# Michigan State University

AgBioResearch

In Cooperation With

## Michigan Potato Industry Commission

# Michigan Potato Research Report

## Volume 53

## 2021

January 12, 2022

To all Michigan Potato Growers and Shippers,

The Michigan Potato Industry Commission continues to provide over $169,000 in direct funding on an annual basis for potato research. This research is the one of the core components that continue to move the Michigan potato industry forward. Expanding research has provided increased insights into varieties, disease, soil fertility, and storage management. Research outcomes continue to provide a competitive advantage for the industry in Michigan and to provide Michigan with a highly respected reputation among the national industry professionals.

The following research report was compiled with the help of the Michigan State University AgBioResearch and Michigan State University Extension. On behalf of all parties, we are proud to present you with the results of the 2021 potato research projects.

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

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

Sincerely,

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

# Table of Contents

# 2021 MICHIGAN POTATO RESEARCH REPORT

C. M. Long, Coordinator

## INTRODUCTION AND ACKNOWLEDGMENTS

The 2021 Potato Research Report contains reports of the many potato research projects conducted by Michigan State University (MSU) potato researchers at several locations. The 2021 report is the 53rd volume, which has been prepared annually since 1969. This volume includes research projects funded by the Potato Special Federal Grant, the Michigan Potato Industry Commission (MPIC), Project GREEEN and numerous other sources. The principal source of funding for each project has been noted in each report.

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

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

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

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

## WEATHER

The overall 6-month average maximum and minimum temperatures during the 2021 growing season were consistent with the 15-year averages at 73°F and 50°F respectively (Table 1). May had slightly cooler temperatures than both the minimum and maximum average. Conversely, June, August, and September were warmer than average. Daytime extreme heat events were lower than average in 2021 with no days or hours in which temperatures exceeded 90°F during the summer. Extreme high nighttime temperatures were higher than average in 2021, with 237 hours of nighttime temperatures above 70°F over 45 days, compared to the seven-year average of 183 hours over 38 days (Table 3).

Rainfall for April through September was 21.49 inches, which was 3.55 inches above the 15-year average (Table 2). A total of 9.15 inches of irrigation water over 15 application timings was applied to MRC 4 between late May and late August. In general, April and May were drier than average while June, July, and September had more precipitation than average.

Table of Contents

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

| Year | April | | May | | June | | July | | August | | September | | Average | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. |
| 2007 | 53 | 33 | 73 | 47 | 82 | 54 | 81 | 56 | 80 | 58 | 76 | 50 | 74 | 50 |
| 2008 | 61 | 33 | 67 | 40 | 77 | 56 | 80 | 58 | 80 | 54 | 73 | 50 | 73 | 49 |
| 2009 | 56 | 33 | 67 | 45 | 76 | 54 | 75 | 53 | 76 | 56 | 74 | 49 | 71 | 48 |
| 2010 | 64 | 33 | 70 | 49 | 77 | 57 | 83 | 62 | 82 | 61 | 69 | 50 | 74 | 52 |
| 2011 | 53 | 33 | 68 | 48 | 77 | 56 | 85 | 62 | 79 | 58 | 70 | 48 | 72 | 51 |
| 2012 | 58 | 33 | 73 | 48 | 84 | 53 | 90 | 62 | 82 | 55 | 74 | 46 | 77 | 50 |
| 2013 | 51 | 33 | 73 | 48 | 77 | 55 | 81 | 58 | 80 | 54 | 73 | 48 | 73 | 49 |
| 2014 | 55 | 33 | 68 | 45 | 78 | 57 | 77 | 54 | 79 | 56 | 72 | 47 | 73 | 49 |
| 2015 | 58 | 33 | 71 | 48 | 76 | 54 | 80 | 56 | 77 | 57 | 77 | 54 | 72 | 49 |
| 2016 | 53 | 32 | 70 | 45 | 78 | 53 | 82 | 60 | 85 | 60 | 78 | 54 | 73 | 51 |
| 2017 | 61 | 39 | 67 | 44 | 78 | 55 | 81 | 58 | 77 | 54 | 77 | 50 | 74 | 50 |
| 2018 | 55 | 33 | 81 | 46 | 84 | 58 | 88 | 64 | 84 | 63 | 76 | 52 | 78 | 53 |
| 2019 | 55 | 35 | 65 | 45 | 75 | 54 | 84 | 69 | 80 | 55 | 73 | 54 | 72 | 52 |
| 2020 | 56 | 29 | 76 | 35 | 77 | 54 | 81 | 68 | 78 | 60 | 70 | 48 | 73 | 49 |
| **2021** | **58** | **35** | **69** | **41** | **80** | **58** | **81** | **58** | **85** | **59** | **76** | **50** | **75** | **50** |
| 15-Year Average | 56 | 33 | 71 | 45 | 78 | 55 | 82 | 60 | 80 | 57 | 74 | 50 | 73 | 50 |

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

| Year | April | May | June | July | August | September | Total |
|---|---|---|---|---|---|---|---|
| 2007 | 2.64 | 1.60 | 1.58 | 2.43 | 2.34 | 1.18 | 11.77 |
| 2008 | 1.59 | 1.69 | 2.95 | 3.07 | 3.03 | 5.03 | 17.36 |
| 2009 | 3.94 | 2.15 | 2.43 | 2.07 | 4.74 | 1.49 | 16.82 |
| 2010 | 1.59 | 3.68 | 3.21 | 2.14 | 2.63 | 1.88 | 15.13 |
| 2011 | 3.42 | 3.08 | 2.38 | 1.63 | 2.57 | 1.84 | 14.92 |
| 2012 | 2.35 | 0.98 | 0.99 | 3.63 | 3.31 | 0.76 | 12.02 |
| 2013 | 7.98 | 4.52 | 2.26 | 1.35 | 4.06 | 1.33 | 21.50 |
| 2014 | 4.24 | 5.51 | 3.25 | 3.71 | 1.78 | 2.35 | 20.84 |
| 2015 | 3.71 | 2.96 | 4.79 | 1.72 | 2.42 | 3.90 | 19.50 |
| 2016 | 2.25 | 2.77 | 1.33 | 3.42 | 5.35 | 3.05 | 18.17 |
| 2017 | 4.45 | 1.98 | 6.37 | 0.92 | 1.36 | 0.70 | 15.78 |
| 2018 | 2.04 | 5.51 | 3.64 | 1.19 | 7.73 | 2.65 | 22.76 |
| 2019 | 2.64 | 5.46 | 2.90 | 2.04 | 3.31 | 5.72 | 22.07 |
| 2020 | 3.49 | 4.75 | 1.40 | 4.07 | 2.21 | 3.12 | 19.04 |
| **2021** | **1.71** | **2.18** | **5.58** | **4.79** | **3.52** | **3.71** | **21.49** |
| 15-Year Average | 3.20 | 3.25 | 3.00 | 2.55 | 3.36 | 2.58 | 17.94 |

Table of Contents

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

| Year | Temperatures > 90°F | | Night (10pm-8am) Temperatures > 70°F | |
|---|---|---|---|---|
| | Hours | Days | Hours | Days |
| 2015 | 0 | 0 | 114 | 31 |
| 2016 | 26 | 7 | 248 | 50 |
| 2017 | 11 | 3 | 123 | 29 |
| 2018 | 26 | 8 | 214 | 46 |
| 2019 | 5 | 2 | 174 | 31 |
| 2020 | 15 | 5 | 171 | 36 |
| **2021** | **0** | **0** | **237** | **45** |
| Average | 12 | 4 | 183 | 38 |

## GROWING DEGREE DAYS

Table 4 summarizes the cumulative growing degree days (GDD) for 2021 while providing historical data from 2009-2020. GDD are presented from May 1st – September 30th using the Baskerville-Emin method with a base temperature of 40°F. The total GDD base 40 at the end of September in 2021 was 3956 (Table 4), which is 151 GDD higher than the 13-year average of 3805.

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

| Year | May | June | July | August | September |
|---|---|---|---|---|---|
| 2009 | 519 | 1264 | 2004 | 2800 | 3420 |
| 2010 | 610 | 1411 | 2424 | 3402 | 3979 |
| 2011 | 567 | 1354 | 2388 | 3270 | 3848 |
| 2012 | 652 | 1177 | 2280 | 3153 | 3762 |
| 2013 | 637 | 1421 | 2334 | 3179 | 3798 |
| 2014 | 522 | 1340 | 2120 | 2977 | 3552 |
| 2015 | 604 | 1353 | 2230 | 3051 | 3789 |
| 2016 | 547 | 1318 | 2263 | 3274 | 4053 |
| 2017 | 480 | 1279 | 2202 | 2990 | 3695 |
| 2018 | 689 | 1487 | 2423 | 3373 | 4073 |
| 2019 | 457 | 1189 | 2179 | 3024 | 3731 |
| 2020 | 488 | 1298 | 2331 | 3241 | 3809 |
| **2021** | **494** | **1362** | **2276** | **3269** | **3956** |
| Average | 559 | 1327 | 2266 | 3154 | 3805 |

*2007-2021 data from the weather station at MSU Montcalm Research Center "Enviro-weather", Michigan Weather Station Network, Entrican, MI.

Table of Contents

## PREVIOUS CROPS, TILLAGE AND FERTILIZERS

The general potato research area utilized in 2021 was Montcalm Research Center property in the field referred to as 'MRC 4.' This acreage was planted to rye in the spring of 2020 with crop residue disked into the soil in fall and sprayed off in the spring of 2021. In the spring of 2021, the recommended rate of potash was broadcast applied following deep-chisel plowing. The ground was vertical tilled and direct planted to potatoes. The area was not fumigated with Vapam prior to potato planting, but Admire Pro® was applied in-furrow at planting.

The soil test analysis for the general crop area (taken in November 2021) was as follows:

| | lbs/A | | | |
|---|---|---|---|---|
| pH | P | K | Ca | Mg |
| 6.3 | 300 (150 ppm) | 226 (113 ppm) | 1164 (582 ppm) | 190 (95 ppm) |

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

| Application | Analysis | Rate | Nutrients ($N$-$P_2O_5$-$K_2O$-Ca/Mg/S/Zn) |
|---|---|---|---|
| Broadcast at plow down | 0-0-22-11Mg-22S | 200 lbs/A | 0-0-44-22Mg-44S |
| | 0-0-0-21Ca-16S | 150 lbs/A | 0-0-0-32Ca-24S |
| | 0-0-0-21Ca-12Mg | 300 lbs/A | 0-0-0-63Ca-36Mg |
| | 10%B | 6 lbs/A | 0.6 lb. B |
| | 0-0-62 | 350 lbs/A | 0-0-217 |
| | 0-0-0-9Zn | 1 qt/A | 0.3 lb. Zn |
| At-planting | 28-0-0 | 24 gpa | 72-0-0 |
| | 10-34-0 | 12 gpa | 14-49-0 |
| At-cultivation | 28-0-0 | 24 gpa | 72-0-0 |
| | 10-34-0 | 12 gpa | 14-49-0 |
| At-hilling | 46-0-0 | 120 lbs/A | 55-0-0 |
| Late side dress (late varieties) | 46-0-0 | 100 lbs/A | 46-0-0 |

## HERBICIDES AND PEST CONTROL

A pre-emergence application of Linex4l/Dual at 1.25 qts/A and Brawl II at 1.0 pts/A was made in late May and early June. Admire Pro® was applied in-furrow at planting at a rate of 8.7 fl oz/A.

Echo 720 (24 oz/A), Manzate (2 lbs/A), Bravo (20 oz/A), and Pencozeb (2 lbs/A) fungicides were applied alone or in combination on twelve dates between June and early September.

Blackhawk (3.3 oz/A), Coragen (6 oz/A), Mustang Maxx (3 oz/A), Asana XL (9 oz/A), and Exirel (13.5 oz/A) insecticides were applied alone or in combination on five dates between June and August.

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

Table of Contents

# 2021 MSU POTATO BREEDING AND GENETICS RESEARCH REPORT
**January 2022**

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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 Michigan's 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, Clarksville 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. This 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 also 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. It has been 12 years since we started the SolCAP project and we are benefiting from the SolCAP SNP array DNA marker technology as we can now query 35,000 SNPs (compared to 8,303 SNPs in initial array). This SolCAP translational genomics project has finally giving us the opportunity to link genetic markers to important traits (reducing sugars, starch, scab resistance, etc.) in the cultivated potato lines and then breed them into elite germplasm. The SNPs also allow us to accurately fingerprint the varieties (DNA

Table of Contents

fingerprinting database with 4,000 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 insect resistance, late blight and PVY resistance, lower reducing sugar and drought. In 2022, we plan to test potatoes with late blight resistance, drought tolerance, invertase silencing and gene editing for PPO and self-compatibility. Furthermore, PotatoesUSA is supporting national early generation trials called the National Chip Processing Trial (NCPT) which will feed lines into the SNAC (SFA) trials and also Fast Track lines into commercial testing (NexGen testing). This national cooperative testing is the key! The PotatoesUSA Fast Track program invests in larger-scale seed increase for early generation promising chip-processing lines for commercial scale evaluation by growers and processors. This has led to the release of Saginaw Chipper (MSR061-1), Manistee (MSL292-A), Huron Chipper (MSW485-2), Mackinaw (MSX540-4), and Petoskey (MSV030-4). The next clones for commercialization are MSZ242-13 and MSW474-1. In the table markets, Blackberry and MSV093-1Y (Bonafide) are showing promise. We also have 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 a number of other traits in the future. We also have a USDA/AFRI diploid breeding grant to develop some foundational diploid breeding germplasm (Potato 2.0). In 2015, we were awarded the USAID grant to generate late blight resistance potatoes for Bangladesh and Indonesia. This Feed the Future project brings us into cutting edge GM work with Simplot and the International Potato Center (CIP). This project has been extended another 5 years and expanded to Kenya and Nigeria. Lastly, we have NSF-funded grants to better understand the potato genome and study wound-healing in potato. We feel that these in-house capacities (both conventional and biotechnological) put us in a unique position to respond to and focus on the most promising directions for variety development and effectively integrate advanced technologies with the breeding of improved chip-processing and tablestock potatoes.

The breeding goals at MSU are based on current and future needs of the Michigan potato industry. Traits of importance include yield potential, 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 cooking quality, bruise resistance, storability, along with shape, internal quality, and appearance. If these goals can be met, we will be able to reduce production input costs, keep potato production profitable as well as reduce the reliance on chemical inputs such as insecticides, fungicides and sprout inhibitors, and improve overall agronomic performance through new potato varieties.

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

Table of Contents

efficiency of the grading process. All entities of the potato group: Potato Breeding and Genetics; Potato Outreach Program; pathologists and soil fertility researchers have access to this new equipment.

**Varietal Development**

**Breeding**

The MSU potato breeding and genetics program is actively producing new germplasm and advanced seedlings that are improved for long-term storage chipping, and resistance to scab, late blight, and Colorado potato beetle. For the 2021 field season, progeny from about 300 crosses were planted and evaluated. Of those, the majority were crosses to select for round whites (chip-processing and tablestock), with the remainder to select for yellow flesh, long/russet types, red skin, and specialty market classes. During the 2021 harvest, about 1,000 selections were made from the 40,000 seedlings produced. Most of these first-year selections are segregating for PVY resistance. All second, third or fourth-year potential chip-processing selections will be tested in January and April 2022 directly out of 45°F (7.2°C) storage. Atlantic, Lamoka 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 and Golden nematode resistance. The majority of our selections now have PVY resistance. Selection in the early generation stages has been enhanced by the incorporation of the scab and late blight (US-23) evaluations of the early generation material. We are pushing our early generation selections from the 30-hill stage into tissue culture to minimize PVY issues in our breeding and seed stock. We are now using 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 are able to remove both PVY and PVS from lines, but PVS can still be difficult to remove in certain lines if the titer is high. We tested the removal of PLRV and succeeded. Over 1500 different varieties and breeding lines are maintained in tissue culture for the breeding and genetics program.

**Chip-Processing**

Over 75% 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 Mackinaw (MSX540-4) (scab, late blight and PVY resistant), Petoskey (MSV030-4) (scab resistant), Huron Chipper (MSW485-2) (late blight resistant), MSZ242-13 (scab resistant), MSW474-1 (scab resistant) and MSZ614-15 (scab, late blight and PVY resistant). We have some newer lines to consider such as MSAA217-3, MSBB230-1 and MSBB058-1. With a successful late blight trial, we are able to confirm resistance in some of our advanced selections. We are using the NCPT trials to more effectively identify promising new selections. Manistee and Mackinaw were licensed to Canada. Saginaw Chipper and Mackinaw are in Australia and South Korea.

Table of Contents

**Tablestock**

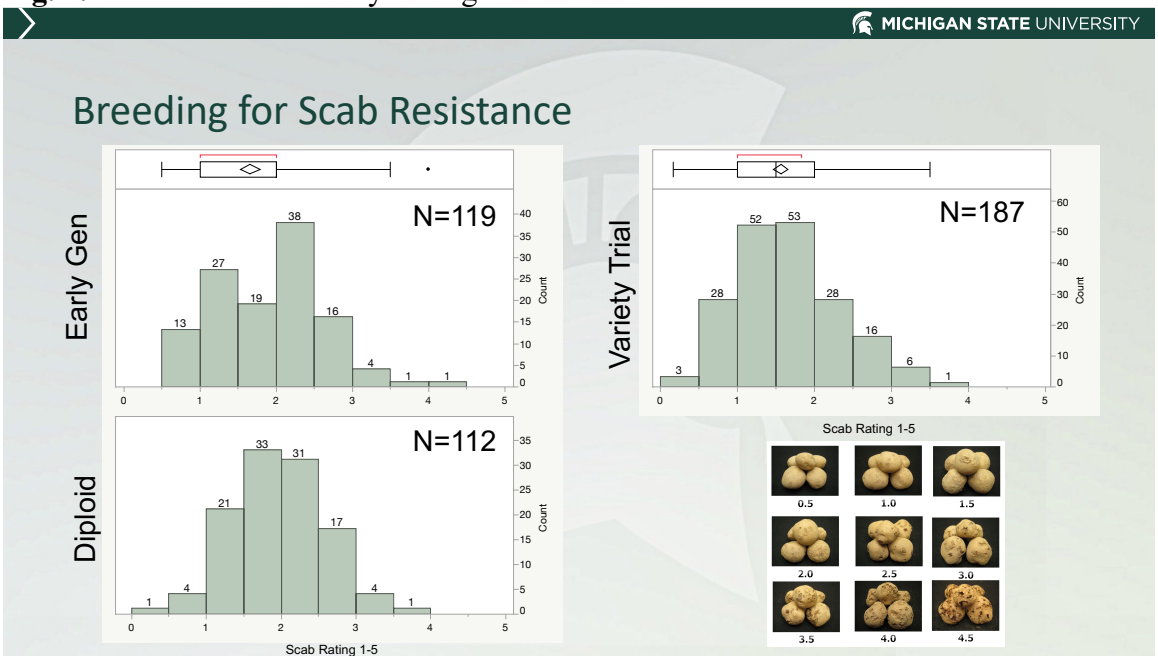
Efforts have been made to identify lines with good appearance with an attractive skin finish, low internal defects, good cooking quality, high marketable yield and resistance to scab, late blight and PVY. Our current tablestock development goals now are to continue to improve the frequency of scab and 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. There is also interest in some additional specialty mini-potatoes for the "Tasteful Selections" market. 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 a number of 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 2021, while others were tested under replicated conditions at the Montcalm Research Center. Promising tablestock lines include MSV093-1Y that we are naming Bonafide (yellow, scab resistant), MST252-1Y (scab resistant), MSV179-1 (scab resistant), MSZ416-8RY (scab resistant) is being licensed by Pro-Health and MSX324-2R (scab resistant). MSZ109-8PP and MSZ109-10PP (Blackberry) are purple-fleshed chippers with deep purple flesh, round shape and attractive skin as well as scab resistance. 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 potato are being marketed in the specialty markets. Blackberry is also being chip-processed by the Great Lakes Chip Co. in Traverse City, MI.

**Disease and Insect Resistance Breeding**

**Scab**: In 2021, we had two locations to evaluate scab resistance: a commercial field with a history of severe scab infection (we thankfully acknowledge the support of Sackett Potatoes for this important trial) and a highly infected site at the Montcalm Research Center. In 2021, the commercial site and the Montcalm Research Center both gave us very good scab infection levels. The susceptible checks of Snowden and Atlantic were highly infected with pitted scab. Promising resistant selections were MST252-1Y, MSV179-1, MSX324-1P, MSW474-01, MSBB614-15, as well as the Z-series selections MSZ242-07, MSZ242-09 and MSZ242-13 from the commercial scab site. If you examine the variety trials at Montcalm Research Center you will notice that many of the lines are scab resistant. We need to continue in this direction of many selections with scab resistance so we can find the great scab resistant chipper as well as table yellow and red. The high level of scab infection at the on-farm site with a history of scab infection and MRC has significantly helped with our discrimination of resistance and susceptibility of our lines. The MRC scab site was used for assessing scab susceptibility in our advanced breeding lines and early generation material and is summarized below (Figure 1). All susceptible check plots (Snowden and Atlantic) were scored as susceptible.

Table of Contents

**Fig. 1.** Scab Disease Nursery Ratings from Montcalm Research Center Trials




Based upon this data, scab resistance is strong in the breeding program. We lead the nation in scab resistant lines. This is evident in the NCPT. These data were also incorporated into the early generation selection evaluation process at Lake City. We are seeing that this expanded effort is leading to more scab resistant lines advancing through the breeding program. The ability to select under commercial settings at Sackett Potatoes is accelerating our ability to select for highly scab resistant varieties. MSZ052-13, MSZ219-1, MSZ219-13, MSZ219-14, MSZ242-09 and MSZ242-13 are some of the first scab resistant chippers to advance through this effort. Other highly scab resistant lines (score < 1.0) are MSBB613-7, MSBB614-15, MSCC282-3RR, MSDD085-13, MSDD247-11, MSEE101-2, MSEE207-2 MSEE247-6WP, MSW474-1, MSX324-1P, MSEE048-2Y, MSEE063-6, MSFF334-1Pinto, MSAA076-04, MSAA076-6, MSAA241-1, MSAA309-15, MSAA498-18, MSBB012-1Y, MSCC376-1, MSDD244-15, MSFF073-3, MSFF178-1, MSY022-2, MSY543-2 and MSZ248-02.

**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 2021 we conducted late blight trials at the MSU campus. We inoculated with the US23 genotype and obtained infection. The infection progressed and we were able to confirm late blight resistance for Mackinaw, Huron Chipper and numerous breeding lines such as MSBB058-4. We are not reporting late blight trial results this year. We will continue with late blight trials in 2022 on the MSU campus.

Table of Contents

**PVY:** We are using PCR-based DNA markers to select potatoes resistant to PVY. The gene is located on Chromosome 11. In our first round we made crosses in 2013 to generate over 7,000 progeny segregating for PVY resistance. Each year since 2013 we are making new crosses, making selections and expanding the germplasm base that has PVY resistance (Fig. 2). In the past year we tested over 1,200 progeny for the PVY resistance marker. The 560 that were marker positive were evaluated at Lake City. About 138 selections were made to advance for further evaluation. We are also using DNA markers to also screen for PVX resistance, PLRV resistance, late blight resistance and Golden nematode resistance. As a result of this work, Mackinaw has PVY resistance. More PVY resistant advanced selections are in the queue that will be evaluated in 2022. We have identified an advanced breeding line, MSCC725-232 that combines three virus resistance genes (PVY, PVX and PLRV). This line is being used as a parent in the breeding program.

**Fig. 2 PVY resistant selections in the breeding program**

MICHIGAN STATE UNIVERSITY

## Breeding for PVY Resistance

| Year | Family | PVYR Selections |
|---|---|---|
| Single<br>12-hill<br>30-hill | MSII<br>MSHH<br>MSGG | In testing<br>103<br>35 |
| | MSFF | 24 |
| | MSEE | 26 |
| | MSDD | 23 |
| | MSCC | 9 |
| | MSBB | 21 |

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

Table of Contents

**MSU Lines with Commercial Tracking**

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**MSV093-1Y (Bonafide)**

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

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

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

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**Mackinaw (MSX540-4) – in Commercial production**

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

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

Table of Contents

chip-processing quality. MSX540-4 has performed well in multiple locations in the PotatoesUSA National Chip Processing Trials (NCPT).

**Incentives for production:** Long-term chip-processing quality with resistance to PVY and late blight, and tolerance to common scab.

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

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

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**Petoskey – in Commercial production (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.

