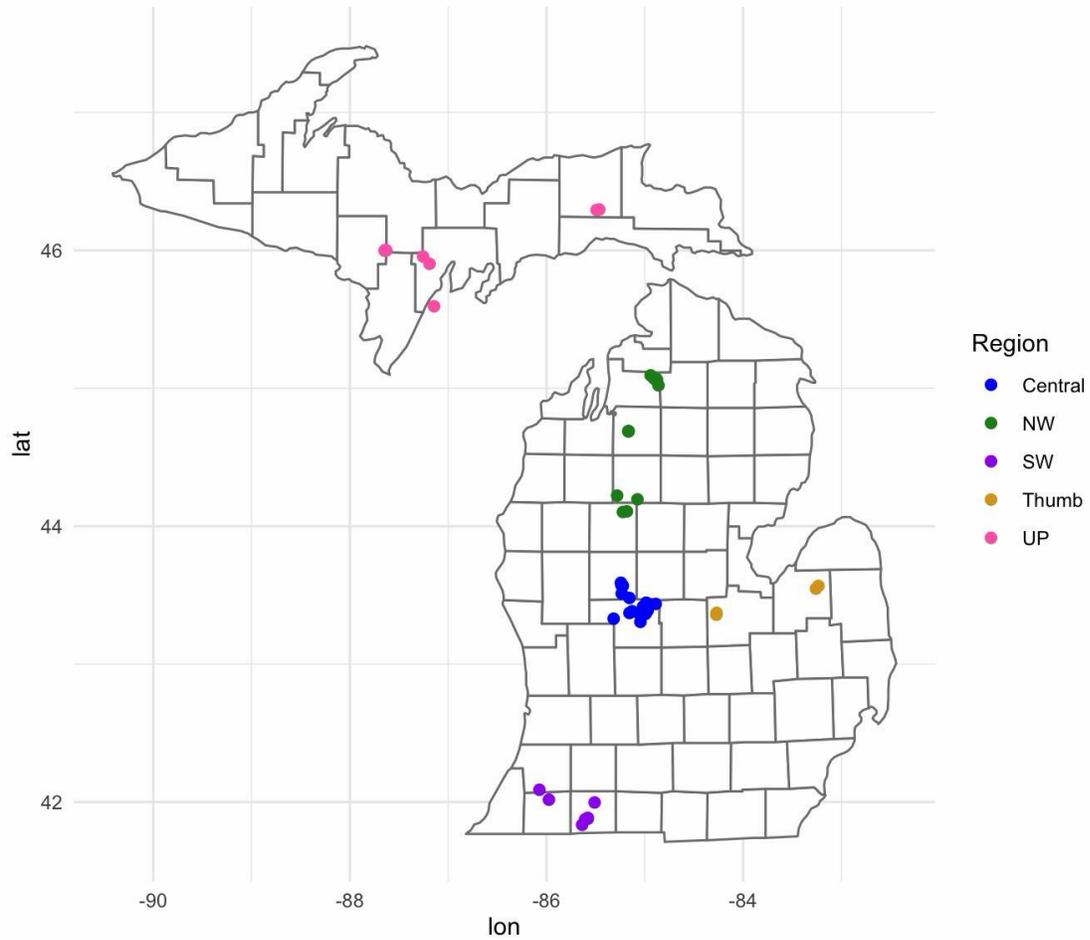


Table 1: Description of soil health metrics and nematode community indices.

Soil Health Metric	
Soil Protein	Soil nitrogen availability; high numbers indicate higher availability
Organic Matter %	The amount of organic matter in soil. 5% or higher is great, 3-6% is ideal for agriculture and under 2% is very low.
POXC	Permanganate oxidizable carbon represents a portion of the organic carbon pool in soils.
Mineralizable C	A different portion of the organic carbon pool in soils. Often correlates to microbial activity.
Nematode Indices	
Maturity Index	Reflects disturbance of soil. High values indicate high rates of disturbance.
Channel Index	Indicates if decomposition is fungal- or bacterial-pathway dominant. Values >50 are fungal and <50 are bacterial. Fungal pathways typically break down complex organic matter slowly.
Basal Index	Reflects food web structure and complexity. Low values indicate a stable, complex food web and high values indicate a depleted, damaged food web.
Enrichment Index	Reflects food availability and nutrient enrichment. High values indicate more food availability.

Structure Index

Reflects soil food web and disturbance via chemical or physical pathways. High values indicate a structured food web and low values indicate a perturbed food web.

Table 2: Mean and standard deviation of soil nutrient analyses of each farm.

Acronym	Timepoint	CEC		pH		Phosphorous		Potassium		Magnesium		Calcium		Sulfur		Boron		Copper		Iron		Manganese		Zinc	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Central1	Pre-plant	3.9	0.6	6.0	0.9	141.3	17.2	149.3	69.4	106.0	34.4	493.3	124.0	24.7	16.6	0.8	0.2	2.7	1.2	186.7	22.4	42.7	18.0	4.2	0.5
	60DAP	4.0	0.4	5.1	0.6	211.0	41.8	110.3	26.8	123.3	45.8	549.7	204.2	54.0	7.5	0.7	0.1	3.8	1.4	226.3	14.2	57.3	14.4	5.5	2.1
Central2	Pre-plant	4.6	1.2	6.4	0.6	247.3	96.4	108.0	42.6	89.3	14.0	834.3	190.2	10.0	2.6	0.7	0.3	3.5	2.0	254.7	35.7	63.3	5.0	5.7	2.4
	60DAP	6.4	2.7	6.2	0.7	246.0	115.7	150.7	51.1	130.3	65.8	1080.7	308.3	43.7	21.0	0.8	0.2	4.5	2.8	261.0	55.0	64.7	6.1	7.0	5.6
Central3	Pre-plant	3.9	0.9	6.3	0.4	277.0	110.2	179.3	42.4	116.5	10.7	665.5	133.4	16.0	6.6	0.6	0.0	3.2	1.3	251.3	13.1	58.0	12.9	6.9	3.3
	60DAP	3.2	0.5	5.7	0.3	247.0	96.1	153.0	26.0	105.0	20.8	553.0	105.6	53.5	12.1	0.8	0.1	2.6	1.4	235.8	25.5	49.5	13.0	6.6	3.5
Central4	Pre-plant	3.7	0.3	6.5	0.2	152.3	14.4	157.0	29.1	110.0	11.3	632.7	89.2	21.7	12.5	2.0	1.6	1.4	0.8	199.3	9.3	50.3	7.4	5.8	2.1
	60DAP	4.2	0.4	6.0	0.6	192.3	30.7	157.0	84.5	108.0	9.8	735.3	43.2	48.3	26.6	1.1	0.4	2.0	1.2	221.0	28.6	48.0	19.3	6.3	2.5
Central5	Pre-plant	3.0	0.7	6.0	0.2	180.0	61.1	124.0	37.3	78.3	15.1	562.5	153.7	15.0	10.1	0.6	0.1	1.9	1.3	238.0	46.9	48.3	21.2	4.0	1.7
	60DAP	3.5	0.5	5.8	0.2	252.0	65.1	164.0	26.9	108.5	16.3	635.3	103.0	60.5	32.3	0.7	0.1	3.0	1.9	238.0	38.4	65.8	11.6	5.5	1.8
NW1	Pre-plant	6.0	3.3	4.9	0.5	95.0	66.1	89.7	80.0	73.3	33.0	339.3	109.7	63.3	60.1	0.7	0.1	0.3	0.2	235.3	44.8	51.7	39.2	3.5	2.9
	60DAP	2.4	1.0	4.9	0.2	125.3	68.1	44.0	15.6	46.3	11.7	320.7	80.4	25.7	7.4	0.7	0.0	1.3	1.5	232.3	17.2	63.7	45.5	4.6	2.3
NW2	Pre-plant	4.2	0.8	6.5	0.3	135.3	70.6	96.0	12.7	99.3	19.7	749.0	85.2	14.0	10.8	0.9	0.2	2.4	1.3	206.8	38.2	48.0	26.2	5.8	2.6
	60DAP	4.1	0.5	5.7	0.3	169.3	70.7	109.0	16.9	138.8	20.1	761.0	131.1	90.8	22.9	0.6	0.0	3.1	1.4	227.3	48.3	57.8	12.6	7.4	0.3
NW3	Pre-plant	4.0	1.4	6.0	0.3	178.8	84.0	144.3	21.2	94.0	18.9	798.3	345.2	25.3	12.3	0.6	0.0	5.2	0.9	266.3	60.5	59.8	12.3	8.8	3.0
	60DAP	3.8	0.8	5.5	0.2	213.8	107.5	109.3	17.3	80.5	23.2	710.8	265.1	68.0	49.1	0.8	0.1	6.0	1.8	242.0	52.8	55.3	14.7	8.5	1.7
NW4	Pre-plant	3.2	0.4	6.2	0.4	208.0	2.8	73.0	12.7	76.5	10.6	646.5	103.9	8.5	0.7	0.6	0.0	5.4	5.0	271.0	8.5	42.5	16.3	10.7	5.4
	60DAP	4.7	0.8	6.1	0.7	277.5	48.8	122.5	14.8	117.0	17.0	811.5	16.3	18.0	0.0	1.5	0.2	6.1	7.1	276.5	64.3	46.0	1.4	11.4	2.3
SW1	Pre-plant	4.2	1.4	6.2	0.5	136.9	45.1	136.7	29.7	110.9	24.1	788.3	256.1	33.6	13.4	0.5	0.1	2.6	2.1	191.4	34.5	96.4	46.4	5.9	2.6
	60DAP	4.6	1.6	6.2	0.4	164.7	56.3	127.7	33.0	122.6	28.4	885.9	277.0	52.1	17.3	1.1	0.3	3.4	3.2	202.9	27.1	103.7	42.7	6.9	2.6
Thumb1	Pre-plant	6.8	1.8	6.8	0.3	133.0	48.2	161.8	106.8	127.5	17.6	1225.0	485.5	63.3	94.8	0.7	0.1	3.2	2.8	192.8	39.7	35.5	27.9	7.8	2.7
	60DAP	7.4	2.8	7.1	0.2	150.0	63.6	134.5	45.8	167.0	64.2	1362.3	491.4	21.8	15.4	1.2	0.5	3.9	2.9	182.0	34.4	51.0	34.5	10.7	5.1
UP1	Pre-plant	5.7	2.3	6.4	0.5	315.8	74.3	139.3	30.6	223.5	86.7	981.8	392.6	7.8	1.5	0.7	0.1	1.9	0.6	255.3	28.0	74.3	24.6	4.5	1.3
	60DAP	10.2	1.4	6.5	0.6	330.3	39.6	152.5	18.2	288.8	94.6	1417.8	220.9	12.0	2.2	0.8	0.1	1.9	0.7	244.5	31.6	92.8	11.2	5.2	1.5
UP2	Pre-plant	7.6	1.8	6.6	0.4	59.7	39.2	95.7	19.5	159.0	16.5	1415.7	303.0	15.0	2.0	0.7	0.2	1.1	1.1	221.3	41.5	54.0	21.3	2.3	0.8
	60DAP	10.4	5.5	6.4	0.7	57.0	20.4	95.3	34.6	181.0	42.6	1974.0	1144.5	28.3	5.9	0.7	0.1	1.1	1.4	206.3	8.1	83.7	30.0	2.8	0.5
UP3	Pre-plant	4.3	0.6	6.5	0.4	305.5	30.4	103.0	32.5	97.0	24.0	784.5	3.5	29.0	21.2	0.6	0.1	2.6	0.1	166.5	12.0	31.0	5.7	4.8	0.3
	60DAP	3.1	0.8	6.1	0.2	300.0	12.7	68.0	5.7	80.0	31.1	635.5	159.1	32.5	17.7	1.0	0.4	2.5	0.9	160.0	12.7	24.5	2.1	4.6	0.3

Figure 2: Soil protein, organic matter %, POXC, and mineralizable C from potato farms in Michigan. Color represents region and pattern indicates timepoint. Values below the red dashed line are considered low, those above the green line are high or very high and those in between are average.

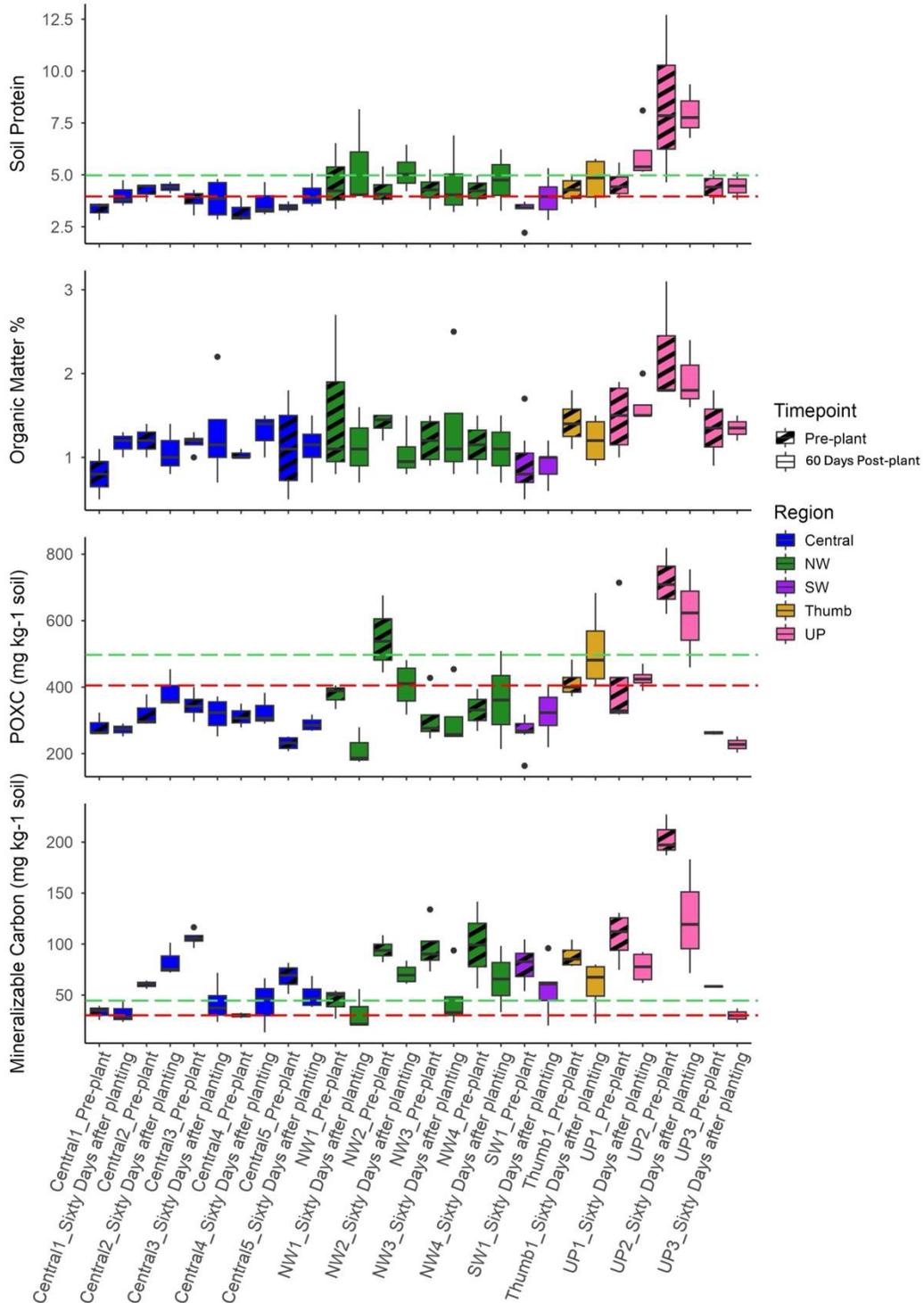


Table 3: Results of a general linear mixed model used to determine how soil health metrics (dependent variable) were affected by farm, time, soil texture or the relationship between time and farm (independent variables). In the model, county was nested within region and used as a blocking term to account for geographic patterns. Bolded values are significant ($P < 0.05$).

	Farm		Timepoint		Soil Texture		Timepoint*Farm	
	P	χ^2	P	χ^2	P	χ^2	P	χ^2
Soil Protein	<0.0001	83.89	0.003	8.89	0.28	2.55	0.99	4.15
Organic Matter %	0.0001	40.55	0.96	0.003	0.90	0.21	0.7	9.80
POXC	<0.0001	197.0	0.88	0.02	0.007	9.99	<0.0001	41.5
Mineralizable C	<0.0001	116.28	<0.0001	44.31	0.005	10.48	0.005	29.80

Figure 3: Total Carbon:Nitrogen Ratio (i.e., energy) from potato farms in Michigan. Color represents region and pattern indicates timepoint. Farm soils typically have values between 10 and 20.

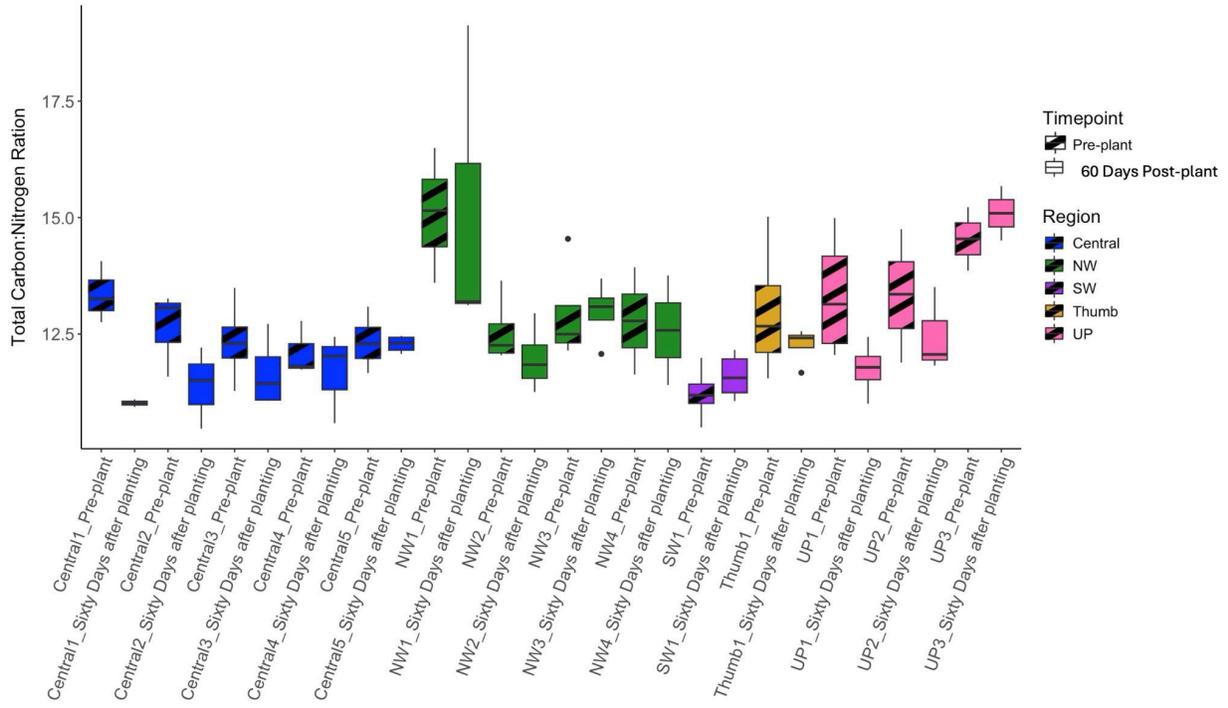


Figure 4: Nematode community indices (Maturity, channel, basal, enrichment and structure index) from potato farms in Michigan. Color represents region and pattern indicates timepoint.

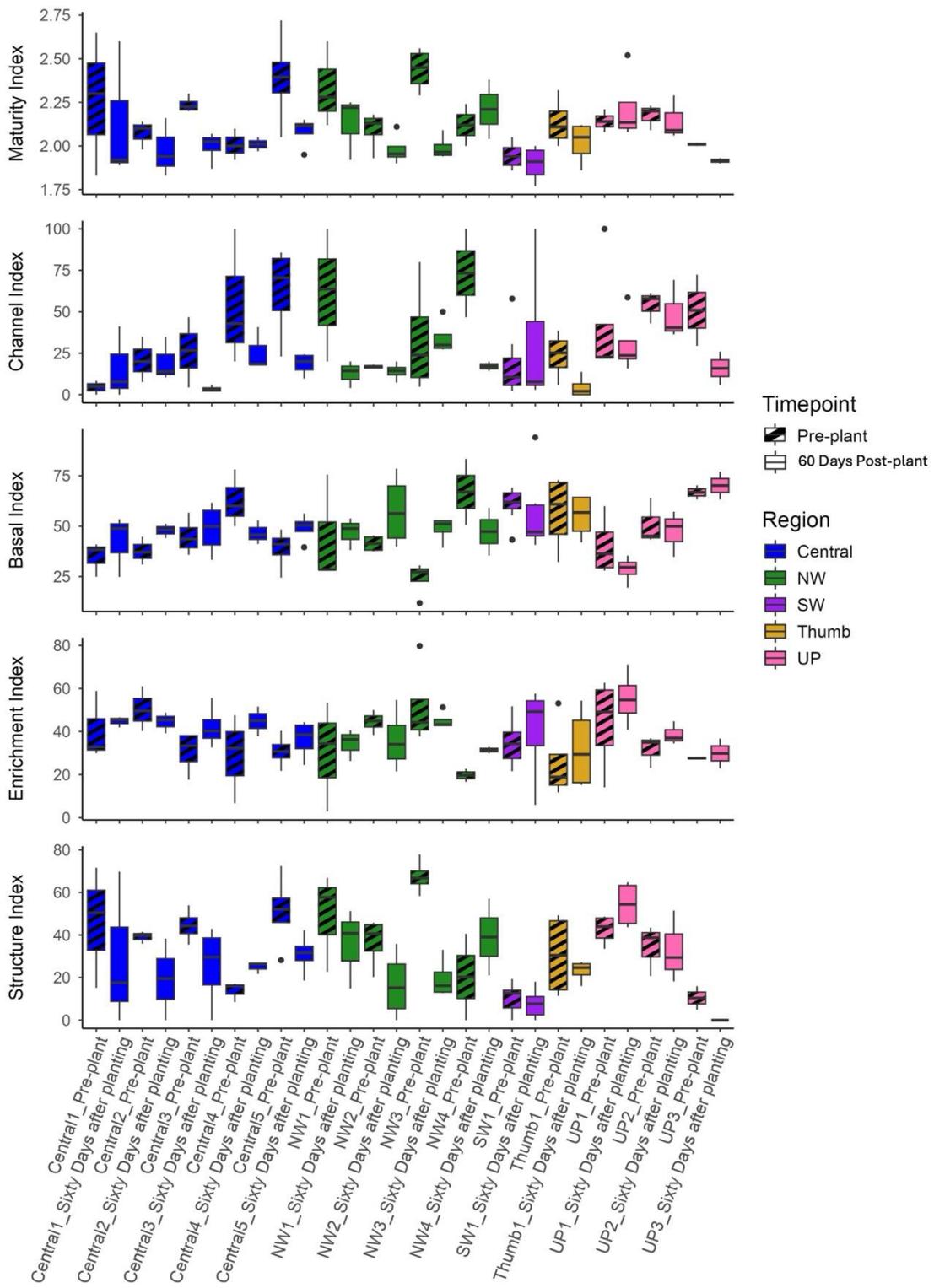


Table 4: Results of a general linear mixed model used to determine how nematode indices (dependent variable) were affected by farm, time, soil texture or the relationship between time and farm (independent variables). In the model, county was nested within a region and used as a blocking term to account for geographic patterns. Bolded values are significant ($P < 0.05$).

	Farm		Timepoint		Soil Texture		Timepoint*Farm	
	P	χ^2	P	χ^2	P	χ^2	P	χ^2
Maturity Index	<0.0001	64.95	<0.0001	23.48	0.23	2.92	0.017	26.08
Channel Index	<0.0001	78.71	0.0003	13.41	0.0002	16.86	<0.0001	41.52
Basal Index	<0.0001	63.23	0.317	0.99	0.09	4.82	0.006	29.43
Enrichment Index	0.02	25.69	0.04	4.19	0.27	2.47	0.73	9.58
Structure Index	<0.0001	67.31	0.0002	14.10	0.26	2.70	0.0008	35.11

Figure 5: Metabolic footprint of nematode communities. The color indicates the farm and region with brown shades being central, green being northwest, blue being southwest, orange being the thumb and pink being the Upper Peninsula. The shape indicates the time point with circles being pre plant and triangles being 60 DAP. Each quadrat represents characteristics of the soil. The top left quadrat indicates highly disturbed soil, the bottom left indicates degraded soil, the top right indicates the soil is maturing and bottom right indicates it is matured.