Table of Contents

***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*).

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**Huron Chipper (MSW485-2) – in Commercial production**

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

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

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

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

Table of Contents

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

---

**Blackberry – in commercial production**
**(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.

Table of Contents

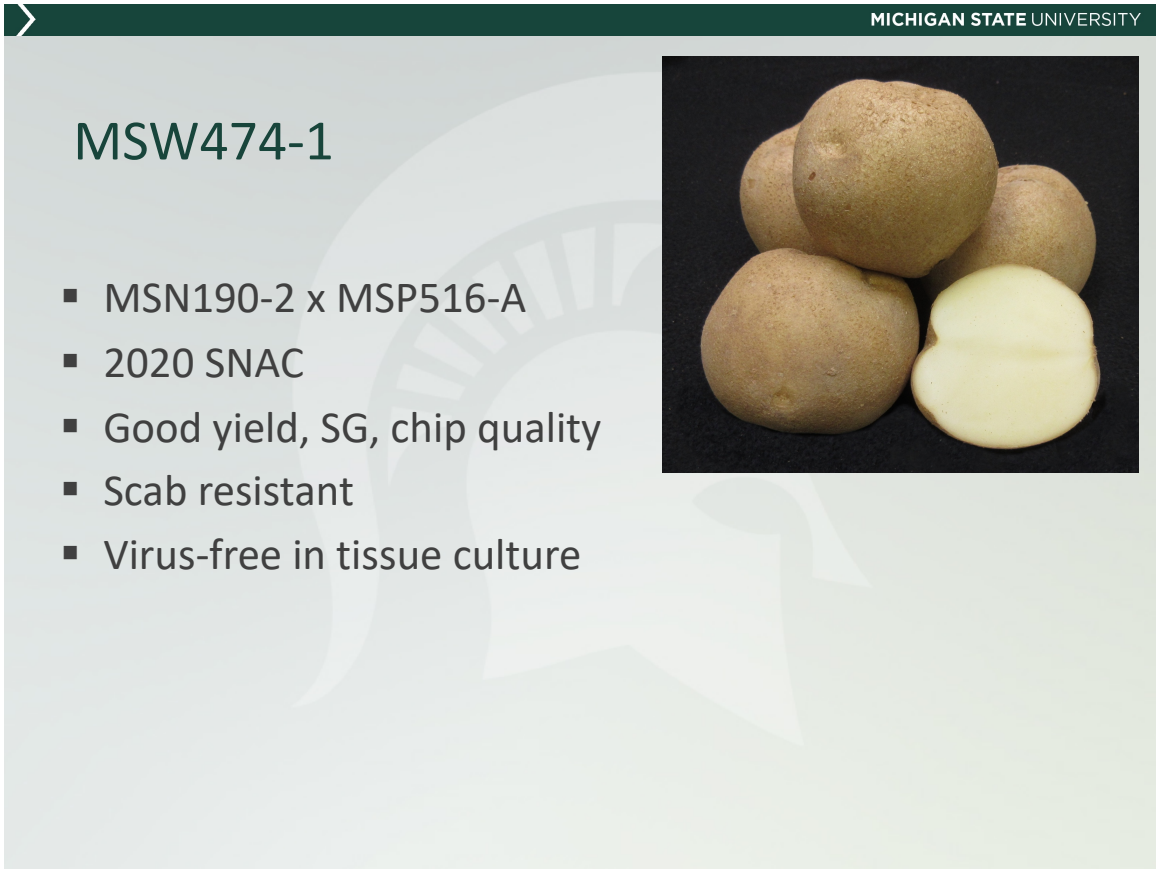
**Culinary Quality:** Gourmet specialty with deep purple flesh and also chip-processes.
**Diseases:** Good common scab resistance.

MICHIGAN STATE UNIVERSITY

## MSZ242-13

- MSR169-8Y x MSU383-A
- Good yield, SG, chip quality
- 2020 SNAC: Very Good in northern sites
- Highly scab tolerant
- Virus-free in tissue culture

Table of Contents




**Application of Molecular Markers in MSU Potato Breeding**

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. Some of the main markers that are used at MSU include: *RYSC3* and M6, *Potato virus Y* (PVY) resistance markers; *RxSP*, a *Potato virus X* (PVX) resistance marker; *TG689*, a Golden Nematode resistance marker; RB and R8, late blight resistance marker. PVY markers have been the most frequently used tools to assist selection in our program due to the importance of PVY resistance. According to the pedigrees, selections from our single-hill trial (1st year of field selection) are screened for PVY markers every year. This allowed for a prioritization of the space in the field, and for earlier, more informed decisions in variety selection.

The trait mapping populations have been a major research focus for us over the previous four years as we try to correlate the field data with the genetic markers. We now have DNA SNP markers linked to late blight resistance, scab resistance, chip color, tuber asparagine and specific gravity. We will now start using this linkage information to assist us in breeding. Our first SNP marker is linked to a gene for late blight resistance on Chr. 9 and the second is located on Chr. 10 with new ones recently identified on Chr. 4 and Chr. 5. The ability to use the DNA markers to stack a set of late blight resistance genes will lead to durable late blight resistance. We are now bringing in late blight resistance genes from germplasm from Europe and China.

Table of Contents

**Decoding *S. chacoense*-derived Colorado Potato Beetle Resistance**

Our goal is to provide durable Colorado potato beetle management in an integrated, sustainable manner. With this research we should be able to move towards developing resistant diploid parental lines for commercial breeding purposes. Our specific objectives are to:

1. Characterize beetle feeding and mortality on gene-edited potato lines lacking expression of candidate genes involved in the *S. chacoense* resistance mechanism.
2. Assess the inheritance of *S. chacoense* host plant resistance in diploid introgression populations.
3. Evaluate the transmission of *S. chacoense* host plant resistance in a set of diverse cultivated diploid clones.

We evaluated the five most resistant inbred lines in the field in comparison to the resistant 80-1 line, the resistant hybrid and susceptible Atlantic. Other research in the breeding program involved creating hybrids with other wild species of potato that may have resistance to insects. We included six lines in the trial to collect preliminary data on this germplasm. To ensure substantial and uniform beetle pressure in the field, the susceptible cultivar Atlantic was planted from seed pieces in early May around the perimeter of the field and in alternate rows of the trial.

The F1 hybrid was highly resistant as well as the five inbred lines. These genotypes held strong against the first generation of beetles but four of the five inbred succumbed to the exceptional second-generation beetle pressure when most of the susceptible Atlantic foliage had already been eaten. Hence, the beetle pressure in the 2021 season was able to separate the higher level of resistance of inbred 431 and the F1 from the four other inbreds. With this information, we are now making crosses with the inbred 431 to our best cultivated diploid germplasm we have developed in our breeding program. Inbred 431 is a great genetic resource because of its high field resistance to the Colorado potato beetle, intermediate tuber glycoalkaloid levels, self-compatibility as well as high male fertility. Using inbred 431 will more likely transmit resistance to a greater percentage of the progeny because the genes related to insect resistance are more likely fixed. Selfing will then recover the homozygous condition of recessive loci contributing to beetle resistance.

Interestingly, four of the 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. One is a hybrid with *S. jamesii* and the other one is a hybrid with *S. commersonii*. Both lines showed a unique resistance phenotype (Figure 3). We have observed leptine-based beetle resistance is a toxic foliar glycoalkaloids as well as a feeding deterrent. The wild species hybrids 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.

Table of Contents

**Figure 3.** Solanum species hybrids with cultivated diploid potato demonstrating new sources of non-leptine-based Colorado potato beetle resistance.

**Overcoming Self-Incompatibility in Diploid Potato Using CRISPR-Cas9**

The aim of this project was to generate a targeted knock-out (KO) of the *S-RNase* and HT-B genes, involved in gametophytic self-incompatibility in diploid potatoes, using CRISPR/Cas9 technology in an effort to avoid self-pollen degradation. We identified *S-RNase* alleles and HT-B with flower-specific expression in two diploid self-incompatible lines using genome resequencing data. *S-RNase* gene mapped to chromosome 1 within a low recombination region and HT-B to chromosome 12. *S-RNase* and *HT-B* double KO lines were obtained causing premature stop codons. Fruits were set in selected KO and produced viable T1 seeds. Our results suggest that creating *S-RNase* KO can contribute to generation of self-compatible lines as a first step for the generation of commercial diploid cultivars. Knocking out HT-B with S-RNase increases seed set in self pollinations. This is now an important trait to work with in our diploid breeding.

**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. Many of the difficulties associated with tetraploid potatoes, such as problems with seed storage, would be greatly reduced if the potato had a lower, and therefore less complicated, ploidy. Our goal is to develop a broad-based dihaploid germplasm that can be used in diploid potato breeding. We started by crossing currently established MSU tetraploid germplasm with a known haploid inducer, *S. phureja* IVP 101. Parent lines were selected based on traits such as high yield, disease resistance, and good chip quality, among others. Resulting seeds were inspected for a purple embryo spot and grown in tissue culture before transplanting in the greenhouse. Chloroplast numbers in guard cells were counted to determine ploidy level. Plants that we determined to be diploid were also SNP genotyped with the Infinium 22 or 30K Potato SNP array for ploidy determination. These dihaploids were then tested for disease resistance markers:

Table of Contents

RYSC3+ (Potato Virus Y extreme resistance), GN (Golden Nematode) resistance, and PVX resistance. Those with a Jacqueline Lee lineage were also tested for presence of late blight resistance via a SNP KASP assay. Confirmed dihaploids were crossed with a diploid self-compatible inbred line of *S. chacoense*, M6 to introgress self-compatibility. Of the hundreds of seeds produced in the past 6 years from these dihaploid crosses with over 30 breeding lines or varieties, about 400 progeny have been confirmed as diploid. These dihaploids (diploids derived from tetraploid varieties) are the foundation of our diploid breeding program for round white potatoes for the chip and table markets. We have also now selected some russet dihaploids and red dihaploids and well as more chippers, table and russets in 2021. We have about 50 good female fertile dihaploids that are forming the core of our varietal diploid breeding program.

**Introgressing Self-compatibility to *Solanum tuberosum* Dihaploids for Diploid Variety Development**

Dihaploids of cultivated potato (*Solanum tuberosum* L.) have been produced for over 50 years to reduce the breeding and genetic challenges of autopolyploidy. Most dihaploids are male sterile (MS) that reduces the benefit of lower ploidy level of cultivated tetraploid potato. In this study, we used three self-compatibility (SC) donors to introgress SC into a wide range of dihaploid germplasm through a series of crosses to dihaploids which we refer to as *S. tuberosum* backcrossing. The SC increased from 11% in the $F_1$ generation to 33% in the $BC_2$ generations. Over 6,000 genome-wide SNPs were used to characterize the germplasm diversity, heterozygosity, and structure in two backcrossing generations. The $BC_3$ generation was significantly improved regarding maturity, scab resistance, average tuber number. In 2021, we yield tested about 85 lines. Over 30 lines were equal or better than Lamoka and Atlantic in yield.

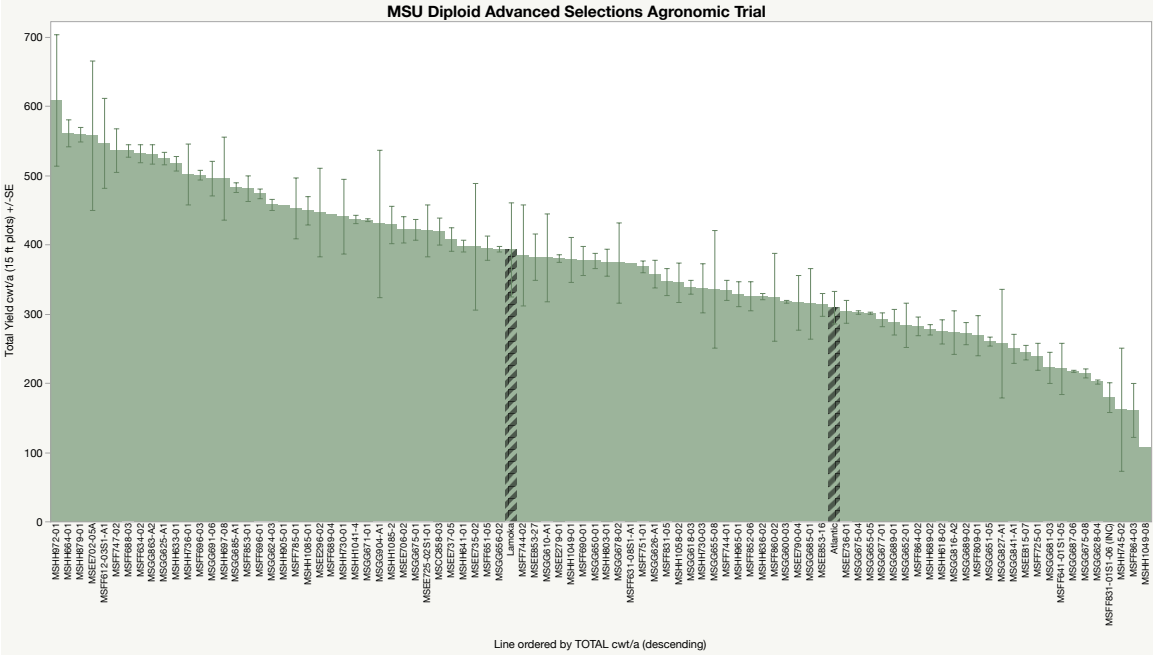



Table of Contents

**Germplasm Enhancement**

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. We have over 40 populations that we have cycled 5 generations to improve for self-compatibility and tuber traits. We have also been crossing self-compatible donors to the dihaploids of Atlantic, Superior, Manistee, MSZ219-14, Kalkaska, MSR127-2, MSS576-5SPL and others so we can develop inbred chip-processing diploid lines. This new diploid potato breeding project is expanding to develop promising lines to use as parents in the future as well as to think about F1 hybrid varieties.

**Certified NFT Minituber Production at Michigan State University**

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

MICHIGAN STATE UNIVERSITY

## 2021 Certified Seed Production at MSU

- 46 Clones, 32,000 Minitubers

| Line | Tubers | Remarks |
|---|---|---|
| Blackberry (MSZ109-10PP) | 2500 | |
| Mackinaw | 2300 | |
| Petoskey | 2000 | |
| Raspberry | 2000 | |
| Spartan Red #2 (Red Marker #2) | 1200 | |
| MSAA076-6 | 600 | |
| MSAA217-3 | 500 | |
| MSAA260-3 | 500 | |
| MSBB058-1 | 500 | |
| MSBB230-1 | 500 | |
| MSBB238-1RY | 500 | |
| MSBB610-13 | 500 | |
| MSBB626-11 | 400 | |
| MSV093-1Y | 1000 | |
| MSV179-1 | 1500 | |

| Line | Tubers | Remarks |
|---|---|---|
| MSW474-1 | 1400 | |
| MSZ109-05RR | 2200 | |
| MSZ109-07PP | 600 | |
| MSZ242-13 | 500 | |
| MSZ416-8RY | 577 | |
| | | |
| DIA-MSU-UB015 | 1100 | USAID-LB |
| Diamant | 550 | USAID-Check |
| Granola_UI | 450 | USAID-Check |

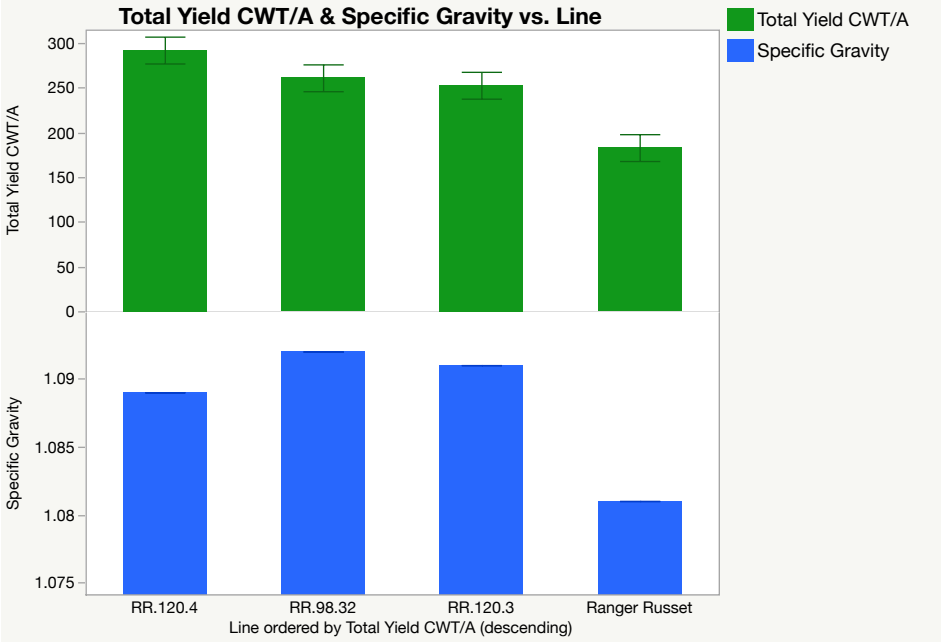
Table of Contents

**Integration of Genetic Engineering with Potato Breeding**

MSU conducts genetic engineering research to introgress and test economically important traits into potato. We have a USAID-funded project to create and commercialize 3-R-gene potato varieties in Bangladesh, Indonesia and Africa. This a partnership with Simplot Plant Sciences. Simplot has been creating the plants for the target countries. 2019 and 2020 greenhouse and field trials show that a high level of resistance to late blight has been achieved in events that have no backbone and are single inserts. Agronomic and late blight trials in Indonesia demonstrate their resistance to late blight and yield well under late blight pressure.


We have also generated lines with the genes for water use efficiency. The XERICO gene is showing the most promise. From 2018 to 2021, 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. Field trials at MRC in 2021 confirm this observation. Lastly, we have generated and selected a Kalkaska invertase silencing line (Kal91.03) that has resistance to accumulating reducing sugars in cold (40°F) storage. We tested the agronomic characteristics of Kal91.03 from 2016-2019. 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.

Table of Contents




MICHIGAN STATE UNIVERSITY

## Agronomic Yield Trials

| | Yield (cwt/a) | | Percent By Weight (%) | | | | | | Quality (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | US#1 | Total | US#1 | Bs | As | OV | PO | SPGR | HH | VD | IBS | BC | |
| Kal.91.03 | 290 | 382 | 75 | 25 | 75 | 0 | 0 | 1.082 | 0 | 10 | 0 | 0 | 2016 |
| Kalkaska | 365 | 438 | 83 | 17 | 83 | 0 | 0 | 1.080 | 5 | 5 | 0 | 0 | 2016 |
| Kal.91.03 | 335 | 399 | 84 | 16 | 84 | 0 | 0 | 1.083 | 0 | 3 | 0 | 0 | 2017 |
| Kalkaska | 348 | 401 | 86 | 13 | 86 | 1 | 0 | 1.087 | 0 | 5 | 0 | 0 | 2017 |
| Kal.91.03 | 313 | 390 | 79 | 20 | 79 | 0 | 0 | 1.082 | 0 | 7 | 0 | 0 | Mean |
| Kalkaska | 356 | 420 | 85 | 15 | 85 | 0 | 0 | 1.084 | 3 | 5 | 0 | 0 | Mean |

2019 – Block trial at MRC, Samples in MPIC Demonstration Storage and MSU Campus

Kal.91.03

Kalkaska *Chipped directly after 6 months at 40F*

Table of Contents

**Funding: Fed. Grant/MPIC/Potatoes USA**

# 2021 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 2021, we tested over 205 varieties and breeding lines in the replicated variety trials, 130 lines in the North Central Regional trial plus over 153 lines in the National Chip Processing Trial (NCPT). The variety evaluation also includes disease testing in the scab nursery (Montcalm Research Center) and foliar late blight evaluation (MSU Campus Plant Pathology Farm). The objectives of the evaluations are to identify superior varieties for fresh or chip-processing markets (chip, round white/yellow table, specialty/red and russet). The varieties were compared in groups according to market class, tuber type, skin color, and to the advancement in selection. Each season, total and marketable yields, specific gravity, tuber appearance, incidence of external and internal defects, chip color (from the field as well as from 45°F (7.2°C) storage at 3 and 6 months), along with susceptibilities to common scab, late blight (foliar and tuber), and blackspot bruising are determined.

We would like to acknowledge the collaborative effort of the Michigan Potato Industry and research colleagues Matthew Klein and the MSU Potato Breeding Team (especially graduate students Natalie Kaiser, Sarah Lee, Kaela Panicucci and Will Behling) for helping to get the field research done.

## PROCEDURE

The field variety trials were conducted at the Montcalm Research Center in Entrican, MI. Due to COVID-19-related university research constraints, trial replication was reduced to a maximum of two. A randomized complete block design was used. The plots were 23 feet (7 m) long and spacing between plants was 10 inches (25.4 cm). Inter-row spacing was 34 inches (86.4 cm). Supplemental irrigation was applied as needed. Nutrient, weed, disease and insect management were similar to recommendations used by the commercial operations in Montcalm County. The field experiments were conducted on a sandy loam soil that has been out of potato production for 5 years. Oats were grown in 2020 on this ground. A few severe rain events in 2021 flooded the northern tiers of some of the trials. There was no serious damage from insects, diseases or weeds.

Table of Contents

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 NCPT and the early observational trials.

2021 was the eleventh 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 9 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 130 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 2021 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. Advanced Chip-Processing Trials (Table 1)

A summary of the 39 entries evaluated in the trial results is given in **Table 1**. Overall, the yields for the Advanced trial (145 days) were above average. The check varieties for this trial were Lamoka, Manistee, Snowden and Atlantic. The highest yielding and most promising lines were MSBB630-2, MSAA252-7, MSBB626-11, MSAA217-3, Mackinaw, Huron Chipper and MSAA076-6. Internal defects were noted with some lines showing susceptibility to hollow heart, IBS or brown center. Specific gravity was average with a trial average of 1.082. Snowden and Atlantic had a specific gravity of 1.084 and 1.089, respectively. All chip-processing entries in the trial had excellent chip-processing quality out of the field, with an SFA score of 1.0. Almost all of the MSU breeding lines have scab resistance. Twenty-four MSU chipping lines were classified as having scab resistance scores equal or better than Lamoka. Mackinaw (MSX540-4) has PVY and late blight resistance while MSZ614-15 and MSBB630-2 has scab, PVY and late blight resistance. Other promising lines to watch are Petoskey, MSZ242-13, MSDD247-11, MSDD247-07, MSBB058-3, MSBB230-1 and MSBB058-4.

Table of Contents

## B. North Central Regional Trial (Table 2)

This trial provided a new format to test our fourth-year material in Michigan as well as ND, MN and WI. The trial with 130 lines was evaluated after 125 days. The promising chippers in the trial were MSFF007-2, MSFF037-17, MSFF017-1 and MSFF097-6. Our promising table lines are MSFF353-R, MSFF182-1R, MSFF130-1R. At this time are results are showing that we are obtaining lines with scab and PVY resistance.

## C. Adaptation Trial (Table 3)

The Adaptation Trial of the tablestock lines was harvested after 145 days and the results of 37 lines are summarized in **Table 3**. The many of the lines evaluated in the Adaptation Trial were tested in the Preliminary Trials the previous year. The reference cultivars Yukon Gold and Superior are reported in the tablestock trial. In general, the yields were average and internal defects were observed in some lines. The promising lines were MSZ416-8RY, MSZ109-8PP, MSDD483-1, MSV093-1Y, MSBB371-1YSPL, MSCC553-1R and MSZ551-1. MSZ551-1 combines high yield with scab, PVY and late blight resistance. We are hoping to commercial MSV093-1Y as Bonafide. Scab tolerance is becoming more prevalent among the advanced selections, but the challenge remains to combine scab, PVY and late blight resistance with a commercial skin finish. Other promising lines in the trial are MSV179-1, MST252-1Y and Blackberry. MSU has obtained PVP for Blackberry. Blackspot bruising was low for most lines.

## D. Preliminary Trials (Tables 4, 5 and 6)

The Preliminary trials (chip, table, pigmented) are the first trials for evaluating new advanced selections from the MSU potato breeding program. The division of the trials was based upon pedigree assessment for chip-processing and tablestock utilization. In 2021, there were 83 harvested entries trialed in the three Preliminary trials at 132 days. PVY resistance is found in over a third of the lines tested.

The chip-processing Preliminary Trial (**Table 4**) had 55 harvested entries after 132 days. Most of the lines chip-processed well from the field but only 14 lines had specific gravity values greater than Snowden at 1.084. Internal quality weakness was predominantly hollow heart. Scab resistance was prevalent among the lines. Promising MSU lines are MSDD376-4, MSFF079-16, MSEE207-2, MSEE063-6, MSEE035-4, MSDD244-05, MSEE101-2, MSDD372-07 and MSEE031-3 combining yield, specific gravity, scab resistance and chip quality. Most of these lines also have PVY resistance. We continue to make progress selecting for chip-processing with scab resistance with 27 lines in the trial with scab ratings equal or lower than 1.7, whereas Snowden had a scab rating of 3.0.

Table of Contents

**Table 5** summarizes 21 harvested tablestock entries evaluated in the Preliminary Tablestock Trial. Reba was the check variety. This tablestock trial was harvested and evaluated after 132 days. MSDD088-1, MSEE048-2Y, MSEE075-1 and FF120-2Y all have high yield potential, low internal defects and scab resistance, as well as low blackspot bruising. In general, the level of scab resistance and internal quality are improving in this pool of lines. We are working towards better skin finish also.

The interest in the specialty market continues to increase. In 2021, 19 harvested entries were evaluated in the Preliminary Pigmented Trial (**Table 6**), which was harvested at 132 days. This trial evaluated breeding lines with unique skin and flesh colors. Many of these MSU lines have commercial agronomic performance and specialty characteristics, but scab resistance varied among the lines. Eight lines were scored as scab resistance. Blackspot bruising is low and internal defects were mostly hollow heart. MSW476-4RY, MSFF247-2Y, MSFF142-2SPL, MSBB308-2P and MSFF305-1RY combine yield and scab resistance.

## E. Diploid Replicated trial (Table 7)

16 Diploid lines were agronomically evaluated against Atlantic and Lamoka. The trial was harvested at 132 days. Four lines were comparable in yield to Atlantic and Lamoka. Three lines that yielded well in 2020 were much lower in yield. We attribute this to virus in the seed used. This trial demonstrates that we are achieving greater yield potential as we breed at the diploid level. We will continue to focus on yield but we will put more emphasis on market traits as we continue to breed and select.

## F. 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 (119 lines) and the scab variety trial (185 lines) and diploid scab trial (188). In 2021, 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 2019-2021 scab ratings are based upon the Montcalm Research Center site. **Table 8** categorizes many of the varieties and advanced selections tested in 2021 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.

Table of Contents

The check varieties Russet Norkotah, GoldRush, Red Norland, Yukon Gold, Pike, Atlantic, and Snowden can be used as references (in bold, **Table 8**). The table is sorted in ascending order by 2021 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 0.2 – 3.5 for the variety trial. A total of 101 entries tested had a scab rating of 1.5 or lower in 2021. Most notable scab resistant MSU lines are found in the trial summaries **(Tables 1-7)**. Of the 119 early generation selections that were evaluated, 59 had scab resistance (scab rating of ≤ 1.5) (**Table 9**).

## F. Late Blight Trial (Table 10)

In 2021, the late blight trial was planted at the East Lansing campus Plant Pathology farm. All entries were planted in early June for late blight evaluation. These include lines tested in a replicated manner from the agronomic variety trial and entries in the early generation observation plots. The trials were inoculated two times in August with the US-23 genotype of *P. infestans*. Late blight infection was progressed well and data was collected into September. Sixteen of 42 lines were classified as late blight resistant in the replicated trial. Twelve of the lines also PVY resistant.

## G. Blackspot Bruise Susceptibility (Table 11)

Evaluations of advanced seedlings and new varieties for their susceptibility to blackspot bruising are also important in the variety evaluation program. Based upon the results collected over the past years, the non-bruised check sample has been removed from our bruise assessment. A composite bruise sample of each line in the trials consisted of 25 tubers (a composite of 4 replications) from each line, collected at the time of grading. The 25-tuber sample was held in 50°F (10°C) storage overnight and then was placed in a hexagon plywood drum and tumbled 10 times to provide a simulated bruise. The samples were peeled in an abrasive peeler in October and individual tubers were assessed for the number of blackspot bruises on each potato. These data are shown in **Table 11**. The bruise data are represented in two ways: percentage of bruise free potatoes and average number of bruises per tuber. A high percentage of bruise-free potatoes is the desired goal; however, the numbers of blackspot bruises per potato is also important. Cultivars which show blackspot incidence greater than Atlantic are approaching the bruise-susceptible rating. In addition, the data is grouped by trial, since the bruise levels can vary between trials. In 2021, the bruise levels were higher than previous years. There are many lines with lower blackspot bruise potential across the trials. Some of our advanced selections are similar to or less than Atlantic and Snowden in their level of bruising. A few lines will high susceptibility to bruise were identified and will be discontinued from testing. All the bruise ratings are also found in the variety trial tables (**Tables 1-7**).

## H. 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

Table of Contents

chip-processing varieties for the industry. Cooperating breeding programs include the USDA (Idaho and Maryland) and land grant universities (Colorado, Maine, Michigan, Minnesota, North Carolina, North Dakota, New York, Oregon, Wisconsin and Texas). The coordinated breeding effort includes early-stage evaluation of key traits (yield, specific gravity, chip color, chip defects and shape) from coordinated trials in 10 locations. Since the inception of the trial in 2010, over 1,000 different potato entries, including reference varieties, have been evaluated. The data for all the lines tested are summarized on a searchable, centralized database housed at Medius (https://potatoesusa.medius.re). More than 40 promising new breeding lines from the trials have been fast-tracked for larger-scale commercial trials and processor evaluation. The NCPT is also a feeder for the national SNAC International trials. We are using the NCPT trials to more effectively identify promising new selections. Notable MSU lines that have been identified are MSW485-2 (Huron Chipper), MSX540-4 (Mackinaw), MSV030-4 (Petoskey), MSW474-1, and MSZ242-13. Our newest graduates of the NCPT are MSBB230-1, MSAA217-3 and MSBB626-11. Minituber production and/or commercial seed have been produced of the newer lines and will be tested in Michigan in 2022.

Table of Contents

**Table 1**

**MICHIGAN STATE UNIVERSITY**
**POTATO BREEDING and GENETICS**

**ADVANCED CHIP-PROCESSING TRIAL**
**MONTCALM RESEARCH CENTER**
**May 5 to September 27, 2021 (145 days)**
**DD Base 40°F 3402[9]**

| | | | | | | | | | | | | | | PERCENT (%) | | | | | | LB[8] | 3-YR AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PVY | | CWT/A | | PERCENT OF TOTAL[1] | | | | | | CHIP | OTF | TUBER QUALITY[4] | | | | | | | RAUDPC | US#1 |
| LINE | Resistant | N | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR | SCORE[2] | SED[3] | HH | VD | IBS | BC | SCAB[5] | MAT[6] | BRUISE[7] | x100 | CWT/A |
| MSBB630-2 | PVYR | 2 | 598 | 642 | 93 | 6 | 93 | 0 | 1 | 1.078 | - | - | 0 | 0 | 10 | 0 | 1.3 | 3.5 | 4.0 | 0.1 | - |
| MSAA252-7 | PVYR | 2 | 551 | 565 | 98 | 2 | 87 | 11 | 0 | 1.081 | 1.0 | 3 | 0 | 5 | 45 | 0 | 1.5 | 4.0 | 3.3 | 1.5 | 470* |
| MSY022-2 | | 2 | 495 | 529 | 93 | 5 | 93 | 0 | 2 | 1.079 | 1.0 | 0 | 35 | 0 | 0 | 0 | 0.5 | 3.0 | 1.8 | - | - |
| MSCC725-232 | PVYR | 2 | 463 | 490 | 94 | 5 | 94 | 0 | 1 | 1.075 | 1.0 | 1 | 50 | 5 | 0 | 5 | 1.8 | 3.0 | 2.1 | - | - |
| MSAA076-6 | | 2 | 429 | 498 | 86 | 14 | 86 | 0 | 0 | 1.083 | 1.0 | 1 | 0 | 0 | 0 | 0 | 0.8 | 2.5 | 2.8 | - | 366 |
| MSBB613-7 | PVYR | 2 | 426 | 438 | 97 | 2 | 97 | 0 | 1 | 1.077 | - | - | 45 | 10 | 0 | 5 | 0.3 | 3.0 | - | 0.9 | - |
| MSBB626-11 | PVYR | 2 | 418 | 435 | 96 | 4 | 95 | 1 | 0 | 1.084 | 1.0 | 1 | 0 | 5 | 0 | 5 | 1.4 | 3.5 | 2.8 | 4.3 | 398* |
| MSAA217-3 | | 2 | 417 | 440 | 95 | 5 | 94 | 1 | 0 | 1.094 | 1.0 | 3 | 70 | 0 | 0 | 0 | 2.3 | 3.0 | 3.0 | - | 332* |
| Mackinaw | PVYR | 2 | 415 | 448 | 93 | 7 | 93 | 0 | 0 | 1.081 | 1.0 | 0 | 0 | 0 | 0 | 0 | 1.8 | 3.0 | 2.2 | 2.1 | 294 |
| Huron Chipper | | 2 | 414 | 453 | 91 | 9 | 91 | 0 | 0 | 1.082 | 1.0 | 2 | 5 | 15 | 0 | 10 | 1.8 | 3.0 | 1.2 | 0.5 | 327 |
| MSAA091-1 | | 2 | 413 | 451 | 91 | 9 | 91 | 0 | 0 | 1.084 | 1.0 | 0 | 5 | 5 | 0 | 0 | 2.3 | 3.0 | 1.2 | 28.4 | - |
| MSDD247-11 | PVYR | 2 | 400 | 429 | 93 | 6 | 93 | 0 | 1 | 1.091 | 1.0 | 0 | 10 | 0 | 0 | 0 | 1.0 | 2.0 | 3.0 | 11.4 | - |
| MSBB075-1Y | | 2 | 400 | 436 | 92 | 6 | 91 | 1 | 2 | 1.078 | 1.0 | 0 | 0 | 5 | 0 | 0 | 2.1 | 2.0 | 2.0 | - | - |
| MSBB058-3 | PVYR | 2 | 390 | 406 | 96 | 4 | 96 | 0 | 0 | 1.080 | 1.0 | 0 | 0 | 0 | 0 | 0 | 1.4 | 4.0 | 3.8 | 0.2 | - |
| MSBB635-14 | PVYR | 2 | 379 | 418 | 90 | 10 | 90 | 0 | 1 | 1.070 | - | - | 0 | 10 | 0 | 0 | 1.3 | 2.5 | - | 1.4 | 349* |
| MSZ242-13 | | 2 | 374 | 395 | 95 | 4 | 95 | 0 | 1 | 1.093 | 1.0 | 0 | 0 | 0 | 0 | 0 | 1.4 | 3.0 | 2.2 | - | 284 |
| MSBB614-15 | PVYR | 2 | 364 | 377 | 97 | 3 | 96 | 1 | 0 | 1.078 | 1.0 | 0 | 15 | 0 | 0 | 5 | 0.7 | 2.5 | 1.6 | 1.1 | - |
| MSAA328-4 | | 2 | 363 | 379 | 96 | 4 | 96 | 0 | 0 | 1.079 | - | - | 0 | 0 | 0 | 0 | 1.2 | 2.5 | - | - | 355* |
| MSCC058-1 | | 2 | 362 | 376 | 96 | 4 | 96 | 0 | 0 | 1.083 | 1.0 | 0 | 5 | 35 | 0 | 0 | 1.2 | 2.5 | 4.0 | - | 326* |
| MSBB230-1 | | 2 | 360 | 423 | 85 | 15 | 85 | 0 | 0 | 1.088 | 1.0 | 0 | 0 | 0 | 5 | 0 | 2.3 | 2.5 | 2.3 | - | - |
| MSBB058-4 | PVYR | 2 | 359 | 402 | 89 | 11 | 89 | 0 | 0 | 1.079 | 1.0 | 0 | 0 | 0 | 0 | 0 | 1.8 | 4.0 | 1.6 | 7.7 | - |
| Petoskey | | 2 | 352 | 414 | 85 | 13 | 85 | 0 | 2 | 1.090 | 1.0 | 0 | 15 | 0 | 0 | 0 | 1.3 | 3.0 | 2.6 | - | 250 |
| Petoskey (POP) | | 2 | 340 | 402 | 85 | 15 | 85 | 0 | 0 | 1.089 | - | - | 0 | 0 | 0 | 5 | 2.3 | 3.0 | 2.6 | - | - |
| **Atlantic** | | **2** | **330** | **358** | **92** | **8** | **92** | **0** | **0** | **1.089** | **1.0** | **2** | **25** | **10** | **0** | **0** | **2.8** | **2.0** | **2.7** | **39.7** | **233** |
| MSZ242-07 | | 2 | 330 | 356 | 92 | 7 | 92 | 0 | 1 | 1.092 | 1.0 | 0 | 0 | 0 | 0 | 0 | 1.3 | 3.0 | 3.1 | - | 285* |
| **Snowden** | | **2** | **321** | **372** | **86** | **14** | **86** | **0** | **0** | **1.084** | - | - | **0** | **25** | **0** | **0** | **3.0** | **2.0** | **2.8** | **10.1** | 239 |
| MSDD247-07 | PVYR | 2 | 308 | 339 | 91 | 9 | 91 | 0 | 0 | 1.095 | 1.0 | 2 | 0 | 0 | 20 | 5 | 0.8 | 3.0 | 3.2 | - | - |
| MSBB611-3 | PVYR | 2 | 307 | 382 | 80 | 18 | 79 | 1 | 2 | 1.083 | - | - | 0 | 0 | 0 | 25 | 1.5 | 3.0 | 3.6 | 0.4 | 314* |
| **Lamoka** | | **2** | **306** | **352** | **87** | **12** | **87** | **0** | **0** | **1.080** | **1.0** | **0** | **0** | **20** | **0** | **0** | **1.5** | **2.0** | **1.6** | **28.6** | 258 |

| | | | | | | | | | | | | | PERCENT (%) | | | | | | | LB[8] | 3-YR AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PVY | | CWT/A | | PERCENT OF TOTAL[1] | | | | | | CHIP | OTF | TUBER QUALITY[4] | | | | | | | RAUDPC | US#1 |
| LINE | Resistant | N | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR | SCORE[2] | SED[3] | HH | VD | IBS | BC | SCAB[5] | MAT[6] | BRUISE[7] | x100 | CWT/A |
| MSBB017-1 | | 2 | 287 | 341 | 84 | 15 | 84 | 0 | 1 | 1.080 | 1.5 | 1 | 20 | 15 | 0 | 0 | 1.8 | 2.0 | 2.6 | - | - |
| MSAA498-18 | | 2 | 277 | 288 | 96 | 4 | 96 | 0 | 0 | 1.081 | 1.0 | 0 | 0 | 0 | 5 | 5 | 0.8 | 2.5 | 1.5 | 10.8 | 290* |
| MSAA260-3 | | 2 | 275 | 319 | 86 | 12 | 85 | 1 | 3 | 1.083 | 1.0 | 1 | 0 | 0 | 10 | 35 | 1.3 | 3.0 | 3.6 | - | 263* |
| MSW474-1 | | 2 | 274 | 350 | 78 | 22 | 78 | 0 | 0 | 1.078 | - | - | 0 | 0 | 0 | 0 | 0.7 | 2.0 | 2.5 | - | - |
| MSAA311-1 | | 2 | 274 | 308 | 89 | 11 | 89 | 0 | 0 | 1.076 | 1.0 | 0 | 0 | 5 | 0 | 5 | 1.3 | 2.0 | 2.1 | - | - |
| MSDD040-01 | | 2 | 273 | 290 | 93 | 6 | 92 | 1 | 1 | 1.074 | - | - | 10 | 0 | 0 | 0 | 1.1 | 2.0 | - | - | - |
| MSDD244-15 | PVYR | 2 | 238 | 265 | 90 | 9 | 90 | 0 | 1 | 1.073 | - | - | 0 | 0 | 15 | 0 | 1.0 | 3.0 | - | - | - |
| Manistee | | 2 | 229 | 265 | 87 | 13 | 87 | 0 | 1 | 1.080 | 1.0 | 0 | 0 | 5 | 0 | 0 | 2.8 | 1.5 | 1.1 | - | 229 |
| MSDD085-13 | PVYR | 2 | 206 | 284 | 72 | 28 | 72 | 0 | 0 | 1.082 | - | - | 0 | 5 | 0 | 5 | 0.7 | 1.0 | 2.0 | - | - |
| MEAN | | | 361 | 398 | | | | | | 1.082 | | | | | | | 1.5 | 2.7 | 2.5 | | 276 |
| $HSD_{0.05}$ | | | 241 | 232 | | | | | | 0.011 | | | | | | | | | | | |

[1]SIZE: B: < 2 in.; A: 2-3.25 in.; OV: > 3.25 in.; PO: Pickouts.

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

[3]SED: Stem End Defect, Based on Paul Bethke's (USDA/UWisconsin - Madison) 0 - 5 scale. 0 = no SED; 3 = significant SED; 5 = severe SED

[4]QUALITY: HH: Hollow Heart; BC: Brown Center; VD: Vascular Discoloration; IBS: Internal Brown Spot. Percent of 40 Oversize and/or A-size tubers cut.

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

[6]MATURITY RATING: August 24, 2021; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

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

[8]LB RAUDPC: Late blight (*P. infestans* US-23) foliar disease reaction.

| | |
|---|---|
| Plant Date: | 5/5/2021 |
| Vine Kill: | 9/8/2021 |
| Days from planting to vine kill: | 126 |

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

**Table 2**



**NORTH CENTRAL REGIONAL TRIAL**
**MONTCALM RESEARCH CENTER**
**May 5 to September 7, 2021 (125 days)**
**DD Base 40°F 3072[6]**

| | | | CWT/A | | PERCENT OF TOTAL[1] | | | | | | | | PERCENT (%) TUBER QUALITY[4] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LINE | PVY Resistant | N | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR | CHIP SCORE[2] | OTF SED[3] | HH | VD | IBS | BC | MAT[5] |
| ***Chip*** | | | | | | | | | | | | | | | | | |
| MSFF007-2 | | 1 | 563 | 606 | 93 | 7 | 93 | 0 | 0 | 1.079 | 1.0 | 1.0 | 0 | 10 | 0 | 0 | 4.0 |
| MSFF036-1 | PVYR | 1 | 551 | 592 | 93 | 7 | 91 | 3 | 0 | 1.072 | 1.0 | 1.0 | 0 | 10 | 0 | 0 | 3.0 |
| W17039-31 | | 1 | 533 | 622 | 86 | 14 | 86 | 0 | 0 | 1.093 | 1.0 | 1.0 | 0 | 10 | 0 | 0 | 4.0 |
| ND14251B-5 | | 1 | 527 | 553 | 95 | 4 | 95 | 0 | 1 | 1.074 | - | - | 0 | 0 | 0 | 0 | 4.0 |
| W17AF6685-2 | | 1 | 508 | 601 | 84 | 14 | 84 | 0 | 1 | 1.080 | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 3.0 |
| ND14247CAB-2 | | 1 | 506 | 545 | 93 | 7 | 93 | 0 | 0 | 1.080 | 1.0 | 1.0 | 10 | 10 | 0 | 0 | 2.0 |
| MSFF037-17 | PVYR | 1 | 498 | 567 | 88 | 11 | 88 | 0 | 1 | 1.082 | 1.5 | 1.0 | 0 | 20 | 0 | 0 | 4.0 |
| W17039-7 | | 1 | 479 | 592 | 81 | 19 | 81 | 0 | 0 | 1.085 | 1.5 | 1.0 | 0 | 0 | 0 | 0 | 3.0 |
| W17AF6670-1 | | 1 | 476 | 520 | 91 | 9 | 91 | 0 | 0 | 1.082 | 1.0 | 0.0 | 0 | 0 | 0 | 0 | 3.0 |
| MN18AF6730-6 | | 1 | 459 | 527 | 87 | 8 | 87 | 0 | 5 | 1.068 | 2.5 | 3.0 | 20 | 20 | 0 | 0 | 3.0 |
| MSFF038-3 | PVYR | 1 | 446 | 487 | 92 | 8 | 92 | 0 | 0 | 1.078 | 1.0 | 1.0 | 0 | 10 | 0 | 0 | 3.0 |
| MN18AF6675-2 | | 1 | 436 | 539 | 81 | 9 | 81 | 0 | 11 | 1.074 | 1.0 | 2.0 | 0 | 0 | 0 | 0 | 3.0 |
| MN18W17043-17 | | 1 | 432 | 472 | 92 | 8 | 92 | 0 | 0 | 1.084 | - | - | 30 | 0 | 10 | 0 | 3.0 |
| MN18W17039-5 | | 1 | 427 | 475 | 90 | 10 | 90 | 0 | 0 | 1.080 | - | - | 0 | 0 | 10 | 0 | 3.0 |
| **Atlantic** | | **2** | **424** | **461** | **92** | **6** | **92** | **0** | **2** | **1.088** | **1.0** | **1.0** | **35** | **0** | **0** | **0** | **2.5** |
| MSFF017-1 | | 1 | 423 | 466 | 91 | 7 | 91 | 0 | 2 | 1.083 | 1.0 | 1.0 | 0 | 10 | 0 | 0 | 3.0 |
| W17066-11 | | 1 | 418 | 487 | 86 | 13 | 86 | 0 | 1 | 1.084 | 1.0 | 0.0 | 10 | 10 | 0 | 0 | 3.0 |
| MSFF050-1 | | 1 | 410 | 477 | 86 | 11 | 83 | 3 | 3 | 1.071 | 1.0 | 1.0 | 10 | 0 | 0 | 10 | 3.0 |
| W17043-37 | | 1 | 406 | 496 | 82 | 18 | 82 | 0 | 0 | 1.089 | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 3.0 |
| W17060-9 | | 1 | 399 | 551 | 73 | 27 | 73 | 0 | 0 | 1.089 | 1.0 | 1.0 | 0 | 10 | 0 | 0 | 4.0 |
| MSFF206-2 | PVYR | 1 | 397 | 446 | 89 | 8 | 89 | 0 | 3 | 1.076 | 1.5 | 2.0 | 0 | 10 | 0 | 0 | 4.0 |
| W17065-21 | | 1 | 396 | 469 | 84 | 8 | 84 | 0 | 8 | 1.079 | 1.0 | 0.0 | 30 | 0 | 10 | 0 | 3.0 |
| W17067-1 | | 1 | 396 | 501 | 79 | 21 | 79 | 0 | 1 | 1.087 | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 3.0 |
| MSFF097-6 | PVYR | 1 | 395 | 476 | 83 | 17 | 83 | 0 | 0 | 1.084 | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 3.0 |
| MSFF217-1 | PVYR | 1 | 383 | 463 | 83 | 16 | 83 | 0 | 1 | 1.076 | 1.0 | 1.0 | 20 | 0 | 0 | 0 | 3.0 |
| MN18AF6730-5 | | 1 | 382 | 444 | 86 | 11 | 86 | 0 | 3 | 1.079 | 1.5 | 2.0 | 0 | 10 | 0 | 0 | 2.0 |
| W17037-3 | | 1 | 362 | 439 | 82 | 15 | 82 | 0 | 3 | 1.080 | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 3.0 |
| MN18W17037-34 | | 1 | 358 | 394 | 91 | 9 | 91 | 0 | 0 | 1.081 | 1.0 | 1.0 | 0 | 10 | 0 | 0 | 3.0 |
| **Lamoka** | | **2** | **355** | **399** | **89** | **10** | **89** | **0** | **2** | **1.081** | **1.0** | **2.0** | **0** | **10** | **5** | **0** | **2.0** |
| MN18W17052-6 | | 1 | 349 | 389 | 90 | 10 | 90 | 0 | 0 | 1.082 | 1.5 | 1.0 | 0 | 0 | 0 | 0 | 3.0 |

| | | | | | | | | | | | | | | PERCENT (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PVY | | CWT/A | | PERCENT OF TOTAL[1] | | | | | | CHIP | OTF | TUBER QUALITY[4] | | | | |
| LINE | Resistant | N | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR | SCORE[2] | SED[3] | HH | VD | IBS | BC | MAT[5] |
| **Snowden** | | **2** | **347** | **406** | **85** | **15** | **85** | **0** | **0** | **1.086** | **1.0** | **1.0** | **0** | **20** | **0** | **0** | **3.0** |
| ND14247CAB-4 | | 1 | 345 | 458 | 75 | 12 | 75 | 0 | 13 | 1.073 | - | - | 40 | 0 | 0 | 0 | 3.0 |
| MSFF077-4 | PVYR | 1 | 344 | 371 | 93 | 7 | 93 | 0 | 0 | 1.073 | 1.0 | 1.0 | 0 | 10 | 0 | 0 | 2.0 |
| MSFF022-2 | | 1 | 342 | 392 | 87 | 13 | 87 | 0 | 0 | 1.076 | 1.5 | 2.0 | 0 | 0 | 0 | 0 | 3.0 |
| MN18W17037-26 | | 1 | 322 | 356 | 91 | 7 | 91 | 0 | 2 | 1.079 | 1.5 | 2.0 | 0 | 10 | 0 | 0 | 3.0 |
| MSFF303-3 | PVYR | 1 | 319 | 429 | 74 | 26 | 74 | 0 | 0 | 1.074 | 1.0 | 1.0 | 0 | 10 | 0 | 0 | 3.0 |
| MN18AF6658-5 | | 1 | 314 | 349 | 90 | 7 | 90 | 0 | 3 | 1.080 | 1.0 | 1.0 | 20 | 10 | 0 | 0 | 3.0 |
| MSFF058-1 | | 1 | 314 | 353 | 89 | 10 | 89 | 0 | 1 | 1.077 | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 2.0 |
| MN18W17057-5 | | 1 | 312 | 337 | 93 | 7 | 93 | 0 | 0 | 1.072 | 1.0 | 1.0 | 0 | 20 | 30 | 0 | 2.0 |
| MN18AF6717-6 | | 1 | 310 | 377 | 82 | 6 | 82 | 0 | 11 | 1.072 | 1.0 | 1.0 | 10 | 0 | 0 | 10 | 4.0 |
| W17060-22 | | 1 | 308 | 343 | 90 | 10 | 90 | 0 | 0 | 1.082 | 1.0 | 1.0 | 0 | 0 | 10 | 0 | 2.0 |
| ND14138AB-9 | | 1 | 307 | 368 | 83 | 17 | 83 | 0 | 0 | 1.081 | 1.0 | 1.0 | 0 | 10 | 0 | 0 | 3.0 |
| W17066-34 | | 1 | 301 | 395 | 76 | 24 | 76 | 0 | 0 | 1.083 | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 2.0 |
| MSFF292-1 | | 1 | 296 | 354 | 84 | 15 | 84 | 0 | 1 | 1.090 | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 3.0 |
| MN18W17037-11 | | 1 | 295 | 325 | 91 | 9 | 91 | 0 | 0 | 1.081 | 1.0 | 1.0 | 10 | 10 | 0 | 10 | 2.0 |
| MSFF206-1 | PVYR | 1 | 295 | 375 | 79 | 20 | 79 | 0 | 2 | 1.077 | 1.0 | 1.0 | 0 | 10 | 0 | 0 | 2.0 |
| W17067-13 | | 1 | 294 | 477 | 62 | 38 | 62 | 0 | 1 | 1.088 | 1.0 | 1.0 | 0 | 10 | 0 | 0 | 2.0 |
| W17049-10 | | 1 | 288 | 387 | 74 | 26 | 74 | 0 | 0 | 1.093 | 1.0 | 1.0 | 0 | 10 | 0 | 0 | 2.0 |
| MN18W17039-25 | | 1 | 285 | 349 | 82 | 18 | 82 | 0 | 0 | 1.088 | 1.5 | 1.0 | 10 | 0 | 10 | 0 | 3.0 |
| MN18W17043-6 | | 1 | 275 | 328 | 84 | 7 | 84 | 0 | 9 | 1.085 | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 2.0 |
| ND14246CAB-4 | | 1 | 268 | 364 | 74 | 26 | 74 | 0 | 0 | 1.070 | 1.0 | 1.0 | 0 | 10 | 0 | 0 | 1.0 |
| MSFF061-1 | | 1 | 265 | 306 | 87 | 12 | 87 | 0 | 2 | 1.081 | 1.0 | 2.0 | 0 | 0 | 10 | 0 | 3.0 |
| MN18W17037-38 | | 1 | 258 | 290 | 89 | 11 | 89 | 0 | 0 | 1.070 | 1.0 | 1.0 | 0 | 0 | 80 | 0 | 2.0 |
| MN18AF6717-2 | | 1 | 258 | 338 | 76 | 22 | 76 | 0 | 1 | 1.092 | 1.0 | 1.0 | 10 | 10 | 0 | 0 | 3.0 |
| MN18W17052-4 | | 1 | 247 | 334 | 74 | 26 | 74 | 0 | 0 | 1.098 | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 4.0 |
| ND14163AB-4 | | 1 | 245 | 320 | 76 | 23 | 76 | 0 | 0 | 1.073 | 1.5 | 1.0 | 0 | 20 | 0 | 0 | 2.0 |
| ND14192B-1 | | 1 | 238 | 330 | 72 | 26 | 72 | 0 | 2 | 1.076 | 1.5 | 1.0 | 0 | 10 | 0 | 0 | 1.0 |
| MN18W17037-21 | | 1 | 218 | 267 | 81 | 19 | 81 | 0 | 0 | 1.083 | 1.0 | 1.0 | 20 | 10 | 10 | 0 | 2.0 |
| ND14165AB-2 | | 1 | 194 | 258 | 75 | 22 | 75 | 0 | 3 | 1.073 | 1.5 | 1.0 | 10 | 0 | 0 | 0 | 2.0 |
| MN18AF6643-13 | | 1 | 133 | 220 | 61 | 28 | 61 | 0 | 11 | 1.072 | 1.0 | 0.0 | 0 | 20 | 0 | 0 | 3.0 |
| ND14199CAB-5 | | 1 | 118 | 454 | 26 | 74 | 26 | 0 | 0 | 1.085 | 1.0 | 0.0 | 10 | 0 | 0 | 0 | 2.0 |
| ND14193ABC-4 | | 1 | 53 | 257 | 21 | 79 | 21 | 0 | 0 | 1.071 | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 1.0 |
| MEAN | | | 352 | 425 | | | | | | 1.080 | | | | | 3.0 | 0.5 | 2.7 |