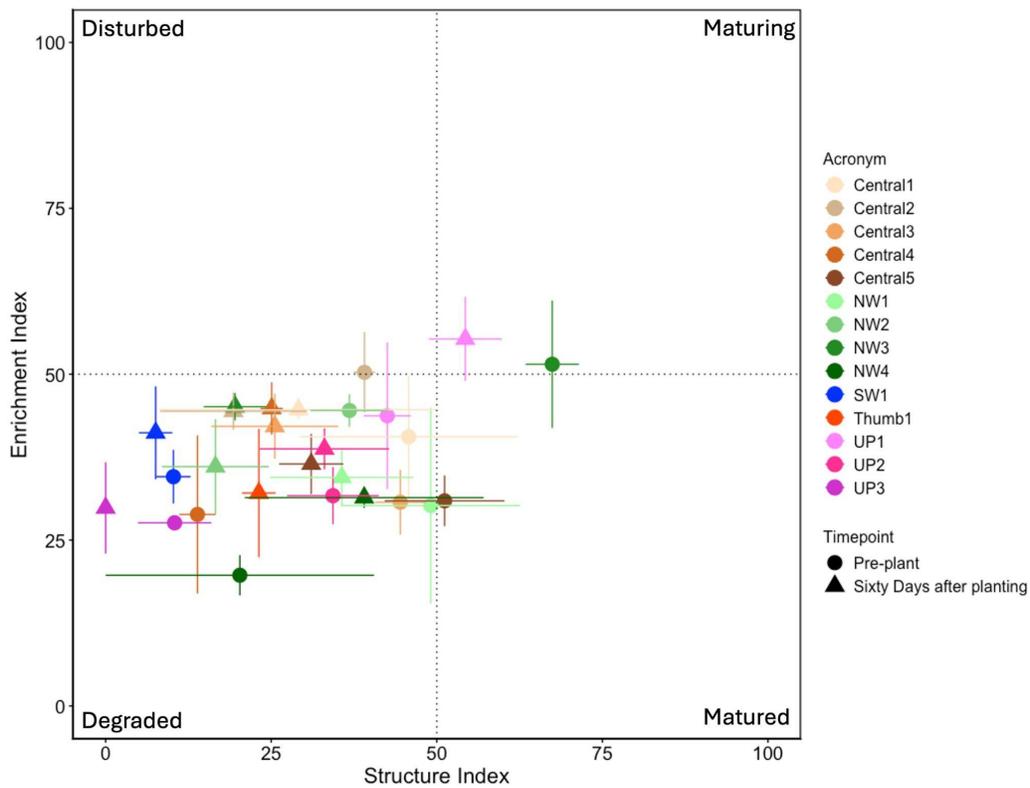
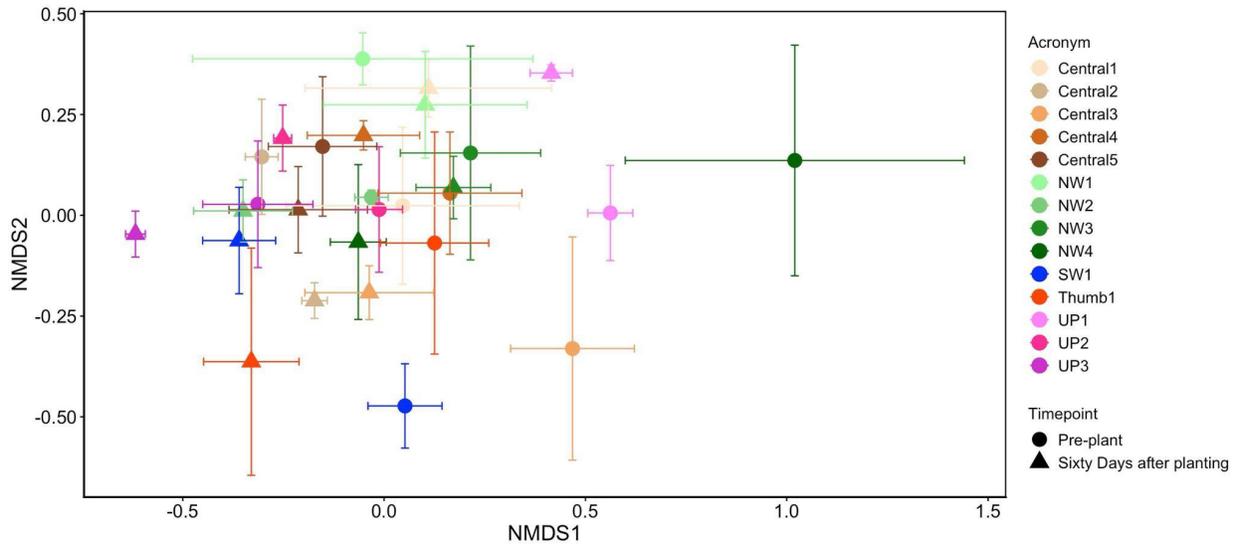


Figure 6: Ordination of nematode communities in an NMDS. The color indicates the farm and region with brown shades being central, green being northwest, blue being southwest, orange being the thumb and pink being the Upper Peninsula. The shape indicates the time point with circles being pre plant and triangles being 60 DAP. Differences in community composition were calculated with PERMANOVA.



	R ²	F	P
Farm	0.28	2.96	0.001
Timepoint	0.05	6.43	0.001
Farm*Timepoint	0.14	1.40	0.006

Figure 7: Relative abundance of nematodes at the trophic level. Color indicates the trophic group with blue being bacterivores, green being herbivores, pink being fungivores, grey being predators, and yellow being omnivores. The solid color bars are pre plant and the bars with dots are 60 DAP.

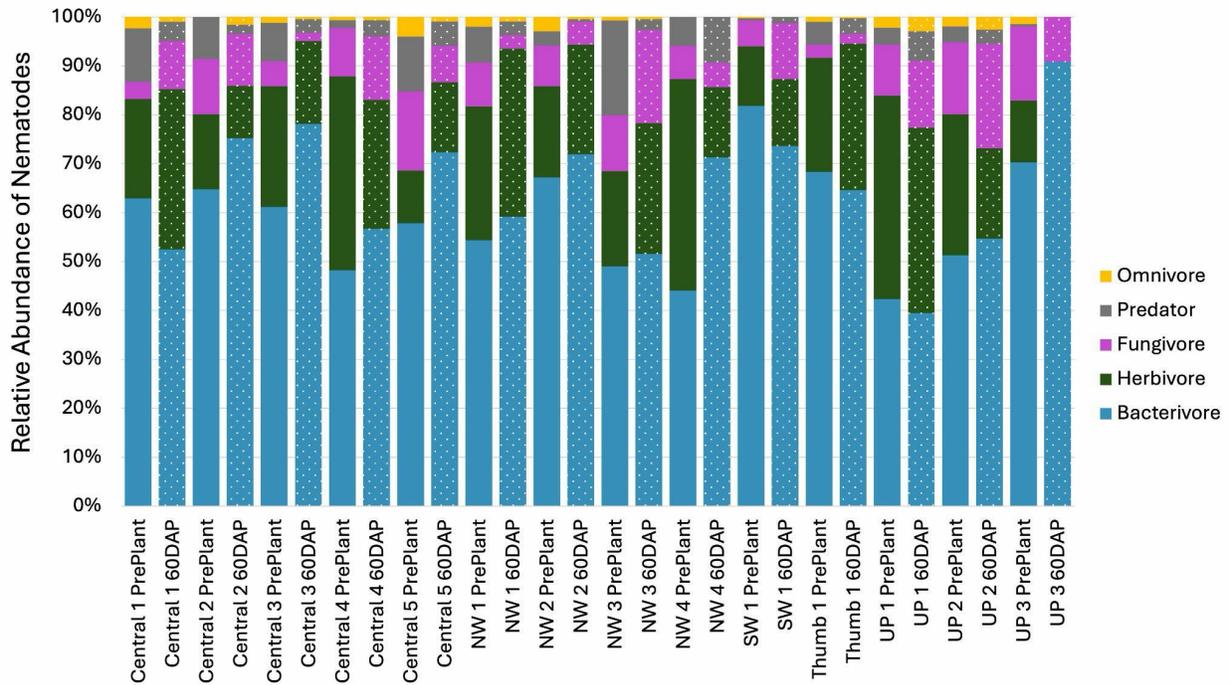
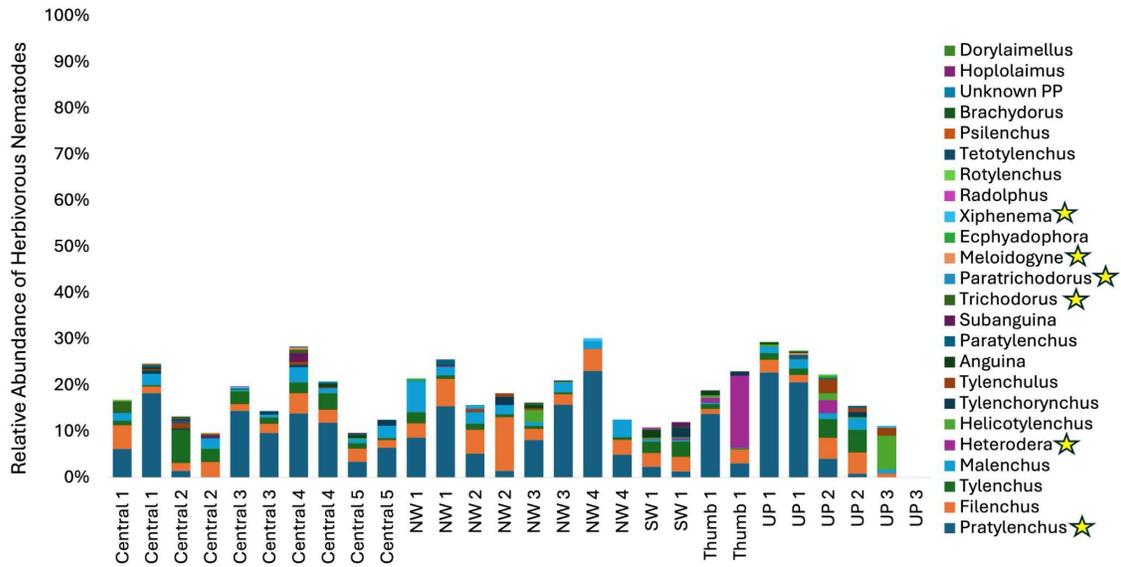
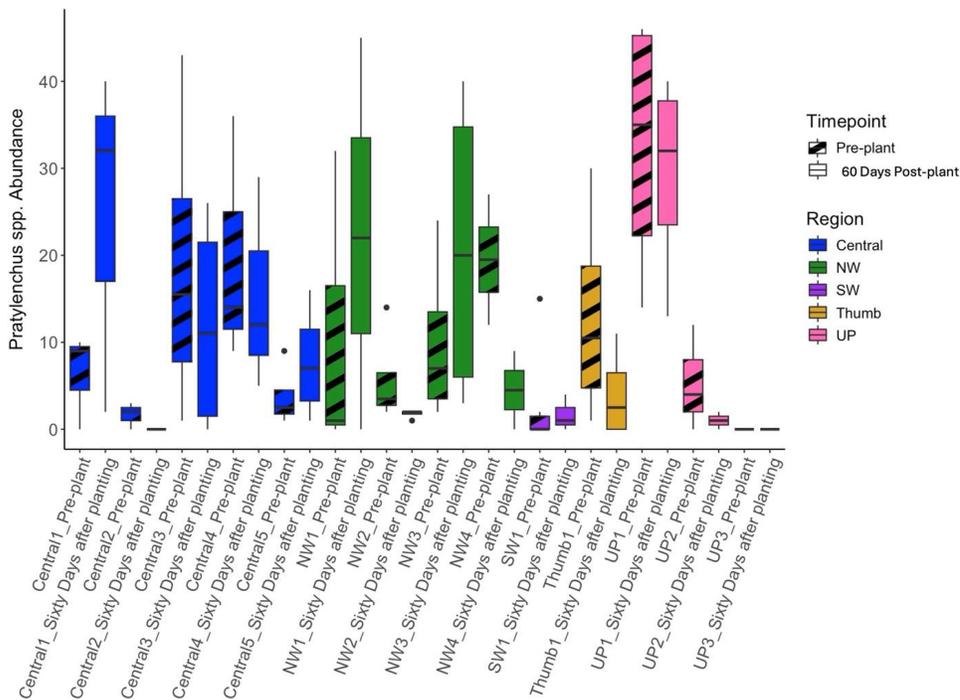


Figure 8: A) Relative abundance of herbivore and plant parasitic taxa in soils. Stars indicate plant parasitic nematodes previously identified as having potential to cause yield losses in potatoes. B) *Pratylenchus* spp. populations in potato farms. The color indicates region and the pattern of the bar indicates time of sampling. These values indicate the relative abundance of *Pratylenchus* in 50 g of soil. The nematodes were identified at the genus level.

A)



B)



Appendix 1:

Soil Health Report

Field Name #: field 76 YEAR: 2025

Thank you for your participation in our soil health study. The MSU Sprunger Lab conducted the following soil health tests for your samples: Routine Soil Nutrients (pH, CEC, OM%), tests that measure soil biology (nematodes), tests that measure the physical structure of the soil (Texture), tests that measure different pools of organic matter (Protein, POXC, Respiration) and energy demand (C:N). Soil sample descriptions from your farm and the corresponding data are below:

Pre-Plant – Sample taken prior to planting

60DAP – Sample taken 60 days after planting

Routine Soil Nutrient Report:

Table 1. Routine soil nutrient test results for your field at Pre-Plant. All nutrients are displayed in parts per million (ppm) units using the Mehlich-3 method unless otherwise specified. The expected ranges come from Spectrum Analytical soil testing lab.

	Pre-Plant	Expected Range
Soil pH	5.8	*6.0-7.0, for most crops
CEC	3.7	Varies
Organic Matter (%)	1.8	See interpretation
K/Mg ratio	1.25	
Ca/Mg ratio	7.63	
P	157	50-80 ppm
K	119	140-240 ppm
Mg	95	160-300 ppm
Ca	725	1200-1800 ppm
S	10	**20-40 ppm
B	0.8	**1.7-2.6 ppm
Cu	2.8	**Varies
Fe	273	**65-185 ppm
Mn	69	**Varies
Zn	5.6	**3.9-10.9 ppm

*Soil pH is a very important measurement. You can fertilize as much as you like, but if your pH isn't optimized, nutrient availability will be restricted. Optimal pH ranges vary depending on crop. **Although soil testing labs often give optimal ranges for sulfur and micronutrients, 'recommended ranges' have not been established through university guidelines for Mehlich-3 extractant.

Organic Matter Test Report:

We measured different parts of the total pool of organic matter. Soil protein is a measure of a large nitrogen pool found within soil organic matter. POXC reflects a pool of carbon that is less accessible to microbes and serves as an early indicator of soil organic matter accumulation. Lastly, respiration is a measure similar to the Haney test or Solvita test that measures the CO₂ respired by the microbes; this gives indication of the microbial activity and the pool of carbon that is most accessible to microbes.

Table 2. Previously observed ranges for soil organic matter indicators for your soil type. The Protein, POXC, and Respiration ranges were calculated based on over 1,000 data points from farms across Ohio, Michigan, Indiana, and Pennsylvania. The following ranges are determined by CEC values.

	Low	Medium	High	Very High
Protein (g/kg soil)	2-4	4-5	5-6	6+
POXC (mg/kg soil)	56-404	404-496	496-598	598+
Respiration (Total Min C/g soil)	5-32	32-43	44-60	60+

Table 3. Pools of organic matter for your samples. The level (low, medium, high) corresponds to where the sample falls within observed ranges for each of these pools (Table 2).

	Pre-Plant	60DAP
Protein	3.5 (Low)	4.11 (Medium)
POXC	207(Low)	268 (Low)
Respiration	51 (High)	52 (High)
Total Carbon/Nitrogen	11.095	12.178

Interpretation:

Protein: Soil protein was low preplant and increased to average post-plant. This may be indicative of a gain in nitrogen throughout the season. However, it may also be influenced by fertilizer rates and timing. Regardless, soil nitrogen is not yet building for long-term gains.

Carbon: Generally, the percentage of organic matter and POXC are low. Respiration (which can reflect organic matter) was high. This might indicate that organic carbon is being used rapidly and the long-term supply is depleted.

Energy: The C:N ratio is good and increases slightly over the growing season. It appears the microbial community is active and decomposing readily. However, it is unlikely that there is carbon building for long-term gains.

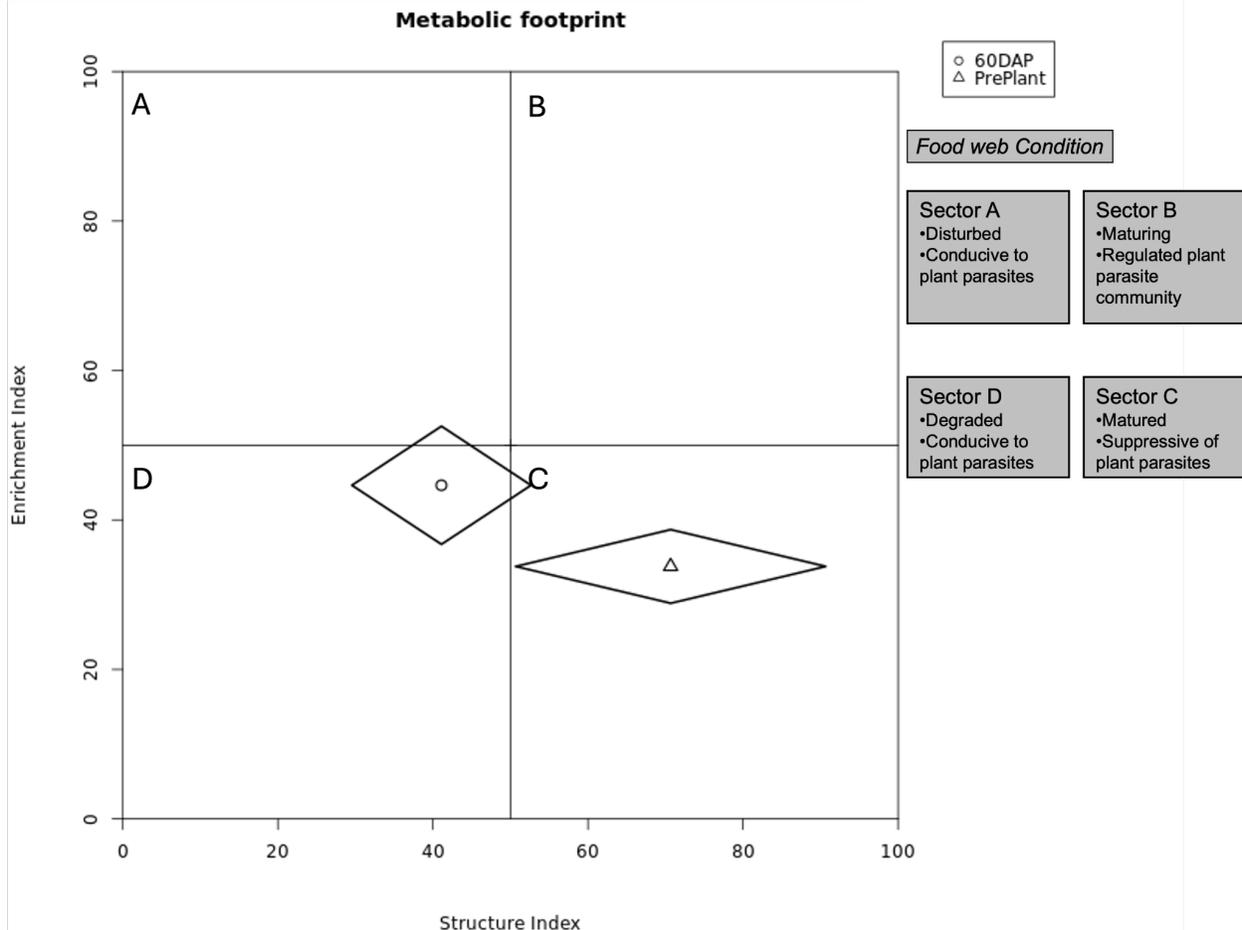
Nematode Identification and Quantification:

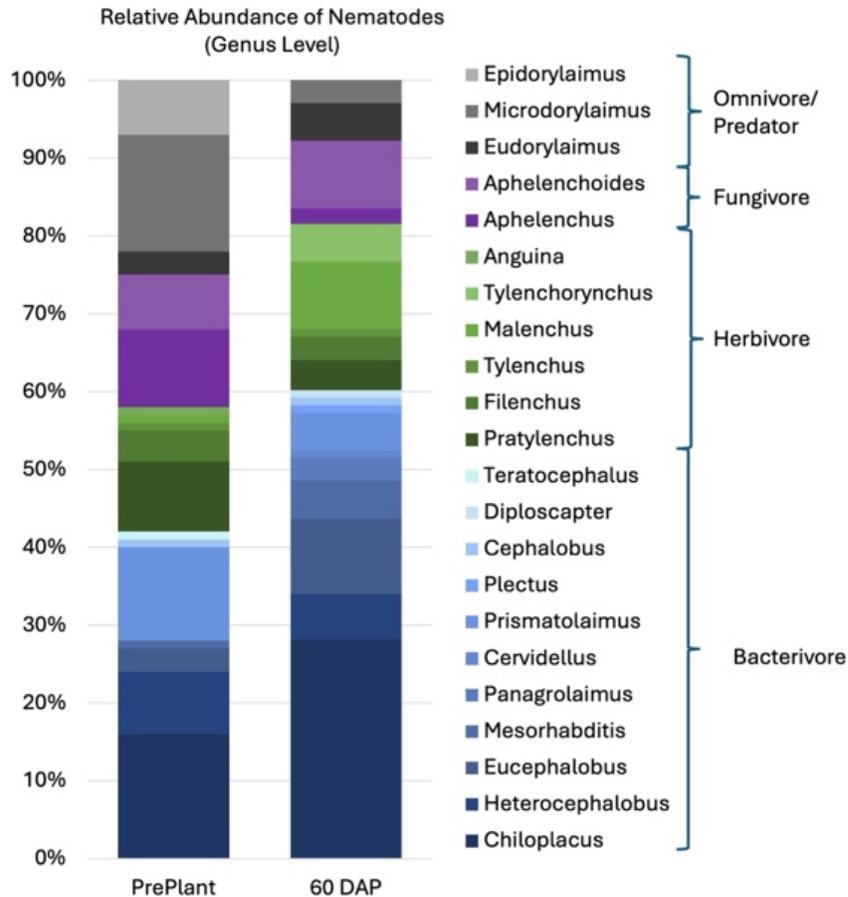
We extracted nematode communities using the Baermann funnel methods and quantified the communities. Identification was done for the first 100 nematodes at the genus-level. Importantly, the absence of plant parasitic nematodes (i.e., *Pratylenchus*) in the soil does not indicate there is no incidence. Plant parasitic nematodes can live inside roots and would not be extracted from standard soil analyses.

Nematode indices are quantified based on colonizer-persister scores for each genus. The maturity index (MI) reflects disturbance with scores close to 1 indicating highly disturbed and closer to 5 indicating stability. The metabolic footprint uses indices to characterize soil health.