| | | | | | | | | | | | | | | PERCENT (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PVY | | CWT/A | | PERCENT OF TOTAL[1] | | | | | | CHIP | OTF | TUBER QUALITY[4] | | | | |
| LINE | Resistant | N | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR | SCORE[2] | SED[3] | HH | VD | IBS | BC | MAT[5] |
| ***Russet*** | | | | | | | | | | | | | | | | | |
| W17091-5rus | | 1 | 593 | 661 | 90 | 9 | 90 | 0 | 1 | 1.076 | - | - | 0 | 0 | 0 | 0 | 4.0 |
| ND14172B-2Russ | | 1 | 524 | 620 | 84 | 14 | 84 | 0 | 2 | 1.090 | - | - | 30 | 0 | 0 | 0 | 3.0 |
| W17098-43rus | | 1 | 477 | 591 | 81 | 17 | 81 | 0 | 2 | 1.080 | - | - | 0 | 0 | 0 | 0 | 2.0 |
| W17079-4rus | | 1 | 456 | 655 | 70 | 28 | 70 | 0 | 3 | 1.081 | - | - | 0 | 0 | 0 | 0 | 4.0 |
| W17069-53rus | | 1 | 436 | 502 | 87 | 10 | 87 | 0 | 3 | 1.083 | - | - | 10 | 0 | 0 | 0 | 4.0 |
| W17099-6rus | | 1 | 393 | 504 | 78 | 14 | 78 | 0 | 8 | 1.076 | - | - | 0 | 0 | 0 | 0 | 2.0 |
| W17096-14rus | | 1 | 373 | 488 | 76 | 16 | 76 | 0 | 7 | 1.083 | - | - | 0 | 0 | 0 | 0 | 2.0 |
| ND14172B-1Russ | | 1 | 353 | 487 | 72 | 23 | 72 | 0 | 5 | 1.083 | - | - | 0 | 0 | 0 | 0 | 3.0 |
| MN18W17079-11 | | 1 | 350 | 391 | 90 | 10 | 90 | 0 | 0 | 1.079 | - | - | 0 | 10 | 0 | 0 | 4.0 |
| W17086-10rus | | 1 | 335 | 453 | 74 | 26 | 74 | 0 | 0 | 1.080 | - | - | 0 | 0 | 0 | 0 | 2.0 |
| W17073-3rus | | 1 | 327 | 446 | 73 | 26 | 73 | 0 | 1 | 1.087 | - | - | 0 | 0 | 0 | 0 | 2.0 |
| ND14172B-4Russ | | 1 | 309 | 361 | 86 | 13 | 86 | 0 | 2 | 1.081 | - | - | 0 | 20 | 0 | 0 | 2.0 |
| W17098-19rus | | 1 | 305 | 408 | 75 | 20 | 75 | 0 | 5 | 1.091 | - | - | 0 | 0 | 0 | 0 | 2.0 |
| W17081-2rus | | 1 | 299 | 436 | 69 | 26 | 69 | 0 | 5 | 1.084 | - | - | 0 | 20 | 0 | 0 | 2.0 |
| W17092-2rus | | 1 | 296 | 361 | 82 | 12 | 82 | 0 | 6 | 1.072 | - | - | 0 | 0 | 0 | 0 | 2.0 |
| ND14173-2Russ | | 1 | 295 | 421 | 70 | 25 | 70 | 0 | 5 | 1.076 | - | - | 0 | 10 | 0 | 0 | 1.0 |
| **Russet Burbank** | | **2** | **279** | **482** | **58** | **33** | **58** | **0** | **9** | **1.072** | **-** | **-** | **10** | **10** | **0** | **0** | **1.5** |
| MN18W17091-5 | | 1 | 264 | 380 | 69 | 31 | 69 | 0 | 0 | 1.072 | - | - | 0 | 0 | 0 | 0 | 1.0 |
| **Goldrush** | | **2** | **252** | **366** | **68** | **27** | **68** | **0** | **5** | **1.070** | **-** | **-** | **0** | **15** | **0** | **0** | **1.5** |
| **Russet Norkotah** | | **1** | **242** | **350** | **69** | **30** | **69** | **0** | **1** | **1.073** | **-** | **-** | **10** | **0** | **0** | **10** | **1.0** |
| ND14261B-1Russ | | 1 | 191 | 336 | 57 | 39 | 57 | 0 | 4 | 1.082 | - | - | 0 | 20 | 0 | 0 | 2.0 |
| MN18AF6758-2 | | 1 | 128 | 241 | 53 | 42 | 53 | 0 | 5 | 1.086 | - | - | 10 | 10 | 0 | 0 | 2.0 |
| ND14174-1Russ | | 1 | 45 | 260 | 17 | 75 | 17 | 0 | 8 | 1.077 | - | - | 0 | 50 | 0 | 0 | 1.0 |
| MEAN | | | 327 | 443 | | | | | | 1.080 | | | | | 0.0 | 0.4 | 2.2 |

| | | | | | | | | | | | | | | PERCENT (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PVY | | CWT/A | | PERCENT OF TOTAL[1] | | | | | | CHIP | OTF | TUBER QUALITY[4] | | | | |
| LINE | Resistant | N | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR | SCORE[2] | SED[3] | HH | VD | IBS | BC | MAT[5] |
| ***Red*** | | | | | | | | | | | | | | | | | |
| MSFF353-1R | | 1 | 636 | 674 | 94 | 6 | 94 | 0 | 0 | 1.073 | 1.5 | 2.0 | 0 | 10 | 0 | 0 | 4.0 |
| W17005-3R | | 1 | 503 | 617 | 82 | 16 | 82 | 0 | 2 | 1.066 | - | - | 0 | 20 | 0 | 0 | 2.0 |
| ND14302-8R | | 1 | 471 | 531 | 89 | 11 | 89 | 0 | 0 | 1.065 | - | - | 0 | 0 | 0 | 0 | 2.0 |
| ND14151-9R | | 1 | 469 | 551 | 85 | 15 | 85 | 0 | 0 | 1.071 | - | - | 0 | 0 | 0 | 0 | 3.0 |
| MN18CO15083-6 | | 1 | 424 | 605 | 70 | 30 | 70 | 0 | 0 | 1.074 | - | - | 0 | 10 | 0 | 0 | 4.0 |
| MN18W17009-1 | | 1 | 400 | 479 | 84 | 14 | 84 | 0 | 2 | 1.067 | - | - | 0 | 0 | 0 | 20 | 2.0 |
| W17AF6698-1R | | 1 | 393 | 497 | 79 | 20 | 79 | 0 | 1 | 1.065 | - | - | 0 | 10 | 0 | 0 | 2.0 |
| MN18W17026-2 | | 1 | 392 | 540 | 73 | 24 | 73 | 0 | 3 | 1.064 | - | - | 0 | 10 | 0 | 0 | 2.0 |
| W17027-3R/Y | | 1 | 370 | 449 | 83 | 17 | 83 | 0 | 0 | 1.070 | - | - | 30 | 0 | 0 | 0 | 2.0 |
| ND14151-24R | | 1 | 370 | 449 | 82 | 15 | 82 | 0 | 2 | 1.063 | - | - | 0 | 0 | 10 | 0 | 3.0 |
| W16025-5R | | 1 | 358 | 485 | 74 | 26 | 74 | 0 | 1 | 1.064 | - | - | 0 | 10 | 0 | 0 | 1.0 |
| ND14336-6R | | 1 | 334 | 412 | 81 | 16 | 81 | 0 | 3 | 1.057 | - | - | 0 | 0 | 0 | 10 | 1.0 |
| W17002-13R | | 1 | 312 | 467 | 67 | 32 | 67 | 0 | 1 | 1.067 | - | - | 0 | 0 | 10 | 0 | 1.0 |
| W16030-4R | | 1 | 311 | 429 | 73 | 27 | 73 | 0 | 1 | 1.066 | - | - | 0 | 0 | 0 | 0 | 1.0 |
| W17026-4R | | 1 | 304 | 460 | 66 | 34 | 66 | 0 | 0 | 1.058 | - | - | 0 | 0 | 0 | 0 | 2.0 |
| ND14151-15R | | 1 | 303 | 429 | 71 | 29 | 71 | 0 | 0 | 1.073 | - | - | 10 | 0 | 0 | 0 | 3.0 |
| **Red Norland** | | **2** | **296** | **352** | **84** | **16** | **84** | **0** | **0** | **1.061** | **-** | **-** | **10** | **20** | **0** | **0** | **1.0** |
| MN18CO15117-2 | | 1 | 296 | 384 | 77 | 20 | 77 | 0 | 3 | 1.075 | - | - | 0 | 0 | 0 | 0 | 2.0 |
| MN18SR00011-2 | | 1 | 292 | 405 | 72 | 28 | 72 | 0 | 0 | 1.073 | - | - | 0 | 10 | 0 | 0 | 2.0 |
| MSFF182-1R | PVYR | 1 | 260 | 475 | 55 | 45 | 55 | 0 | 1 | 1.085 | 1.5 | 2.0 | 0 | 30 | 0 | 0 | 3.0 |
| ND14151-20R | | 1 | 257 | 405 | 63 | 36 | 63 | 0 | 1 | 1.064 | - | - | 0 | 20 | 0 | 0 | 3.0 |
| **Dark Red Norland** | | **2** | **255** | **302** | **85** | **15** | **85** | **0** | **1** | **1.060** | **-** | **-** | **5** | **10** | **0** | **0** | **1.5** |
| W17027-2R | | 1 | 240 | 439 | 55 | 44 | 55 | 0 | 2 | 1.061 | - | - | 0 | 0 | 0 | 0 | 1.0 |
| **Red LaSoda** | | **1** | **234** | **289** | **81** | **18** | **81** | **0** | **1** | **1.067** | **-** | **-** | **0** | **10** | **0** | **10** | **2.5** |
| MSFF130-1R | PVYR | 1 | 203 | 365 | 56 | 44 | 56 | 0 | 0 | 1.067 | - | - | 0 | 10 | 0 | 0 | 2.0 |
| ND14299-3RY | | 1 | 202 | 293 | 69 | 30 | 69 | 0 | 1 | 1.070 | - | - | 0 | 20 | 0 | 0 | 1.0 |
| ND14168B-2R | | 1 | 179 | 370 | 48 | 49 | 48 | 0 | 3 | 1.084 | - | - | 0 | 0 | 0 | 0 | 2.0 |
| W17007-5R | | 1 | 171 | 306 | 56 | 42 | 56 | 0 | 2 | 1.063 | - | - | 0 | 20 | 0 | 0 | 1.0 |
| MSFF160-1R | | 1 | 121 | 218 | 56 | 42 | 56 | 0 | 2 | 1.058 | - | - | 0 | 10 | 0 | 0 | 4.0 |
| MSFF145-2R | | 1 | 110 | 265 | 42 | 58 | 42 | 0 | 1 | 1.070 | - | - | 0 | 0 | 0 | 0 | 1.0 |
| MSFF223-1RY | PVYR | 1 | 108 | 269 | 40 | 57 | 40 | 0 | 3 | 1.077 | 1.5 | 2.0 | 0 | 0 | 0 | 0 | 1.0 |
| MSFF228-1RY | | 1 | 63 | 321 | 20 | 80 | 20 | 0 | 0 | 1.064 | - | - | 0 | 0 | 0 | 0 | 1.0 |
| MEAN | | | 301 | 423 | | | | | | 1.068 | | | | | 0.6 | 1.3 | 2.0 |

| | | | | | | | | | | | | | | PERCENT (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PVY | | CWT/A | | PERCENT OF TOTAL[1] | | | | | | CHIP | OTF | TUBER QUALITY[4] | | | | |
| LINE | Resistant | N | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR | SCORE[2] | SED[3] | HH | VD | IBS | BC | MAT[5] |
| ***Speciality*** | | | | | | | | | | | | | | | | | |
| MSFF335-2RR | | 1 | 545 | 654 | 83 | 17 | 83 | 0 | 0 | 1.063 | 2.0 | 2.0 | 0 | 0 | 0 | 0 | 4.0 |
| MN18TX17760-2 | | 1 | 484 | 544 | 89 | 4 | 89 | 0 | 6 | 1.067 | 2.0 | 3.0 | 0 | 0 | 0 | 0 | 3.0 |
| MSFF351-1RR | | 1 | 369 | 496 | 74 | 19 | 74 | 0 | 6 | 1.064 | - | - | 0 | 0 | 0 | 10 | 3.0 |
| MN18CO16154-9 | | 1 | 310 | 441 | 70 | 29 | 70 | 0 | 1 | 1.089 | - | - | 0 | 0 | 100 | 0 | 2.0 |
| MSFF335-1RR | | 1 | 279 | 566 | 49 | 51 | 49 | 0 | 0 | 1.069 | - | - | 0 | 0 | 0 | 0 | 3.0 |
| MN18TX17730-8 | | 1 | 194 | 426 | 46 | 53 | 46 | 0 | 2 | 1.072 | 1.5 | 2.0 | 0 | 10 | 0 | 0 | 3.0 |
| MSFF134-2RR | | 1 | 141 | 274 | 51 | 47 | 51 | 0 | 2 | 1.066 | - | - | 0 | 20 | 0 | 0 | 1.0 |
| MN18CO16213-2 | | 1 | 63 | 253 | 25 | 75 | 25 | 0 | 0 | 1.075 | 1.5 | 2.0 | 0 | 0 | 0 | 0 | 2.0 |
| MEAN | | | 298 | 457 | | | | | | 1.070 | | | | | 12.5 | 1.3 | 2.6 |
| $HSD_{0.05}$ | | | 303 | 361 | | | | | | 0.009 | | | | | | | |

[1]SIZE: B: < 2 in.; A: 2-3.25 in.; OV: > 3.25 in.; PO: Pickouts.

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

[3]SED: Stem End Defect, Based on Paul Bethke's (USDA/UWisconsin - Madison) 0 - 5 scale. 0 = no SED; 3 = significant SED; 5 = severe SED

[4]QUALITY: HH: Hollow Heart; BC: Brown Center; VD: Vascular Discoloration; IBS: Internal Brown Spot. Percent of 40 Oversize and/or A-size tubers cut.

[5]MATURITY RATING: August 24, 2021; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

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

Plant Date: 5/5/2021

Vine Kill: 8/27/2021

Days from planting to vine kill: 114

**Table 3**

**MICHIGAN STATE UNIVERSITY**
**POTATO BREEDING and GENETICS**

**ADAPTATION TRIAL, TABLESTOCK LINES**
**MONTCALM RESEARCH CENTER**
**May 5 to September 27, 2021 (145 days)**
**DD Base 40°F 3402[7]**

| | | | | | | | | | | | PERCENT (%) | | | | | | | LB[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PVY | | CWT/A | | PERCENT OF TOTAL[1] | | | | | | TUBER QUALITY[2] | | | | | | | RAUDPC |
| LINE | Resistant | N | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR | HH | VD | IBS | BC | SCAB[3] | MAT[4] | BRUISE[5] | x100 |
| MSZ551-1 | PVYR | 2 | 548 | 588 | 93 | 5 | 91 | 2 | 2 | 1.077 | 0 | 20 | 20 | 5 | 1.2 | 4.0 | 2.1 | 0.2 |
| MSX245-2Y | | 2 | 511 | 547 | 93 | 6 | 92 | 1 | 1 | 1.087 | 0 | 10 | 0 | 0 | 1.7 | 4.0 | 2.4 | 10.4 |
| MSX156-1Y | | 2 | 482 | 502 | 96 | 2 | 84 | 12 | 2 | 1.069 | 0 | 0 | 0 | 0 | 2.2 | 3.0 | - | 29.9 |
| MSBB343-2Y | | 2 | 474 | 502 | 95 | 5 | 92 | 3 | 0 | 1.082 | 5 | 10 | 0 | 0 | 1.8 | 2.0 | 1.2 | - |
| MSV093-1Y | | 2 | 451 | 494 | 91 | 6 | 91 | 0 | 2 | 1.078 | 0 | 0 | 0 | 0 | 1.7 | 3.0 | 1.0 | - |
| Blackberry | | 2 | 429 | 530 | 81 | 19 | 81 | 0 | 0 | 1.062 | 0 | 0 | 0 | 0 | 2.2 | 3.0 | 0.4 | - |
| MSV179-1 | | 2 | 427 | 445 | 96 | 2 | 95 | 1 | 2 | 1.064 | 5 | 5 | 5 | 0 | 1.5 | 3.0 | 1.9 | - |
| MSZ109-08PP | | 2 | 413 | 476 | 87 | 11 | 87 | 0 | 2 | 1.064 | 0 | 0 | 0 | 0 | 1.3 | 2.5 | 0.5 | - |
| MSCC447-1WR | | 2 | 397 | 436 | 91 | 9 | 90 | 1 | 0 | 1.074 | 0 | 0 | 0 | 0 | 2.2 | 3.5 | 2.1 | 24 |
| MSCC447-01WP | | 2 | 379 | 447 | 84 | 16 | 84 | 0 | 1 | 1.076 | 0 | 0 | 0 | 0 | 2.7 | 3.5 | 2.9 | - |
| MSAA174-1 | PVYR | 2 | 375 | 413 | 91 | 7 | 90 | 0 | 3 | 1.065 | 0 | 10 | 15 | 25 | 1.8 | 3.0 | 1.7 | - |
| MSCC302-1 | | 2 | 372 | 444 | 82 | 17 | 82 | 0 | 0 | 1.079 | 0 | 0 | 0 | 5 | 2.0 | 2.0 | 2.4 | 8.2 |
| MSDD483-1 | PVYR | 2 | 364 | 461 | 79 | 21 | 79 | 0 | 1 | 1.077 | 0 | 0 | 10 | 0 | 2.0 | 2.5 | - | - |
| MSZ615-2 | | 2 | 346 | 369 | 94 | 6 | 94 | 0 | 0 | 1.071 | 0 | 5 | 0 | 0 | 1.5 | 1.5 | 1.4 | - |
| MSZ590-1SPL | | 2 | 344 | 404 | 85 | 14 | 85 | 0 | 1 | 1.068 | 10 | 0 | 0 | 0 | 1.3 | 2.5 | 1.5 | 14 |
| MST252-1Y | | 2 | 332 | 416 | 80 | 14 | 80 | 0 | 6 | 1.072 | 0 | 5 | 0 | 0 | 1.5 | 1.0 | 1.5 | 27.3 |
| MSZ416-8RY | | 2 | 332 | 380 | 87 | 9 | 87 | 0 | 4 | 1.059 | 0 | 5 | 0 | 0 | 1.0 | 2.0 | 0.5 | - |
| MSZ598-2 | | 2 | 330 | 357 | 92 | 7 | 91 | 1 | 1 | 1.073 | 0 | 10 | 0 | 0 | 1.8 | 2.0 | 1.3 | - |
| MSAA101-01RR | | 2 | 324 | 431 | 75 | 25 | 75 | 0 | 0 | 1.079 | 0 | 0 | 0 | 0 | 1.2 | 2.5 | 2.2 | - |
| MSZ427-3R | | 2 | 313 | 378 | 83 | 17 | 83 | 0 | 0 | 1.062 | 0 | 5 | 0 | 0 | 2.7 | 1.5 | 1.2 | - |
| MSCC553-1R | PVYR | 2 | 305 | 342 | 89 | 9 | 88 | 1 | 1 | 1.071 | 0 | 0 | 0 | 0 | 2.5 | 3.0 | 1.1 | 12.4 |
| MSZ513-2 | | 2 | 286 | 317 | 90 | 9 | 90 | 0 | 1 | 1.074 | 0 | 0 | 0 | 0 | 1.7 | 2.0 | 0.9 | - |
| MSBB371-1YSPL | | 2 | 280 | 330 | 85 | 15 | 85 | 0 | 0 | 1.077 | 0 | 5 | 0 | 0 | 1.3 | 1.5 | 1.3 | - |
| **Yukon Gold** | | **2** | **261** | **289** | **91** | **6** | **91** | **0** | **3** | **1.076** | **35** | **5** | **5** | **0** | **1.8** | **1.5** | **0.8** | **43.1** |
| MSCC720-1WP | | 2 | 240 | 407 | 59 | 41 | 59 | 0 | 0 | 1.081 | 0 | 0 | 0 | 0 | 3.3 | 2.0 | 2.2 | - |
| MSBB351-1 | | 2 | 237 | 261 | 91 | 9 | 89 | 2 | 0 | 1.053 | 0 | 0 | 0 | 0 | 1.2 | 1.5 | 0.2 | 16.3 |
| MSAA127-1PP | | 2 | 227 | 318 | 71 | 28 | 71 | 0 | 1 | 1.056 | 0 | 0 | 0 | 0 | 1.5 | 1.5 | 1.4 | - |
| MSCC614-1RYSPL | | 2 | 224 | 413 | 54 | 46 | 54 | 0 | 0 | 1.082 | 0 | 5 | 0 | 0 | 1.7 | 2.5 | nd | 30.4 |
| MSDD254-1SPL | | 2 | 220 | 244 | 90 | 9 | 89 | 1 | 1 | 1.062 | 10 | 5 | 0 | 5 | 1.8 | 1.0 | 0.2 | - |

| | | | | | | | | | | | PERCENT (%) | | | | | | | LB[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PVY | | CWT/A | | PERCENT OF TOTAL[1] | | | | | | TUBER QUALITY[2] | | | | | | | RAUDPC |
| LINE | Resistant | N | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR | HH | VD | IBS | BC | SCAB[3] | MAT[4] | BRUISE[5] | x100 |
| MSBB364-1 | | 2 | 213 | 228 | 93 | 5 | 93 | 0 | 2 | 1.051 | 0 | 0 | 0 | 0 | 1.5 | 3.0 | 0.6 | - |
| MSZ157-3 | | 2 | 208 | 322 | 65 | 34 | 65 | 0 | 1 | 1.078 | 0 | 0 | 0 | 5 | 2.5 | 2.0 | 0.5 | - |
| MSZ427-1R | | 2 | 201 | 339 | 62 | 18 | 61 | 1 | 19 | 1.066 | 0 | 10 | 0 | 0 | 1.5 | 2.5 | 0.6 | - |
| **Superior** | | **2** | **169** | **209** | **81** | **19** | **81** | **0** | **0** | **1.071** | **0** | **5** | **0** | **0** | **0.7** | **1.0** | **1.0** | - |
| MEAN | | | 334 | 395 | | | | | | 1.071 | | | | | 1.8 | 2.3 | 1.3 | |
| $HSD_{0.05}$ | | | 270 | 260 | | | | | | 0.013 | | | | | | | | |

[1]SIZE: B: < 2 in.; A: 2-3.25 in.; OV: > 3.25 in.; PO: Pickouts.

[2]QUALITY: HH: Hollow Heart; BC: Brown Center; VD: Vascular Discoloration; IBS: Internal Brown Spot. Percent of 40 Oversize and/or A-size tubers cut.

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

[4]MATURITY RATING: August 24, 2021; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering). Plant Date: 5/5/2021

[5]BRUISE: Simulated blackspot bruise test average number of spots per tuber. Vine Kill: 9/8/2021

[6]LB RAUDPC: Late blight (*P. infestans* US-23) foliar disease reaction. [7]Enviroweather: Entrican Station. Planting to vine kill 126

**Table 4**

**MICHIGAN STATE UNIVERSITY**
**POTATO BREEDING and GENETICS**

**PRELIMINARY TRIAL, CHIP-PROCESSING LINES**
**MONTCALM RESEARCH CENTER**
**May 5 to September 14, 2021 (132 days)**
**DD Base 40°F 3402[9]**

| | | | | | | | | | | | | | PERCENT (%) | | | | | | | LB[8] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PVY | | CWT/A | | PERCENT OF TOTAL[1] | | | | | | CHIP | OTF | TUBER QUALITY[4] | | | | | | | RAUDPC |
| LINE | Resistant | N | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR | SCORE[2] | SED[3] | HH | VD | IBS | BC | SCAB[5] | MAT[6] | BRUISE[7] | x100 |
| MSBB190-2 | | 1 | 564 | 583 | 97 | 3 | 96 | 1 | 0 | 1.081 | 1.0 | 2.0 | 0 | 0 | 0 | 0 | 1.7 | 3.0 | 3.2 | - |
| MSDD376-4 | PVYR | 1 | 560 | 600 | 93 | 5 | 92 | 1 | 1 | 1.093 | 1.0 | 0.0 | 10 | 0 | 0 | 0 | 1.5 | 3.0 | 3.4 | - |
| MSFF079-16 | PVYR | 1 | 551 | 565 | 98 | 2 | 89 | 9 | 0 | 1.078 | 1.0 | 1.0 | 20 | 10 | 0 | 0 | - | 3.0 | 2.1 | - |
| MSEE207-2 | PVYR | 1 | 534 | 562 | 95 | 5 | 95 | 0 | 0 | 1.080 | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 0.5 | 3.0 | 1.6 | - |
| MSFF031-3 | PVYR | 1 | 517 | 591 | 88 | 12 | 88 | 0 | 0 | 1.074 | 1.0 | 1.0 | 0 | 10 | 0 | 0 | 1.2 | 2.0 | 1.7 | - |
| MSEE063-6 | PVYR | 1 | 508 | 537 | 95 | 5 | 93 | 1 | 1 | 1.079 | 2.0 | 3.0 | 10 | 10 | 0 | 0 | 0.7 | 3.0 | 2.3 | - |
| MSFF031-6 | PVYR | 1 | 507 | 557 | 91 | 9 | 91 | 0 | 0 | 1.070 | 1.0 | 2.0 | 0 | 0 | 0 | 0 | 1.0 | 3.0 | 2.3 | - |
| MSEE035-4 | PVYR | 1 | 472 | 514 | 92 | 8 | 91 | 1 | 1 | 1.089 | 1.0 | 1.0 | 10 | 0 | 0 | 0 | 1.2 | 4.0 | 4.1 | - |
| MSFF008-1 | | 1 | 455 | 485 | 94 | 6 | 93 | 1 | 0 | 1.074 | - | - | 0 | 0 | 0 | 0 | 1.2 | 3.0 | - | - |
| MSX495-2 | | 1 | 442 | 475 | 93 | 3 | 93 | 0 | 4 | 1.079 | 1.0 | 0.0 | 20 | 0 | 0 | 0 | 2.2 | 3.0 | 2.9 | 0.3 |
| MSDD244-05 | PVYR | 1 | 426 | 460 | 93 | 6 | 91 | 1 | 2 | 1.088 | 1.5 | 3.0 | 20 | 20 | 0 | 0 | 1.3 | 3.0 | 2.9 | - |
| MSEE101-2 | | 1 | 405 | 435 | 93 | 6 | 93 | 0 | 0 | 1.090 | 1.5 | 1.0 | 20 | 0 | 0 | 0 | 0.5 | 2.0 | 2.9 | - |
| MSDD372-07 | PVYR | 1 | 400 | 469 | 85 | 15 | 85 | 0 | 0 | 1.093 | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 1.7 | 3.0 | 3.2 | - |
| MSEE163-1 | | 1 | 397 | 444 | 89 | 10 | 89 | 0 | 0 | 1.072 | - | - | 0 | 30 | 0 | 0 | 1.0 | 2.0 | - | - |
| MSEE169-1 | PVYR | 1 | 397 | 425 | 93 | 5 | 93 | 0 | 2 | 1.071 | - | - | 0 | 50 | 50 | 0 | 1.2 | 3.0 | - | - |
| MSEE031-3 | PVYR | 1 | 392 | 431 | 91 | 6 | 91 | 0 | 3 | 1.086 | 1.0 | 2.0 | 10 | 10 | 0 | 0 | 1.3 | 3.0 | 3.3 | - |
| MSBB029-1Y | | 1 | 387 | 466 | 83 | 14 | 83 | 0 | 2 | 1.081 | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 1.0 | 2.0 | 1.8 | - |
| **Atlantic** | | **1** | **381** | **415** | **92** | **6** | **92** | **0** | **2** | **1.092** | **1.0** | **1.0** | **40** | **20** | **0** | **0** | **2.8** | **3.0** | **2.5** | **39.7** |
| MSDD553-1 | PVYR | 1 | 365 | 386 | 95 | 5 | 95 | 0 | 0 | 1.079 | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 2.2 | 4.0 | 1.7 | - |
| MSBB008-3 | | 1 | 357 | 395 | 91 | 9 | 91 | 0 | 1 | 1.085 | 1.0 | 2.0 | 20 | 0 | 0 | 10 | 1.0 | 2.0 | 2.5 | - |
| MSDD249-9 | PVYR | 1 | 337 | 354 | 95 | 5 | 94 | 1 | 0 | 1.081 | 1.0 | 2.0 | 0 | 0 | 10 | 0 | 1.8 | 3.0 | 2.6 | - |
| MSEE016-07 | | 1 | 333 | 347 | 96 | 4 | 96 | 0 | 0 | 1.092 | 1.0 | 1.0 | 10 | 0 | 0 | 0 | 1.8 | 3.0 | 2.0 | - |
| MSBB190-3 | | 1 | 326 | 339 | 96 | 4 | 96 | 0 | 0 | 1.076 | - | - | 0 | 0 | 0 | 0 | 2.0 | 3.0 | - | - |
| MSFF029-10 | PVYR | 1 | 324 | 390 | 83 | 17 | 83 | 0 | 0 | 1.090 | 1.0 | 1.0 | 0 | 20 | 0 | 0 | 1.8 | 3.0 | 1.0 | - |
| MSEE016-10 | PVYR | 1 | 322 | 378 | 85 | 15 | 85 | 0 | 0 | 1.091 | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 2.0 | 3.0 | 3.5 | - |
| MSZ218-5 | PVYR | 1 | 319 | 337 | 95 | 5 | 95 | 0 | 0 | 1.078 | - | - | 50 | 10 | 0 | 0 | 1.3 | 3.0 | - | - |
| MSDD372-15 | | 1 | 314 | 329 | 96 | 4 | 96 | 0 | 0 | 1.084 | 1.0 | 2.0 | 10 | 0 | 0 | 0 | 1.0 | 4.0 | 2.0 | - |
| MSAA678-1 | | 1 | 314 | 359 | 87 | 12 | 87 | 0 | 1 | 1.075 | - | - | 10 | 0 | 0 | 0 | 1.0 | 2.0 | - | - |
| MSV241-2 | | 1 | 305 | 334 | 91 | 8 | 91 | 0 | 1 | 1.091 | 1.5 | 1.0 | 50 | 20 | 0 | 0 | 2.2 | 3.0 | 3.4 | - |
| MSEE002-3 | | 1 | 304 | 345 | 88 | 12 | 88 | 0 | 0 | 1.091 | 1.0 | 2.0 | 0 | 0 | 0 | 0 | 2.2 | 3.0 | 2.2 | - |
| MSFF072-1Y | PVYR | 1 | 294 | 353 | 83 | 7 | 83 | 0 | 9 | 1.085 | 1.5 | 1.0 | 10 | 0 | 0 | 0 | 1.8 | 3.0 | 2.2 | - |
| MSFF073-3 | PVYR | 1 | 293 | 329 | 89 | 10 | 89 | 0 | 1 | 1.089 | 1.0 | 2.0 | 0 | 0 | 0 | 0 | 0.8 | 3.0 | 2.3 | - |
| MSY089-2 | | 1 | 290 | 307 | 94 | 6 | 91 | 3 | 0 | 1.076 | - | - | 0 | 60 | 0 | 10 | 2.5 | 3.0 | - | - |
| MSZ042-07 | | 1 | 288 | 301 | 96 | 3 | 93 | 2 | 2 | 1.073 | - | - | 70 | 20 | 0 | 0 | 1.7 | 3.0 | - | - |

| | | | | | | | | | | | | | PERCENT (%) | | | | | | | LB[8] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PVY | | CWT/A | | PERCENT OF TOTAL[1] | | | | | | CHIP | OTF | TUBER QUALITY[4] | | | | | | | RAUDPC |
| LINE | Resistant | N | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR | SCORE[2] | SED[3] | HH | VD | IBS | BC | SCAB[5] | MAT[6] | BRUISE[7] | x100 |
| MSFF002-1 | | 1 | 277 | 318 | 87 | 13 | 87 | 0 | 0 | 1.078 | 1.0 | 1.0 | 0 | 10 | 0 | 0 | 1.5 | 2.0 | 1.7 | - |
| MSAA241-1 | | 1 | 277 | 291 | 95 | 5 | 95 | 0 | 0 | 1.075 | - | - | 0 | 50 | 0 | 0 | 0.8 | 2.0 | - | - |
| MSFF035-2 | PVYR | 1 | 271 | 330 | 82 | 13 | 82 | 0 | 5 | 1.079 | 1.0 | 1.0 | 10 | 0 | 0 | 0 | 1.5 | 1.0 | 2.8 | - |
| **Snowden** | | **1** | **267** | **309** | **86** | **14** | **86** | **0** | **0** | **1.084** | **1.0** | **2.0** | **0** | **10** | **0** | **0** | **3.0** | **2.0** | **2.6** | **10.1** |
| MSEE191-3Y | PVYR | 1 | 249 | 265 | 94 | 5 | 88 | 5 | 1 | 1.072 | - | - | 30 | 0 | 0 | 0 | 2.2 | 4.0 | - | - |
| **Pike** | | **1** | **232** | **263** | **88** | **12** | **88** | **0** | **0** | **1.083** | **1.0** | **2.0** | **0** | **0** | **0** | **0** | **1.0** | **2.0** | **1.8** | - |
| MSAA266-1 | | 1 | 202 | 232 | 87 | 4 | 87 | 0 | 9 | 1.066 | - | - | 0 | 0 | 0 | 0 | 1.5 | 2.0 | - | - |
| MSEE182-3 | PVYR | 1 | 114 | 149 | 76 | 24 | 76 | 0 | 0 | 1.080 | 1.0 | 0.0 | 0 | 0 | 10 | 10 | 1.7 | 2.0 | 0.6 | - |
| MSAA309-15 | | 1 | 69 | 120 | 57 | 39 | 57 | 0 | 4 | 1.074 | - | - | 0 | 0 | 0 | 0 | 0.8 | 1.0 | - | 41.7 |
| MEAN | | | 357 | 392 | | | | | | 1.081 | | | | | | | 1.5 | 2.7 | 2.4 | |

[1]SIZE: B: < 2 in.; A: 2-3.25 in.; OV: > 3.25 in.; PO: Pickouts.

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

[3]SED: Stem End Defect, Based on Paul Bethke's (USDA/UWisconsin - Madison) 0 - 5 scale. 0 = no SED; 3 = significant SED; 5 = severe SED

[4]QUALITY: HH: Hollow Heart; BC: Brown Center; VD: Vascular Discoloration; IBS: Internal Brown Spot. Percent of 40 Oversize and/or A-size tubers cut.

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

[6]MATURITY RATING: August 24, 2021; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

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

[8]LB RAUDPC: Late blight (*P. infestans* US-23) foliar disease reaction.

Plant Date: 5/5/2021

Vine Kill: 9/8/2021

Days from planting to vine kill: 126

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

**Table 5**

**MICHIGAN STATE UNIVERSITY**
**POTATO BREEDING and GENETICS**

**PRELIMINARY TRIAL, TABLESTOCK LINES**
**MONTCALM RESEARCH CENTER**
**May 5 to September 14, 2021 (132 days)**
**DD Base 40°F 3402[7]**

| | | | | | | | | | | | | PERCENT (%) | | | | | | LB[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PVY | | CWT/A | | PERCENT OF TOTAL[1] | | | | | | TUBER QUALITY[2] | | | | | | | RAUDPC |
| LINE | Resistant | N | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR | HH | VD | IBS | BC | SCAB[3] | MAT[4] | BRUISE[5] | x100 |
| MSCC300-1 | | 1 | 530 | 600 | 88 | 10 | 87 | 2 | 2 | 1.072 | 20 | 0 | 0 | 0 | 2.8 | 3.0 | 1.0 | - |
| MSDD088-1 | | 1 | 525 | 558 | 94 | 6 | 93 | 1 | 0 | 1.073 | 0 | 0 | 0 | 0 | 1.7 | 3.0 | 0.4 | 47.1 |
| MSEE048-2Y | PVYR | 1 | 467 | 489 | 95 | 5 | 95 | 0 | 0 | 1.077 | 0 | 0 | 0 | 0 | 0.7 | 3.0 | 1.8 | - |
| MSDD251-2Y | | 1 | 455 | 500 | 91 | 9 | 91 | 0 | 0 | 1.072 | 60 | 0 | 0 | 0 | 2.5 | 2.0 | 0.7 | 27.1 |
| MSEE075-1 | PVYR | 1 | 453 | 461 | 98 | 2 | 91 | 7 | 0 | 1.074 | 0 | 10 | 0 | 0 | 2.0 | 3.0 | 2.0 | - |
| MSFF211-2 | PVYR | 1 | 448 | 477 | 94 | 5 | 94 | 0 | 1 | 1.065 | 40 | 0 | 0 | 10 | 1.3 | 3.0 | 0.4 | - |
| MSFF191-1Y | PVYR | 1 | 440 | 476 | 92 | 8 | 92 | 0 | 0 | 1.068 | 60 | 0 | 0 | 10 | 2.0 | 3.0 | 0.6 | - |
| MSFF120-2Y | | 1 | 405 | 432 | 94 | 6 | 94 | 0 | 0 | 1.076 | 0 | 0 | 0 | 10 | 1.0 | 2.0 | 1.4 | - |
| MSZ610-3 | | 1 | 402 | 422 | 95 | 4 | 91 | 4 | 1 | 1.082 | 10 | 30 | 50 | 0 | - | 3.0 | 2.8 | - |
| MSEE052-5 | | 1 | 346 | 379 | 91 | 5 | 91 | 0 | 3 | 1.073 | 0 | 0 | 0 | 0 | 1.7 | 3.0 | 0.4 | - |
| MSBB213-1SPL | | 1 | 289 | 319 | 91 | 9 | 88 | 3 | 0 | 1.075 | 0 | 10 | 0 | 0 | 1.8 | 4.0 | 3.0 | - |
| **Reba** | | **1** | **283** | **305** | **93** | **6** | **93** | **0** | **1** | **1.071** | **10** | **0** | **0** | **0** | **2.2** | **2.0** | **1.6** | - |
| MSBB323-1 | | 1 | 276 | 298 | 93 | 7 | 93 | 0 | 0 | 1.089 | 0 | 0 | 0 | 50 | 1.3 | 3.0 | 1.0 | - |
| MSX137-6 | PVYR | 1 | 260 | 338 | 77 | 21 | 77 | 0 | 2 | 1.074 | 0 | 10 | 0 | 0 | 2.8 | 2.0 | 1.4 | - |
| MSDD107-1Y | | 1 | 234 | 329 | 71 | 29 | 71 | 0 | 0 | 1.075 | 0 | 0 | 0 | 0 | 1.8 | 5.0 | 1.2 | - |
| MSFF055-1Y | | 1 | 208 | 311 | 67 | 33 | 67 | 0 | 0 | 1.068 | 0 | 0 | 0 | 0 | 1.0 | 2.0 | 1.2 | - |
| MSFF189-1Y | | 1 | 199 | 230 | 86 | 14 | 86 | 0 | 0 | 1.063 | 0 | 0 | 0 | 0 | 2.0 | 1.0 | 0.2 | - |
| MSFF178-1 | | 1 | 189 | 214 | 88 | 12 | 88 | 0 | 0 | 1.066 | 0 | 0 | 0 | 0 | 0.8 | 3.0 | 0.5 | - |
| MSZ263-4 | | 1 | 147 | 191 | 77 | 23 | 77 | 0 | 0 | 1.073 | 0 | 0 | 0 | 0 | 1.7 | 3.0 | 0.3 | - |
| MSBB262-1YSpl | | 1 | 130 | 259 | 50 | 50 | 50 | 0 | 0 | 1.066 | 0 | 0 | 0 | 0 | 2.0 | 1.0 | 0 | 53.1 |
| MSCC512-1PP | | 1 | 124 | 369 | 34 | 66 | 34 | 0 | 0 | 1.068 | 0 | 0 | 0 | 0 | 2.5 | 2.0 | 1.3 | - |
| MEAN | | | 324 | 379 | | | | | | 1.072 | | | | | 1.8 | 2.7 | 1.1 | |

[1]SIZE: B: < 2 in.; A: 2-3.25 in.; OV: > 3.25 in.; PO: Pickouts.

[2]QUALITY: HH: Hollow Heart; BC: Brown Center; VD: Vascular Discoloration; IBS: Internal Brown Spot. Percent of 40 Oversize and/or A-size tubers cut.

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

[4]MATURITY RATING: August 24, 2021; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

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

[6]LB RAUDPC: Late blight (*P. infestans* US-23) foliar disease reaction.

Plant Date: 5/5/2021
Vine Kill: 9/8/2021
Days from planting to vine kill: 126

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

**Table 6**

**MICHIGAN STATE UNIVERSITY**
**POTATO BREEDING and GENETICS**

**PRELIMINARY TRIAL, PIGMENTED LINES**
**MONTCALM RESEARCH CENTER**
**May 5 to September 14, 2021 (132 days)**
**DD Base 40°F 3402[7]**

| | | | | | | | | | | | PERCENT (%) | | | | | | | LB[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PVY | | CWT/A | | PERCENT OF TOTAL[1] | | | | | | TUBER QUALITY[2] | | | | | | | RAUDPC |
| LINE | Resistant | N | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR | HH | VD | IBS | BC | SCAB[3] | MAT[4] | Bruise[5] | x100 |
| MSEE055-1R | PVYR | 1 | 525 | 576 | 91 | 9 | 90 | 1 | 0 | 1.074 | 0 | 0 | 0 | 0 | 3.0 | 3.0 | 1.4 | - |
| MSW476-4RY | | 1 | 418 | 473 | 88 | 12 | 87 | 1 | 0 | 1.078 | 10 | 20 | 0 | 0 | 1.3 | 2.0 | 1.2 | - |
| MSFF230-2PY | | 1 | 409 | 469 | 87 | 10 | 87 | 0 | 3 | 1.077 | 0 | 10 | 0 | 0 | 3.3 | 4.0 | 1.8 | - |
| MSBB281-1PY | | 1 | 400 | 423 | 95 | 5 | 95 | 0 | 0 | 1.076 | 10 | 0 | 0 | 0 | 2.5 | 3.0 | - | - |
| MSFF247-2Y | PVYR | 1 | 396 | 477 | 83 | 16 | 83 | 0 | 1 | 1.069 | 0 | 0 | 0 | 0 | 2.0 | 2.0 | 0.8 | - |
| MSFF230-1 | | 1 | 393 | 605 | 65 | 34 | 65 | 0 | 1 | 1.086 | 0 | 0 | 0 | 0 | 3.5 | 4.0 | 1.5 | - |
| MSFF200-4PYSPL | PVYR | 1 | 387 | 507 | 76 | 24 | 76 | 0 | 0 | 1.065 | 0 | 10 | 0 | 0 | 2.3 | 2.0 | 1.5 | - |
| MSFF142-2Spl | | 1 | 379 | 421 | 90 | 10 | 90 | 0 | 0 | 1.071 | 0 | 0 | 0 | 10 | 1.0 | 2.0 | 0.8 | - |
| MSBB308-2P | | 1 | 367 | 408 | 90 | 10 | 90 | 0 | 0 | 1.062 | 0 | 0 | 0 | 0 | 1.2 | 2.0 | 0.9 | - |
| MSFF134-1PP | | 1 | 365 | 444 | 82 | 18 | 82 | 0 | 0 | 1.075 | 0 | 0 | 0 | 0 | 1.8 | 2.0 | 0.0 | - |
| MSAA157-2PY | | 1 | 341 | 421 | 81 | 19 | 81 | 0 | 0 | 1.071 | 70 | 0 | 0 | 0 | 3.3 | 3.0 | 1.7 | 32.0 |
| MSFF305-1RY | PVYR | 1 | 334 | 385 | 87 | 11 | 87 | 0 | 2 | 1.066 | 0 | 10 | 0 | 0 | 1.7 | 3.0 | 0.6 | - |
| MSFF034-4P | PVYR | 1 | 321 | 417 | 77 | 19 | 77 | 0 | 5 | 1.067 | 40 | 10 | 40 | 0 | 2.2 | 3.0 | 0.6 | - |
| MSFF142-1P | | 1 | 317 | 461 | 69 | 31 | 69 | 0 | 0 | 1.073 | 0 | 10 | 0 | 0 | 1.5 | 4.0 | - | - |
| **Dark Red Norland** | | **1** | **310** | **386** | **80** | **18** | **80** | **0** | **2** | **1.063** | **0** | **0** | **0** | **0** | **1.2** | **1.0** | **0.2** | - |
| MSX324-1P | | 1 | 296 | 351 | 84 | 15 | 84 | 0 | 1 | 1.086 | 0 | 10 | 0 | 0 | 0.5 | 2.0 | 2.0 | 11.6 |
| MSFF334-1Pinto | | 1 | 124 | 205 | 61 | 39 | 61 | 0 | 1 | 1.058 | 0 | 0 | 0 | 0 | 0.7 | 5.0 | - | - |
| MSFF030-1WR | PVYR | 1 | 102 | 174 | 59 | 35 | 59 | 0 | 7 | 1.059 | 0 | 0 | 0 | 0 | 1.2 | 2.0 | - | - |
| MSFF198-13PY | PVYR | 1 | 101 | 262 | 39 | 61 | 39 | 0 | 0 | 1.065 | 0 | 0 | 0 | 0 | 1.0 | 4.0 | 0.6 | |
| MEAN | | | 331 | 414 | | | | | | 1.071 | | | | | 1.9 | 2.8 | 1.0 | |

[1]SIZE: B: < 2 in.; A: 2-3.25 in.; OV: > 3.25 in.; PO: Pickouts.

[2]QUALITY: HH: Hollow Heart; BC: Brown Center; VD: Vascular Discoloration; IBS: Internal Brown Spot. Percent of 40 Oversize and/or A-size tubers cut.

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

[4]MATURITY RATING: August 24, 2021; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

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

[6]LB RAUDPC: Late blight (*P. infestans* US-23) foliar disease reaction.

Plant Date: 5/5/2021
Vine Kill: 9/8/2021
Days from planting to vine kill: 126

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

**Table 7**

**MICHIGAN STATE UNIVERSITY**
**POTATO BREEDING and GENETICS**

**DIPLOID REPLICATED TRIAL**
**MONTCALM RESEARCH CENTER**
**May 5 to September 14, 2021 (132 days)**
**DD Base 40°F 3402[8]**

| | | CWT/A | | PERCENT OF TOTAL[1] | | | | | | | | PERCENT (%) TUBER QUALITY[4] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LINE | N | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR | CHIP SCORE[2] | OTF SED[3] | HH | VD | IBS | BC | SCAB[5] | MAT[6] | BRUISE[7] |
| MSHH1037-01 | 2 | 435 | 520 | 84 | 16 | 84 | 0 | 1 | 1.076 | 2.0 | 3 | 0 | 5 | 0 | 0 | 1.8 | 3.0 | 1.5 |
| MSGG685-05 | 2 | 395 | 550 | 72 | 24 | 72 | 0 | 5 | 1.071 | 1.5 | 3 | 0 | 0 | 0 | 0 | 1.5 | 3.5 | 1.1 |
| MSGG863-A1 | 2 | 374 | 405 | 93 | 7 | 93 | 0 | 0 | 1.079 | 1.0 | 1 | 0 | 5 | 0 | 0 | 2.3 | 2.5 | 2.1 |
| **Atlantic** | **2** | **366** | **393** | **93** | **6** | **93** | **0** | **1** | **1.091** | **1.0** | **1** | **20** | **0** | **0** | **5** | **2.8** | **2.0** | **1.7** |
| MSHH699-02 | 2 | 336 | 482 | 70 | 27 | 69 | 0 | 3 | 1.073 | 2.0 | 2 | 20 | 5 | 5 | 0 | 2.8 | 4.0 | 1.6 |
| **Lamoka** | **2** | **324** | **375** | **86** | **13** | **86** | **0** | **1** | **1.086** | **1.0** | **1** | **0** | **10** | **0** | **0** | **1.5** | **2.0** | **1.9** |
| MSEE815-06 | 2 | 266 | 332 | 80 | 15 | 80 | 0 | 6 | 1.078 | 1.0 | 1 | 20 | 10 | 15 | 40 | 1.5 | 2.0 | 2.8 |
| MSHH618-01 | 2 | 251 | 389 | 65 | 31 | 65 | 0 | 4 | 1.063 | 2.5 | 3 | 0 | 0 | 0 | 0 | 1.3 | 3.0 | 0.8 |
| MSDD829-09 | 2 | 230 | 298 | 76 | 22 | 76 | 0 | 1 | 1.070 | 2.5 | 2 | 0 | 0 | 0 | 0 | 2.0 | 4.0 | 1.3 |
| MSHH1056-01 | 2 | 212 | 290 | 73 | 24 | 73 | 0 | 3 | 1.074 | 2.0 | 2 | 50 | 5 | 15 | 20 | 2.5 | 4.0 | 2.0 |
| MSGG623-A2 | 2 | 210 | 437 | 48 | 47 | 48 | 0 | 5 | 1.083 | 2.0 | 2 | 75 | 0 | 0 | 0 | 2.3 | 3.0 | 1.0 |
| MSGG653-A2 | 2 | 205 | 478 | 43 | 50 | 43 | 0 | 7 | 1.082 | 2.5 | 2 | 0 | 0 | 0 | 0 | 2.5 | 3.5 | 1.5 |
| MSGG676-01 | 2 | 192 | 307 | 63 | 33 | 63 | 0 | 4 | 1.073 | 1.5 | 2 | 10 | 5 | 0 | 0 | 1.5 | 3.0 | 1.3 |
| MSEE824-04 | 2 | 186 | 271 | 69 | 31 | 69 | 0 | 0 | 1.086 | 1.0 | 1 | 65 | 0 | 0 | 0 | 2.0 | 2.0 | 1.1 |
| MSHH701-01 | 2 | 145 | 332 | 44 | 53 | 44 | 0 | 3 | 1.081 | 1.5 | 2 | 5 | 10 | 5 | 10 | 1.5 | 4.0 | 2.4 |
| MSGG600-06 | 2 | 131 | 356 | 37 | 61 | 37 | 0 | 2 | 1.098 | 1.0 | 1 | 0 | 0 | 0 | 0 | 1.3 | 2.5 | 1.4 |
| MSHH972-03 | 2 | 106 | 379 | 28 | 72 | 28 | 0 | 0 | 1.076 | 2.0 | 1 | 0 | 0 | 5 | 0 | 1.8 | 3.5 | 2.2 |
| MSGG603-A5 | 2 | 52 | 342 | 15 | 84 | 15 | 0 | 1 | 1.078 | 2.5 | 3 | 20 | 0 | 0 | 0 | 2.8 | 2.0 | 1.2 |
| MEAN | | 245 | 385 | | | | | | 1.079 | | | | | | | 2.0 | 3.0 | 1.6 |
| $HSD_{0.05}$ | | 138 | 162 | | | | | | 0.012 | | | | | | | | | |

[1]SIZE: B: < 2 in.; A: 2-3.25 in.; OV: > 3.25 in.; PO: Pickouts.