Table 7. Nematode abundance and community indices

	Pre-Plant	60 DAP
Abundance	338	697
Maturity Index	2.72 (Moderate)	2.15 (Moderate)





Interpretation:

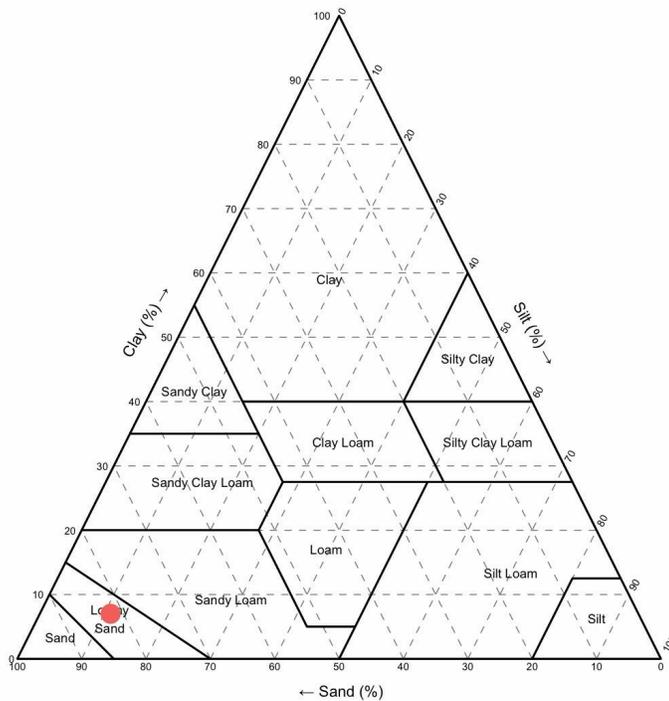
The nematode community indicates some degree of disturbance preplant with disturbance increasing over the growing season. Specifically, the MI remains moderate but decreases over the growing season. The metabolic footprint indicates a mature soil preplant but a degraded soil post plant. Given the high amount of soil disturbance in potato cropping systems, this is not abnormal. The trophic composition of the community is balanced preplant with a high number of predators and omnivores. These nematodes are highly sensitive to physical disturbance and decrease over the growing season. This is likely the cause of the decrease in MI and the results of the post plant metabolic footprint. There are *Pratylenchus* spp. present at both time points but the numbers decrease over the growing season.

Soil Texture

Soil texture is the percentage of sand, silt and clay. Below is your sample's soil texture from Table 6 mapped out on the USDA Texture Triangle.

Table 6. Texture of your samples.

Texture	
Sand %	82
Silt %	11
Clay %	7
USDA Texture Class	Loamy Sand



Summary:

Overall: The field is a Loamy Sand, which is common for potato fields in Michigan. We recommend considering more management practices to improve carbon and nitrogen for long-term gains in soil health. While the nematode community is relatively good compared to other Michigan potato farms, management strategies should continue to focus on building up the community preplant and recovery of the community after the season.

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

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²Department of Plant, Soil and Microbial Science

Introduction

Michigan has experienced increasingly erratic precipitation, and rainfall intensity has risen significantly in recent years. Because potato fields are typically tilled, they are especially vulnerable to soil loss through runoff and erosion, particularly on sloped areas. One practice that may help reduce runoff and sediment loss is reservoir tillage. This method creates small depressions between crop rows to capture and retain rainfall or irrigation water. By holding water in place, reservoir tillage can reduce runoff while increasing water and nutrient availability to the crop. Although this practice has been successfully implemented in potato production in other states, its effects on water and nutrient management under Michigan's soil conditions and climate have not been thoroughly evaluated. To address this gap, the team conducted a study in 2024 and continued the research in 2025 to further evaluate treatment effects

Methods

In 2025, the project team (MSU Irrigation Lab and MSU Soil Fertility & Nutrient Management Program) continued to collaborate with Walther Farms to evaluate the effects of reservoir tillage (Dammer Diker) on retaining water and nutrients in a potato field. The yields and quality of potatoes were also observed. This research consists of two treatments: 1) control and 2) reservoir tillage, which utilizes Dammer-Diker. Each treatment was replicated four times. Teros 12 sensors were installed at 9-, 18-, and 24-inch depths to track the soil moisture, temperature, and electrical conductivity on the hill and between the hills. ZL-6 Metergroup dataloggers were used to collect sensor values every 15 minutes. Suction lysimeters were also installed to monitor nitrate levels. Figure 1 shows the demonstration field and the effects of reservoir tillage on water retention. Runoff was also measured using customized flumes and buckets. A metal plate was installed at an upgradient of 50 ft. from the collection point, only to collect runoff and sediments from each treatment area. Installed flumes and collection containers are below. Potato growth was also monitored during the growing season. Potato yield and quality were also monitored.



Figure 1. Geographical location of the study plot with experimental design (left) and applied reservoir tillage (right), during the growing season.

Results and Conclusions

Runoff and soil moisture monitoring

In 2024, reservoir tillage significantly improved field performance relative to the conventional tillage control. Runoff volume ($P = 0.045$) and sediment loss ($P = 0.001$) were both reduced, with runoff decreasing by 56% and sediment loss by 67%. These results demonstrate that reservoir tillage effectively retains water and soil within the field. Soil moisture sensor data supported this finding, showing consistently higher soil moisture levels in reservoir tillage plots throughout the growing season. In contrast, the 2025 results did not show statistically significant differences between reservoir tillage and conventional tillage in either runoff volume ($P = 0.14$) or sediment loss ($P = 0.17$). This year-to-year variability is likely driven by differences in precipitation. The 2024 season was relatively wet, receiving approximately 16 inches of rainfall during the growing season, which increased the potential for runoff and magnified treatment effects. In comparison, 2025 was considerably drier, with roughly 10 inches of growing-season rainfall, reducing overall runoff and limiting treatment separation. Both test areas in 2024 and 2025 had similar moderate to moderately steep slopes (approximately 5-7%), ensuring comparability across years. Despite differences in runoff and sediment responses, soil moisture data from both years showed a consistent pattern, reservoir tillage maintained higher soil moisture throughout the growing season compared with the control. Figures 2 and 3 illustrate these seasonal soil moisture trends for 2024 and 2025, respectively. In conclusion, these findings indicate that reservoir tillage can substantially reduce runoff and sediment loss under wetter conditions and consistently enhance soil moisture retention across growing seasons.

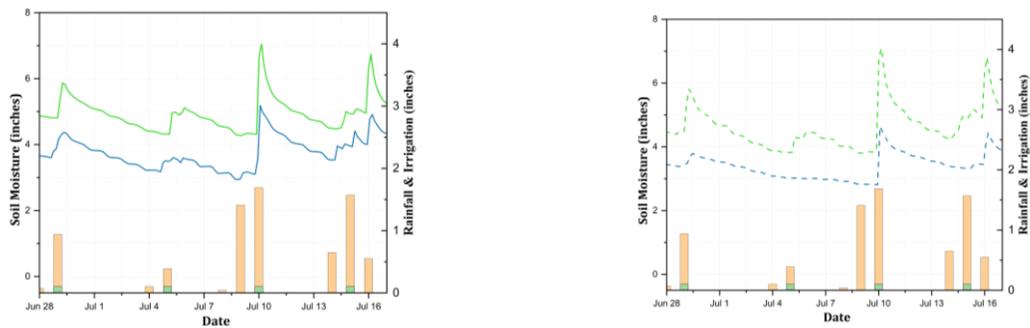


Figure 2. Composite soil moisture comparison at furrow (left), and hill (right) locations for the 2024 growing season.

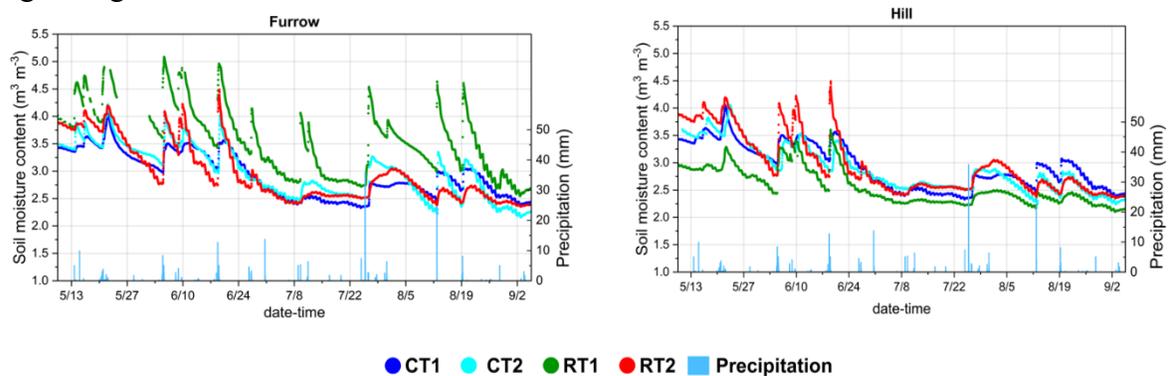


Figure 3. Composite soil moisture comparisons at furrow (left), and hill (right) locations, during the 2025 growing season. #1 Sensors are installed at 6 inch depth. #2 Sensors are installed at 12 inch depth.

Assessment of runoff under varying rainfall intensity

The research team further examined the conditions under which reservoir tillage provides the greatest hydrological benefits using HYDRUS soil water flow modeling. The model was calibrated with field data collected in 2024 and validated with the 2025 dataset.

Runoff simulations indicated a clear nonlinear relationship with rainfall intensity, showing substantial differences between conventional tillage and reservoir tillage in instantaneous runoff flux (Figure 4). Model scenarios indicated that reductions in instantaneous runoff under RT followed an exponential decay pattern as rainfall intensity increased, supported by a strong nonlinear fit ($R^2 = 0.87$). Runoff initiation for both tillage systems occurred at a rainfall intensity of approximately 0.75 in/hour.

The greatest treatment differences, an 80% to 90% reduction in instantaneous runoff under reservoir tillage, occurred at lower rainfall intensities near 0.75 in/hour. At moderate intensities (0.79–1.0 in/hour), reductions ranged from 20% to 60%. However, as rainfall intensity exceeded 1.0 in/hour, RT's relative effectiveness declined. At intensities above 1.1 in/hour, runoff reductions narrowed to only 0% to 10%, indicating limited hydrological advantage during very high-intensity storms. Overall, these results highlight rainfall intensity as a critical determinant of reservoir tillage performance, with the greatest benefits occurring during precipitation events with intensities of 0.75–1 in/hour.

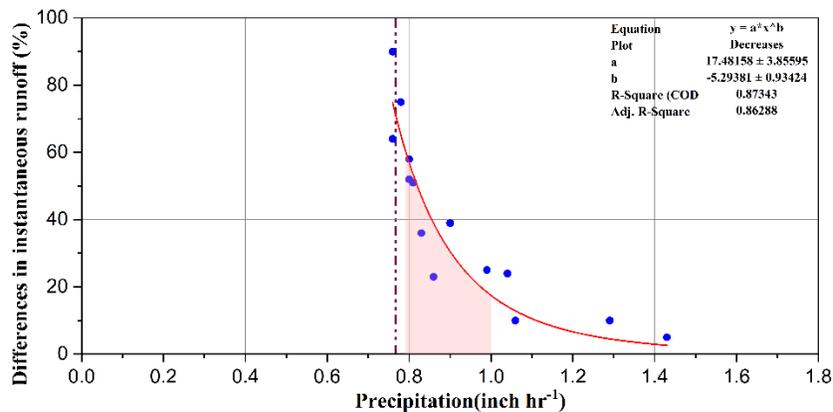


Figure 4. Differences in instantaneous runoff between reservoir tillage and conventional tillage (%), based on instantaneous rainfall (cm hr^{-1}), due to different tillage treatments.

Assessment of runoff under varying daily rainfall amounts

Figure 5 presents simulation results of cumulative runoff under reservoir tillage compared with conventional tillage across a range of daily rainfall amounts. Across all rainfall scenarios, cumulative runoff was consistently lower under reservoir tillage; however, no clear trend was observed with increasing daily precipitation amount, unlike the intensity-based responses shown in Figure 4. In conclusion, reservoir tillage provides meaningful environmental benefits in sloped potato fields, including improved soil moisture retention and a reduced risk of soil loss.

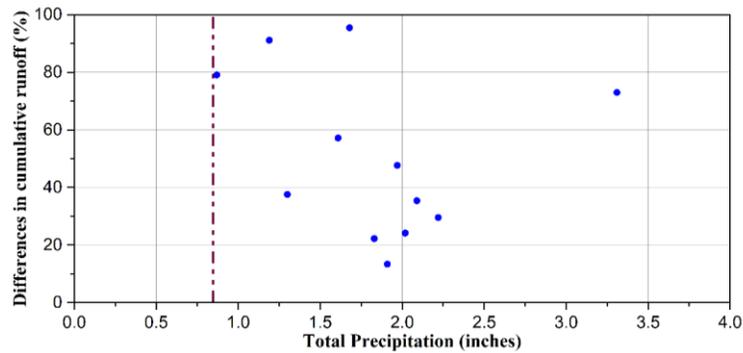


Figure 5. Effect of different tillage treatments on cumulative runoff, based on total daily precipitation (inches).

Yields and quality

Although no statistically significant differences in overall yield were detected between the two treatments in 2025, reservoir tillage produced more consistent yields and reduced variability compared with the control. This greater uniformity is particularly valuable for potato marketability, as stable production supports more predictable grading and supply. Quality assessments, including pink eye, IBS, misshapes, grub damage, hollow heart, seed grade, specific gravity, marketable grade, and oversize, were also conducted, and no significant differences were observed between treatments.

In conclusion, across both the 2024 and 2025 growing seasons, yield variability was consistently lower under reservoir tillage. This stability is likely associated with improved water and nutrient retention, supporting more uniform crop development.

Acknowledgement

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

Project Title: Exploring the Efficacy of 1,4-Dimethylnaphthalene (1,4-DMN) in Enhancing Wound Healing and Reducing Pathogen Spread in Stored Potato Tubers

1. Introduction

Michigan's potato industry is dependent on long-term storage to ensure a continuous supply of raw products for the chipping sector. Tubers are commonly stored for up to 10 months, during which mechanical injuries incurred during harvest, handling, and transportation represent a major vulnerability. These wounds disrupt the native periderm and create entry points for bacterial and fungal pathogens, leading to disease development, increased moisture loss, and reduced marketability (Czajkowski et al. 2011). Even modest levels of postharvest decay can translate into substantial economic losses when scaled across commercial storage facilities (Stefaniak et al 2021).

Successful wound healing in potato tubers depends on rapid suberization and periderm regeneration, processes that restore the protective barrier and limit pathogen ingress. While temperature, humidity, and curing duration are known to influence wound closure, fewer practical tools are available to actively enhance wound-associated defense responses under commercial storage conditions. Consequently, there is a need for storage-compatible interventions that both support wound healing and limit pathogen establishment following mechanical injury.

1,4-Dimethylnaphthalene (1,4-DMN) is a naturally occurring volatile compound in potato tubers and is widely used in commercial storage as a sprout suppressant. Its efficacy in extending dormancy through vapor-phase application is well established, and its use is already integrated into commercial storage facilities. However, beyond sprout suppression, relatively little is known

about how commercially relevant concentrations of 1,4-DMN influence wound-associated physiological responses or pathogen development within tuber tissues.

This study was designed to evaluate whether exposure to 1,4-DMN at and around label-equivalent concentrations influences wound healing and disease development in stored potato tubers. The experimental approach focused on standardized wound creation followed by inoculation with representative bacterial and fungal storage pathogens, *Pectobacterium carotovorum* subsp. *carotovorum* (cause bacterial soft rot) and *Fusarium sambucinum* (cause Fusarium dry rot), respectively. These pathogens were selected to represent contrasting infection strategies, rapid maceration by bacteria versus progressive fungal colonization, allowing assessment of whether 1,4-DMN effects were broadly antimicrobial or pathogen-specific.

To ensure direct relevance to commercial practice, 1,4-DMN was applied in the vapor phase using an inert carrier within sealed containers, with application rates spanning sub-label, label-equivalent (~20 ppm), and modestly high-label concentrations. This concentration range was selected to determine whether antifungal or wound-related effects emerge at doses already used for sprout suppression, or whether higher exposures are required to influence pathogen spread.

Although the initial focus of the project intend to emphasize on enhancement of wound healing and periderm formation, early observations revealed limited effects on bacterial soft rot pathogen but a consistent suppression of *F. sambucinum* spread in 1,4-DMN-treated tubers suggesting the fungistatic role of the compound. Consequently, the study was designed to emphasize pathogen spread dynamics and concentration-dependent responses, while still considering wound healing as a interacting process. By linking storage-relevant application rates with pathogen outcomes, this work provides new insight into the potential expanded role of 1,4-DMN in postharvest disease management and storage loss reduction.

2. Methodology

i. Tuber Material, Wounding, and Pathogen Inoculation

Seed tubers of three commercially relevant potato varieties, Lamoka, Manistee, and Mackinaw were obtained from local Michigan growers. Tubers were visually inspected to exclude defects or pre-existing disease, and randomly assigned to either 1,4-dimethylnaphthalene (1,4-DMN)-treated or untreated control groups. Disease-free tubers were selected and stored at 4 °C in the dark. Subsequently, the tubers were superficially sterilized in 0.5% sodium hypochlorite for 5 min, rinsed thrice with sterile water, and air-dried for one hour in a laminar flow hood before the application of treatment.

To reflect commercial handling conditions, tubers were first wounded prior to chemical treatment. Standardized wounds (15 mm diameter × 2 mm depth) were created on the tuber surface using sterile tools. Immediately following wounding, tubers were inoculated with one of the following treatments:

- (a) *Pectobacterium carotovorum* subsp. *carotovorum* (100 µL of 10⁸ CFU mL⁻¹ suspension),
- (b) *Fusarium sambucinum* (3-mm diameter mycelial plug)
- (c) a non-inoculated control.

Following pathogen inoculation, tubers were placed in sealed 5-L TLC glass containers at a fixed mass of approximately 1.5 kg per container. After a 6-h equilibration period, 1,4-DMN was applied at an application rate equivalent to 20 ppm (mg kg⁻¹ fresh weight). The compound was dispensed onto 5cm² filter paper within each container, which served as an inert carrier to facilitate volatilization and uniform vapor-phase exposure, consistent with commercial storage

application methods. Disease progression was evaluated at 3 and 6 days after inoculation by visual assessment of pathogen spread, lesion development and internal tissue discoloration (at day 6). The evaluation of mycelial growth was performed in two diametrically opposite directions, considering an average of three readings per replicate. At day 6, the tubers were cut along the longitudinal axis around the inoculation sites. Disease development was determined by the rotten area around each wound site as described by de Sousa Santos et al. 2023.

ii. *Microscopy and Wound-Healing Assessment*

To examine anatomical changes associated with wound healing, subsets of tubers were sectioned parallel and perpendicular to the wound surface. Thin sections were stained with toluidine blue and phloroglucinol- HCl to visualize lignin deposition, pectin cross-linking, and suberin formation (UV-visualization). Sections were examined using light and fluorescence microscopy to assess periderm development and structural responses to wounding in treated and untreated tubers.

To fully understand the effect of 1,4 DMN concentration on the pathogen growth and disease progression 1,4-DMN was applied using target concentrations of 0, 5, 10, 15, 20, 25, 30 and 35 ppm. 1, 4 DMN (C₁₀H₆(CH₃)₂; molecular weight: 156.22) was purchased from Millipore Sigma in aqueous form. Tubers were first wounded prior to chemical treatment. Standardized wounds (15 mm diameter × 2 mm depth) were created on the tuber surface using sterile tools. Immediately following wounding, tubers were inoculated with a 3mm-plug of *F. sambucinum*. Following pathogen inoculation, tubers from each variety were placed in sealed 5-L TLC glass containers at a fixed mass of approximately 1.5 kg per container. After a 6-h equilibration period, 1,4-DMN treatments were applied to the containers, and the experiment was repeated twice. The

spread of the fungi was repeatedly measured in day 3, 6, 9 and 12. At day 12, the tubers were horizontally cut, and the internal depth of infection was measured as well.

3. Results

Wound inoculation experiments revealed marked differences in the responses of the two tested pathogens to 1,4-DMN treatment. At 6 days after inoculation, the spread of *F. sambucinum* was significantly reduced in tubers treated with 1,4-DMN compared with untreated controls. In treated tubers, fungal growth was typically confined to the immediate wound margin, whereas in untreated tubers the pathogen expanded radially beyond the wound site. When tubers were bisected through the inoculation point, however, no consistent differences in internal infection depth were observed between treated and untreated tubers at this early stage.

In contrast, tubers inoculated with *P. carotovorum* subsp. *carotovorum* exhibited rapid tissue maceration, water-soaked lesions, and a characteristic foul odor within 6 days after inoculation. Soft rot expansion and tissue breakdown were similar in 1,4-DMN-treated and untreated tubers, indicating that 1,4-DMN did not measurably affect bacterial soft-rot development under the conditions tested. Based on this lack of response, subsequent experiments focused exclusively on *F. sambucinum*.

At 3 days after inoculation, two-way ANOVA revealed a significant main effect of 1,4-DMN treatment on fungal spread, with treated tubers exhibiting reduced growth expansion compared with untreated controls ($F_{1,32} = 29.42$, $P = 5.79 \times 10^{-6}$). Tuber variety had no significant effect on fungal spread ($F_{1,32} = 0.01$, $P = 0.93$), and no significant tuber variety \times treatment interaction was detected ($F_{1,32} = 0.13$, $P = 0.72$), indicating that the fungistatic effect of 1,4-DMN was consistent across varieties.

A similar pattern was observed at 6 days after inoculation. The main effect of 1,4-DMN treatment remained significant ($F_{1,32} = 19.94$, $P = 9.31 \times 10^{-5}$), whereas neither tuber variety ($F_{1,32} = 0.04$, $P = 0.85$) nor the tuber x treatment interaction ($F_{1,32} = 1.14$, $P = 0.29$) significantly influenced fungal spread. Together, these results demonstrate that the suppressive effect of 1,4-DMN on *F. sambucinum* growth persisted through day 6 and was independent of tuber variety (Figure 1).

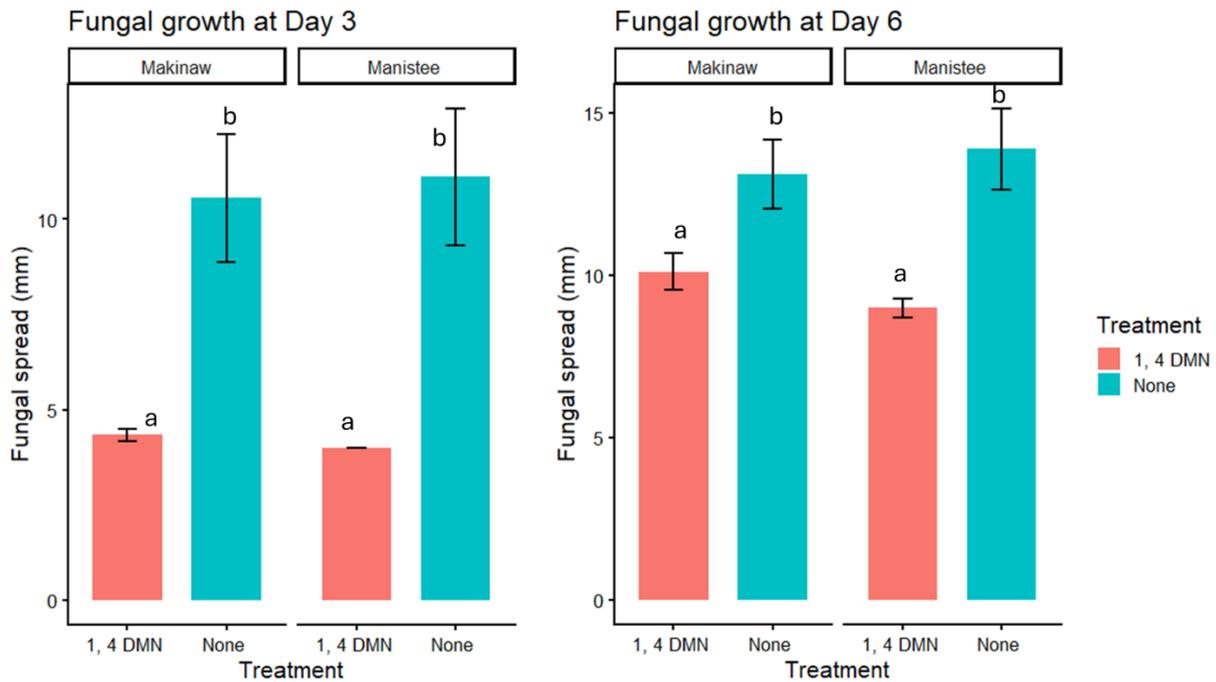


Figure 1. The effect of 20 ppm 1, 4 DMN on the growth of *F. sambucinum* at day 3 and 6, respectively.

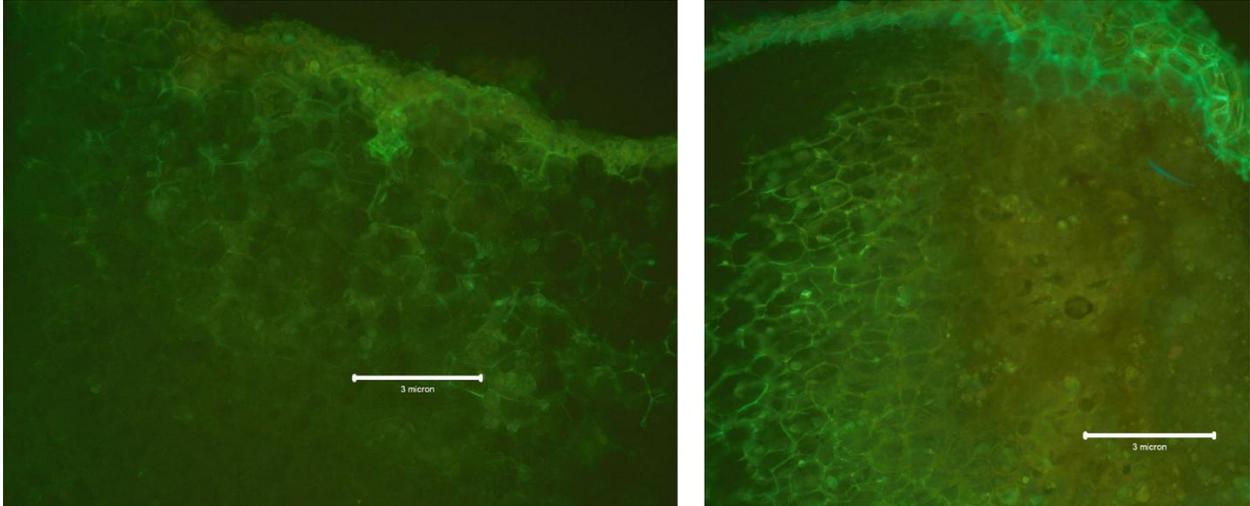


Figure 2. The suberized layer formation after 9-day post wounding in both 1,4 DMN treated and non-treated tuber of Mackinaw. (Preliminary results suggest no significant differences were observed but further detailed study is needed).

Repeated-measures ANOVA confirmed a highly significant effect of 1,4-DMN concentration on fungal spread ($F_{7,40} = 78.52, P < 0.001$), a strong effect of time ($F_{3,120} = 1098.30, P < 0.001$), and a significant treatment x day interaction ($F_{21,120} = 20.27, P < 0.001$). These results indicate that the magnitude of disease suppression by 1,4-DMN varied over time (Figure 2). Lower concentrations temporarily reduced fungal spread at early sampling points, but this effect diminished as storage duration increased. In contrast, the highest concentration (35 ppm) consistently suppressed fungal growth throughout the observation period, particularly in the Manistee variety.

Fungal growth varied strongly with 1,4-DMN concentration. Tubers receiving no treatment or low concentrations (5, 10, and 15 ppm) exhibited extensive mycelial growth by 6 days after inoculation, comparable to untreated controls. In contrast, tubers treated with 20, 25, and 30 ppm

showed significantly reduced fungal spread through day 6, indicating that concentrations at or above the commercial label rate delayed pathogen development.

By 9 days after inoculation, sustained suppression of fungal growth was observed only at the highest concentration tested (i.e. 35 ppm). At concentrations ≤ 30 ppm, fungal growth increased over time, suggesting that *F. sambucinum* was able to overcome the inhibitory effects of 1,4-DMN. At 35 ppm, however, fungal growth was strongly suppressed, with little to no fluffy mycelial development and no complete colonization of the wound surface. In these high-concentration treatments, fungal growth appeared to halt at the wound margin, potentially allowing wound-healing processes to progress and limit further infection. In contrast, untreated and low-concentration treatments exhibited dense mycelial growth that rapidly covered the wounded area, overwhelming host defenses.

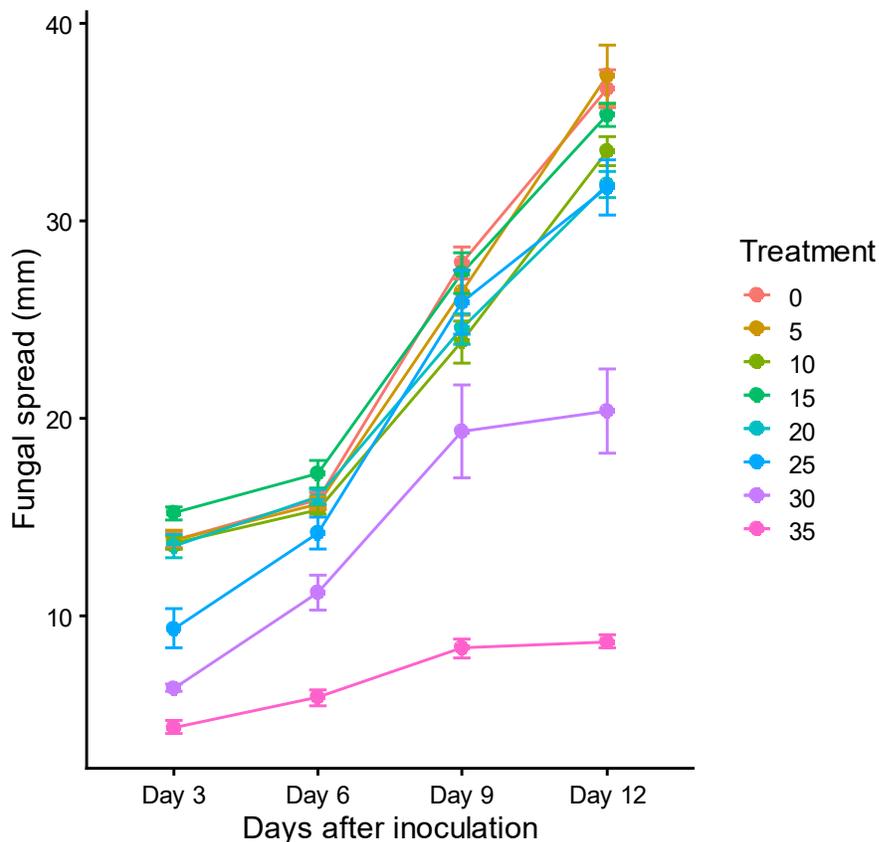


Figure 2: Fungal spread over time under various 1, 4 DMN concentration treatments in Manistee.



Figure 4. Comparison of *Fusarium sambucinum* spread in Manistee potato tubers treated with 1,4-DMN at 15 ppm and 35 ppm, respectively, 9 days after inoculation.

Overall, these results demonstrate that 1,4-DMN significantly reduced the spread of *F. sambucinum* in wounded potato tubers in a concentration- and time-dependent manner, while no measurable suppression was observed for *P. carotovorum* subsp. *carotovorum*. Concentrations at or above the commercial label rate (> 20 ppm) delayed fungal spread, whereas higher concentrations provided more sustained suppression. Growth inhibition at higher concentrations appeared to create a window period that may allow wound-healing processes to limit pathogen colonization. Although a direct stimulatory effect of 1,4-DMN on wound-healing processes was not evident, the compound may contribute indirectly to wound healing by suppressing pathogen growth. By limiting fungal colonization at the wound site, 1,4-DMN may allow the remaining wounded tissue sufficient time to undergo suberization and new periderm formation, thereby reducing subsequent infection levels.

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2025 MPIC-funded potato research report

Project title: Assessing aphid risk to seed potato in Michigan

PI: Zsafia Szendrei

Research Objectives

Objective 1) Develop and share an aphid sampling protocol with seed potato growers, process sampling data for analysis.

Objective 2) Analyze and share aphid results with stakeholders.

Results:

Obj. 1)

In the winter of 2025, we collaborated with Damen Curzer, the Executive Director of the Michigan Seed Potato Association to reach out to seed potato growers and gauge their interest in participating in the pilot aphid monitoring program. We also developed a sampling protocol that explained to growers how to use and preserve the yellow sticky card traps, as well as an Aphid Monitoring app that growers used to submit photos of cards and view weekly total aphid means over time. We shared the program at the Winter Seed Potato Growers Meeting on February 19th, and 14 growers were willing to sample in a total of 36 seed potato fields. We then held a webinar on April 28th on the aphid sampling protocol and how to use the Aphid Monitoring app, and sampling began once the potato plants began to emerge from the soil.

We processed the submitted aphid photo data for 12 weeks, from the beginning of June to the end of August 2025, counting the total number of aphids per card and publishing the total aphid abundance across all submitted sites in the app each week. This showed that aphid abundance was stable throughout June and July but spiked in August before decreasing again. These trends correlate with aphid abundance trends in the rest of the region and with the forecasted Potato Virus Y risk for the UP in the decision support model available through the University of Wisconsin's Vegetable and Disease Incidence Forecasting Network (VDIFN) (Fig. 1). However, aphid abundance did not increase in our sampling data until week 9, which suggests that aphid conditions in the

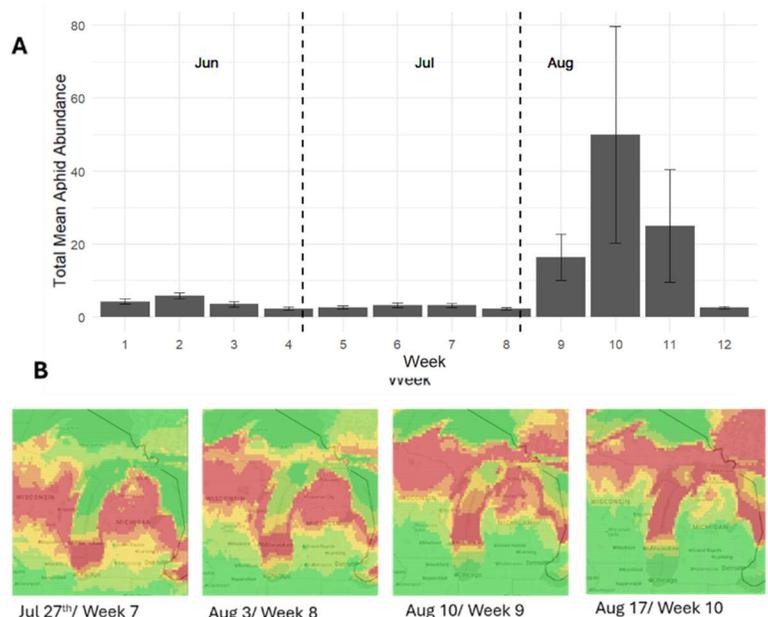


Figure 1. A) Total mean aphid abundance with standard error bars. B) PVY risk forecasts from the VDIFN website when aphid abundance is highest. Red is highest risk, and green is lowest.

UP lag behind the risk forecast model. In addition to counting aphids and providing weekly mean abundance, we also collected the cards from growers once sampling and harvest ended and attempted to identify each aphid to species, using a microscope and aphid key. We were able to identify approximately 75% of all aphids to the genus level.

Obj. 2)

We have used this data to estimate the risk of Potato Virus Y transmission. The PVY risk index is estimated by taking the total weekly abundance of each vector species and multiplying by its transmission efficiency (as available in scientific literature). This method is also used to develop the VDIFN risk forecasts. By completing this for all vector species found in each week, the sum risk index shows how PVY risk changes across the growing season. We found that while aphid abundance corresponds to the forecasted PVY risk, the PVY risk index did not because many of the aphids driving the peak abundance were not PVY vectors (Fig. 2). Furthermore, we found that PVY risk index was higher in the early season, when there were fewer aphids total, but a higher proportion of vector species.

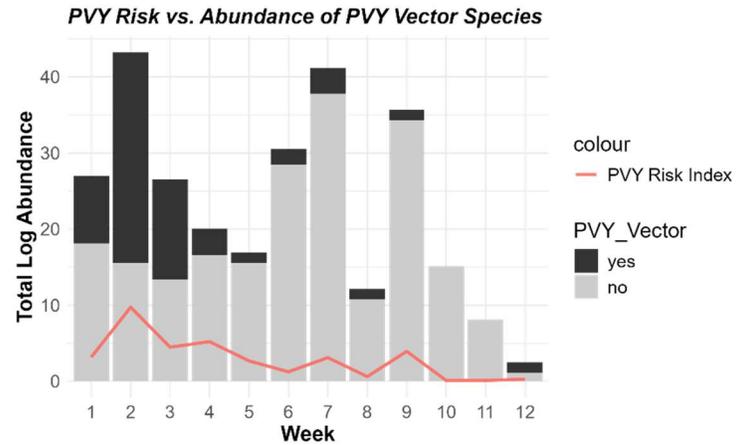


Figure 2. Aphid abundance from yellow sticky traps in 2025 and identified to species. Total weekly log abundance of PVY vector species is black, and non-vectors are gray.

The preliminary results of this analysis were shared with seed potato growers at their Summer Seed Potato Growers Meeting on August 13th, and a more complete overview of the results will be shared at the Winter Potato Conference on January 28th. I also distributed information about aphid management to stakeholders at the MSU Potato Field Day on August 7th and the UP Potato Field Day on August 28th.

Investigating Integrated Weed Management Strategies for Potatoes-2025 MPIC Research Report

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Michigan potato production is threatened, on an annual basis, by many pests. These pests result in six to ten percent crop loss and in millions of dollars of lost sales. Colorado potato beetle (CPB) is the most important defoliator of potatoes world-wide. CPB has developed resistance to all known classes of insecticides used to control it in commercial production. 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: *Conduct field studies to investigate the impacts of herbicide and application of potato sprout inhibitors for volunteer potato management.* Variability in volunteer emergence, large energy reserves, and daughter tuber production reduces the reliability of conventional herbicides for effective control. Maleic hydrazide (MH), a plant growth regulator historically used to inhibit sprouting in long-term potato storage, may offer potential as a management tool by preventing daughter tuber formation and thereby reducing volunteer pressure in subsequent seasons. This study was conducted in 2025 at East Lansing, MI, using a randomized complete block design with four replications. To simulate volunteers, potatoes were spread at a density of 3.25 tubers m² and tilled in with a disk. Treatments were arranged factorially and included four application timings (24, 31, 38, and 45 days after planting-DAP) and three herbicide treatments: mesotrione alone (MESO), mesotrione plus maleic hydrazide (MESO + MH), and a non-treated control (NTC). Data collected included visual foliar injury ratings (14, 21, and 28 days after application-DAA). Additionally, five plants per plot were excavated to assess daughter tuber production, including tuber number and total tuber weight per plant. All data were analyzed using linear mixed-effects models in R and treatment means were separated using Tukey's HSD. Visual foliar injury ratings were significantly affected by application timing ($p < 0.0001$) across all timepoints, with the greatest control observed at the earliest application timing and the least control at the latest timing. Daughter tuber number was significantly affected by application timing ($p = 0.043$), with the 38 DAP timing producing 22% more tubers than the 31 DAP timing. Daughter tuber weight per plant was significantly affected by treatment ($p < 0.0001$), with non-treated controls producing 47% greater tuber weight than MESO and MESO + MH treatments. Resulting daughter tubers are currently in storage to understand the impacts of maleic hydrazide on tuber viability. This study will be conducted again in 2026.

Objective 2: Investigate volunteer potato control in rotational crops (soybean, sugarbeet, winter wheat, dry bean, and alfalfa). This study investigated control of volunteer potatoes in rotational crops outside of corn. With the growing diversity of potato cropping systems there is a need to investigate control of volunteer potatoes in diverse rotational crops. This study was conducted at the Montcalm Research Center. Potatoes were spread and incorporated to simulate a dense population of volunteers. Herbicide applications (Table 1) were applied to 8-12 in volunteers. Overall, increasing rates of Roundup (glyphosate) resulted in sufficient daughter tuber control (Figure 1. 1-3). For treatments relying on 2,4-D (Enlist) the addition of glyphosate is needed to control daughter tubers (Figure 1. 4-6). Raptor and Basagran application regardless of rate were not effective (Figure 1. 7-8). Clarity applied at the rate used in winter wheat was not effective (Figure 1. 9), however Huskie application reduced daughter tuber production (Figure 1, 10). Stinger HL application was not highly effective (Figure 1, 11).

Table 1. Herbicide treatments utilized in objective 2.

Treatment No.	Treatment Name	Rate
1	Roundup PowerMax3	20 fl oz/a
1	AMS	8.5 lb/100 gal
2	Roundup PowerMax3	30 fl oz/a
2	AMS	8.5 lb/100 gal
3	Roundup PowerMax3	40 fl oz/a
3	AMS	8.5 lb/100 gal
4	Enlist Duo	4.75 pt/a
5	Enlist	2 pt/a
5	Roundup PowerMax3	30 fl oz/a
5	AMS	8.5 lb/100 gal
6	Enlist	2 pt/a
7	Raptor	4 fl oz/a
7	Basagran	12.8 fl oz/a
7	COC	1% v/v
7	AMS	8.5 lb/100 gal
8	Raptor	4 fl oz/a
8	Basagran	6.4 fl oz/a
8	COC	1% v/v
8	AMS	8.5 lb/100 gal
9	Clarity	4 fl oz/a
10	Huskie	15 fl oz/a
10	NIS	0.25% v/v
10	AMS	8.5 lb/100 gal
11	Stinger HL	0.2 pt/a

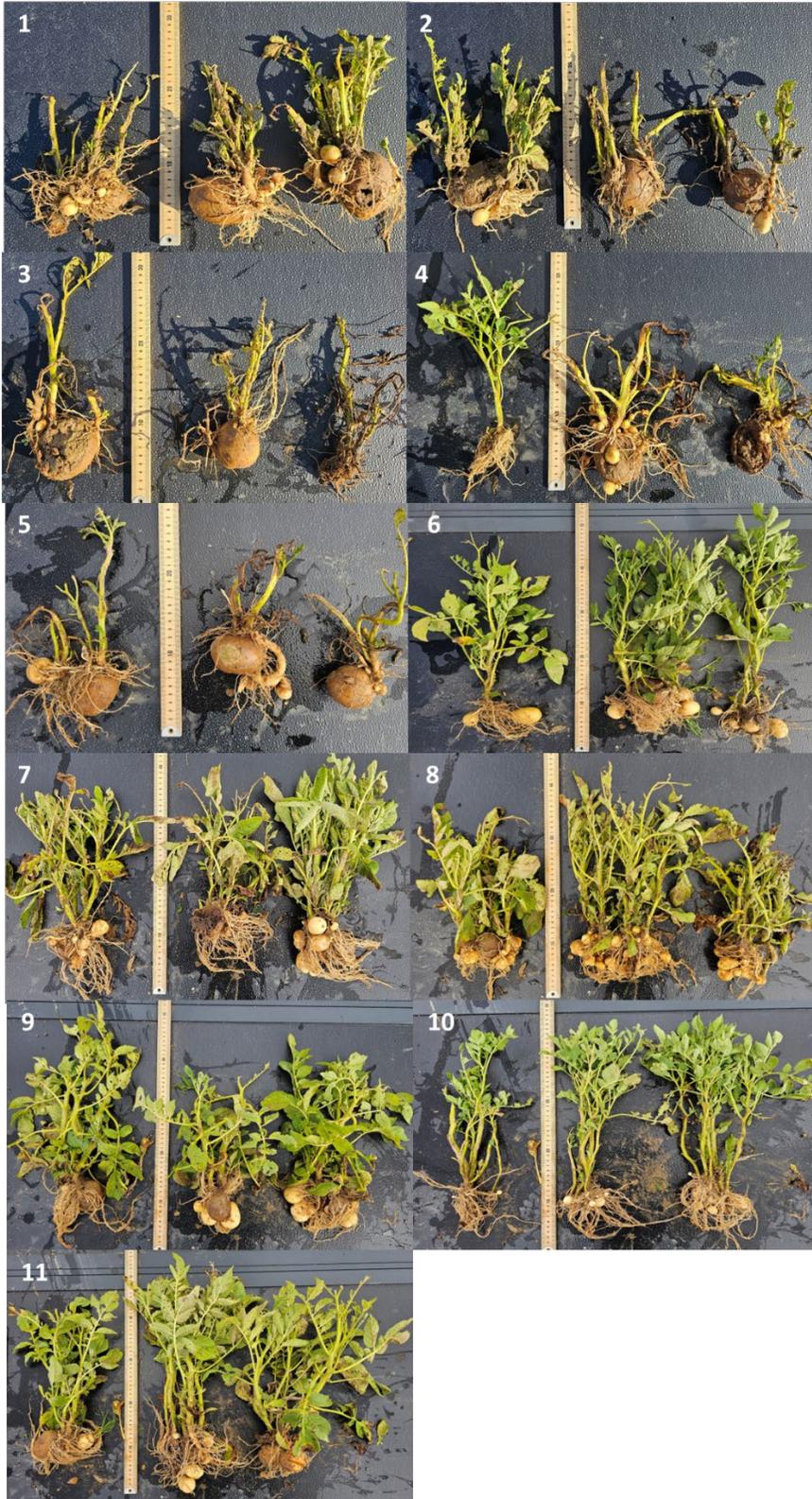


Figure 1. Volunteer potato control 28 days after herbicide application. Numbers refer to treatments outlined in Table 1.

Funding: Fed. Grant/MPIC/Potatoes USA

2025 POTATO VARIETY EVALUATIONS

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INTRODUCTION

Each year, the MSU potato breeding and genetics team conducts a series of variety trials to assess advanced potato selections from the Michigan State University and other potato breeding programs at the Montcalm Research Center (MRC). In 2025, we tested 350 varieties and breeding lines in the replicated variety trials. The variety evaluation also includes disease testing in the scab nursery (Montcalm Research Center) and foliar late blight evaluation and PVY resistance screening (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 accomplish the field research studies.

PROCEDURE

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

2025 was the fifteenth 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 83 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 2025 late blight trial was conducted at the MSU campus Plant Pathology Farm. The simulated blackspot bruise (from 50°F tuber temperature) results for average spots per tuber have also been incorporated into the summary sheets.

RESULTS

A. Agronomic trials from Montcalm Research Center

Tables 1-7 summarize the agronomic results from the Montcalm Research Center. The scab and late blight trial results are added to the tables as well as the blackspot bruise data. The lines that show promise in 2025 are highlighted in green. In general, the yields were below average. 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 (82 lines) and the scab variety trial (118 lines) and diploid scab trial (225). In 2025, 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 2023-2025 scab ratings are based upon the Montcalm Research Center site. **Table 8** categorizes many of the varieties and advanced selections tested in 2025 over a three-year period. The varieties and breeding lines are placed into nine categories based upon scab infection level and lesion severity. A rating of 0 indicates zero scab infection. A score of 1.0 indicates a trace amount of infection. A moderate resistance (1.2 – 1.5) correlates with <10% infection without pitting. Scores of 4.0 or greater are found on lines with >50% surface infection and severe pitted lesions.

The check varieties Red Norland, Yukon Gold, Mackinaw, Lamoka, Atlantic, and Snowden can be used as references (in bold, **Table 8**). The table is sorted in ascending order by 2024 scab rating. This year's results continue to indicate that we have been able to breed numerous lines with resistance to scab. Average scab ratings ranged from 0.3 – 3.5 for the variety trial. A total of 69 entries tested had a scab rating of 1.7 or lower in 2025. Most notable scab resistant MSU lines are found in the trial summaries (**Tables 1-7**). Of the 109 early generation selections that were evaluated, 45 had scab resistance (scab rating of ≤ 1.5) (**Table 9**).

C. Late Blight Trial

In 2025, the late blight trial was planted at the East Lansing campus Plant Pathology farm. All entries were planted in late June for late blight evaluation. These include lines tested in a replicated manner from the agronomic variety trial and entries in the early generation observation plots. The trials were inoculated two times in August with the US-23 genotype of *P. infestans*. Late blight infection was identified but the weather conditions suppressed the infection and never reached a level to differentiate resistance from susceptibility. No data is reported this year.