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

[3]SED: Stem End Defect, Based on Paul Bethke's (USDA/UWisconsin - Madison) 0 - 5 scale. 0 = no SED; 3 = significant SED; 5 = severe SED

[4]QUALITY: HH: Hollow Heart; BC: Brown Center; VD: Vascular Discoloration; IBS: Internal Brown Spot. Percent of 40 Oversize and/or A-size tubers cut.

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

[6]MATURITY RATING: August 24, 2021; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

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

Plant Date: 5/5/2021
Vine Kill: 9/8/2021
Days from planting to vine kill: 126

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

**Table 8**

**MICHIGAN STATE UNIVERSITY**

**POTATO BREEDING and GENETICS**

## 2019-2021 SCAB DISEASE TRIAL SUMMARY
## SCAB NURSERY, MONTCALM RESEARCH CENTER , MI

| LINE | 3-YR* AVG. | 2021 RATING | 2021 WORST | 2021 N | 2020 RATING | 2020 WORST | 2020 N | 2019 RATING | 2019 WORST | 2019 N |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Sorted by ascending 2021 Average Rating;*** | | | | | | | | | | |
| MSZ052-13 | 0.4 | 0.2 | 0.5 | 3 | 0.5 | 0.5 | 3 | 0.7 | 1.0 | 3 |
| MSBB613-7 | - | 0.3 | 0.5 | 3 | | | | | | |
| MSBB614-15 | - | 0.3 | 0.5 | 3 | | | | | | |
| MSCC282-3RR | 0.5* | 0.5 | 0.5 | 3 | 0.5 | 0.5 | 3 | | | |
| MSDD085-13 | - | 0.5 | 0.5 | 3 | | | | | | |
| MSDD247-11 | - | 0.5 | 0.5 | 3 | | | | | | |
| MSEE101-2 | 0.8* | 0.5 | 0.5 | 3 | 1.0 | 1.5 | 3 | | | |
| MSEE207-2 | 0.6* | 0.5 | 0.5 | 3 | 0.7 | 1.0 | 3 | | | |
| MSEE247-6WP | 0.8* | 0.5 | 0.5 | 3 | 1.0 | 1.5 | 3 | | | |
| MSW474-1 | - | 0.5 | 0.5 | 3 | | | | | | |
| MSX324-1P | 0.9 | 0.5 | 0.5 | 3 | 1.0 | 1.0 | 3 | 1.3 | 1.5 | 3 |
| MSEE048-2Y | - | 0.7 | 1.0 | 3 | | | | | | |
| MSEE063-6 | 0.8* | 0.7 | 1.0 | 3 | 1.0 | 1.0 | 3 | | | |
| MSFF334-1Pinto | - | 0.7 | 1.0 | 3 | | | | | | |
| **Superior** | **1.4** | **0.7** | **1.0** | **3** | **1.8** | **2.5** | **2** | **1.7** | **2.0** | **3** |
| MSAA076-04 | - | 0.8 | 1.0 | 2 | | | | | | |
| **Goldrush Russet** | **0.6** | **0.8** | **1.5** | **3** | **0.3** | **0.5** | **3** | **0.7** | **1.0** | **3** |
| MSAA076-6 | 1.3 | 0.8 | 1.0 | 3 | 1.3 | 1.5 | 3 | 1.8 | 2.5 | 3 |
| MSAA241-1 | 1.0* | 0.8 | 1.5 | 3 | 1.2 | 1.5 | 3 | | | |
| MSAA309-15 | - | 0.8 | 1.0 | 3 | | | | | | |
| MSAA498-18 | 0.8* | 0.8 | 1.0 | 3 | 0.8 | 1.0 | 3 | | | |
| MSBB012-1Y | - | 0.8 | 1.0 | 3 | | | | | | |
| MSCC376-1 | - | 0.8 | 1.5 | 3 | | | | | | |
| MSDD244-15 | - | 0.8 | 1.0 | 3 | | | | | | |
| MSFF073-3 | - | 0.8 | 1.0 | 3 | | | | | | |
| MSFF178-1 | - | 0.8 | 1.0 | 3 | | | | | | |
| MSY022-2 | - | 0.8 | 1.5 | 3 | | | | | | |
| MSY543-2 | - | 0.8 | 1.5 | 3 | | | | | | |
| MSZ242-09 | 1.2 | 0.8 | 1.5 | 3 | 1.3 | 2.0 | 3 | 1.5 | 1.5 | 2 |
| MSZ248-02 | 1.3* | 0.8 | 1.5 | 3 | 1.7 | 2.0 | 3 | | | |
| Vanguard Russet | 1.2 | 0.8 | 1.0 | 3 | 1.5 | 2.0 | 3 | 1.3 | 1.5 | 3 |
| MSAA311-1 | - | 1.0 | 2.0 | 3 | | | | | | |
| MSAA678-1 | - | 1.0 | 1.5 | 3 | | | | | | |
| MSBB008-3 | - | 1.0 | 1.5 | 3 | | | | | | |
| MSBB029-1Y | - | 1.0 | 2.0 | 3 | | | | | | |
| MSBB625-2 | 0.9* | 1.0 | 1.0 | 3 | 0.8 | 1.0 | 3 | | | |
| MSBB634-8 | 1.2 | 1.0 | 1.5 | 3 | 1.2 | 1.5 | 3 | 1.5 | 2.0 | 3 |
| MSCC374-1Y | - | 1.0 | 1.5 | 3 | | | | | | |
| MSCC542-1P | 1.3* | 1.0 | 1.0 | 3 | 1.5 | 2.0 | 3 | | | |

Table of Contents

**Table 8**

**MICHIGAN STATE UNIVERSITY**

**POTATO BREEDING and GENETICS**

## 2019-2021 SCAB DISEASE TRIAL SUMMARY
## SCAB NURSERY, MONTCALM RESEARCH CENTER , MI

| LINE | 3-YR* AVG. | 2021 RATING | 2021 WORST | 2021 N | 2020 RATING | 2020 WORST | 2020 N | 2019 RATING | 2019 WORST | 2019 N |
|---|---|---|---|---|---|---|---|---|---|---|
| MSDD372-15 | - | 1.0 | 1.0 | 3 | | | | | | |
| MSEE054-20 | - | 1.0 | 1.5 | 3 | | | | | | |
| MSEE163-1 | 1.0* | 1.0 | 1.0 | 3 | 1.0 | 1.0 | 3 | | | |
| MSEE255-1 | 1.3* | 1.0 | 1.0 | 3 | 1.5 | 1.5 | 3 | | | |
| MSFF031-6 | - | 1.0 | 1.5 | 3 | | | | | | |
| MSFF055-1Y | - | 1.0 | 1.0 | 3 | | | | | | |
| MSFF120-2Y | - | 1.0 | 1.5 | 3 | | | | | | |
| MSFF142-2Spl | - | 1.0 | 1.5 | 3 | | | | | | |
| MSFF198-13PY | - | 1.0 | 1.5 | 3 | | | | | | |
| MSZ248-10 | 1.0* | 1.0 | 1.5 | 3 | 1.0 | 1.5 | 3 | | | |
| MSZ416-8RY | 1.1 | 1.0 | 1.0 | 3 | 1.2 | 1.5 | 3 | 1.0 | 1.5 | 3 |
| **Pike** | **1.1** | **1.0** | **1.0** | **3** | **0.8** | **1.0** | **3** | **1.5** | **2.0** | **3** |
| **Dark Red Norland** | **1.2*** | **1.2** | **2.0** | **3** | | | | **1.2** | **2.0** | **6** |
| MSAA101-1RR | 0.9 | 1.2 | 1.5 | 3 | 0.8 | 1.0 | 3 | 0.8 | 1.5 | 3 |
| MSBB017-1 | 1.5* | 1.2 | 1.5 | 3 | 1.8 | 2.5 | 3 | | | |
| MSBB058-4 | - | 1.2 | 1.5 | 3 | | | | | | |
| MSBB308-2P | 1.2 | 1.2 | 1.5 | 3 | 1.2 | 2.0 | 3 | 1.2 | 1.5 | 3 |
| MSBB351-1 | 1.0* | 1.2 | 1.5 | 3 | 0.8 | 1.5 | 3 | | | |
| MSBB626-11 | 1.0* | 1.2 | 1.5 | 3 | 0.8 | 1.5 | 3 | | | |
| MSBB635-14 | 1.3 | 1.2 | 1.5 | 3 | 1.7 | 2.0 | 3 | 1.2 | 1.5 | 3 |
| MSDD247-07 | - | 1.2 | 1.5 | 3 | | | | | | |
| MSDD271-10 | - | 1.2 | 1.5 | 3 | | | | | | |
| MSEE035-4 | - | 1.2 | 1.5 | 3 | | | | | | |
| MSEE169-1 | 1.3* | 1.2 | 1.5 | 3 | 1.3 | 1.5 | 3 | | | |
| MSFF008-1 | - | 1.2 | 1.5 | 3 | | | | | | |
| MSFF030-1WR | - | 1.2 | 1.5 | 3 | | | | | | |
| MSFF031-3 | - | 1.2 | 1.5 | 3 | | | | | | |
| MSZ551-1 | 1.6 | 1.2 | 2.0 | 3 | 1.8 | 2.5 | 3 | 1.8 | 2.0 | 3 |
| Petoskey | 1.3 | 1.3 | 2.0 | 6 | 1.3 | 1.5 | 3 | 1.3 | 2.0 | 3 |
| MSAA036-3 | - | 1.3 | 2.0 | 3 | | | | | | |
| MSAA252-7 | 1.4* | 1.3 | 2.5 | 3 | 1.5 | 2.0 | 3 | | | |
| MSAA392-5Y | - | 1.3 | 1.5 | 3 | | | | | | |
| MSBB323-1 | - | 1.3 | 1.5 | 3 | | | | | | |
| MSBB371-1YSpl | 1.4 | 1.3 | 2.0 | 3 | 1.2 | 2.0 | 3 | 1.8 | 2.0 | 3 |
| MSCC287-1 | 1.5* | 1.3 | 1.5 | 3 | 1.7 | 2.0 | 3 | | | |
| MSDD244-05 | - | 1.3 | 2.0 | 3 | | | | | | |
| MSEE031-3 | 1.2* | 1.3 | 2.0 | 3 | 1.0 | 1.0 | 3 | | | |
| MSEE074-1 | - | 1.3 | 1.5 | 3 | | | | | | |
| MSFF211-2 | - | 1.3 | 1.5 | 3 | | | | | | |
| MSW476-4RY | - | 1.3 | 2.0 | 3 | 2.0 | 2.0 | 3 | | | |
| MSX324-2R | 1.2 | 1.3 | 2.0 | 3 | 1.2 | 1.5 | 3 | 1.2 | 2.0 | 3 |

Table of Contents

**Table 8**

**MICHIGAN STATE UNIVERSITY**

**POTATO BREEDING and GENETICS**

## 2019-2021 SCAB DISEASE TRIAL SUMMARY
## SCAB NURSERY, MONTCALM RESEARCH CENTER , MI

| LINE | 3-YR* AVG. | 2021 RATING | 2021 WORST | 2021 N | 2020 RATING | 2020 WORST | 2020 N | 2019 RATING | 2019 WORST | 2019 N |
|---|---|---|---|---|---|---|---|---|---|---|
| MSZ109-8PP | 1.3* | 1.3 | 1.5 | 3 | 1.2 | 1.5 | 3 | | | |
| MSZ218-5 | - | 1.3 | 1.5 | 3 | | | | | | |
| MSZ590-1 | 1.1 | 1.3 | 1.5 | 3 | 0.7 | 1.0 | 3 | 1.3 | 1.5 | 3 |
| **Lamoka** | **1.3** | **1.5** | **2.0** | **3** | **0.8** | **1.0** | **3** | **1.5** | **2.0** | **3** |
| MSAA127-7PP | 1.7 | 1.5 | 2.0 | 3 | 1.7 | 2.5 | 3 | 1.8 | 2.0 | 3 |
| MSAA161-4RY | 1.4 | 1.5 | 2.0 | 3 | 1.3 | 2.5 | 3 | 1.3 | 1.5 | 3 |
| MSAA217-3 | 1.9* | 1.5 | 2.0 | 3 | 2.3 | 3.0 | 3 | | | |
| MSAA266-1 | - | 1.5 | 2.0 | 3 | | | | | | |
| MSAA328-4 | 1.4* | 1.5 | 1.5 | 3 | 1.3 | 1.5 | 3 | | | |
| MSBB364-1 | 1.4 | 1.5 | 1.5 | 3 | 1.5 | 2.0 | 3 | 1.3 | 1.5 | 3 |
| MSCC058-1 | 1.6* | 1.5 | 2.0 | 3 | 1.7 | 2.0 | 3 | | | |
| MSDD376-4 | - | 1.5 | 2.5 | 3 | | | | | | |
| MSEE075-1Spl | - | 1.5 | 1.5 | 1 | | | | | | |
| MSFF002-1 | - | 1.5 | 2.5 | 3 | | | | | | |
| MSFF035-2 | - | 1.5 | 2.0 | 3 | | | | | | |
| MSFF142-1P | - | 1.5 | 2.0 | 3 | | | | | | |
| MST252-1Y | 1.3 | 1.5 | 2.0 | 3 | 0.8 | 1.0 | 3 | 1.7 | 2.0 | 3 |
| MSV179-1 | 1.5 | 1.5 | 1.5 | 3 | 1.5 | 2.5 | 3 | 1.5 | 2.0 | 2 |
| MSV498-1 | 1.4 | 1.5 | 2.0 | 3 | 1.7 | 2.0 | 3 | 1.2 | 2.0 | 3 |
| MSZ427-1R | 1.0 | 1.5 | 2.0 | 3 | 0.8 | 1.0 | 3 | 0.7 | 1.5 | 3 |
| MSZ615-2 | 1.4 | 1.5 | 2.0 | 3 | 1.5 | 1.5 | 3 | 1.2 | 1.5 | 3 |
| Bonafide (MSV093-1Y) | 1.5 | 1.7 | 2.0 | 3 | 1.7 | 2.0 | 3 | 1.2 | 1.5 | 3 |
| MSAA196-1 | 1.7* | 1.7 | 2.0 | 3 | 1.7 | 2.5 | 3 | | | |
| MSAA260-3 | 1.4* | 1.7 | 2.0 | 3 | 1.2 | 1.5 | 3 | | | |
| MSBB058-3 | - | 1.7 | 2.0 | 3 | | | | | | |
| MSBB190-2 | - | 1.7 | 2.0 | 3 | | | | | | |
| MSBB630-2 | - | 1.7 | 2.0 | 3 | | | | | | |
| MSCC614-1RYSpl | 1.7* | 1.7 | 2.0 | 3 | 1.7 | 2.5 | 3 | | | |
| MSDD040-01 | - | 1.7 | 2.0 | 3 | | | | | | |
| MSDD088-1 | - | 1.7 | 2.0 | 3 | | | | | | |
| MSDD372-07 | - | 1.7 | 2.0 | 3 | | | | | | |
| MSEE052-5 | 1.4* | 1.7 | 2.0 | 3 | 1.2 | 1.5 | 3 | | | |
| MSEE182-3 | 1.1* | 1.7 | 3.0 | 3 | 0.5 | 1.0 | 3 | | | |
| MSFF305-1RY | - | 1.7 | 2.0 | 3 | | | | | | |
| MSX245-2Y | 1.8 | 1.7 | 2.0 | 3 | 1.8 | 2.0 | 3 | 2.0 | 2.0 | 3 |
| MSZ042-07 | - | 1.7 | 2.0 | 3 | | | | | | |
| MSZ263-4 | - | 1.7 | 2.0 | 3 | | | | | | |
| MSZ513-2 | 1.6 | 1.7 | 2.0 | 3 | 1.5 | 2.0 | 3 | 1.7 | 2.0 | 3 |
| Huron Chipper | 1.7 | 1.8 | 2.0 | 3 | 1.3 | 1.5 | 3 | 2.0 | 2.5 | 3 |
| Mackinaw[PVYR, LBR] | 1.7 | 1.8 | 2.5 | 3 | 1.7 | 2.0 | 3 | | | |

Table of Contents

**Table 8**

**MICHIGAN STATE UNIVERSITY**

**POTATO BREEDING and GENETICS**

## 2019-2021 SCAB DISEASE TRIAL SUMMARY
## SCAB NURSERY, MONTCALM RESEARCH CENTER , MI

| LINE | 3-YR* AVG. | 2021 RATING | 2021 WORST | 2021 N | 2020 RATING | 2020 WORST | 2020 N | 2019 RATING | 2019 WORST | 2019 N |
|---|---|---|---|---|---|---|---|---|---|---|
| MSAA174-1 | 1.7 | 1.8 | 2.5 | 3 | 1.7 | 2.0 | 3 | 1.5 | 1.5 | 3 |
| MSBB213-1Spl | 1.5 | 1.8 | 2.5 | 3 | 1.5 | 1.5 | 3 | 1.3 | 1.5 | 2 |
| MSBB230-1 | - | 1.8 | 2.0 | 3 | | | | | | |
| MSBB343-2Y | - | 1.8 | 2.0 | 3 | | | | | | |
| MSCC725-232 | 1.5* | 1.8 | 2.0 | 3 | 1.2 | 1.5 | 3 | | | |
| MSDD107-1Y | - | 1.8 | 2.0 | 3 | | | | | | |
| MSDD249-9 | - | 1.8 | 2.0 | 3 | | | | | | |
| MSDD254-1Spl | - | 1.8 | 2.0 | 3 | | | | | | |
| MSEE016-07 | - | 1.8 | 2.5 | 3 | | | | | | |
| MSFF029-10 | - | 1.8 | 2.0 | 3 | | | | | | |
| MSFF072-1Y | - | 1.8 | 3.0 | 3 | | | | | | |
| MSFF134-1PP | - | 1.8 | 2.0 | 3 | | | | | | |
| MSZ242-07 | 1.4 | 1.8 | 2.0 | 3 | 1.0 | 1.5 | 3 | 1.3 | 1.5 | 3 |
| MSZ598-2 | - | 1.8 | 2.0 | 3 | | | | | | |
| **Yukon Gold** | **2.4** | **1.8** | **2.5** | **3** | **2.5** | **2.5** | **1** | **3.0** | **3.5** | **6** |
| MSAA072-5 | - | 2.0 | 3.0 | 3 | | | | | | |
| MSBB190-3 | - | 2.0 | 2.5 | 3 | | | | | | |
| MSBB262-1YSpl | - | 2.0 | 3.0 | 3 | | | | | | |
| MSCC302-1 | 2.0* | 2.0 | 2.5 | 3 | 2.0 | 2.5 | 3 | | | |
| MSDD483-1 | - | 2.0 | 2.0 | 3 | | | | | | |
| MSEE016-10 | - | 2.0 | 2.0 | 3 | | | | | | |
| MSEE075-1 | - | 2.0 | 2.0 | 2 | | | | | | |
| MSFF189-1Y | - | 2.0 | 2.0 | 3 | | | | | | |
| MSFF191-1Y | - | 2.0 | 2.5 | 3 | | | | | | |
| MSFF247-2Y | - | 2.0 | 2.5 | 3 | | | | | | |
| MSY544-5R | - | 2.0 | 3.0 | 3 | | | | | | |
| MSZ242-13 | 1.4 | 2.0 | 2.0 | 3 | 1.2 | 1.5 | 3 | 1.2 | 1.5 | 3 |
| Blackberry | 1.6 | 2.2 | 3.0 | 3 | 1.3 | 1.5 | 3 | 1.2 | 1.5 | 3 |
| MSCC447-1WR | 2.0* | 2.2 | 3.0 | 3 | 1.8 | 2.0 | 3 | | | |
| MSCC576-1 | 2.0* | 2.2 | 2.5 | 3 | 1.8 | 2.0 | 3 | | | |
| MSDD553-1 | - | 2.2 | 2.5 | 3 | | | | | | |
| MSEE002-3 | - | 2.2 | 2.5 | 3 | | | | | | |
| MSEE191-3Y | - | 2.2 | 2.5 | 3 | | | | | | |
| MSFF034-4P | - | 2.2 | 4.0 | 3 | | | | | | |
| MSV241-2 | - | 2.2 | 3.0 | 3 | | | | | | |
| MSX156-1Y | 2.3 | 2.2 | 2.5 | 3 | 2.2 | 2.5 | 3 | 2.7 | 3.0 | 3 |
| MSX495-2 | - | 2.2 | 3.0 | 3 | | | | | | |
| MSZ436-2Spl | 1.9 | 2.2 | 3.0 | 3 | 1.8 | 2.0 | 3 | 1.8 | 2.0 | 3 |
| **Reba** | **2.4** | **2.2** | **2.5** | **3** | **2.7** | **3.0** | **3** | **2.5** | **2.5** | **2** |
| MSAA091-1 | - | 2.3 | 3.0 | 3 | | | | | | |
| MSBB075-1Y | 2.2* | 2.3 | 3.0 | 3 | | | | 2.2 | 2.5 | 3 |

Table of Contents

**Table 8**

**MICHIGAN STATE UNIVERSITY**

**POTATO BREEDING and GENETICS**

## 2019-2021 SCAB DISEASE TRIAL SUMMARY
## SCAB NURSERY, MONTCALM RESEARCH CENTER , MI

| LINE | 3-YR* AVG. | 2021 RATING | 2021 WORST | 2021 N | 2020 RATING | 2020 WORST | 2020 N | 2019 RATING | 2019 WORST | 2019 N |
|---|---|---|---|---|---|---|---|---|---|---|
| MSFF200-4PYSpl | - | 2.3 | 3.0 | 3 | | | | | | |
| MSBB032-1 | - | 2.5 | 3.5 | 3 | | | | | | |
| MSBB281-1PY | - | 2.5 | 3.0 | 3 | | | | | | |
| MSCC512-1PP | 2.3* | 2.5 | 4.0 | 3 | 2.0 | 2.0 | 3 | | | |
| MSCC553-1R | - | 2.5 | 3.0 | 3 | | | | | | |
| MSDD251-2Y | - | 2.5 | 3.5 | 3 | | | | | | |
| MSY089-2 | - | 2.5 | 3.0 | 3 | | | | | | |
| MSZ157-3 | - | 2.5 | 3.0 | 3 | | | | | | |
| MSBB611-3 | 2.6* | 2.7 | 3.0 | 3 | 2.5 | 3.5 | 3 | | | |
| MSCC447-01WP | - | 2.7 | 3.0 | 3 | | | | | | |
| MSZ427-3R | 2.0 | 2.7 | 3.5 | 3 | 2.0 | 2.5 | 3 | 1.3 | 2.0 | 3 |
| **Russet Norkotah** | **2.4** | **2.7** | **3.0** | **3** | **2.5** | **3.0** | **3** | **2.2** | **3.0** | **3** |
| **Atlantic** | **2.4** | **2.8** | **3.5** | **3** | **1.9** | **3.0** | **6** | **2.5** | **2.5** | **3** |
| Manistee | 2.8 | 2.8 | 3.0 | 3 | 2.5 | 3.0 | 3 | 3.0 | 3.5 | 3 |
| MSBB375-1 | - | 2.8 | 3.5 | 3 | | | | | | |
| MSCC300-1 | 2.4* | 2.8 | 3.5 | 3 | 2.0 | 2.0 | 3 | | | |
| MSX137-6 | 2.3* | 2.8 | 3.0 | 3 | 1.7 | 2.0 | 3 | | | |
| MSAA240-5 | - | 3.0 | 3.0 | 3 | | | | | | |
| MSEE055-1R | 2.5* | 3.0 | 3.5 | 3 | 2.0 | 2.5 | 2 | | | |
| **Snowden** | **2.7** | **3.0** | **3.5** | **3** | **2.4** | **3.5** | **6** | 2.8 | 3.5 | 6 |
| MSAA157-2PY | 3.2 | 3.3 | 4.0 | 3 | 2.8 | 4.0 | 3 | 3.3 | 3.5 | 3 |
| MSCC720-1WP | - | 3.3 | 4.0 | 3 | | | | | | |
| MSFF230-2PY | - | 3.3 | 4.0 | 3 | | | | | | |
| MSFF230-1 | - | 3.5 | 4.0 | 3 | | | | | | |
| MEAN | | 1.6 | | | 1.5 | | | 1.6 | | |

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

N = Number of replications.

*2-Year Average.

Table of Contents

**Table 9**

**MICHIGAN STATE UNIVERSITY**

**POTATO BREEDING and GENETICS**

## 2021 SCAB DISEASE EARLY GENERATION TRIAL SUMMARY
## SCAB NURSERY, MONTCALM RESEARCH CENTER, MI

| LINE | 2021 RATING | 2021 N | LINE | 2021 RATING | 2021 N |
|---|---|---|---|---|---|
| *Sorted by ascending 2021 Rating:* | | | | | |
| MSFF132-1R | 0.5 | 1 | MSGGUNK-4Spl | 1.0 | 1 |
| MSGG088-4 | 0.5 | 1 | MSFF292-1 | 1.5 | 1 |
| MSGG242-1 | 0.5 | 1 | MSFF321-1 | 1.5 | 1 |
| MSGG242-3 | 0.5 | 1 | MSFF335-2RR | 1.5 | 1 |
| MSGG267-2 | 0.5 | 1 | MSGG008-11 | 1.5 | 1 |
| MSGG268-4 | 0.5 | 1 | MSGG041-3 | 1.5 | 1 |
| MSGG275-1 | 0.5 | 1 | MSGG080-4Spl | 1.5 | 1 |
| MSGG282-08 | 0.5 | 1 | MSGG136-1P | 1.5 | 1 |
| MSGG282-09 | 0.5 | 1 | MSGG190-3 | 1.5 | 1 |
| MSGG349-3 | 0.5 | 1 | MSGG214-08 | 1.5 | 1 |
| MSGG394-1 | 0.5 | 1 | MSGG221-3 | 1.5 | 1 |
| MSGG426-2 | 0.5 | 1 | MSGG248-1 | 1.5 | 1 |
| MSGG445-11 | 0.5 | 1 | MSGG260-7 | 1.5 | 1 |
| MSFF017-1 | 1.0 | 1 | MSGG275-6 | 1.5 | 1 |
| MSFF160-1R | 1.0 | 1 | MSGG302-1 | 1.5 | 1 |
| MSFF182-1R | 1.0 | 1 | MSGG302-3 | 1.5 | 1 |
| MSFF223-1RY | 1.0 | 1 | MSGG331-3 | 1.5 | 1 |
| MSFF334-1Pinto | 1.0 | 1 | MSGG356-3 | 1.5 | 1 |
| MSFF351-1RR | 1.0 | 1 | MSGG409-3 | 1.5 | 1 |
| MSGG001-7Y | 1.0 | 1 | MSGG436-3 | 1.5 | 1 |
| MSGG072-3 | 1.0 | 1 | MSFF022-2 | 2.0 | 1 |
| MSGG087-2PY | 1.0 | 1 | MSFF037-17 | 2.0 | 1 |
| MSGG158-11PP | 1.0 | 1 | MSFF077-4 | 2.0 | 1 |
| MSGG186-2 | 1.0 | 1 | MSFF097-6 | 2.0 | 1 |
| MSGG190-1 | 1.0 | 1 | MSFF134-2RR | 2.0 | 1 |
| MSGG282-07 | 1.0 | 1 | MSFF149-1 | 2.0 | 1 |
| MSGG282-10 | 1.0 | 1 | MSFF206-1 | 2.0 | 1 |
| MSGG282-20 | 1.0 | 1 | MSFF303-3 | 2.0 | 1 |
| MSGG333-1 | 1.0 | 1 | MSFF338-1PP | 2.0 | 1 |
| MSGG349-2 | 1.0 | 1 | MSFF353-1R | 2.0 | 1 |
| MSGG380-1 | 1.0 | 1 | MSGG039-10 | 2.0 | 1 |
| MSGG385-1 | 1.0 | 1 | MSGG039-11 | 2.0 | 1 |
| MSGG391-2 | 1.0 | 1 | MSGG084-1 | 2.0 | 1 |
| MSGG398-1 | 1.0 | 1 | MSGG135-1R | 2.0 | 1 |
| MSGG406-1 | 1.0 | 1 | MSGG137-1R | 2.0 | 1 |
| MSGG407-2 | 1.0 | 1 | MSGG147-3P | 2.0 | 1 |
| MSGG409-1 (mini) | 1.0 | 1 | MSGG163-1 | 2.0 | 1 |
| MSGG409-2 | 1.0 | 1 | MSGG169-2 | 2.0 | 1 |
| MSGG432-2 | 1.0 | 1 | MSGG178-2 | 2.0 | |

Table of Contents

**Table 9**

**MICHIGAN STATE UNIVERSITY**

**POTATO BREEDING and GENETICS**

## 2021 SCAB DISEASE EARLY GENERATION TRIAL SUMMARY
## SCAB NURSERY, MONTCALM RESEARCH CENTER, MI

| LINE | 2021 RATING | 2021 N | LINE | 2021 RATING | 2021 N |
|---|---|---|---|---|---|
| *Sorted by ascending 2021 Rating:* | | | | | |
| MSGG194-3 | 2.0 | 1 | MSGG028-4Y | 2.5 | 1 |
| MSGG195-1 | 2.0 | 1 | MSGG039-08 | 2.5 | 1 |
| MSGG216-1 | 2.0 | 1 | MSGG068-1 | 2.5 | 1 |
| MSGG219-1 | 2.0 | 1 | MSGG068-2 | 2.5 | 1 |
| MSGG247-2 | 2.0 | 1 | MSGG078-7 | 2.5 | 1 |
| MSGG263-1 | 2.0 | 1 | MSGG108-2RR | 2.5 | 1 |
| MSGG276-4 | 2.0 | 1 | MSGG127-3R | 2.5 | 1 |
| MSGG289-1 | 2.0 | 1 | MSGG181-5 | 2.5 | 1 |
| MSGG290-1 | 2.0 | 1 | MSGG190-4 | 2.5 | 1 |
| MSGG294-1 | 2.0 | 1 | MSGG207-1 | 2.5 | 1 |
| MSGG320-5 | 2.0 | 1 | MSGG212-2 | 2.5 | 1 |
| MSGG328-3 | 2.0 | 1 | MSGG212-4 | 2.5 | 1 |
| MSGG328-5 | 2.0 | 1 | MSGG254-3 | 2.5 | 1 |
| MSGG343-1 | 2.0 | 1 | MSGG260-6 | 2.5 | 1 |
| MSGG365-1 | 2.0 | 1 | MSGG030-2 | 3.0 | 1 |
| MSGG391-1 | 2.0 | 1 | MSGG030-3 | 3.0 | 1 |
| MSGG415-7 | 2.0 | 1 | MSGG102-1RR | 3.0 | 1 |
| MSGG433-2 | 2.0 | 1 | MSGG105-1RP | 3.0 | 1 |
| MSGG437-4 | 2.0 | 1 | MSGG018-2Y | 3.5 | 1 |
| MSFF335-1RR | 2.5 | 1 | MSGG156-12PP | 4.0 | 1 |
| MSFF335-3Pinto | 2.5 | 1 | | | |

Table of Contents

**Table 10**



## 2021 MSU LATE BLIGHT VARIETY TRIAL
## PLANT PATHOLOGY FARM, LANSING, MI

| ***Line Sort:*** | | | ***RAUDPC Sort:*** | | | | |
|---|---|---|---|---|---|---|---|
| | | RAUDPC[1] | | | RAUDPC[1] | *Pedigrees go w/ RAUDPC Sort* | |
| LINE | N | MEAN | LINE | N | MEAN | Female | Male |
| **Atlantic** | **2** | **39.7** | MSBB630-2 | 3 | 0.1 | Lady Liberty | Kalkaska |
| Huron Chipper | 3 | 0.5 | MSBB058-3 | 3 | 0.2 | NY148 | MSR127-2 |
| **Lamoka** | **2** | **28.6** | MSZ551-1 | 3 | 0.2 | MSM182-1 | MSL268-D |
| Mackinaw | 1 | 2.1 | MSX495-2 | 2 | 0.3 | MSQ131-A | Kalkaska |
| MSAA091-1 | 3 | 28.4 | MSBB611-3 | 2 | 0.4 | NY148 | MSR128-4Y |
| MSAA157-2PY | 2 | 32.0 | Huron Chipper | 3 | 0.5 | MSQ070-1 | MSR156-7 |
| MSAA196-1 | 1 | 0.6 | MSAA196-1 | 1 | 0.6 | MSW151-5 | MSQ440-2 |
| MSAA252-7 | 3 | 1.5 | MSBB634-8 | 3 | 0.6 | Lady Liberty | MSR169-8Y |
| MSAA309-15 | 3 | 41.7 | MSZ042-7 | 1 | 0.7 | ND8331Cb-3 | MSQ086-3 |
| MSAA498-18 | 1 | 10.8 | MSBB613-7 | 3 | 0.9 | Saginaw Chipper | McBride |
| MSBB058-3 | 3 | 0.2 | MSBB614-15 | 3 | 1.1 | Saginaw Chipper | MSR127-2 |
| MSBB058-4 | 3 | 7.7 | MSBB635-14 | 3 | 1.4 | Lady Liberty | MSS297-3 |
| MSBB213-1Spl | 3 | 12.1 | MSAA252-7 | 3 | 1.5 | NY148 | MSQ089-1 |
| MSBB262-1YSpl | 2 | 53.1 | Mackinaw | 1 | 2.1 | Saginaw Chipper | Lamoka |
| MSBB351-1 | 2 | 16.3 | MSBB626-11 | 3 | 4.3 | Saginaw Chipper | Kalkaska |
| MSBB611-3 | 2 | 0.4 | MSBB058-4 | 3 | 7.7 | NY148 | MSR127-2 |
| MSBB613-7 | 3 | 0.9 | MSBB625-2 | 3 | 8.0 | MSW242-1 | MSS297-3 |
| MSBB614-15 | 3 | 1.1 | MSCC302-1 | 1 | 8.2 | MST500-1 | MSQ086-3 |
| MSBB625-2 | 3 | 8.0 | **Snowden** | **3** | **10.1** | **Lenape** | **Wischip** |
| MSBB626-11 | 3 | 4.3 | MSX245-2Y | 2 | 10.4 | Manistee | McBride |
| MSBB630-2 | 3 | 0.1 | MSAA498-18 | 1 | 10.8 | MSV092-2 | Elkton |
| MSBB634-8 | 3 | 0.6 | MSDD247-11 | 3 | 11.4 | Mackinaw | MSV383-B |
| MSBB635-14 | 3 | 1.4 | MSX324-1P | 2 | 11.6 | MSN105-1 | Colonial Purple |
| MSCC302-1 | 1 | 8.2 | MSBB213-1Spl | 3 | 12.1 | MSS576-5 | Lamoka |
| MSCC447-1WR | 2 | 24.0 | MSCC553-1R | 2 | 12.4 | Red Marker #2 | ND7132-1R |
| MSCC553-1R | 2 | 12.4 | MSZ590-1Spl | 2 | 14.0 | Superior | Picasso |
| MSCC614-1RYSpl | 2 | 30.4 | MSEE247-6WP | 2 | 15.8 | MSX148-1WP | MSZ219-46 |
| MSDD088-1 | 1 | 47.1 | MSBB351-1 | 2 | 16.3 | MSS483-1 | MSQ440-2 |
| MSDD247-11 | 3 | 11.4 | MSCC447-1WR | 2 | 24.0 | MSX035-WP | MSQ086-3 |
| MSDD251-2Y | 2 | 27.1 | MSDD251-2Y | 2 | 27.1 | Yukon Gem | MSM288-2Y |
| MSEE247-6WP | 2 | 15.8 | MST252-1Y | 3 | 27.3 | MSL024-AY | MSL211-3 |
| MST252-1Y | 3 | 27.3 | MSAA091-1 | 3 | 28.4 | MSS165-2Y | Lamoka |
| MSX156-1Y | 3 | 29.9 | **Lamoka** | **2** | **28.6** | **NY120** | **NY115** |
| MSX245-2Y | 2 | 10.4 | MSX156-1Y | 3 | 29.9 | MSI005-20Y | Boulder |
| MSX324-1P | 2 | 11.6 | MSCC614-1RYSpl | 2 | 30.4 | Gold Nugget | MSS934-4 |
| MSX495-2 | 2 | 0.3 | MSAA157-2PY | 2 | 32.0 | Spartan Splash | Purple Heart |
| MSY022-2 | 3 | 32.5 | MSY022-2 | 3 | 32.5 | MSS176-1 | MST096-2Y |
| MSZ042-7 | 1 | 0.7 | **Atlantic** | **2** | **39.7** | **Wauseon** | **Lenape** |
| MSZ551-1 | 3 | 0.2 | MSAA309-15 | 3 | 41.7 | Atlantic | Lamoka |
| MSZ590-1Spl | 2 | 14.0 | **Yukon Gold** | **1** | **43.1** | **W5279-4** | **Norgleam** |
| **Snowden** | **3** | **10.1** | MSDD088-1 | 1 | 47.1 | NY154 | MSQ086-3 |
| **Yukon Gold** | **1** | **43.1** | MSBB262-1YSpl | 2 | 53.1 | MSN105-1 | MSR241-4RY |

[1]Ratings indicate the average plot RAUDPC (Relative Area Under the Disease Progress Curve).
LB Isolate used: US-23

Table of Contents

**Table 11**

**MICHIGAN STATE UNIVERSITY**
**POTATO BREEDING and GENETICS**

## 2021 BLACKSPOT BRUISE SUSCEPTIBILITY TEST
## SIMULATED BRUISE SAMPLES*

| ENTRY | SP GR | NUMBER OF SPOTS PER TUBER | | | | | | PERCENT (%) BRUISE FREE | AVERAGE SPOTS/TUBER |
|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5+ | | |
| **ADAPTATION TRIAL, CHIP-PROCESSING LINES** | | | | | | | | | |
| Manistee | 1.080 | 8 | 9 | 6 | 1 | 1 | 0 | 32 | 1.1 |
| Huron Chipper | 1.082 | 10 | 6 | 5 | 3 | 1 | 0 | 40 | 1.2 |
| MSAA091-1 | 1.084 | 5 | 12 | 5 | 3 | 0 | 0 | 20 | 1.2 |
| MSAA498-18 | 1.081 | 7 | 6 | 6 | 5 | 1 | 0 | 28 | 1.5 |
| MSBB614-15 | 1.078 | 5 | 7 | 7 | 6 | 0 | 0 | 20 | 1.6 |
| **Lamoka** | **1.080** | **4** | **9** | **8** | **4** | **1** | 0 | **15** | **1.6** |
| MSBB058-4 | 1.079 | 3 | 11 | 5 | 5 | 1 | 0 | 12 | 1.6 |
| MSY022-2 | 1.079 | 5 | 7 | 6 | 4 | 2 | 1 | 20 | 1.8 |
| FL2137 | 1.087 | 4 | 7 | 5 | 5 | 3 | 1 | 16 | 2.0 |
| MSDD085-13 | 1.082 | 0 | 7 | 12 | 6 | 0 | 0 | 0 | 2.0 |
| MSBB075-1Y | 1.078 | 3 | 7 | 6 | 5 | 3 | 1 | 12 | 2.0 |
| MSCC725-232 | 1.075 | 1 | 1 | 8 | 2 | 1 | 0 | 8 | 2.1 |
| MSAA311-1 | 1.076 | 3 | 4 | 8 | 8 | 1 | 1 | 12 | 2.1 |
| MSZ242-13 | 1.093 | 3 | 7 | 6 | 4 | 2 | 3 | 12 | 2.2 |
| Mackinaw | 1.081 | 0 | 5 | 11 | 7 | 2 | 0 | 0 | 2.2 |
| MSBB230-1 | 1.088 | 0 | 8 | 8 | 3 | 6 | 0 | 0 | 2.3 |
| MSW474-1 | 1.078 | 2 | 4 | 7 | 6 | 4 | 2 | 8 | 2.5 |
| MSBB017-1 | 1.080 | 1 | 4 | 5 | 10 | 4 | 1 | 4 | 2.6 |
| Petoskey | 1.090 | 2 | 3 | 6 | 8 | 4 | 2 | 8 | 2.6 |
| Petoskey (POP) | 1.089 | 1 | 4 | 5 | 9 | 6 | 0 | 4 | 2.6 |
| **Atlantic** | **1.089** | **1** | **4** | **6** | **7** | **2** | **4** | **4** | **2.7** |
| MSAA076-6 | 1.083 | 0 | 4 | 7 | 7 | 5 | 2 | 0 | 2.8 |
| MSBB626-11 | 1.084 | 2 | 5 | 5 | 4 | 3 | 6 | 8 | 2.8 |
| **Snowden** | **1.084** | **2** | **3** | **1** | **12** | **3** | **3** | **8** | **2.8** |
| MSDD247-11 | 1.091 | 2 | 5 | 2 | 4 | 7 | 5 | 8 | 3.0 |
| MSAA217-3 | 1.094 | 0 | 0 | 10 | 8 | 1 | 5 | 0 | 3.0 |
| MSZ242-07 | 1.092 | 0 | 2 | 5 | 10 | 4 | 4 | 0 | 3.1 |
| MSDD247-07 | 1.095 | 0 | 2 | 5 | 9 | 5 | 4 | 0 | 3.2 |
| MSAA252-7 | 1.081 | 0 | 2 | 2 | 8 | 6 | 3 | 0 | 3.3 |
| MSBB611-3 | 1.083 | 0 | 1 | 4 | 6 | 5 | 7 | 0 | 3.6 |
| MSAA260-3 | 1.083 | 0 | 1 | 4 | 7 | 5 | 8 | 0 | 3.6 |
| MSBB058-3 | 1.080 | 0 | 1 | 3 | 6 | 4 | 10 | 0 | 3.8 |
| MSBB630-2 | 1.078 | 1 | 3 | 0 | 3 | 3 | 15 | 4 | 4.0 |
| MSCC058-1 | 1.083 | 0 | 1 | 2 | 4 | 8 | 10 | 0 | 4.0 |
| **ADAPTATION TRIAL, TABLESTOCK LINES** | | | | | | | | | |
| MSBB351-1 | 1.053 | 21 | 4 | 0 | 0 | 0 | 0 | 84 | 0.2 |
| MSDD254-1SPL | 1.062 | 20 | 5 | 0 | 0 | 0 | 0 | 80 | 0.2 |
| Blackberry | 1.062 | 17 | 8 | 1 | 0 | 0 | 0 | 65 | 0.4 |

Table of Contents

**Table 11**

**MICHIGAN STATE UNIVERSITY**
**POTATO BREEDING and GENETICS**

## 2021 BLACKSPOT BRUISE SUSCEPTIBILITY TEST
## SIMULATED BRUISE SAMPLES*

| ENTRY | SP GR | NUMBER OF SPOTS PER TUBER 0 | 1 | 2 | 3 | 4 | 5+ | PERCENT (%) BRUISE FREE | AVERAGE SPOTS/TUBER |
|---|---|---|---|---|---|---|---|---|---|
| MSZ109-08PP | 1.064 | 13 | 14 | 0 | 0 | 0 | 0 | 48 | 0.5 |
| MSZ416-8RY | 1.059 | 16 | 8 | 3 | 0 | 0 | 0 | 59 | 0.5 |
| MSZ157-3 | 1.078 | 13 | 11 | 1 | 0 | 0 | 0 | 52 | 0.5 |
| MSBB364-1 | 1.051 | 13 | 10 | 2 | 0 | 0 | 0 | 52 | 0.6 |
| MSZ427-1R | 1.066 | 14 | 7 | 4 | 0 | 0 | 0 | 56 | 0.6 |
| **Yukon Gold** | **1.076** | **10** | **11** | **2** | **2** | 0 | 0 | **40** | **0.8** |
| MSZ513-2 | 1.074 | 9 | 10 | 4 | 1 | 0 | 0 | 38 | 0.9 |
| **Superior** | **1.071** | **7** | **11** | **6** | **1** | 0 | 0 | **28** | **1.0** |
| MSV093-1Y | 1.078 | 8 | 9 | 5 | 2 | 0 | 0 | 33 | 1.0 |
| MSCC553-1R | 1.071 | 7 | 10 | 6 | 2 | 0 | 0 | 28 | 1.1 |
| MSZ427-3R | 1.062 | 7 | 9 | 7 | 2 | 0 | 0 | 28 | 1.2 |
| MSBB343-2Y | 1.082 | 8 | 7 | 7 | 3 | 0 | 0 | 32 | 1.2 |
| MSZ598-2 | 1.073 | 7 | 6 | 9 | 1 | 1 | 0 | 29 | 1.3 |
| MSBB371-1YSPL | 1.077 | 5 | 11 | 6 | 4 | 0 | 0 | 19 | 1.3 |
| MSZ615-2 | 1.071 | 6 | 8 | 7 | 4 | 0 | 0 | 24 | 1.4 |
| MSAA127-1PP | 1.056 | 4 | 11 | 6 | 4 | 0 | 0 | 16 | 1.4 |
| MSZ590-1SPL | 1.068 | 7 | 4 | 8 | 5 | 0 | 0 | 29 | 1.5 |
| MST252-1Y | 1.072 | 3 | 9 | 10 | 1 | 1 | 0 | 13 | 1.5 |
| MSAA174-1 | 1.065 | 4 | 7 | 6 | 4 | 2 | 0 | 17 | 1.7 |
| MSV179-1 | 1.064 | 5 | 4 | 7 | 6 | 3 | 0 | 20 | 1.9 |
| MSCC447-1WR | 1.074 | 2 | 4 | 9 | 9 | 1 | 0 | 8 | 2.1 |
| MSZ551-1 | 1.077 | 2 | 5 | 9 | 4 | 4 | 0 | 8 | 2.1 |
| MSAA101-01RR | 1.079 | 0 | 6 | 12 | 3 | 4 | 0 | 0 | 2.2 |
| MSCC720-1WP | 1.081 | 0 | 4 | 11 | 9 | 0 | 0 | 0 | 2.2 |
| MSCC302-1 | 1.079 | 3 | 4 | 4 | 9 | 5 | 0 | 12 | 2.4 |
| MSX245-2Y | 1.087 | 1 | 3 | 9 | 8 | 4 | 0 | 4 | 2.4 |
| MSCC447-01WP | 1.076 | 0 | 3 | 1 | 5 | 2 | 2 | 0 | 2.9 |
| **PRELIMINARY TRIAL, CHIP-PROCESSING LINES** | | | | | | | | | |
| MSEE182-3 | 1.080 | 13 | 9 | 2 | 1 | 0 | 0 | 52 | 0.6 |
| MSFF029-10 | 1.090 | 10 | 7 | 7 | 1 | 0 | 0 | 40 | 1.0 |
| MSEE207-2 | 1.080 | 2 | 9 | 9 | 4 | 0 | 0 | 8 | 1.6 |
| MSFF002-1 | 1.078 | 0 | 11 | 11 | 1 | 1 | 0 | 0 | 1.7 |
| MSDD553-1 | 1.079 | 3 | 9 | 7 | 5 | 1 | 0 | 12 | 1.7 |
| MSFF031-3 | 1.074 | 2 | 11 | 7 | 2 | 3 | 0 | 8 | 1.7 |
| **Pike** | **1.083** | **3** | **6** | **9** | **7** | **0** | **0** | **12** | **1.8** |
| MSBB029-1Y | 1.081 | 4 | 6 | 8 | 5 | 1 | 1 | 16 | 1.8 |
| MSDD372-15 | 1.084 | 4 | 6 | 7 | 6 | 2 | 1 | 15 | 2.0 |
| MSEE016-07 | 1.092 | 3 | 3 | 7 | 10 | 0 | 0 | 13 | 2.0 |
| MSFF079-16 | 1.078 | 3 | 5 | 7 | 6 | 4 | 0 | 12 | 2.1 |