D. Blackspot Bruise Susceptibility (Table 10)

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 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 10**. 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 2025, the bruise levels were higher than previous years for some trials. 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 with 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 1,300 different potato entries, including reference varieties, have been evaluated. The data for all the lines tested are summarized on a searchable, centralized database housed at Medius (<https://potatoesusa.medius.re>). More than 45 promising new breeding lines from the trials have been fast-tracked for larger-scale commercial trials and processor evaluation. The NCPT is also a feeder for the national SNAC International trials. We are using the NCPT trials to more effectively identify promising new selections. Notable MSU lines that have been identified are MSW485-2 (Huron Chipper), MSX540-4 (Mackinaw), MSV030-4 (Petoskey), and MSZ242-13 (Dundee). Our newest graduates of the NCPT are MSBB058-1, MSDD247-11 and MSDD247-07. Minituber production and/or commercial seed have been produced of the newer lines and will be tested in Michigan in 2026.

Table 1

ADVANCED CHIP-PROCESSING TRIAL
MONTCALM RESEARCH CENTER
May 8 to September 24, 2025 (134 days)
DD Base 40°F 3131.2⁸

LINE	PVY Resistant	N	CWT/A		PERCENT OF TOTAL ¹							SFA OTTF ²	PERCENT (%) TUBER QUALITY ³					SCAB ⁴	MAT ⁵	BRUISE ⁶	3-YR AVG
			US#1	TOTAL	US#1	Bs	As	A1	A2	OV	PO		SP GR	HH	VD	IBS	BC				US#1 CWT/A
NY174		2	409	458	89	10	89	71	18	0	1	1.082	1.0	0	0	0	0	2.5	2.0	1.9	464*
Huron Chipper		2	398	465	86	14	86	58	28	0	0	1.076	1.0	5	0	0	0	1.5	3.5	1.1	-
MSHH015-5	PVYR	2	363	393	92	9	89	50	40	3	0	1.076	1.0	0	0	5	0	1.7	2.5	1.6	-
MSHH034-12	PVYR	2	340	370	92	8	92	52	41	0	0	1.078	1.0	5	0	20	0	1.5	2.0	1.0	-
MSAA076-6		2	329	372	89	11	89	53	35	0	1	1.079	1.0	0	0	15	0	1.7	3.5	3.7	368
MSGG409-3	PVYR	2	326	407	80	20	80	68	13	0	0	1.075	1.0	0	0	10	0	1.7	3.5	0.7	-
MSHH068-10	PVYR	2	324	360	90	10	90	72	19	1	0	1.076	1.0	0	0	0	0	1.8	2.0	1.3	-
MSDD247-11	PVYR	2	314	367	85	14	85	72	14	0	2	1.085	1.0	0	0	0	0	0.8	3.0	3.1	307
MSGG409-2	PVYR	2	308	381	81	11	79	42	37	3	9	1.071	1.0	5	0	10	0	1.5	3.0	0.8	-
MSHH018-3	PVYR	2	307	327	94	6	94	54	41	0	1	1.076	1.0	0	0	5	0	1.8	2.5	1.6	-
MSGG426-2	PVYR	2	304	329	92	6	92	56	37	0	2	1.075	1.0	0	0	10	0	0.7	3.0	0.8	-
MSFF038-3	PVYR	2	301	339	89	12	89	52	37	0	0	1.076	1.0	15	0	0	0	1.5	3.0	1.9	357
MSFF037-17	PVYR	2	301	372	81	17	81	68	13	0	3	1.075	1.0	0	0	0	0	1.7	3.0	0.7	-
MSDD244-05	PVYR	2	290	306	95	5	95	46	49	0	1	1.082	1.0	0	0	5	0	0.5	3.0	1.3	342
MSFF335-2RR		2	283	345	82	19	82	71	12	0	0	1.061	2.0	5	0	0	0	1.8	4.0	0.5	-
MSHH130-1	PVYR	2	275	341	81	19	81	71	11	0	1	1.077	1.0	0	0	5	0	1.8	2.0	1.9	-
MSBB058-1		2	271	306	89	7	87	50	37	2	5	1.081	1.0	0	0	5	0	1.2	2.5	2.3	313
MSHH137-1	PVYR	2	267	323	83	17	83	73	10	0	1	1.077	1.0	0	0	0	0	1.0	2.0	1.1	-
MSHH053-19	PVYR	2	260	316	82	17	82	60	23	0	1	1.072	1.0	15	0	5	0	0.7	2.0	1.0	-
MSDD372-15	PVYR	2	258	293	88	12	87	61	26	1	0	1.080	1.0	20	0	10	0	1.0	4.0	1.4	-
Atlantic		2	257	291	88	9	88	60	28	0	3	1.079	1.0	45	0	5	0	2.8	2.5	2.3	232
MSBB617-02	PVYR	2	251	274	92	6	91	41	50	2	3	1.070	1.5	45	0	0	0	0.5	3.0	0.5	309*
Mackinaw	PVYR	2	249	285	86	14	86	71	15	0	0	1.083	1.0	0	0	0	0	1.3	2.5	1.4	308
MSEE207-2	PVYR	2	244	286	86	13	85	66	20	1	1	1.073	1.0	0	0	10	0	0.8	3.5	-	350
Manistee		2	235	276	85	16	85	63	23	0	0	1.070	1.0	10	0	0	0	2.3	1.5	0.5	286
MSDD249-09	PVYR	2	235	281	84	10	81	52	29	3	7	1.075	1.0	0	0	5	0	1.2	3.0	0.8	341
Lamoka		2	234	287	82	16	82	72	10	0	3	1.074	1.0	0	0	0	0	0.9	2.5	0.6	281
Bliss		2	233	285	82	16	82	72	10	0	3	1.080	1.0	0	0	0	0	1.8	2.5	0.6	250
MSEE035-4	PVYR	2	233	294	80	12	80	50	30	0	9	1.082	1.0	25	0	0	0	0.7	3.0	1.3	-
MSGG282-20	PVYR	2	233	263	88	8	87	50	38	2	4	1.073	1.0	5	0	0	0	1.0	3.0	1.0	355*
MSHH053-04	PVYR	2	225	265	85	8	85	55	30	1	7	1.083	1.0	0	0	0	0	1.0	4.0	0.7	-
NY177		2	222	292	76	25	76	74	2	0	0	1.091	1.0	0	0	15	0	1.8	2.0	3.0	317*
MSII040-1		2	207	250	83	17	83	72	12	0	1	1.082	1.0	0	0	5	0	1.5	2.0	2.9	-
MSDD247-07	PVYR	2	207	231	88	11	88	66	22	0	2	1.087	1.0	0	0	10	0	1.0	3.0	1.1	298

LINE	PVY Resistant	N	CWT/A		PERCENT OF TOTAL ¹							SFA OTTF ²	PERCENT (%) TUBER QUALITY ³						3-YR AVG US#1 CWT/A		
			US#1	TOTAL	US#1	Bs	As	A1	A2	OV	PO		SP GR	HH	VD	IBS	BC	SCAB ⁴	MAT ⁵	BRUISE ⁶	CWT/A
Petoskey		2	206	252	83	15	80	60	20	3	3	1.078	1.0	0	0	5	0	1.5	2.0	1.1	274
Dundee		2	195	242	79	18	79	58	22	0	4	1.086	1.0	5	0	5	0	1.5	3.0	0.9	310
MSBB230-1		2	193	225	86	13	86	67	19	0	1	1.075	1.0	0	0	0	0	2.3	2.5	0.7	291
MSDD372-07	PVYR	2	193	230	84	16	84	60	24	0	0	1.089	1.0	0	0	5	0	1.3	3.5	1.7	-
MSBB614-11	PVYR	2	181	223	82	14	82	60	22	0	5	1.070	1.0	0	0	0	0	0.8	3.0	1.7	-
MSEE016-10	PVYR	2	164	243	68	32	68	64	4	0	0	1.080	1.0	0	0	0	0	1.5	2.5	1.4	-
MSDD244-15	PVYR	2	162	177	91	7	86	44	42	6	3	1.074	1.0	10	0	0	0	1.2	3.0	2.6	233
MSHH134-20	PVYR	2	148	204	73	26	73	65	8	0	2	1.075	1.0	5	0	10	0	0.8	3.5	1.6	-
Snowden		2	143	194	72	28	72	67	5	0	1	1.077	1.0	0	0	0	0	3.0	1.5	2.0	193
MEAN			257	303								1.077	1.0					1.4	2.8	1.4	296
HSD _{0.05}			225	237								0.010									

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

²CHIP SCORE: SNAC Scale (Out of the field); Ratings: 1-5; 1: Excellent, 5: Poor.

³QUALITY: HH: Hollow Heart; BC: Brown Center; IBS: Internal Brown Spot. Percent of 20 Oversize and/or A-size tubers cut.

⁴SCAB DISEASE RATING: MSU Scab Nursery; 0: No Infection; 1: Low Infection <5%; 3: Intermediate; 5: Highly Susceptible.

⁵MATURITY RATING: August 20, 2025; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

⁶BRUISE: Simulated blackspot bruise test, average number of spots per tuber.

Plant Date: 5/8/25

Vine Kill: 9/2/25

Days from planting to vine kill: 117

⁸Enviroweather: Entrican Station. Planting to vine kill

Table 2

NORTH CENTRAL REGIONAL TRIAL
MONTCALM RESEARCH CENTER
May 8 to September 4, 2025 (119 days)
DD Base 40°F 3003.4⁵

LINE	N	CWT/A		PERCENT OF TOTAL ¹							PERCENT (%) TUBER QUALITY ²						
		US#1	TOTAL	US#1	Bs	As	A1	A2	OV	PO	SP GR	HH	VD	IBS	BC	SCAB ³	MAT ⁴
Chip																	
W22079-5	1	437	531	82	18	82	72	10	0	0	1.071	0	0	0	0	2.0	3.0
W21057-2	1	366	438	83	12	77	42	36	6	4	1.076	10	0	0	0	1.5	4.0
MSJJ039-3	1	361	395	92	8	92	65	26	0	0	1.077	0	0	0	0	1.0	3.0
W22086-33	1	361	474	76	24	76	69	8	0	0	1.076	30	0	0	0	2.5	3.0
MSJJ040-8	1	356	403	88	8	88	62	26	0	4	1.074	0	0	0	0	1.5	2.0
MN21ND1845B-088	1	355	454	78	15	78	53	25	0	7	1.063	0	0	10	0	3.0	2.0
W22094-5	1	353	404	87	8	87	53	34	0	4	1.082	40	10	0	0	0.5	3.0
W22093-28	1	333	414	80	20	80	61	20	0	0	1.080	30	10	0	0	2.5	4.0
W22077-4	1	326	357	91	8	91	50	41	0	0	1.079	0	10	90	0	0.5	3.0
W22080-20	1	318	392	81	19	81	78	3	0	0	1.069	0	0	0	0	1.0	2.0
MSJJ033-5	1	316	389	81	16	81	67	14	0	3	1.086	0	0	0	0	1.5	3.0
W22078-21	1	315	373	84	11	84	74	10	0	5	1.080	20	0	0	10	3.0	3.0
W21059-32	1	299	356	84	16	84	60	24	0	0	1.072	0	0	0	0	2.5	2.0
W22096-14	1	296	354	84	7	84	51	32	0	9	1.073	10	0	0	0	2.0	2.0
W22095-13	1	295	322	92	8	92	68	24	0	1	1.078	40	10	0	0	3.0	2.0
MSJJ056-3	1	293	500	59	41	59	58	1	0	1	1.078	0	0	0	0	1.0	3.0
MSJJ043-01	1	280	303	93	6	93	44	49	0	2	1.063	0	0	0	0	1.5	2.0
W22091-1	1	278	306	91	8	91	40	50	0	2	1.083	70	0	0	0	1.5	4.0
W21072-5	1	275	324	85	15	85	69	16	0	0	1.082	10	0	0	0	2.5	3.0
W21075-1	1	270	295	92	8	92	72	20	0	0	1.073	40	0	0	0	1.5	3.0
W22078-14	1	269	338	79	13	79	62	17	0	8	1.079	20	10	0	0	2.5	3.0
MSJJ044-06	1	265	294	90	9	90	63	27	0	1	1.082	10	0	0	0	1.0	3.0
ND20191-6	1	254	309	82	15	82	58	24	0	3	1.057	0	10	0	10	0.5	2.0
MSJJ034-1	1	249	297	84	16	84	55	29	0	0	1.077	0	0	0	0	1.0	2.0
Snowden	2	242	293	82	17	82	69	14	0	1	1.077	30	10	0	0	2.0	2.5
W22077-1	1	239	296	81	14	81	59	22	0	5	1.084	0	0	0	0	0.5	2.0
W22073-10	1	238	275	86	13	86	72	14	0	1	1.069	0	10	0	0	2.5	1.0
W22078-16	1	238	322	74	12	74	56	18	0	14	1.081	10	0	10	0	2.5	4.0
W21061-4	1	228	256	89	7	89	50	39	0	4	1.077	0	0	0	0	1.5	1.0

LINE	N	PERCENT (%)															
		CWT/A		PERCENT OF TOTAL ¹								TUBER QUALITY ²					
		US#1	TOTAL	US#1	Bs	As	A1	A2	OV	PO	SP GR	HH	VD	IBS	BC	SCAB ³	MAT ⁴
W22088-26	1	224	325	69	31	69	68	1	0	0	1.082	0	0	0	0	1.0	3.0
W22085-1	1	223	336	66	34	66	65	2	0	0	1.075	0	10	0	0	1.5	1.0
Lamoka	2	220	252	88	11	88	81	7	0	2	1.073	0	10	0	5	1.5	2.0
W21065-14	1	219	265	83	17	83	68	15	0	0	1.080	0	0	0	0	3.0	3.0
MSJJ044-05	1	209	239	87	10	87	51	37	0	3	1.078	0	0	10	0	2.0	2.0
W22075-17	1	208	286	73	27	73	71	2	0	0	1.082	0	0	0	0	2.0	2.0
W22085-18	1	206	303	68	30	68	66	2	0	2	1.085	0	0	0	0	1.5	3.0
W22090-5	1	205	255	80	16	80	69	12	0	4	1.083	10	0	40	0	0.5	3.0
MSJJ039-6	1	204	270	76	20	76	58	18	0	4	1.074	0	10	0	0	1.5	1.0
MSJJ014-7	1	199	326	61	39	61	56	5	0	0	1.070	0	0	40	0	2.0	3.0
MSJJ043-08	1	197	235	84	12	84	50	34	0	4	1.073	0	10	0	0	1.0	2.0
W22073-32	1	190	241	79	21	79	65	14	0	0	1.085	10	10	0	0	2.5	2.0
MN21ND1835B-143	1	188	294	64	26	64	47	17	0	11	1.075	40	0	0	0	1.0	3.0
W21064-29	1	178	252	71	28	71	68	2	0	2	1.083	0	0	0	0	1.5	2.0
W22095-16	1	176	264	67	26	67	55	12	0	7	1.070	10	0	0	10	2.0	2.0
ND20191-38	1	172	259	66	34	66	64	2	0	0	1.066	0	10	0	0	2.5	1.0
ND20186-2	1	169	216	78	6	78	36	42	0	16	1.059	20	0	0	20	1.5	2.0
W21058-6	1	168	299	56	38	56	53	3	0	6	1.072	0	0	0	0	1.5	3.0
MSJJ054-1	1	167	243	69	28	69	60	8	0	4	1.075	10	10	10	0	2.0	2.0
W21072-3	1	167	213	78	22	78	54	24	0	0	1.076	10	10	0	0	2.0	2.0
MN21ND1835B-136	1	160	239	67	29	67	62	5	0	4	1.071	0	0	0	0	1.5	3.0
TXND22085-3	1	154	212	73	22	73	69	4	0	5	1.063	20	0	0	0	1.5	2.0
AFND7639-2	1	145	215	67	31	67	57	10	0	2	1.064	0	0	0	0	1.5	3.0
ND20191-7	1	133	201	66	30	66	55	10	0	4	1.078	0	0	0	0	2.5	2.0
ND20202-1	1	106	157	67	31	67	57	11	0	1	1.060	0	10	0	0	3.0	2.0
W22094-19	1	83	189	44	55	44	44	0	0	1	1.089	0	0	0	0	0.5	3.0
MN21ND1845B-030	1	80	138	58	38	58	58	0	0	3	1.071	0	0	0	0	0.5	2.0
MN21ND1835B-129	1	78	149	52	37	52	42	10	0	10	1.072	60	0	0	0	2.0	3.0
TXND22002-1	1	77	149	52	48	52	47	5	0	0	1.069	40	0	0	0	1.0	3.0
MN21ND1835B-029	1	43	117	37	57	37	37	0	0	7	1.080	0	0	0	0	1.5	3.0
W22073-3	1	43	112	38	55	38	38	0	0	7	1.064	0	0	0	0	2.0	1.0
MN21ND1835B-146	1	27	140	19	74	19	19	0	0	7	1.075	0	0	0	0	1.5	3.0
MEAN		225	293								1.075					1.7	2.5
Russet																	
AND18320-2Russ	1	303	386	79	12	79	49	29	0	10	1.070	30	0	0	0	2.0	3.0

LINE	N	PERCENT (%)															
		CWT/A		PERCENT OF TOTAL ¹								TUBER QUALITY ²					
		US#1	TOTAL	US#1	Bs	As	A1	A2	OV	PO	SP GR	HH	VD	IBS	BC	SCAB ³	MAT ⁴
ND21245-4Russ	1	296	406	73	12	73	59	14	0	15	1.070	0	0	0	0	1.0	3.0
ND21245-1Russ	1	254	327	78	19	78	74	4	0	4	1.071	10	0	0	0	0.5	2.0
AND18344-5Russ	1	237	318	74	26	74	65	10	0	0	1.066	0	0	0	0	2.5	3.0
ND21245-3Russ	1	158	247	64	28	64	64	0	0	8	1.075	0	0	0	0	0.5	2.0
Russet Norkotah	2	153	239	64	27	64	55	9	0	10	1.062	30	10	0	0	1.3	1.0
MN190014-115	1	145	253	57	23	57	51	6	0	19	1.068	0	0	0	0	2.0	1.0
AFND7590-2Russ	1	139	271	51	40	51	46	5	0	9	1.069	0	10	0	0	2.0	2.0
Goldrush Russet	2	126	250	51	39	51	47	4	0	11	1.058	0	20	0	0	0.5	1.5
AFND7589-4Russ	1	85	176	48	52	48	48	0	0	0	1.069	50	0	0	0	1.5	1.0
MEAN		190	287								1.068					-	2.0
<i>Pigmented</i>																	
MSJJ103-3R	1	272	370	74	26	74	68	5	0	0	1.059	0	0	0	0	2.0	2.0
MSJJ103-2R	1	170	265	64	35	64	60	5	0	1	1.065	0	0	0	0	2.5	2.0
MSJJ104-4RY	1	159	239	67	32	67	67	0	0	2	1.058	0	0	0	0	2.0	3.0
Dark Red Norland	1	148	254	58	35	58	52	7	0	7	1.052	30	20	0	0	1.0	1.0
MSJJ086-2PP	1	143	299	48	46	48	48	0	0	6	1.073	0	0	0	0	1.0	2.0
AFND7682-4R	1	142	229	62	24	62	54	7	0	14	1.061	0	0	0	0	2.0	3.0
MSJJ083-1RR	1	114	254	45	54	45	45	0	0	1	1.056	0	0	0	0	1.0	2.0
MEAN		164	273								1.061					-	2.1
<i>Table/Speciality</i>																	
MSJJ1112-2Y	1	389	493	79	18	77	65	12	2	3	1.073	0	10	0	10	2.0	3.0
Colomba	2	325	435	73	18	73	64	9	0	10	1.046	0	10	0	0	1.5	2.0
MSJJ1101-1	1	200	289	69	26	69	64	5	0	5	1.058	0	0	0	0	2.5	2.0
MSJJ1112-1	1	105	225	47	45	47	47	0	0	8	1.071	0	10	0	0	1.0	2.0
MSJJ1104-2Y	1	53	166	32	66	32	32	0	0	2	1.080	0	0	0	0	1.0	3.0
MEAN		214	322								1.066					1.6	2.4
HSD _{0.05}		NS	NS								0.012						

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

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

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

⁴MATURITY RATING: August 20, 2025; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

⁵Enviroweather: Entrican Station. Planting to vine kill

Plant Date: 5/8/25

Vine Kill: 8/27/25

Days from planting to vine kill: 111

Table 3

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICSADAPTATION TRIAL, TABLESTOCK LINES
MONTCALM RESEARCH CENTER
May 8 to September 11, 2025 (126 days)
DD Base 40°F 3131.2⁶

LINE	PVY Resistant	N	CWT/A		PERCENT OF TOTAL ¹							PERCENT (%) TUBER QUALITY ²						SCAB ³	MAT ⁴	BRUISE ⁵
			US#1	TOTAL	US#1	Bs	As	A1	A2	OV	PO	SP GR	HH	VD	IBS	BC				
MSGG039-11Y	PVYR	2	418	472	89	9	89	59	30	0	3	1.063	0	10	0	0	2.7	2.0	0.1	
MSFF031-6	PVYR	2	391	423	92	8	91	48	43	1	0	1.062	0	5	0	10	1.0	3.5	0.3	
Bonafide		2	376	400	94	5	92	43	49	2	2	1.066	0	0	0	0	1.5	4.0	0.1	
MSGG135-1R	PVYR	2	339	407	83	17	83	46	38	0	1	1.070	0	0	0	0	1.5	3.5	0.2	
Dark Red Norland		2	315	385	82	17	43	40	3	39	2	1.056	10	25	0	0	1.7	1.0	0.3	
Spartan Red		2	312	356	87	14	86	63	24	1	0	1.066	0	5	0	0	3.0	2.0	0.4	
MSHH172-3PP	PVYR	2	260	299	87	13	86	51	35	1	1	1.064	0	0	0	0	1.7	3.0	-	
MSII353-2Y		2	254	310	81	16	81	71	11	0	3	1.056	0	10	0	0	1.8	3.5	0.2	
Chas		2	253	363	70	17	70	60	10	0	14	1.045	0	0	0	0	2.0	2.0	0.0	
MSHH161-06R	PVYR	2	251	292	86	8	83	48	35	3	7	1.064	0	15	0	15	1.5	3.5	0.1	
Merlot		2	250	295	85	15	85	66	19	0	1	1.067	0	0	0	0	1.5	3.0	0.2	
Colomba		2	244	327	74	18	74	62	12	0	9	1.046	0	10	0	0	1.5	1.0	0.3	
MSHH228-3PP	PVYR	2	244	317	77	23	77	63	14	0	0	1.059	0	0	0	0	2.5	3.5	-	
MSHH170-5RR	PVYR	2	225	301	75	25	75	66	9	0	1	1.066	0	0	0	0	0.7	3.0	-	
Superior		2	216	253	86	12	86	74	12	0	4	1.059	5	15	10	5	1.3	1.0	0.2	
MSFF030-1WR		2	200	311	64	25	64	58	6	0	11	1.054	0	0	0	0	2.0	2.0	0.1	
Blackberry		1	193	317	61	37	61	56	5	0	2	1.063	0	0	0	0	1.2	4.0	-	
Stella Gold		2	189	293	64	34	64	61	3	0	3	1.055	0	5	0	0	2.0	2.0	0.0	
MSHH164-03RY	PVYR	2	172	189	91	10	91	56	35	0	0	1.071	0	0	0	5	1.5	3.0	0.1	
MSHH224-4		2	151	284	54	41	54	51	3	0	6	1.055	0	15	0	0	1.3	2.0	0.8	
MSHH176-2R	PVYR	2	149	209	71	27	71	61	11	0	2	1.058	0	5	0	0	1.8	2.5	0.1	
MSHH224-1Y		2	97	230	42	49	42	40	2	0	10	1.050	0	0	0	0	0.8	2.5	0.2	
MSFF305-1RY	PVYR	2	78	119	66	35	66	56	10	0	0	1.059	0	0	0	0	1.3	3.5	0.1	
MEAN			242	311								1.060					1.6	2.7	0.2	
HSD _{0.05}			276	315								0.009								

¹SIZE: B: < 1 7/8 in.; A1: > 1 7/8- < 2 9/16 in.; A2: > 2 9/16- < 3.25 in.; OV: > 3.25 in.; PO: Pickouts.²QUALITY: HH: Hollow Heart; BC: Brown Center; IBS: Internal Brown Spot. Percent of 20 Oversize and/or A-size tubers cut.³SCAB DISEASE RATING: MSU Scab Nursery; 0: No Infection; 1: Low Infection <5%; 3: Intermediate; 5: Highly Susceptible.⁴MATURITY RATING: August 20, 2025; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).⁵BRUISE: Simulated blackspot bruise test average number of spots per tuber.

Plant Date: 5/8/25

Vine Kill: 9/2/25

Days from planting to vine kill: 117

⁶Enviroweather: Entrican Station. Planting to vine kill

Table 4

PRELIMINARY TRIAL, CHIP-PROCESSING LINES
MONTCALM RESEARCH CENTER
May 6 to September 11, 2025 (126 days)
DD Base 40°F 3131.2⁷

LINE	PVY Resistant	N	CWT/A		PERCENT OF TOTAL ¹							OTF SFA ²	PERCENT (%) TUBER QUALITY ³							
			US#1	TOTAL	US#1	Bs	As	A1	A2	OV	PO		SP GR	HH	VD	IBS	BC	SCAB ⁴	MAT ⁵	BRUISE ⁶
MSGG863-A2		1	491	539	91	7	90	57	33	1	1	1.076	1.0	0	0	0	10	1.8	4.0	0.3
MSGG276-4	PVYR	1	420	444	95	5	95	63	31	0	0	1.069	1.0	0	10	0	0	2.5	3.0	0.3
MSHH069-3	PVYR	1	379	401	94	4	92	46	46	3	2	1.071	1.0	10	10	0	0	2.0	4.0	0.4
Kalkaska		1	375	446	84	16	84	53	31	0	0	1.081	1.0	10	0	0	0	1.2	4.0	1.5
ND13220C-3		1	370	502	74	23	74	69	4	0	3	1.088	1.0	20	0	0	0	2.0	4.0	1.0
MSII176-3	PVYR	1	361	415	87	13	87	74	13	0	0	1.084	1.0	20	10	0	0	2.7	3.0	1.1
AF6671-10		1	348	369	94	6	94	53	42	0	0	1.082	1.0	0	10	0	0	2.0	2.0	0.6
MSGG268-4	PVYR	1	345	368	94	6	91	38	53	3	0	1.072	1.0	0	0	0	0	1.2	3.0	0.2
Spartan Splash		1	333	409	81	17	81	71	10	0	1	1.068	-	0	0	0	0	2.5	1.0	1.1
MSHH113-06		1	329	380	86	10	86	47	39	0	4	1.080	1.0	10	0	0	0	0.7	3.0	1.4
MSCC725-232	PVYR	1	318	361	88	9	88	50	38	0	3	1.074	1.0	0	0	0	0	1.0	4.0	0.4
MSII075-1		1	310	373	83	13	83	69	14	0	4	1.084	1.0	0	10	0	0	0.8	4.0	2.0
MSGG349-3	PVYR	1	305	345	89	10	89	68	21	0	1	1.068	1.0	20	10	0	0	0.8	3.0	0.3
AF6206-5		1	304	374	81	9	81	52	29	0	10	1.087	1.0	0	10	0	0	2.3	3.0	1.6
MSFF292-01		1	302	336	90	9	90	70	20	0	2	1.087	1.0	0	0	0	0	1.2	3.0	1.7
Snowden		1	290	325	89	11	89	71	18	0	0	1.071	1.0	50	60	0	0	3.0	3.0	0.7
MSGG263-1	PVYR	1	282	311	91	9	91	49	42	0	0	1.074	1.0	0	0	0	0	0.7	3.0	0.3
Atlantic		1	269	317	85	9	85	58	26	0	6	1.081	1.0	10	0	0	0	2.8	2.0	1.1
MSII147-3	PVYR	1	268	313	86	14	86	76	10	0	0	1.069	1.0	0	0	0	0	0.5	2.0	0.4
MSII142-1		1	264	352	75	22	75	67	9	0	2	1.075	1.0	10	0	0	0	1.2	3.0	0.5
MSII186-1		1	264	302	87	13	87	76	12	0	0	1.077	1.0	0	10	0	0	1.5	3.0	0.4
MSII108-4	PVYR	1	261	307	85	13	85	57	28	0	2	1.084	1.0	0	30	0	0	2.2	3.0	-
AF6200-7		1	258	290	89	4	89	64	25	0	7	1.092	1.0	0	0	0	0	3.0	3.0	-
MSII128-4	PVYR	1	244	295	83	17	83	66	17	0	0	1.089	1.0	0	0	0	0	2.2	4.0	0.5
Lamoka		1	242	286	85	10	85	67	18	0	5	1.071	1.0	0	20	0	0	0.9	3.0	0.5
Paige		1	235	297	79	17	79	71	8	0	4	1.093	1.0	0	0	0	0	1.3	3.0	1.8
MSII105-1		1	216	245	88	12	88	58	30	0	0	1.083	1.0	0	0	0	0	2.3	1.0	0.2
MSII126-4	PVYR	1	215	278	77	10	77	57	20	0	12	1.080	1.0	0	10	0	0	0.8	1.0	0.3
MSII119-2		1	212	292	73	14	73	64	8	0	13	1.079	1.0	0	10	0	0	1.7	1.0	0.7
MSII163-1		1	211	275	77	21	77	74	3	0	2	1.086	1.0	0	10	0	0	2.0	1.0	1.0
MSEE010-03	PVYR	1	210	235	89	8	87	65	22	2	3	1.069	1.0	0	10	0	0	1.2	3.0	0.0
AF6565-8		1	203	246	83	7	83	56	26	0	10	1.076	1.0	30	0	0	0	2.3	3.0	0.6
MSDD039-01		1	193	236	82	17	82	60	22	0	2	1.073	1.0	0	0	0	0	1.7	4.0	0.4
MSHH018-4	PVYR	1	160	237	67	33	67	62	6	0	0	1.077	1.0	0	0	0	0	2.0	4.0	0.2
MSII117-10	PVYR	1	151	232	65	34	65	61	3	0	1	1.067	1.0	0	10	0	0	1.0	3.0	0.2
MEAN			284	335								1.078						1.7	2.9	0.7

LINE	PVY Resistant	CWT/A		PERCENT OF TOTAL ¹								OTF SFA ²	PERCENT (%) TUBER QUALITY ³					SCAB ⁴	MAT ⁵	BRUISE ⁶
		N	US#1	TOTAL	US#1	Bs	As	A1	A2	OV	PO		SP	GR	HH	VD	IBS			
																Plant Date:	5/8/25			
																Vine Kill:	9/2/25			
																Days from planting to vine kill:	117			

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

²CHIP SCORE: SNAC Scale (Out of the field); Ratings: 1-5; 1: Excellent, 5: Poor.

³QUALITY: HH: Hollow Heart; BC: Brown Center; IBS: Internal Brown Spot. Percent of 10 Oversize and/or A-size tubers cut.

⁴SCAB DISEASE RATING: MSU Scab Nursery; 0: No Infection; 1: Low Infection <5%; 3: Intermediate; 5: Highly Susceptible.

⁵MATURITY RATING: August 20, 2025; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

⁶BRUISE: Simulated blackspot bruise test average number of spots per tuber.

⁷Enviroweather: Entrican Station. Planting to vine kill

Table 5

PRELIMINARY TRIAL, TABLESTOCK LINES
 MONTCALM RESEARCH CENTER
 May 8 to September 11, 2025 (126 days)
 DD Base 40°F 3131.2⁶

LINE	PVY Resistant	N	CWT/A		PERCENT OF TOTAL ¹							SP GR	PERCENT (%) TUBER QUALITY ²				SCAB ³	MAT ⁴	BRUISE ⁵
			US#1	TOTAL	US#1	Bs	As	A1	A2	OV	PO		HH	VD	IBS	BC			
MSII306-05Y		1	415	461	90	8	90	61	29	0	2	1.054	0	10	0	0	1.5	3.0	2.0
Dark Red Norland		1	332	381	87	11	87	77	10	0	2	1.054	0	20	0	0	1.7	1.0	1.5
MSHH056-03	PVYR	1	296	370	80	19	80	71	9	0	1	1.064	0	10	0	0	1.2	4.0	0.5
Jelly		1	245	334	73	16	73	61	12	0	11	1.068	20	0	0	0	2.2	3.0	1.0
Gala		1	230	396	58	37	58	58	0	0	4	1.055	0	0	0	0	2.5	2.0	2.0
Reba		1	213	257	83	16	83	60	22	0	2	1.062	10	0	0	0	2.3	2.0	1.5
MSHH056-19	PVYR	1	207	246	84	16	84	73	12	0	0	1.061	0	10	0	0	1.2	3.0	1.0
AC11596-1rSTO		1	195	257	76	22	76	73	3	0	2	1.055	0	0	0	0	3.2	3.0	2.0
Christel		1	182	335	54	32	54	49	5	0	14	1.052	0	20	0	0	1.8	2.0	2.0
Queen Anne		1	127	241	53	45	53	52	0	0	2	1.054	0	0	0	0	1.8	1.0	1.5
MSII326-1		1	123	204	60	39	60	58	3	0	1	1.047	0	20	0	0	1.8	1.0	1.0
MSII325-1Y		1	65	154	42	58	42	42	0	0	0	1.048	0	10	0	0	1.7	1.0	0.5
MEAN			219	303								1.056					1.9	2.2	1.4

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

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

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

⁴MATURITY RATING: August 20, 2025; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

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

⁶Enviroweather: Entrican Station. Planting to vine kill

Plant Date: 5/8/25

Vine Kill: 9/2/25

Days from planting to vine kill: 117

Table 6

PRELIMINARY TRIAL, PIGMENTED LINES
MONTCALM RESEARCH CENTER
May 6 to September 11, 2025 (126 days)
DD Base 40°F 3131.2⁶

LINE	PVY Resistant	N	CWT/A		PERCENT OF TOTAL ¹						PERCENT (%) TUBER QUALITY ²						SCAB ³	MAT ⁴	Bruise ⁵	
			US#1	TOTAL	US#1	Bs	As	A1	A2	OV	PO	SP GR	HH	VD	IBS	BC				
Spartan Red		1	246	287	86	13	86	52	33	0	1	1.063	0	20	0	0	3.0	3.0	0.3	
Dark Red Norland		1	235	270	87	13	87	84	3	0	0	1.049	0	20	0	0	1.7	1.0	0.2	
MSHH149-17R	PVYR	1	223	292	76	24	76	66	11	0	0	1.059	0	0	0	10	2.8	2.0	0.3	
MSGG102-1RR		1	175	244	72	26	72	59	13	0	2	1.061	0	0	0	0	3.2	4.0	-	
Raspberry		1	162	303	54	43	54	53	0	0	3	1.058	0	0	0	0	3.3	1.0	0.2	
MSII414-6PP		1	141	181	78	21	78	57	21	0	1	1.052	0	0	0	0	1.8	4.0	-	
MSFF228-2RY		1	107	201	53	46	53	49	4	0	1	1.057	0	0	0	0	1.8	2.0	0.2	
MSFF198-13PY	PVYR	1	82	209	40	60	40	40	0	0	0	1.052	0	0	0	0	2.3	1.0	0.3	
MSII416-6R	PVYR	1	57	128	45	55	45	45	0	0	0	1.053	0	0	0	0	2.8	3.0	0.0	
MSAA101-1RR		1	44	142	31	68	31	31	0	0	1	1.067	0	0	0	0	0.5	1.0	0.5	
MEAN			147	226								1.057					1.0	2.3	2.2	0.2

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

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

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

⁴MATURITY RATING: August 20, 2025; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

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

Plant Date: 5/8/25

Vine Kill: 9/2/25

Days from planting to vine kill: 117

⁶Enviroweather: Entrican Station. Planting to vine kill

Table 7

MICI
POTATO

DIPLOID REPLICATED TRIAL
MONTCALM RESEARCH CENTER
May 8 to September 24, 2025 (139 days)
DD Base 40°F 3131.2⁷

LINE	N	CWT/A		PERCENT OF TOTAL ¹							SFA	PERCENT (%) TUBER QUALITY ³					SCAB ⁴
		US#1	TOTAL	US#1	Bs	As	A1	A2	OV	PO		SP GR	OTF ²	HH	VD	IBS	
MSGG691-06	2	285	338	84	16	84	72	13	0	0	1.075	-	5	5	10	0	3.0
MSHH693-01	2	261	306	84	16	84	65	20	0	0	1.065	-	75	0	0	0	3.0
MSII1109-1	2	245	318	77	24	77	63	14	0	0	1.071	-	0	0	0	0	1.8
MSJJ1880-1	2	239	268	90	11	90	57	32	0	0	1.066	-	0	25	5	0	1.0
MSJJ1112-2Y	2	222	256	86	14	85	55	30	1	0	1.073	1.5	5	15	5	0	1.0
MSHH699-02	2	210	286	74	26	74	63	12	0	0	1.069	-	25	0	0	0	3.0
Atlantic	2	205	227	91	9	91	53	38	0	0	1.081	1.0	35	15	0	0	2.8
Mackinaw	2	202	240	84	16	84	71	14	0	0	1.082	1.0	0	0	10	0	1.3
MSJJ1278-1	2	197	244	80	20	80	57	24	0	0	1.049	-	25	20	15	0	2.5
MSHH685-A1	2	184	290	64	37	64	55	8	0	0	1.077	1.5	45	5	0	0	2.5
MSHH710-A2	2	179	224	80	21	80	59	21	0	0	1.068	-	0	25	0	0	2.0
MSEE706-03S1-02	2	163	246	67	34	67	65	2	0	0	1.076	-	0	35	0	5	1.5
MSII1117-1	2	157	247	64	37	64	61	3	0	0	1.075	-	0	0	5	0	1.0
MSHH614-A7	2	156	186	84	16	84	69	16	0	0	1.057	-	0	0	0	0	3.5
MSJJ1101-1	2	155	224	70	31	70	65	5	0	0	1.066	-	0	5	0	0	3.3
MSHH1042-A2	2	155	221	69	31	69	67	3	0	0	1.076	1.0	0	5	0	0	2.3
MSHH1041-04	2	139	208	67	33	67	63	4	0	0	1.078	2.0	0	0	0	5	2.0
MSJJ1290-1	2	137	204	66	34	66	58	8	0	0	1.059	-	35	0	15	0	1.3
MSJJ1290-2	2	125	196	64	37	64	58	6	0	0	1.065	-	5	0	0	0	2.0
MSHH878-02	2	120	228	51	49	51	47	5	0	0	1.077	1.5	10	0	0	0	1.0
MSHH970-A6	2	113	218	53	48	53	53	0	0	0	1.075	-	0	10	0	0	3.0
MSJJ1041-2	2	105	168	62	38	62	61	1	0	0	1.084	1.0	0	0	0	0	3.0
MSJJ1113-4	2	102	173	59	41	59	56	3	0	0	1.070	-	0	0	0	0	1.3
MSII1139-3	2	95	193	49	51	49	45	5	0	0	1.064	-	5	30	15	0	1.8

LINE	N	CWT/A		PERCENT OF TOTAL ¹							SFA	PERCENT (%) TUBER QUALITY ³					SCAB ⁴
		US#1	TOTAL	US#1	Bs	As	A1	A2	OV	PO		SP GR	OTF ²	HH	VD	IBS	
MSJJ1211-1	2	93	165	56	44	56	53	4	0	0	1.056	-	0	0	0	5	2.0
MSJJ1031-1	2	92	183	50	50	50	49	1	0	0	1.069	-	5	10	0	0	3.5
MSHH614-A1	2	86	121	72	29	72	53	19	0	0	1.065	-	10	25	0	25	1.5
MSHH1045-01	2	78	165	47	53	47	43	4	0	0	1.070	-	0	0	0	0	2.0
MSHH1040-A5	2	69	173	40	61	40	40	0	0	0	1.075	-	0	0	0	0	2.0
MSII1081-1	2	63	140	45	55	45	43	3	0	0	1.090	1.5	5	0	5	5	1.3
MSJJ1112-1	2	48	157	31	69	31	31	0	0	0	1.073	1.0	0	25	0	0	0.8
MSHH1120-02	2	46	138	33	68	33	33	0	0	0	1.087	-	75	0	0	0	0.8
MSHH1042-A1	2	24	115	21	79	21	21	0	0	0	1.074	-	0	0	0	0	0.5
MSJJ1118-1	2	18	121	13	88	13	13	0	0	0	1.069	-	0	0	0	0	1.3
MEAN		140	211								1.071						2.0

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

²CHIP SCORE: SNAC Scale (Out of the field); Ratings: 1-5; 1: Excellent, 5: Poor.

³QUALITY: HH: Hollow Heart; BC: Brown Center; IBS: Internal Brown Spot. Percent of 20 Oversize and/or A-size tubers cut.

⁴SCAB DISEASE RATING: MSU Scab Nursery; 0: No Infection; 1: Low Infection <5%; 3: Intermediate; 5: Highly Susceptible.

⁵MATURITY RATING: August 20, 2025; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

Days from planting

⁷Enviroweather: Entrican St

Table 8

**2023-25 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, MONTCALM RESEARCH CENTER, MI**

LINE	3-YR* AVG.	2025 RATING	2025 WORST	2025 N	2024 RATING	2024 WORST	2024 N	2023 RATING	2023 WORST	2023 N
<i>Sorted by ascending 2025 Average Rating:</i>										
MSAA101-1RR	-	0.5	0.5	3						
MSBB617-02	0.8*	0.5	0.5	3	1.2	1.5	3			
MSDD244-05	0.8	0.5	0.5	3	1.2	1.5	3	0.7	1.0	3
MSII147-3	-	0.5	0.5	3						
MSEE035-4	-	0.7	1.0	3						
MSGG263-1	-	0.7	1.0	3						
MSGG426-2	-	0.7	1.0	3						
MSHH053-19	0.8*	0.7	1.0	3	1.0	1.5	3			
MSHH113-06	1.1*	0.7	1.0	3	1.5	1.5	3			
MSHH170-5RR	0.5*	0.7	1.0	3	0.3	0.5	3			
MSEE207-2	0.7	0.8	1.0	2	1.0	1.5	3	0.3	0.5	3
MSII126-4	-	0.8	1.0	2						
MSBB371-1YSPL	1.0	0.8	1.0	3	1.0	1.5	3	1.2	2.0	3
MSBB614-11	0.8*	0.8	1.0	3	0.7	1.5	3			
MSDD247-11	0.7	0.8	1.5	3	0.8	1.0	3	0.5	0.5	3
MSGG349-3	-	0.8	1.0	3						
MSHH134-20	0.8*	0.8	1.0	3	0.7	1.0	3			
MSHH224-1Y	1*	0.8	1.0	3	1.2	1.5	3			
MSII075-1	-	0.8	1.0	3						
Lamoka	1.3	0.9	1.5	6	1.5	1.5	3	1.3	1.5	3
MSCC725-232	-	1.0	1.5	3						
MSDD247-07	1.1	1.0	1.0	3	1.3	1.5	3	1.0	1.0	3
MSDD372-15	-	1.0	1.0	3						
MSFF031-6	1.0	1.0	1.0	3	1.0	1.5	3	1.0	1.5	3
MSGG282-20	1.1*	1.0	1.5	3	1.2	1.5	3			
MSHH053-04	1.1*	1.0	1.0	3	1.2	1.5	3			
MSHH137-1	0.9*	1.0	1.5	3	0.8	1.0	3			
MSII117-10	-	1.0	1.0	3						
Blackberry	1.3	1.2	1.5	3	1.7	2.0	3	1.2	2.0	3
Kalkaska	-	1.2	1.5	3						
MSBB058-1	1.3	1.2	1.5	3	1.5	2.0	3	1.3	1.5	2
MSDD244-15	1.0	1.2	2.0	3	0.7	1.0	3	1.2	2.0	3
MSDD249-9	1.2	1.2	1.5	3	1.5	2.0	3	1.0	1.5	3
MSEE010-03	-	1.2	1.5	3						
MSFF292-01	-	1.2	1.5	3						
MSGG268-4	0.9*	1.2	2.0	3	0.7	1.0	3			
MSHH056-03	1.2*	1.2	1.5	3	1.2	1.5	3			
MSHH056-19	1.3*	1.2	1.5	3	1.5	2.5	3			
MSII142-1	-	1.2	1.5	3						
MSDD372-07	-	1.3	2.0	3						
MSFF305-1RY	1.5	1.3	1.5	3	1.8	2.5	3	1.3	2.0	3
MSHH224-4Y	-	1.3	2.0	3						
Paige	-	1.3	1.5	3						
Superior	-	1.3	1.5	3						
Bonafide	-	1.5	2.0	3						
Colomba	1.4	1.5	2.0	3	1.0	1.5	3	1.8	3.0	3
Dundee	1.1	1.5	1.5	3	1.0	2.0	3	0.8	1.0	3

Table 8

2023-25 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, MONTCALM RESEARCH CENTER , MI

LINE	3-YR*	2025	2025	2025	2024	2024	2024	2023	2023	2023
	AVG.	RATING	WORST	N	RATING	WORST	N	RATING	WORST	N
Huron Chipper	1.4*	1.5	2.0	3	1.3	2.0	3			
Merlot	1.9	1.5	2.0	3	2.0	2.5	3	2.2	2.5	3
MSEE016-10	-	1.5	1.5	3						
MSFF038-3	1.6	1.5	1.5	3	1.5	2.0	3	1.7	2.5	3
MSGG135-1R	1.4	1.5	3.0	3	1.0	1.0	3	1.8	2.0	2
MSGG409-2	1.5*	1.5	1.5	3	1.5	1.5	3			
MSHH034-12	1.4*	1.5	1.5	3	1.3	1.5	3			
MSHH161-06R	1.7*	1.5	2.0	3	1.8	2.0	3			
MSHH164-03RY	1.2*	1.5	2.0	3	0.8	1.0	3			
MSII040-1	-	1.5	2.0	3						
MSII186-1	-	1.5	1.5	2						
MSII306-05Y	-	1.5	2.0	3						
Petoskey	1.5	1.5	2.0	3	1.7	2.0	3	1.3	1.5	6
Dark Red Norland	1.2	1.7	2.0	9	0.9	1.5	9	0.9	1.5	9
MCAA076-6	1.3	1.7	2.0	3	1.3	1.5	3	0.8	1.0	3
MSDD039-01	-	1.7	2.0	3						
MSFF037-17	-	1.7	2.0	3						
MSGG409-3	-	1.7	2.0	3						
MSHH015-5	1.3*	1.7	2.0	3	0.8	1.0	3			
MSHH172-3PP	1.8*	1.7	3.0	3	2.0	2.0	3			
MSII119-2	-	1.7	2.0	3						
MSII325-1Y	-	1.7	2.5	3						
Bliss (NY163)	1.6	1.8	2.5	3	1.2	1.5	3	1.7	2.0	3
Christel	1.6*	1.8	2.0	3	1.3	1.5	3			
Mackinaw ^{PVYR, LBR}	1.3	1.8	2.0	3	1.5	2.0	3	0.7	1.5	6
MSFF228-2RY	-	1.8	2.5	3						
MSFF335-2RR	1.4	1.8	2.0	3	1.3	1.5	3	1.2	1.5	3
MSGG863-A2	-	1.8	2.5	3						
MSHH018-3	1.7*	1.8	2.0	3	1.5	1.5	3			
MSHH068-10	2.1*	1.8	2.0	3	2.3	2.5	3			
MSHH130-1	1.8*	1.8	2.0	3	1.8	2.5	3			
MSHH176-2R	2*	1.8	2.0	3	2.2	3.0	3			
MSII326-1	-	1.8	2.5	3						
MSII353-2Y	-	1.8	2.0	3						
MSII414-6PP	-	1.8	2.5	3						
NY177	1.8*	1.8	2.0	3	1.7	2.0	3			
Queen Anne	1.8*	1.8	2.0	3	1.8	2.0	3			
AF6671-10	-	2.0	2.5	3						
Chas	1.8*	2.0	3.0	3	1.5	2.0	3			
MSFF030-1WR	1.9	2.0	2.5	3	1.8	2.5	3	1.8	2.0	3
MSHH018-4	1.9*	2.0	2.0	3	1.8	2.0	3			
MSHH069-3	1.7*	2.0	2.0	2	1.3	1.5	3			
MSII163-1	-	2.0	2.5	3						
ND13220C-3	1.9*	2.0	2.0	3	1.8	2.0	4			
Stella Gold	-	2.0	2.0	3						
Jelly	2.2	2.2	2.5	3	2.2	2.5	3	2.2	2.5	3
MSII108-4	-	2.2	2.5	3						
MSII128-4	-	2.2	2.5	3						

Table 8

**2023-25 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, MONTCALM RESEARCH CENTER , MI**

LINE	3-YR* AVG.	2025 RATING	2025 WORST	2025 N	2024 RATING	2024 WORST	2024 N	2023 RATING	2023 WORST	2023 N
AF6206-5	-	2.3	2.5	3						
AF6565-8	-	2.3	2.5	3						
Manistee	2.4	2.3	3.0	3	2.3	3.0	3	2.5	3.0	3
MSBB230-1	2.1	2.3	3.0	3	2.3	2.5	3	1.7	2.0	3
MSFF198-13PY	2*	2.3	2.5	3	1.7	2.0	3			
MSII105-1	-	2.3	2.5	3						
Reba	2.3	2.3	2.5	3	2.7	3.0	3	2.0	2.5	3
Gala	2.5*	2.5	2.5	2	2.5	3.0	3			
MSGG276-4	-	2.5	3.0	3						
MSHH228-3PP	2.6*	2.5	3.0	3	2.7	3.5	3			
NY174	2.1*	2.5	3.0	3	1.7	2.5	3			
Spartan Splash	2.2	2.5	2.5	2	2.5	3.0	3	1.7	2.5	3
MSGG039-11Y	2.5	2.7	3.0	3	2.3	2.5	3	2.5	3.0	3
MSII176-3	-	2.7	3.0	3						
MSHH149-17R	2.8*	2.8	3.5	3	2.8	3.5	3			
MSII416-6R	-	2.8	4.0	3						
Atlantic	2.8	2.9	3.5	6	2.9	3.5	7	2.6	3.0	6
AF6200-7	-	3.0	4.0	3						
Snowden	3.0	3.0	4.0	6	2.9	4.0	6	3.0	3.5	6
Spartan Red	-	3.0	4.0	6						
AC11596-1rSTO	-	3.2	3.5	3						
MSGG102-1RR	-	3.2	3.5	3						
Raspberry	-	3.3	3.5	2						
Mean		1.6				1.9			1.9	
HSD_{0.05} =										

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

N = Number of replications.

*2-Year Average.

Table 9

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

2025 SCAB DISEASE EARLY GENERATION TRIAL SUMMARY
SCAB NURSERY, MONTCALM RESEARCH CENTER, MI

LINE	2025 RATING	2025 N	LINE	2025 RATING	2025 N
<i>Sorted by ascending 2025 Rating:</i>					
MSJJ044-02	0.5	1.0	MSKK097-03	1.5	1.0
MSJJ083-1RR	0.5	1.0	MSKK109-03Y	1.5	1.0
MSJJ103-3R	0.5	1.0	MSKK140-02RR	1.5	1.0
MSJJ188-3	0.5	1.0	MSKK147-01	1.5	1.0
MSKK028-03	0.5	1.0	MSJJ044-06	2.0	1.0
MSKK057-06	0.5	1.0	MSJJ056-3	2.0	1.0
MSKK061-004	0.5	1.0	MSJJ086-2PP	2.0	1.0
MSJJ033-5	1.0	1.0	MSJJ090-1WR	2.0	1.0
MSJJ039-3	1.0	1.0	MSJJ188-5	2.0	1.0
MSJJ040-8	1.0	1.0	MSKK006-01	2.0	1.0
MSJJ043-08	1.0	1.0	MSKK060-02Y	2.0	1.0
MSJJ054-1	1.0	1.0	MSKK061-065	2.0	1.0
MSKK010-01	1.0	1.0	MSKK061-143	2.0	1.0
MSKK026-08	1.0	1.0	MSKK061-157	2.0	1.0
MSKK030-02	1.0	1.0	MSKK061-162	2.0	1.0
MSKK031-04	1.0	1.0	MSKK061-174	2.0	1.0
MSKK034-01	1.0	1.0	MSKK091-02Y	2.0	1.0
MSKK034-05	1.0	1.0	MSKK095-01R	2.0	1.0
MSKK035-02	1.0	1.0	MSKK107-01RR	2.0	1.0
MSKK037-01	1.0	1.0	MSKK107-02RR	2.0	1.0
MSKK039-01	1.0	1.0	MSJJ034-1	2.5	1.0
MSKK041-07	1.0	1.0	MSJJ041-07	2.5	1.0
MSKK055-07	1.0	1.0	MSJJ041-11	2.5	1.0
MSKK058-02	1.0	1.0	MSJJ044-05	2.5	1.0
MSKK061-083	1.0	1.0	MSJJ103-2R	2.5	1.0
MSKK075-01	1.0	1.0	MSJJ104-4RY	2.5	1.0
MSKK104-04	1.0	1.0	MSKK041-03	2.5	1.0
MSKK115-03Y	1.0	1.0	MSKK056-02	2.5	1.0
MSKK122-06SPL	1.0	1.0	MSKK061-077	2.5	1.0
MSJJ014-7	1.5	1.0	MSKK061-094	2.5	1.0
MSJJ039-6	1.5	1.0	MSKK061-100	2.5	1.0
MSJJ043-01	1.5	1.0	MSKK061-133	2.5	1.0
MSKK010-6	1.5	1.0	MSKK061-163	2.5	1.0
MSKK011-01	1.5	1.0	MSKK061-168	2.5	1.0
MSKK017-01	1.5	1.0	MSKK121-04Y	2.5	1.0
MSKK026-09	1.5	1.0	MSKK061-039	3.0	1.0
MSKK032-03	1.5	1.0	MSKK061-087	3.0	1.0
MSKK038-01	1.5	1.0	MSKK061-108	3.0	1.0
MSKK041-04	1.5	1.0	MSKK061-121	3.0	1.0
MSKK060-03Y	1.5	1.0	MSKK061-123	3.0	1.0
MSKK061-111	1.5	1.0	MSKK139-02	3.0	1.0

Table 11

2025 BLACKSPOT BRUISE SUSCEPTIBILITY TEST
SIMULATED BRUISE SAMPLES*

ENTRY	SP GR	NUMBER OF SPOTS PER TUBER						PERCENT (%)	AVERAGE SPOTS/TUBER
		0	1	2	3	4	5+	BRUISE FREE	
ADAPTATION TRIAL, CHIP-PROCESSING LINES									
Manistee	1.070	13	5	2	0	0	0	65	0.5
MSBB617-02	1.070	12	7	1	0	0	0	60	0.5
MSFF335-2RR	1.061	11	9	0	0	0	0	55	0.5
Lamoka	1.074	12	5	3	0	0	0	60	0.6
Bliss	1.080	10	8	2	0	0	0	50	0.6
MSFF037-17	1.075	12	3	5	0	0	0	60	0.7
MSGG409-3	1.075	10	7	3	0	0	0	50	0.7
MSHH053-04	1.083	12	4	3	1	0	0	60	0.7
MSBB230-1	1.075	9	8	3	0	0	0	45	0.7
MSDD249-09	1.075	8	9	3	0	0	0	40	0.8
MSGG426-2	1.075	11	6	2	0	0	1	55	0.8
MSGG409-2	1.071	9	6	5	0	0	0	45	0.8
Dundee	1.086	10	8	1	0	2	0	48	0.9
MSHH053-19	1.072	8	8	1	3	0	0	40	1.0
MSGG282-20	1.073	8	6	5	0	1	0	40	1.0
MSHH034-12	1.078	8	6	5	0	1	0	40	1.0
MSDD247-07	1.087	7	8	3	1	1	0	35	1.1
MSHH137-1	1.077	8	5	5	2	0	0	40	1.1
Huron Chipper	1.076	9	5	1	5	0	0	45	1.1
Petoskey	1.078	5	10	4	0	1	0	25	1.1
MSDD244-05	1.082	7	6	5	0	1	1	35	1.3
MSHH068-10	1.076	6	6	6	1	1	0	30	1.3
MSEE035-4	1.082	7	5	5	2	0	1	35	1.3
MSDD372-15	1.080	3	9	6	2	0	0	15	1.4
MSEE016-10	1.080	5	8	3	3	1	0	25	1.4
Mackinaw	1.083	7	4	3	3	2	0	37	1.4
MSHH015-5	1.076	2	9	5	4	0	0	10	1.6
MSHH018-3	1.076	4	7	4	4	1	0	20	1.6
MSHH134-20	1.075	4	7	4	3	2	0	20	1.6
MSBB614-11	1.070	2	9	6	1	1	1	10	1.7
MSDD372-07	1.089	2	9	4	3	2	0	10	1.7
MSHH130-1	1.077	6	4	1	7	0	2	30	1.9
MSFF038-3	1.076	4	3	7	4	1	1	20	1.9
NY174	1.082	1	9	5	3	0	2	5	1.9
Snowden	1.077	6	5	1	4	2	3	29	2.0
MSBB058-1	1.081	0	9	4	3	1	3	0	2.3
Atlantic	1.079	1	6	6	2	3	2	5	2.3
MSDD244-15	1.074	2	3	4	5	5	1	10	2.6
MSII040-1	1.082	0	3	4	6	6	1	0	2.9
NY177	1.091	1	2	3	7	4	3	5	3.0
MSDD247-11	1.085	0	2	6	5	3	4	0	3.1
MSAA076-6	1.079	0	2	4	1	4	9	0	3.7
ADAPTATION TRIAL, TABLESTOCK LINES									

Stella Gold	1.055	20	0	0	0	0	0	100	0.0
Chas	1.045	21	1	0	0	0	0	95	0.0
Bonafide	1.066	19	1	0	0	0	0	95	0.1
MSHH164-03RY	1.071	19	2	0	0	0	0	90	0.1
MSFF030-1WR	1.054	18	2	0	0	0	0	90	0.1
MSFF305-1RY	1.059	18	2	0	0	0	0	90	0.1
MSHH161-06R	1.064	18	2	0	0	0	0	90	0.1
MSHH176-2R	1.058	18	2	0	0	0	0	90	0.1
MSGG039-11Y	1.063	19	3	0	0	0	0	86	0.1
MSCC553-1R	1.067	17	3	0	0	0	0	85	0.2
MSGG135-1R	1.070	16	4	0	0	0	0	80	0.2
MSII353-2Y	1.056	16	4	0	0	0	0	80	0.2
Superior	1.059	16	4	0	0	0	0	80	0.2
MSHH224-1Y	1.050	15	2	1	0	0	0	83	0.2
Colomba	1.046	15	5	0	0	0	0	75	0.3
Dark Red Norland	1.056	15	5	0	0	0	0	75	0.3
MSFF031-6	1.062	14	6	0	0	0	0	70	0.3
Spartan Red	1.066	15	3	2	0	0	0	75	0.4
MSHH224-4	1.055	8	8	4	0	0	0	40	0.8

PRELIMINARY TRIAL, CHIP-PROCESSING LINES

MSEE010-03	1.069	20	0	0	0	0	0	100	0.0
MSGG268-4	1.072	17	3	0	0	0	0	85	0.2
MSHH018-4	1.077	17	3	0	0	0	0	85	0.2
MSII105-1	1.083	17	3	0	0	0	0	85	0.2
MSII117-10	1.067	17	3	0	0	0	0	85	0.2
MSGG276-4	1.069	15	5	0	0	0	0	75	0.3
MSGG349-3	1.068	15	5	0	0	0	0	75	0.3
MSGG263-1	1.074	14	6	0	0	0	0	70	0.3
MSGG863-A2	1.076	14	6	0	0	0	0	70	0.3
MSII126-4	1.080	15	4	1	0	0	0	75	0.3
MSCC725-232	1.074	14	5	1	0	0	0	70	0.4
MSII147-3	1.069	14	5	1	0	0	0	70	0.4
MSHH069-3	1.071	12	7	0	0	0	0	63	0.4
MSII186-1	1.077	13	6	1	0	0	0	65	0.4
MSDD039-01	1.073	13	3	1	1	0	0	72	0.4
Lamoka	1.071	12	7	1	0	0	0	60	0.5
MSII142-1	1.075	12	7	1	0	0	0	60	0.5
MSII128-4	1.089	12	6	2	0	0	0	60	0.5
AF6671-10	1.082	13	4	2	1	0	0	65	0.6
AF6565-8	1.076	10	8	2	0	0	0	50	0.6
MSII119-2	1.079	12	4	2	2	0	0	60	0.7
Snowden	1.071	9	8	3	0	0	0	45	0.7
ND13220C-3	1.088	7	7	6	0	0	0	35	1.0
MSII163-1	1.086	8	6	4	2	0	0	40	1.0
MSII176-3	1.084	5	10	3	0	1	0	26	1.1
Atlantic	1.081	9	5	3	2	0	1	45	1.1
MSHH113-06	1.080	3	8	8	1	0	0	15	1.4
Kalkaska	1.081	3	8	5	4	0	0	15	1.5
AF6206-5	1.087	2	7	6	4	0	0	11	1.6
MSFF292-01	1.087	0	9	10	0	1	0	0	1.7
Paige	1.093	2	10	3	2	1	2	10	1.8
MSII075-1	1.084	2	7	5	3	1	2	10	2.0

PRELIMINARY TRIAL, TABLESTOCK LINES

Gala	1.055	18	2	0	0	0	0	90	0.1
Dark Red Norland	1.054	17	3	0	0	0	0	85	0.2
MSII325-1Y	1.048	18	4	0	0	0	0	82	0.2
Christel	1.052	16	4	0	0	0	0	80	0.2
MSII326-1	1.047	16	4	0	0	0	0	80	0.2
Queen Anne	1.054	16	4	0	0	0	0	80	0.2
AC11596-1rSTO	1.055	15	5	0	0	0	0	75	0.3
Reba	1.062	15	5	0	0	0	0	75	0.3
MSHH056-19	1.061	15	6	0	0	0	0	71	0.3
Jelly	1.068	15	4	1	0	0	0	75	0.3
MSHH056-03	1.064	14	5	1	0	0	0	70	0.4
MSII306-05Y	1.054	14	3	2	1	0	0	70	0.5
Spartan Splash	1.068	8	5	4	3	0	0	40	1.1

PRELIMINARY TRIAL, PIGMENTED LINES

MSII416-6R	1.053	18	0	0	0	0	0	100	0.0
MSFF228-2RY	1.057	17	3	0	0	0	0	85	0.2
Dark Red Norland	1.049	16	4	0	0	0	0	80	0.2
Raspberry	1.058	16	4	0	0	0	0	80	0.2
MSFF198-13PY	1.052	15	5	0	0	0	0	75	0.3
MSHH149-17R	1.059	16	3	1	0	0	0	80	0.3
Spartan Red	1.063	15	5	0	0	0	0	75	0.3
MSAA101-1RR	1.067	11	8	1	0	0	0	55	0.5

USPB/SFA TRIAL CHECK SAMPLES (Not bruised)

WF17066-34	1.083	12	4	6	3	0	0	48	1.0
Lamoka	1.081	8	9	4	3	1	0	32	1.2
Snowden	1.083	3	5	4	3	1	9	12	2.8
AF6565-8	1.087	0	4	4	7	5	5	0	3.1
W17AF6670-1	1.085	1	4	4	4	5	7	4	3.2
AF6206-5	1.091	0	2	4	10	5	4	0	3.2
ND13220C-3	1.101	1	0	4	3	7	10	4	3.8
NY174	1.088	0	0	4	5	4	12	0	4.0
NY177	1.097	0	1	2	4	5	13	0	4.1
MSBB058-1	1.090	0	0	1	2	4	18	0	4.6

USPB/SFA TRIAL BRUISE SAMPLES

W17066-34	1.085	11	9	4	1	0	0	44	0.8
Lamoka	1.081	5	3	7	5	1	4	20	2.2
AF6206-5	1.091	5	1	5	4	7	3	20	2.6
Snowden	1.083	2	4	6	5	3	5	8	2.7
W17AF6670-1	1.083	2	3	5	3	5	7	8	3.1
AF6565-8	1.087	0	3	4	5	7	6	0	3.4
NY174	1.088	1	2	3	6	2	11	4	3.6
ND13220C-3	1.101	1	1	2	3	4	15	4	4.0
MSBB058-1	1.090	0	4	1	2	1	17	0	4.0
NY177	1.097	0	0	0	4	4	17	0	4.5

NATIONAL COORDINATED PROCESSORS TRIAL (Tier 2 and Fast Track entries)

W19027-51	1.078	19	1	0	0	0	0	95	0.1
A16150-1C	1.069	16	4	0	0	0	0	80	0.2
MN20AF7174-001	1.059	17	2	1	0	0	0	85	0.2
NDTX2024-2W	1.071	13	7	0	0	0	0	65	0.4
W19027-4	1.073	12	7	0	0	0	0	63	0.4
MSDD376-4	1.067	13	6	1	0	0	0	65	0.4

A15311-6Ctrv	1.061	14	3	3	0	0	0	70	0.5
AOR10902-2	1.071	11	9	0	0	0	0	55	0.5
MSHH034-12	1.072	13	4	1	1	0	0	68	0.5
MSHH018-4	1.078	13	4	2	1	0	0	65	0.6
B3471-1	1.067	10	9	0	1	0	0	50	0.6
MSDD247-07	1.079	9	10	1	0	0	0	45	0.6
AF6911-4	1.078	11	6	2	1	0	0	55	0.7
W19023-24	1.078	10	8	1	1	0	0	50	0.7
MSFF038-3	1.071	12	5	2	0	0	1	60	0.7
NC1127-30GS	1.075	10	8	2	1	0	0	48	0.7
AF6896-1	1.076	12	5	1	1	0	1	60	0.8
MSHH018-3	1.074	11	5	3	0	1	0	55	0.8
AF6978-1	1.073	9	7	3	1	0	0	45	0.8
MSDD244-05	1.074	12	2	4	1	1	0	60	0.9
NY179	1.070	8	8	3	1	0	0	40	0.9
NYU34-3	1.076	7	9	4	0	0	0	35	0.9
NYV123-1	1.073	11	6	1	0	1	1	55	0.9
NY174 - FAST TRACK	1.078	7	7	5	1	0	0	35	1.0
NYV6-11	1.068	8	6	4	1	1	0	40	1.1
B3296-3	1.070	7	5	4	1	1	0	39	1.1
AFC6911-2Wadg	1.078	7	7	2	1	1	2	35	1.4
BNC811-15	1.076	6	6	4	3	0	1	30	1.4
Snowden	1.069	3	10	4	2	1	0	15	1.4
ND13220C-3 - FAST TRACK	1.082	6	4	4	2	1	1	33	1.5
NY180	1.075	4	7	5	3	1	0	20	1.5
NYU15-8	1.066	5	6	4	4	1	0	25	1.5
NC1130-02GS	1.083	7	3	2	1	3	2	39	1.8
NY181	1.081	6	3	4	4	1	2	30	1.9
W19031-8	1.084	3	9	1	3	2	2	15	1.9
NC1110-15GS	1.081	7	4	0	3	3	3	35	2.0
NYV119-5	1.075	2	9	3	1	2	3	10	2.1
NY177 - FAST TRACK	1.087	0	9	5	2	1	3	0	2.2
Lamoka	1.072	3	3	5	6	0	3	15	2.3
B3403-6	1.081	4	2	6	2	3	3	20	2.4
Atlantic	1.073	2	6	3	2	3	3	11	2.4
MSBB058-1 - FAST TRACK	1.086	3	3	5	2	2	5	15	2.6
NY175	1.081	1	4	4	3	2	6	5	3.0
MSDD247-11	1.080	2	2	2	2	5	7	10	3.4
AF6880-9	1.075	0	3	4	3	0	10	0	3.5

Diploid (2x) Trial

MSJJ1112-2Y	1.073	16	4	0	0	0	0	80	0.2
MSJJ1113-4	1.070	12	7	1	0	0	0	60	0.5
MSHH699-02	1.069	12	7	3	0	0	0	55	0.6
MSHH614-A7	1.057	10	8	2	0	0	0	50	0.6
MSHH614-A4	-	11	6	1	2	0	0	55	0.7
MSJJ1880-1	1.066	14	4	1	2	1	0	64	0.7
MSHH1042-A2	1.076	10	6	1	3	0	0	50	0.9
MSHH693-01	1.065	10	4	4	2	0	0	50	0.9
MSJJ1278-1	1.049	7	9	1	3	0	0	35	1.0
MSJJ1031-1	1.069	5	10	1	3	1	0	25	1.3
MSEE706-03S1-02	1.076	6	6	4	3	0	1	30	1.4
MSHH710-A2	1.068	3	8	6	3	0	0	15	1.5
Atlantic	1.081	2	6	7	3	2	0	10	1.9
MSJJ1290-1	1.059	6	2	3	6	1	2	30	2.0

MSII1081-1	1.090	2	5	6	5	1	1	10	2.1
Mackinaw	1.082	2	7	3	4	1	2	11	2.1
MSHH685-A1	1.077	4	3	4	5	4	0	20	2.1
MSGG655-A3	-	0	4	11	3	1	1	0	2.2
MSJJ1101-1	1.066	2	3	7	2	2	2	11	2.3
MSHH970-A6	1.075	1	6	8	3	5	1	4	2.3
MSJJ1211-1	1.056	0	7	5	4	2	3	0	2.5
MSII1117-1	1.075	0	3	7	6	3	1	0	2.6
MSJJ1041-2	1.084	0	3	5	7	2	4	0	3.0
MSII1109-1	1.071	0	0	5	8	4	3	0	3.3
MSII1139-3	1.064	0	2	2	2	11	3	0	3.6

* Twenty A-size tuber samples were collected at harvest (25 for SNAC Trial), 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 10/29/25. The table is presented in ascending order of average number of spots per tuber.

2025 MSU POTATO BREEDING AND GENETICS RESEARCH REPORT
January 2026

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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. In 2026 we have the 5th version of the array. We have markers linked to specific resistance genes for virus, late blight, golden nematode and also vine maturity in the cultivated potato lines and then breed them into elite germplasm. The SNPs also allow us to accurately fingerprint the varieties (DNA fingerprinting database with 5,000 entries). In addition, our program has been utilizing genetic engineering as a tool to introduce new genes to improve varieties and advanced germplasm for traits such as tuber

size profile, insect resistance, late blight and PVY resistance, lower reducing sugar, lower blackspot bruising, higher yield and specific gravity and drought resistance. In 2026, we will continue to test our engineered potatoes for late blight resistance, virus resistance, higher solids, drought tolerance and invertase silencing (cold chipping). Furthermore, PotatoesUSA is supporting national early generation trials through the National Chip Processing Trial (NCPT) which will feed lines into the SNAC trials and also Fast Track lines into commercial testing (NexGen testing). This national cooperative testing is the key to determining the commercial potential of our advanced lines. This has led to the release of Saginaw Chipper, Manistee, Huron Chipper, Mackinaw, Petoskey and now Dundee. In the table markets, Blackberry and Bonafide were released. We also have had funding to develop genome editing technologies that may not be classified as regulated through a USDA/BRAG grant. This technology can be used to introduce lower sugars, bruising and asparagine as well several other traits in the future. We also had a USDA/AFRI diploid breeding grant to develop some foundational diploid breeding germplasm (Potato 2.0). We are also screening for new sources of late blight resistance through a USDA/AFRI grant. We have a USDA/SCRI grant to support the breeding of Colorado potato beetle resistant potatoes. In 2015, we were awarded the USAID grant to generate late blight resistance potatoes for Bangladesh and Indonesia and now includes Nigeria and Kenya. This Feed the Future project brings us into cutting edge GM work with Simplot and the International Potato Center (CIP). This project was unexpectedly cancelled by the federal government when USAID was dismantled in March 2025. We feel that these in-house capacities (both conventional and biotechnological) put us in a unique position to respond to and focus on the most promising directions for variety development and effectively integrate advanced technologies with the breeding of improved chip-processing and tablestock potatoes.

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

Varietal Development

Breeding

The MSU potato breeding and genetics program is actively producing new germplasm and advanced seedlings that are improved for long-term storage chipping, and resistance to scab, late blight, and Colorado potato beetle. For the 2025 field season, progeny from about 400 crosses were planted and evaluated. Of those, the majority were crosses to select for round whites (chip-processing), with the remainder to select for yellow flesh, red skin, and specialty market classes. During the 2025 harvest, 900 selections in a field 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 2025 directly out of 45°F (7.2°C) storage. Mackinaw, Lamoka, Manistee and Snowden are chip-processed as check cultivars. Selections have been identified at each stage of the selection cycle that have desirable agronomic characteristics and chip-processing potential. At the 12-hill and 30-hill evaluation state, about 300 and 100 selections were made, respectively: based on chip quality, specific gravity, scab resistance, late blight resistance and DNA markers for PVY resistance. Most of our advanced selections now have PVY resistance at the tetraploid level. Selection in the early generation stages has been enhanced by the incorporation of the scab and late blight (US-23) evaluations of the early generation material. We are pushing our early generation selections from the 30-hill stage into tissue culture to minimize PVY issues in our breeding and seed stock. We use a cryotherapy method as well as the traditional methods that was developed in our lab to remove viruses. This technique predictably and quickly removes virus from tissue culture stocks. Our results show that we can remove both PVY and PVS from lines, but PVS can still be difficult to remove in certain lines if the titer is high. Over 1,200 different varieties and breeding lines are maintained in tissue culture for the breeding and genetics program.

Chip-Processing

Over 80% of the single hill selections have a chip-processing parent in their pedigree. We prioritize scab resistance and PVY resistance in our chip-processing selections. Our most promising advanced chip-processing lines are MSBB058-1 (scab resistant), MSDD244-05, MSDD247-07 and MSDD247-11 all combine high specific gravity, earlier maturity and lower blackspot bruising as well as scab and PVY resistance. We have some newer lines to consider such as from the FF, GG and HH generations. With a successful late blight trial in 2023 and 2024, we were able to confirm resistance in some of our advanced selections. In 2025 the late blight trial could not generate a sustained infection, so no data was collected. We are using the NCR and 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. Malbec and Spartan Red are licensed to Uruguay.

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 2025, while others were tested under replicated conditions at the Montcalm Research Center. Promising tablestock lines

include MSHH174-17R 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 to be named Grand Haven. We are working with Chris Long to select a new cohort of red-skinned and yellow-fleshed potato lines. Jacqueline Lee (late blight resistant) was licensed to Australia and is being grown in Central America for its late blight resistance. Raspberry, Blackberry, MSQ558-2RR (Ruby Rose) and our PVY resistant Red Marker #2 (Spartan Red) potato are being marketed in the specialty markets. Blackberry is also being chip-processed by the Great Lakes Chip Co. in Traverse City, MI. Higher antioxidants are found in Blackberry.

Disease and Insect Resistance Breeding

Scab: In 2025, we had evaluated scab resistance at a highly infected site at the Montcalm Research Center. The Montcalm Research Center site gave us very good scab infection levels as well as previous years. The susceptible checks of Snowden and Atlantic were highly infected with pitted scab. Promising resistant selections will be summarized in the variety report. If you examine the variety trials at Montcalm Research Center in the variety report, you will notice that many of the lines are scab resistant. We need to continue in this direction of many selections with scab resistance so we can find the great scab resistant chipper as well as table yellows and reds. The high level of scab infection at the on-farm site with a history of scab infection and MRC has significantly helped with our discrimination of resistance and susceptibility of our lines. The MRC scab site was used for assessing scab susceptibility in our advanced breeding lines and early generation material. All susceptible check plots (Snowden and Atlantic) were scored as susceptible.

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

Fig. 1. Scab Disease Ratings of the Tier 2 NCPT lines from Montcalm Research Center Trials

2025 National Chip-Processing Trial (NCPT) Overall Merit Ranking Summary for the Replicated (Tier 2) Trial																	Overall				
Line	Tier	Female	Male	Program	Merit											Loc Adjusted			Scab Severity		
					CA	FL	NC	TX	MD	MI	NY	ND	OR	WI	N	Fresh Count	Storage Count	Overall	Loc Adj	1 Lo-5 Hi	MSU Avg
AF5933-4	2	Eva	AF4386-16	UME-ME	1	2	2	2	2	ND	ND	ND	ND	ND	5	9	0	9	18	1.8	ND
NY174	FT	NY148	NYE48-2	Fast Track	ND	0	2	0	0	2	2	2	2	2	9	2	10	12	13	2.2	1.0
NY177	FT	NY148	NYE48-2	Fast Track	ND	0	0	2	0	2	2	2	2	2	9	2	10	12	13	1.3	2.0
Atlantic	CHECK	Wauseon	Lenape	Check	1.0	2.0	2.0	0.0	1.5	0.0	2.0	0.0	1.0	2.0	10	7	5	12	12	2.4	2.5
MSB8058-1	FT	NY148	MSR127-2	Fast Track	ND	2	0	0	0	2	2	2	0	2	9	2	8	10	11	1.3	1.0
ND13220C-3	FT	ND028779C-3	ND060686C-1	Fast Track	ND	0	2	0	2	0	2	2	0	2	9	4	6	10	11	2.3	2.5
NY179	2	Andover	Lady Liberty	CU-NY	0	1	2	1	2	0	2	0	2	1	10	6	5	11	11	2.5	2.0
NY180	2	NY148	NYE48-2	CU-NY	1	1	1	0	2	2	2	0	1	1	10	5	6	11	11	2.2	2.0
NYV119-5	2	NY156	NYM18-2	CU-NY	0	1	2	1	1	2	1	0	2	1	10	5	6	11	11	1.7	1.3
Snowden	CHECK	B5141-6	Wischip	Check	2.0	1.5	2.0	0.7	1.0	0.0	1.5	0.5	1.5	0.0	10	7	4	11	11	2.2	2.8
NY181	2	NY156	NYF31-3	CU-NY	1	0	2	1	0	0	2	1	2	1	10	4	6	10	10	2.3	2.8
W19023-24	2	W14NY09-2	W13NYP102-7	UW-WI	1	2	1	0	0	2	2	0	1	1	10	4	6	10	10	1.5	1.5
AF6911-4	2	MSAFB611-5	NY152	UME-ME	1	1	1	0	0	2	0	1	2	1	10	3	6	9	9	1.7	1.5
B3403-6	2	NY121	B2489-6	USDA-ME	1	1	2	1	0	2	0	0	0	2	10	5	4	9	9	1.8	1.8
MSDD247-07	2	Mackinaw	MSV383-B	MSU-MI	1	0	0	0	1	2	1	1	1	2	10	2	7	9	9	1.3	1.5
MSDD247-11	2	Mackinaw	MSV383-B	MSU-MI	0	0	0	0	2	2	2	0	1	2	10	2	7	9	9	1.0	1.0
MSHH034-12	2	MSAA217-03	MSAA252-7	MSU-MI	0	1	1	0	1	2	1	0	2	1	10	3	6	9	9	1.7	1.0
W19027-51	2	W14NY09-2	W6609-3	UW-WI	0	2	2	1	2	0	2	0	0	0	10	7	2	9	9	1.3	0.5
AF6880-9	2	TUNDRA	NY152	UME-ME	0	2	0	0	1	2	2	0	0	1	10	3	5	8	8	1.7	1.3
NC821-30	2	NC41-1	NC182-5	NCSU-NC	0	1	2	0	1	0	2	0	1	1	10	4	4	8	8	2.3	2.8
NYU15-8	2	Lady Liberty	Pike	CU-NY	0	1	1	0	2	0	1	0	1	2	10	4	4	8	8	1.5	2.0
NYV6-11	2	Lady Liberty	Lamoka	CU-NY	2	1	0	0	1	0	2	0	2	0	10	4	4	8	8	1.7	1.5
W19031-8	2	MSV156-2	NYP116-6	UW-WI	1	1	1	1	1	2	0	0	1	0	10	5	3	8	8	1.8	1.3
AF6896-1	2	AF4552-5	PIKE	UME-ME	1	1	1	0	1	0	1	1	0	1	10	4	3	7	7	1.7	0.8
BNC811-15	2	NC308-2	Atlantic	USDA-ME	0	2	1	0	1	0	2	0	0	1	10	4	3	7	7	3.0	3.0
MSDD376-4	2	NY148	MSV033-1	MSU-MI	1	2	2	0	0	0	0	0	0	2	10	5	2	7	7	1.7	0.5
MSFF038-3	2	Mackinaw	MSR127-2	MSU-MI	0	1	0	0	2	2	2	0	0	0	10	3	4	7	7	1.3	1.0
NC1127-30GS	2	NCB3171-7	NC470-3	NCSU-NC	1	0	2	0	0	0	0	1	2	1	10	3	4	7	7	2.3	2.5
NY175	2	Lady Liberty	NYF31-3	CU-NY	1	0	2	0	2	0	2	0	0	0	10	5	2	7	7	2.0	2.3
NYV123-1	2	NYL8-12	NYM18-2	CU-NY	1	0	1	1	2	0	1	0	1	0	10	5	2	7	7	2.7	2.8
AF6911-2Wadg	2	MSAFB611-5	Lady Liberty	CSU-CO	0	0	1	0	2	2	0	ND	1	0	9	3	3	6	7	2.0	1.3
Lamoka	CHECK	NY120	NY115	Check	ND	1.0	0.0	0.0	0.5	2.0	0.0	1.0	1.0	0.0	9	2	4	6	6	1.6	1.3
MSDD244-05	2	Mackinaw	MSR127-2	MSU-MI	0	0	0	1	0	2	1	0	1	1	10	1	5	6	6	1.3	1.0
W19027-4	2	W14NY09-2	W6609-3	UW-WI	0	2	0	0	2	0	0	0	1	1	10	4	2	6	6	1.5	0.8
AF6978-1	2	NY121	NICOLET	UME-ME	1	ND	ND	0	ND	0	0	2	1	0	7	1	3	4	6	2.3	2.8
AOR18354-7	2	AC01144-1W	Lamoka	OSU-OR	0	2	1	1	1	0	0	0	0	0	10	5	0	5	5	1.5	2.0
B3296-3	2	Milton Pearl	B1416-2	USDA-ME	1	0	1	0	0	0	2	0	1	0	10	2	3	5	5	2.5	1.8
MSHH018-3	2	Mackinaw	MSB8633-18	MSU-MI	0	0	1	0	0	2	2	0	0	0	10	1	4	5	5	1.8	1.3
MSHH018-4	2	Mackinaw	MSB8633-18	MSU-MI	0	0	0	0	1	2	1	0	1	0	10	1	4	5	5	1.8	1.3
A16150-1C	2	AC00206-2W	Lamoka	USDA-ID	0	1	0	0	2	0	0	0	1	0	10	3	1	4	4	2.3	2.5
AOR10902-2	2	NY121	NY139	OSU-OR	1	0	1	0	0	0	0	0	1	1	10	2	2	4	4	2.0	1.5
B3471-1	2	BTD0013-44	B1709-6	USDA-ME	1	0	0	0	2	0	0	1	0	0	10	3	1	4	4	2.7	2.8
NYU34-3	2	NYM18-2	Waneta	CU-NY	1	0	0	0	1	0	0	0	1	1	10	2	2	4	4	1.5	1.3
MN20AF7174-001	2	MSR127-2	Saginaw Chipper	UMN-MN	0	2	0	0	1	0	0	0	0	0	10	3	0	3	3	1.5	1.0
NC1110-15GS	2	NCB3258-1	B2463-7	NCSU-NC	1	0	1	0	0	0	0	0	0	0	10	2	0	2	2	3.0	2.3
NC1130-02GS	2	Pirola	NC470-3	NCSU-NC	1	0	0	0	0	0	0	0	0	1	10	1	1	2	2	2.2	2.0
A15311-6Ctrv	2	CO03243-3W	NDAA081451CB-1CY	USDA-ID	0	0	0	0	0	0	0	1	0	0	10	0	1	1	1	2.2	2.0
COTX19084-2W	2	CO13233-1W	CO10073-7W	TAMU-TX	0	0	0	0	0	0	0	0	0	1	10	0	1	1	1	3.2	2.0
NDTX2024-2W	2	DakotaDiamond	Pike	TAMU-TX	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	1.5	1.3
Total Entries:	49				25	38	43	14	44	38	48	19	39	38	163	181	344				

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 2025 we conducted late blight trials at the MSU campus. We inoculated with the US23 genotype but infection did not progress so no data was collected this year.

PVY: We are using PCR-based DNA markers to select potatoes resistant to PVY. The gene is located on Chromosome 11. Each year since 2013 we are making new crosses, making selections, and expanding the germplasm base that has PVY resistance. In the past year we tested over 800 progeny for the PVY resistance marker. The marker positive selections were evaluated at Lake City Research Center. With the development of molecular markers for potato breeding, marker-assisted selection has been incorporated into our routine breeding practice and greatly facilitate the selection process. At times we are using DNA markers to also screen for PVX resistance, PLRV resistance, late blight resistance and Golden nematode resistance. DNA markers allow for a prioritization of the space in the field, and for earlier, more informed decisions in variety selection. The advanced selections from the breeding program were evaluated in a field PVY trial on campus in 2025. The results

validated the lines carrying the markers for PVY resistance. I want to note that we also determined that Blackberry had PVY resistance! Currently 80% of the selections in the breeding program have PVY resistance with the majority (over 90%) of the advanced breeding lines having PVY resistance.

MSU Lines with Commercial Tracking

Petoskey (MSV030-4)

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



Strengths: Petoskey is a chip-processing potato with resistance to common scab (*Streptomyces scabies*). This variety has high specific gravity and yield potential, with attractive, uniformly round tubers.

Petoskey has a medium vine and a mid-season maturity and has demonstrated excellent long-term storage chip-processing quality. MSV030-4 has performed well in Michigan and multiple locations in the PotatoesUSA National Chip Processing Trials (NCPT) and national SFA (SNaC) trials.

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

Morphological Characteristics:

Plant: Medium height vine, semi-erect with a balance between stems and foliage visible, and flowers.

Tubers: Uniform, smooth, round tubers with lightly netted, tan colored skin. Tubers have a white flesh with a low incidence of internal defects.

Agronomic Characteristics:

Vine Maturity: Mid-full season maturity.

Tubers: Smooth, round tubers with lightly netted, tan colored skin and white flesh.

Yield: Above average yield under irrigated conditions, with uniform tubers.

Specific Gravity: Averages higher than Atlantic and Snowden.

Culinary Quality: Chip-processes from short and long-term storage.

Diseases: Resistant to common scab (*Streptomyces scabies*).

Huron Chipper (MSW485-2)

Parentage: MSQ070-1 x MSR156-7

Developers: Michigan State University and the MSU AgBioResearch.

Plant Variety Protection: To Be Applied For.

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



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

Morphological Characteristics:

Plant: Medium height vine, semi-erect with a balance between stems and foliage visible, and flowers.

Tubers: Uniform, smooth, round tubers with lightly netted, tan colored skin. Tubers have a white flesh with a low incidence of internal defects.

Agronomic Characteristics:

Vine Maturity: Mid-season maturity.

Tubers: Smooth, round tubers with lightly netted, tan colored skin and a white flesh.

Yield: Above average yield under irrigated conditions, with uniform tubers.

Specific Gravity: Averages similar to above Atlantic and Snowden.

Culinary Quality: Chip-processes from short to long-term storage.

Diseases: Resistant to late blight (*Phytophthora infestans*) and tolerant to common scab (*Streptomyces scabies*).

Blackberry (MSZ109-10PP)

Parentage: COMN07-W112BG1 x MSU200-5PP

Developers: Michigan State University and the MSU AgBioResearch

Plant Variety Protection: To Be Applied For.



Strengths: Blackberry is a tablestock variety with unique purple skin and a deep purple flesh.

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

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

Morphological Characteristics:

Plant: Full-sized vine, semi-erect with a balance between stems and foliage visible, and flowers.

Tubers: Round tubers with a smooth skin and unique purple skin and purple flesh color. Tubers have a deep purple flesh with a low incidence of internal defects.

Agronomic Characteristics:

Maturity: Mid-season.

Tubers: Round tubers with unique purple skin and deep purple flesh.

Yield: Above average yield.

Specific Gravity: Averages 1.065 in Michigan.

Culinary Quality: Gourmet specialty with deep purple flesh and also chip-processes.

Diseases: Good common scab resistance.

Dundee (MSZ242-13)

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



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

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

Morphological Characteristics:

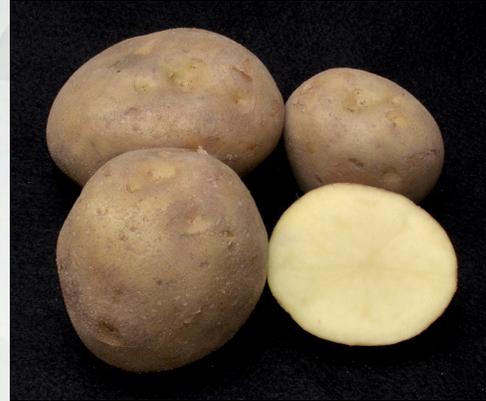
Plant: Medium height vine, semi-erect with a balance between stems and foliage visible.
Tubers: Uniform, smooth, round tubers with lightly netted, tan colored skin. Tubers have a white flesh with a low incidence of internal defects.

Agronomic Characteristics:

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

MSBB058-1 (NY148 x MSR127-3) “Mecosta”

- High SG
- Common Scab Resistant
- Storage Chip Quality
- PUSA Fast Track Seed (FY3)
- 4 Demo Storage Bulk Bins (2025-2026)
- 3 Demo Storage Bulk Bins (2026-2027)



MSDD244-05 (Mackinaw x MSR127-2)

- High SG
- PVY Resistant (*Ry adg*)
- Common Scab Resistant
- Mod. Late Blight Resistance
- Storage Chip Quality
- PUSA Fast Track Seed (FY1)
- Demo Storage Bulk Bin (2026-2027)



MSDD247-07 (Mackinaw x MSV383-B)

- High SG
- PVY Resistant (*Ry adg*)
- Common Scab Resistant
- Mod. Late Blight Resistance
- Storage Chip Quality
- PUSA Fast Track Seed (FY1-2)



MSDD247-11 (Mackinaw x MSV383-B)

- High SG
- PVY Resistant (*Ry adg*)
- Common Scab Resistant
- Late Blight Resistant
- Storage Chip Quality
- PUSA Fast Track Seed (FY1-2)



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

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

We made crosses with the best CPB resistant inbred line ‘431’. Using inbred 431 will more likely transmit resistance to a greater percentage of the progeny because the genes related to insect resistance are more likely fixed from inbreeding. Selfing will recover the homozygous condition of recessive loci contributing to beetle resistance. In 2024 we made selections in the families for tuber appearance on the survivors at the end of the season. Based on field and detached leaf tests, MSKK1709-10 and a progeny from selfing are beetle resistant. We also learned that MSKK1709-10 is PVY resistant. Further crosses are being made with the resistant lines so we can further adapt the beetle resistant germplasm.

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

Figure 2. Montcalm Research Center Nursery. Resistance lines observed in the trial.



2025 Field Trial at Montcalm Research Center



S. pinnatisectum,
June 25 to July 23



Dihaploid Potato Production at Michigan State University

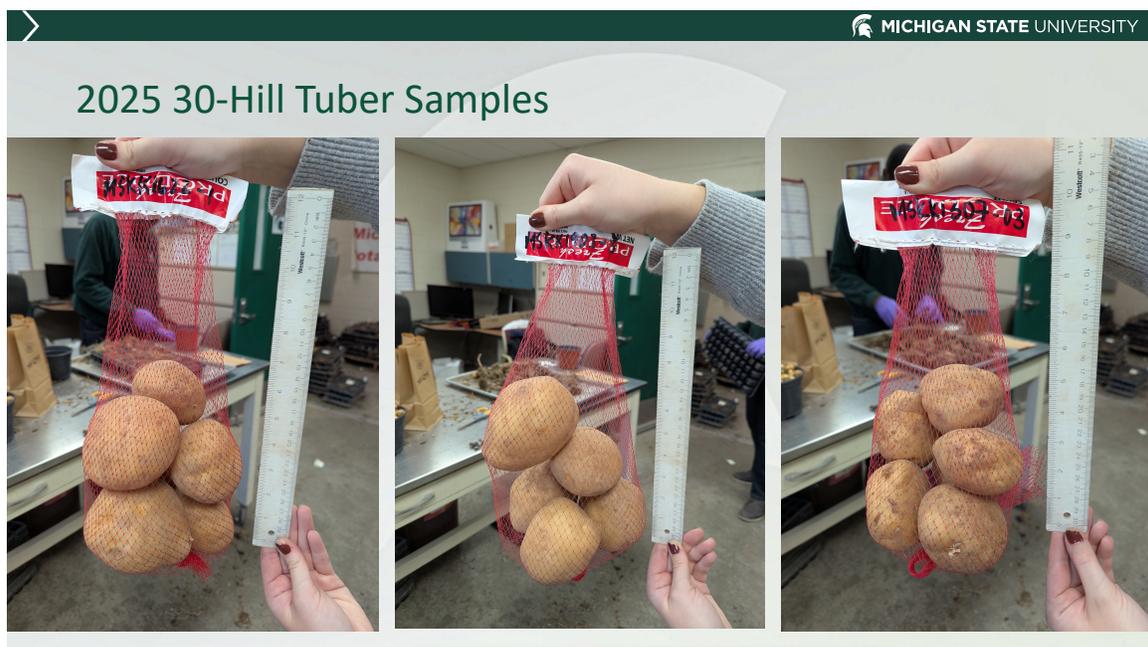
The benefits of developing a richer germplasm of dihaploid potatoes brings the industry ever closer to the expansive changes that would come with diploid potatoes. Our goal is to develop a broad-based dihaploid germplasm that is the foundation of diploid potato breeding focused on variety development.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

Diploid Breeding

The diploid genetic material represent material from South American potato species and other countries around the world that are potential sources of resistance to Colorado potato beetle, late blight, potato early die, and ability to cold-chip process. We are now placing more emphasis on the diploid breeding effort because of the advantages the breeding system brings when we introduce the ability to self-pollinate a line. Features of diploid breeding include 1) a simpler genetic system than current breeding methods, 2) tremendous genetic diversity for economic traits, 3) minimal crossing barriers to cultivated potato, 4) the

ability to reduce genetic load (or poor combinations) through selfing and 5) the ability to create true breeding lines like wheat, soybeans and dry beans. We are also using some inbred lines of *S. chacoense* that have fertility and vigor (also a source of *Verticillium* wilt resistance to initiate our efforts to develop inbred lines with our own diploid germplasm. Through 10 years of crossing and selecting we have bred diploid breeding lines that yield and size as well as tetraploid potato varieties. From 2021-25, we have yield tested about over 300 breeding lines. In 2021 over 30 lines were equal or better than Lamoka and Atlantic in yield. The 2025 data validate the results from the past years so we are confident that we can develop potato varieties with this new breeding approach. We are also identifying more lines will excellent tuber appearance (Figure 3)

Figure 3. Diploid year 3 selections.



Integration of Genetic Engineering with Potato Breeding

MSU conducts genetic engineering research to introgress and test economically important traits into potato. We have generated lines with the genes for water use efficiency. The XERICO gene is showing the most promise. From 2018 to 2023, we conducted trials at MRC with Ranger Russet events. These results are indicating that we are not seeing a yield reduction from the XERICO gene and the XERICO events also had a higher specific gravity than Ranger Russet. In 2024 we were able to get USDA approval to grow these lines without regulation. We are now transforming varieties important to Michigan to raise the specific gravity. Lastly, we have generated and selected a Kalkaska invertase silencing line (Kal91.03) that has resistance to accumulating reducing sugars in cold (40°F) storage. We tested the agronomic characteristics of Kal91.03 from 2016-2023. The initial results are suggesting that the

invertase silencing line has good tuber type, size, and similar specific gravity. This suggests that we can correct sugar issues in a chip processing lines with this genetic engineering strategy. We also obtained USDA approval to grow this line without regulation. We are also targeting Michigan varieties for invertase silencing to increase their chip processing quality and long-term storability. The first new events with invertase silencing and XERICO were planted in the field for screening in 2025.

Figure 4. Chips from Kal91.3 stored at 40F for 6 months