Table of Contents

**Table 11**

**MICHIGAN STATE UNIVERSITY**
**POTATO BREEDING and GENETICS**

## 2021 BLACKSPOT BRUISE SUSCEPTIBILITY TEST
## SIMULATED BRUISE SAMPLES*

| ENTRY | SP GR | NUMBER OF SPOTS PER TUBER 0 | 1 | 2 | 3 | 4 | 5+ | PERCENT (%) BRUISE FREE | AVERAGE SPOTS/TUBER |
|---|---|---|---|---|---|---|---|---|---|
| MSFF072-1Y | 1.085 | 1 | 6 | 8 | 7 | 3 | 0 | 4 | 2.2 |
| MSEE002-3 | 1.091 | 1 | 4 | 9 | 9 | 1 | 0 | 4 | 2.2 |
| MSFF073-3 | 1.089 | 1 | 5 | 6 | 9 | 2 | 0 | 4 | 2.3 |
| MSEE063-6 | 1.079 | 2 | 4 | 6 | 9 | 0 | 2 | 9 | 2.3 |
| MSFF031-6 | 1.070 | 2 | 6 | 8 | 7 | 3 | 2 | 7 | 2.3 |
| MSBB008-3 | 1.085 | 1 | 4 | 2 | 12 | 2 | | 5 | 2.5 |
| **Atlantic** | **1.092** | **1** | **5** | **4** | **12** | **2** | **1** | **4** | **2.5** |
| **Snowden** | **1.084** | **0** | **4** | **8** | **11** | **1** | **2** | **0** | **2.6** |
| MSDD249-9 | 1.081 | 0 | 7 | 3 | 10 | 2 | 3 | 0 | 2.6 |
| MSFF035-2 | 1.079 | 1 | 4 | 3 | 11 | 4 | 2 | 4 | 2.8 |
| MSEE101-2 | 1.090 | 1 | 1 | 6 | 10 | 6 | 1 | 4 | 2.9 |
| MSDD244-05 | 1.088 | 0 | 2 | 5 | 10 | 7 | 0 | 0 | 2.9 |
| MSX495-2 | 1.079 | 0 | 1 | 2 | 9 | 1 | 1 | 0 | 2.9 |
| MSBB190-2 | 1.081 | 0 | 0 | 5 | 7 | 2 | 3 | 0 | 3.2 |
| MSDD372-07 | 1.093 | 0 | 2 | 6 | 7 | 4 | 6 | 0 | 3.2 |
| MSEE031-3 | 1.086 | 0 | 2 | 1 | 11 | 9 | 1 | 0 | 3.3 |
| MSV241-2 | 1.091 | 0 | 1 | 2 | 12 | 7 | 3 | 0 | 3.4 |
| MSDD376-4 | 1.093 | 0 | 3 | 1 | 9 | 5 | 6 | 0 | 3.4 |
| MSEE016-10 | 1.091 | 0 | 0 | 3 | 8 | 9 | 3 | 0 | 3.5 |
| MSEE035-4 | 1.089 | 0 | 0 | 0 | 5 | 8 | 8 | 0 | 4.1 |
| **PRELIMINARY TRIAL, TABLESTOCK LINES** | | | | | | | | | |
| MSBB262-1YSpl | 1.066 | 26 | 1 | 0 | 0 | 0 | 0 | 96 | 0.0 |
| MSFF189-1Y | 1.063 | 22 | 4 | 0 | 0 | 0 | 0 | 85 | 0.2 |
| MSZ263-4 | 1.073 | 19 | 6 | 1 | 0 | 0 | 0 | 73 | 0.3 |
| MSEE052-5 | 1.073 | 19 | 3 | 3 | 0 | 0 | 0 | 76 | 0.4 |
| MSFF211-2 | 1.065 | 17 | 6 | 2 | 0 | 0 | 0 | 68 | 0.4 |
| MSDD088-1 | 1.073 | 14 | 11 | 0 | 0 | 0 | 0 | 56 | 0.4 |
| MSFF178-1 | 1.066 | 13 | 10 | 1 | 0 | 0 | 0 | 54 | 0.5 |
| MSFF191-1Y | 1.068 | 14 | 8 | 3 | 0 | 0 | 0 | 56 | 0.6 |
| MSDD251-2Y | 1.072 | 13 | 9 | 4 | 0 | 0 | 0 | 50 | 0.7 |
| MSBB323-1 | 1.089 | 7 | 14 | 2 | 2 | 0 | 0 | 28 | 1.0 |
| MSCC300-1 | 1.072 | 8 | 11 | 6 | 1 | 0 | 0 | 31 | 1.0 |
| MSFF055-1Y | 1.068 | 9 | 6 | 7 | 3 | 0 | 0 | 36 | 1.2 |
| MSDD107-1Y | 1.075 | 9 | 5 | 8 | 2 | 1 | 0 | 36 | 1.2 |
| MSCC512-1PP | 1.068 | 9 | 5 | 6 | 5 | 0 | 0 | 36 | 1.3 |
| MSFF120-2Y | 1.076 | 7 | 10 | 2 | 4 | 1 | 1 | 28 | 1.4 |
| MSX137-6 | 1.074 | 5 | 10 | 4 | 6 | 0 | 0 | 20 | 1.4 |
| **Reba** | **1.071** | **2** | **11** | **9** | **4** | **0** | **0** | **8** | **1.6** |
| MSEE048-2Y | 1.077 | 3 | 10 | 3 | 6 | 2 | 0 | 13 | 1.8 |
| MSEE075-1 | 1.074 | 2 | 8 | 7 | 3 | 5 | 0 | 8 | 2.0 |

Table of Contents

**Table 11**

**MICHIGAN STATE UNIVERSITY**
**POTATO BREEDING and GENETICS**

## 2021 BLACKSPOT BRUISE SUSCEPTIBILITY TEST
## SIMULATED BRUISE SAMPLES*

| ENTRY | SP GR | NUMBER OF SPOTS PER TUBER 0 | 1 | 2 | 3 | 4 | 5+ | PERCENT (%) BRUISE FREE | AVERAGE SPOTS/TUBER |
|---|---|---|---|---|---|---|---|---|---|
| MSZ610-3 | 1.082 | 0 | 1 | 9 | 9 | 5 | 1 | 0 | 2.8 |
| MSBB213-1SPL | 1.075 | 0 | 3 | 3 | 11 | 6 | 2 | 0 | 3.0 |
| **PRELIMINARY TRIAL, PIGMENTED LINES** | | | | | | | | | |
| MSFF134-1PP | 1.075 | 23 | 1 | 0 | 0 | 0 | 0 | 96 | 0.0 |
| **Dark Red Norland** | **1.063** | **24** | **4** | **1** | **0** | **0** | **0** | **83** | **0.2** |
| MSFF034-4P | 1.067 | 10 | 14 | 0 | 0 | 0 | 0 | 42 | 0.6 |
| MSFF305-1RY | 1.066 | 14 | 9 | 2 | 1 | | | 54 | 0.6 |
| MSFF198-13PY | 1.065 | 12 | 10 | 3 | 0 | 0 | 0 | 48 | 0.6 |
| MSFF142-2Spl | 1.071 | 8 | 16 | 0 | 1 | 0 | 0 | 32 | 0.8 |
| MSFF247-2Y | 1.069 | 10 | 9 | 6 | 0 | 0 | 0 | 40 | 0.8 |
| MSBB308-2P | 1.062 | 9 | 12 | 2 | 2 | 0 | 0 | 36 | 0.9 |
| MSW476-4RY | 1.078 | 8 | 8 | 6 | 3 | 0 | 0 | 32 | 1.2 |
| MSEE055-1R | 1.074 | 6 | 8 | 7 | 4 | 0 | 0 | 24 | 1.4 |
| MSFF200-4PYSPL | 1.065 | 4 | 9 | 8 | 4 | 0 | 0 | 16 | 1.5 |
| MSFF230-1 | 1.086 | 2 | 12 | 8 | 3 | 0 | 0 | 8 | 1.5 |
| MSAA157-2PY | 1.071 | 3 | 6 | 10 | 4 | 0 | 0 | 13 | 1.7 |
| MSFF230-2PY | 1.077 | 0 | 11 | 9 | 5 | 0 | 0 | 0 | 1.8 |
| MSX324-1P | 1.086 | 0 | 7 | 8 | 6 | 1 | 0 | 0 | 2.0 |
| **DIPLOID REPLICATED TRIAL** | | | | | | | | | |
| MSHH618-01 | 1.063 | 20 | 5 | 1 | 0 | 0 | 0 | 77 | 0.3 |
| MSGG863-A1 | 1.079 | 6 | 10 | 7 | 2 | 0 | 0 | 24 | 1.2 |
| MSHH699-02 | 1.074 | 3 | 10 | 11 | 1 | 0 | 0 | 12 | 1.4 |
| MSHH1056-01 | 1.074 | 4 | 10 | 4 | 5 | 2 | 0 | 16 | 1.6 |
| MSGG653-A2 | 1.081 | 4 | 2 | 12 | 7 | 0 | 0 | 16 | 1.9 |
| MSHH701-01 | 1.081 | 2 | 7 | 8 | 4 | 1 | 1 | 9 | 1.9 |
| **Lamoka** | **1.087** | **1** | **9** | **7** | **6** | **2** | **0** | **4** | **2.0** |
| MSEE824-04 | 1.086 | 1 | 6 | 6 | 11 | 1 | 0 | 4 | 2.2 |
| MSEE815-06 | 1.078 | 1 | 5 | 5 | 10 | 3 | 0 | 4 | 2.4 |
| MSGG676-01 | 1.073 | 0 | 4 | 8 | 9 | 3 | 1 | 0 | 2.6 |
| MSHH972-03 | 1.076 | 0 | 4 | 9 | 7 | 2 | 3 | 0 | 2.6 |
| MSHH1037-01 | 1.076 | 0 | 3 | 11 | 3 | 2 | 6 | 0 | 2.9 |
| MSGG623-A2 | 1.083 | 0 | 3 | 3 | 3 | 2 | 3 | 0 | 2.9 |
| MSGG600-06 | 1.098 | 0 | 3 | 7 | 6 | 6 | 3 | 0 | 3.0 |
| **Atlantic** | **1.091** | **0** | **1** | **4** | **10** | **10** | **0** | **0** | **3.2** |
| MSGG603-A5 | 1.078 | 0 | 2 | 5 | 8 | 6 | 4 | 0 | 3.2 |
| MSGG685-05 | 1.071 | 0 | 2 | 3 | 9 | 6 | 5 | 0 | 3.4 |
| MSDD829-09 | 1.07 | 0 | 1 | 4 | 5 | 7 | 8 | 0 | 3.7 |

Table of Contents

**Table 11**

**MICHIGAN STATE UNIVERSITY**
**POTATO BREEDING and GENETICS**

## 2021 BLACKSPOT BRUISE SUSCEPTIBILITY TEST
## SIMULATED BRUISE SAMPLES*

| | | NUMBER OF SPOTS PER TUBER | | | | | | PERCENT (%) BRUISE FREE | AVERAGE SPOTS/TUBER |
|---|---|---|---|---|---|---|---|---|---|
| ENTRY | SP GR | 0 | 1 | 2 | 3 | 4 | 5+ | | |
| **USPB/SFA TRIAL CHECK SAMPLES (Not bruised)** | | | | | | | | | |
| NY163 | 1.083 | 19 | 5 | 1 | 0 | 0 | 0 | 76 | 0.3 |
| NYOR14Q9-9 | 1.080 | 20 | 4 | 0 | 1 | 0 | 0 | 80 | 0.3 |
| W12078-76 | 1.092 | 17 | 7 | 1 | 0 | 0 | 0 | 68 | 0.4 |
| **Lamoka** | **1.082** | **13** | **9** | **3** | **0** | **0** | **0** | **52** | **0.6** |
| MSZ242-13 | 1.094 | 15 | 6 | 3 | 1 | 0 | 0 | 60 | 0.6 |
| MSAFB605-4 | 1.078 | 12 | 11 | 1 | 1 | 0 | 0 | 48 | 0.6 |
| MSW474-1 | 1.081 | 14 | 7 | 3 | 1 | 0 | 0 | 56 | 0.6 |
| **Snowden** | **1.079** | **13** | **7** | **3** | **1** | **1** | **0** | **52** | **0.8** |
| NY165 | 1.081 | 8 | 9 | 6 | 2 | 0 | 0 | 32 | 1.1 |
| **USPB/SFA TRIAL BRUISE SAMPLES** | | | | | | | | | |
| NY163 | 1.083 | 2 | 5 | 9 | 3 | 5 | 1 | 8 | 2.3 |
| W12078-76 | 1.092 | 0 | 7 | 6 | 5 | 6 | 1 | 0 | 2.5 |
| MSZ242-13 | 1.094 | 2 | 3 | 5 | 7 | 5 | 3 | 8 | 2.8 |
| NYOR14Q9-9 | 1.080 | 1 | 5 | 3 | 6 | 8 | 2 | 4 | 2.8 |
| **Lamoka** | **1.082** | **1** | **2** | **5** | **7** | **6** | **4** | **4** | **3.1** |
| MSAFB605-4 | 1.078 | 1 | 1 | 4 | 10 | 5 | 4 | 4 | 3.2 |
| MSW474-1 | 1.081 | 0 | 1 | 3 | 3 | 4 | 14 | 0 | 4.1 |
| NY165 | 1.081 | 0 | 1 | 1 | 1 | 3 | 19 | 0 | 4.5 |
| **Snowden** | **1.079** | **0** | **0** | **0** | **1** | **3** | **21** | **0** | **4.8** |

* Thirteen to twenty-five (dependent on the number of replications used) A-size tuber samples were collected at harvest, held at 50 F at least 12 hours, and placed in a six-sided plywood drum and tumbled to produce simulated bruising. Samples were abrasive-peeled and scored 10/26/21 (SNAC trial by POP) all other trials 11/11/2021 (PBG).
The table is presented in ascending order of average number of spots per tuber.

Table of Contents

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# 2021 On-Farm Potato Variety Trials

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Cooperator: James DeDecker, (Presque Isle Co.)

## INTRODUCTION

Our main objectives for on-farm potato variety trials are to: 1) identify promising lines for further testing and evaluation, 2) conduct larger scale commercial agronomic and processing trials through multi-acre block plantings, and 3) use trial data to encourage the commercialization of new varieties in the state of Michigan. We share our results with growers, breeders, and processors across the country to aid in the development of new varieties. In 2021, we conducted 35 on-farm potato variety trials with 13 growers in 11 counties.

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

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

## PROCEDURE

### *A. Processing Variety Trials*

We evaluated 82 chip processing varieties in 2021. To evaluate selected processing lines, we used the following check varieties: Altantic, Lamoka, and Snowden. For all trials, we used 10” in-row seed spacing and 34” rows (Table 2).

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

Table of Contents

*B. Processing Variety Trials*

We conducted the Potatoes USA/SNAC Int. Trial for Michigan at Sandyland Farms, LCC (Montcalm County). We planted nine varieties in 300' strips and harvested three, 23-ft sections of row for each variety. Our check varieties were 'Lamoka' and 'Snowden'(Tables 3 to 7). For more details on this trial, please reference the 2021 annual report published by Potatoes USA.

*C. Fresh Market Trials*

Within the fresh market trials, we evaluated 105 primary entries (this does not include entries from Potatoes USA/NFPT trial) which included: 28 russet, 22 red, 39 yellow, 1 novelty, and 15 round white types (Tables 9 and 10). To evaluate selected table-stock lines, we used the following check varieties:
Red: Dark Red Norland
Round White: Reba, Superior
Russet: Russet Norkotah, Silverton Russet
Yellow: Yukon Gold
We planted all trials with 34" wide rows and 10" in-row seed spacing.

We evaluated the majority of our fresh market trials as strip trials. These trials consisted of a single 60-100' for each variety of which we harvested and graded a single 23-ft section . We planted the NFPT trial at Walther Farms, Inc. as single 15' long strips and harvested the entire strip (Table 11). 2021 was the third year conducting an early generation tablestock variety trial with red skin white flesh and yellow skin potato varieties. This trail was planted and harvested like the NFPT trial, and took place at Walther Farms, Inc (Table 12). We planted Walther Farms, Inc. trials trial with three, 15-ft rows and harvested the middle row. We also conducted multi-acre block plantings of promising, non-commercialized trials at Kitchen Farms and Walther Farms Cass City. Agronomic production practices for these block plantings varied based on each grower's production system.

**RESULTS**

*A. Processing Variety Trial Results*

We recorded general descriptions, pedigrees, and scab ratings for all varieties tested in 2021 (Table 1) and evaluated these varieties based on yield, specific gravity, internal quality, common scab ratings, and maturity (Table 2). Below are six superior processing varieties from 2021.

> **NY165:** This Cornell variety was only evaluated at one location in 2021 due to seed availability. It had the third highest yield US#1 yield of 600 cwt/A and a total yield of 662 cwt/A. The size breakdown was 90% A sized tubers, eight percent B sized tubers, and one percent pickouts. The specific gravity was 1.078, slightly below the trial average of 1.080. Internal quality was excellent with no defects observed in 2021. The fresh chip score was 1.0 with a stem end score of 1.4, above the trial average. The vine vigor and vine maturity were consistent with the trial averages, with scores of 3.2 and 2.8, respectively. The tubers had a flattened oval type, darker netted skin, and slightly recessed apical eyes. It will be evaluated in storage as part of the SNAC trial.

Table of Contents

**CO12293-1W:** This Colorado State University variety was evaluated in the Montcalm Research Center Box Bin trial in 2021. It had a very high US#1 yield of 590 cwt/A and high total yield of 668 cwt/A. The tuber size breakdown was consistent with the trial average, with 88% A sized tubers and nine percent B sized tubers. The specific gravity of 1.082 was slightly above the trial average. Internal quality was excellent with no defects observed in 2021. This variety is susceptible to common scab, with a scab rating of 2.5, above the trial average. CO12293-1W had a moderately vigorous vine and full season vine maturity. The tubers were generally uniform with light skin.

**NY174:** This Cornell variety was evaluated at four locations in 2021. It had a very high US#1 and total yield of 568 cwt/A and 629 cwt/A, respectively. It had a high percentage of A sized tubers and few pickouts. The specific gravity of 1.086 was above the trial average of 1.080. The fresh chip score and stem end defect score were both below the trial average with good chip quality observed. The tubers had a flattened oval type with thin skin. The vine type was larger than average with a mid-season maturity. It will be evaluated in storage at the Montcalm Research Center during the 2021-2022 storage season.

**MSW474-1:** This Michigan State University variety was evaluated at 13 locations in 2021. It had an above average yield of 493 cwt/A and total yield of 580 cwt/A. There were slightly more B sized tubers than average, 14%. Specific gravity was 1.081, slightly above the trial average. Internal quality was excellent, no defects were observed in 2021. The fresh chip color score of 1.5 was acceptable, and the stem end defect score of 0.4 was below the trial average. This variety has a moderately vigorous vine and mid-season vine maturity. The tubers had darker heavy netted skin and deeper apical eyes. Some sticky stolons were observed. It will be evaluated in storage at the Montcalm Research Center during the 2021-2022 storage season.

**MSAA260-3:** This Michigan State University variety was evaluated at two locations in 2021. It had an above average US#1 yield of 484 cwt/A and total yield of 533 cwt/A. It had 90% A sized tubers. Eight percent each of vascular discoloration, internal brown spot, and brown center were observed in 2021. The specific gravity of 1.081 was slightly above the trial average. Chip color and stem end defect ratings were both acceptable. This variety had slightly more common scab susceptibility than average, 1.3 vs 1.1. Vine maturity was slightly earlier than average. The tubers were uniform with a blocky round type.

**MSAFB609-12:** This Michigan State University variety had an average US#1 and total yield in 2021 when evaluated at ten locations. The tuber size profile was consistent with the trial average, and the specific gravity of 1.082 was slightly higher than average. Internal quality was excellent, with no internal defects observed. Fresh chip score, stem end defect score, and common scab ratings were all consistent with the trial average. The plant produced medium sized vines and had a mid-season maturity. The tubers were uniform and round with light this skin. Some points were observed. This variety will be evaluated in storage at the Montcalm Research Center during the 2021-2022 storage season.

Table of Contents

*B. Potatoes USA/SNAC Int. Chip Trial*

In 2021, we conducted the Potatoes USA / SNAC Int. Michigan chip trial at Sandyland Farms, LLC in Montcalm County. We compared yield, size distribution, and specific gravity of seven test varieties to Lamoka and Snowden (Table 3). We also evaluated at-harvest raw tuber quality (Table 4) and sent samples to Herr Foods, Inc. (Nottingham, PA) where potatoes were processed and scored for out of the field chip quality (Table 5). We assessed blackspot bruise susceptibility (Table 6) and conducted pre-harvest panels for each variety (Tables 7A and B).

The varieties with the highest US#1 yields were NY165, MSAFB605-4, and MSW474-1, with yields ranging from 532 cwt/A to 600 cwt/A. MSAFB605-4 also had the highest percent of US #1 tubers at 92%, while MSW474-1 had the lowest at 86%. The average specific gravity of the trial was 1.081 (Table 3). W12078-76 has the highest incidence of internal defects, with 27% hollow heart, three percent vascular discoloration, and 17% brown center. NYOR14Q9-9 had 10% hollow heart, higher than the trial average of four percent (Table 4). Samples collected on October 13$^{th}$ were processed by Herr's Foods, Inc. on October 18$^{th}$. NY163 was ranked first by Herr's and has a SFA color of 2 and 3.4% internal defects. W12078-76 was also ranked highly, with a SNAC color of 2 and six percent total defects. NYOR14Q9-9 was ranked last with a SFA color of 3, 35% total defects, stem end defects, edge color, and scab (Table 5). Black spot bruise assessments demonstrated that NY163, W12078-76, and MSZ242-13 were most resistant to black spot bruising, while NY165 and Snowden were most susceptible (Table 6).

*C. Fresh Market and Variety Trial Results*

We recorded general descriptions, pedigrees, and scab ratings for all fresh market varieties evaluated in 2021 (Table 8) and assessed these varieties based on yield, specific gravity, internal quality, common scab ratings, and maturity (Tables 9 and 10). The NFPT and Early Generation Tablestock trials screen potato selections under initial evaluation. In 2021, 56 NFPT-designated russet varieties and an additional 14 russet selections were evaluated (Table 11). Continued evaluation of these varieties are determined based on national performance. In total, 60 red skin potato varieties from Cornell University, University of Maine, Michigan State University, Colorado State University, Texas A & M University, and North Dakota State University potato breeding programs were grown in Michigan. Of these, 16 varieties were chosen for continued evaluation in Michigan (Table 12). They were be grown in 15-foot plots in 2022. Below are top performing russet, yellow, red, white, and novelty fresh pack varieties.

*Russets*

**AF6377-13:** This University of Maine variety was evaluated for the first time in 2021 at only one location due to seed availability. It had the fifth highest yield in 2021 with 436 cwt/A US#1 tubers and 78% US#1 tubers. It had a slightly larger tuber size profile than average, with 21% oversize tubers. AF6377-13 had an above average specific gravity of 1.080, clean internals excluding 20% brown center, and no common scab. It had an attractive tuber shape with dark russet skin.

**W13A11229-1RUS:** This variety had the seventh highest US#1 yield of 403 cwt/A at ten locations. It had a light russet skin type and 75% US#1 tubers, higher than the trial average of 73%. This medium maturing variety had a moderately vigorous vine type and a common scab rating of 0.6. It had a specific gravity of 1.083, above the trial averag

Table of Contents

W13A11229-1RUS had 12% hollow heart and seven percent vascular discoloration in 2021.

**A08433-4sto:** This Aberdeen, Idaho variety also had a high total yield of 529 cwt/A with 79% US #1 tubers. It had an above average specific gravity of 1.080 and a common scab rating of 0.6. This full season variety had a moderately vigorous vine, and moderate hollow heart. This variety had an oblong to long flattened tuber type. A08433-4sto has multiple disease resistances including PVY, *Verticillium* Wilt, Early Blight, and tuber Late Blight.

**CO10085-1RUS:** This Colorado State University selection had an average yield of 344 cwt/A US#1 tubers and a total yield of 471 cwt/A. It had a very high specific gravity of 1.084 and good internal quality. This full season variety had a common scab score of 0.9. Prominent eyes were observed in these oblong tubers. This variety will be observed at seven locations in 2021 and bulk plantings will be conducted in 2022.

*Yellow Flesh*

**Columba:** This yellow-fleshed variety had the highest total and US#1 trial yield of 670 and 601 cwt/A, respectively. It produced 90% A-sized tubers and had a lower specific gravity of 1.052. Internal quality was very good with seven percent vascular discoloration and two percent internal brown spot observed. Columba was an earlier maturing variety with a score of 1.6. This variety had a common scab rating of 0.3, and medium yellow flesh. It had smooth, waxy skin, but did not have a consistently uniform tuber type. Some heat sprouts were observed in 2021, likely due to early maturity and delayed harvest.

**Danina:** This variety has a consistent attractive appearance with a smooth skin finish and medium yellow flesh. With a US#1 yield of 504 and total yield of 610 cwt/A, this variety produced 83% US#1 tubers. It had an average rating for skin waxiness and higher rating for yellow flesh color. It had a slightly later vine maturity than the trial average. Danina had good internal quality with three percent hollow heart and six percent vascular discoloration, both of which are at the trial average.

**MSV093-1Y (Bonafide)**: This Michigan State University selection had a high yield of 523 cwt/A in 2021 with 92% US#1 potatoes. MSV093-1Y had a higher-than-average proportion of A-sized tubers and a consistent shape. It had a specific gravity of 1.069, slightly higher than the trial average of 1.067. It had a larger vine type and a full season vine maturity. It had excellent internal quality, with no defects observed across seven locations.

**Goldfinger**: This variety was first evaluated in 2021 and was grown at four locations. It had a US #1 yield of 470 cwt/A with 75% US #1 tubers. It had smooth waxy skin and bright appearance. Some heat sprouts were observed, likely due to the earlier vine maturity and delayed harvest in some trials. At 1.053, it had a lower-than-average specific gravity, and a common scab rating of 0.8. Goldfinger had one percent vascular discoloration, five percent internal brown spot, and three percent brown center.

Table of Contents

*Red Skin*

**NDAF113484B-1**: This North Dakota selection was the second highest yielding variety in the 2021 red skin potato trial with a US #1 yield of 459 cwt/A and a total yield of 528 cwt/A. It was evaluated at five locations in 2021 and had 87% US #1 tubers. NDAF113484B-1 had a specific gravity of 1.063, slightly lower than the trial average of 1.067. It had good internal quality with defects at or below four percent. This mid-season variety had a common scab rating of 0.5. The tubers had an attractive skin color, a round type, and deeper eyes.

**NDA050237B-1R**: This variety had the highest US #1 yield of 482 cwt/A and a specific gravity of 1.062. Its internal quality was generally good with ten percent vascular discoloration and one percent brown center. This variety had an oval tuber type with uniform skin color and slight skinning. It had a late season maturity and moderately vigorous vine. Skin color was a deep, attractive red, and was moderately waxy. Slight sticky stolons were observed, likely due to full season maturity requirements.

**CO99076-6R:** This early maturing Colorado variety produced attractive, uniform tubers with deep red skin. It had a US #1 yield of 411 cwt/A, above the trial average of 320 cwt/A. CO99076-6R had a larger size profile with only eight percent B size tubers. It had good internal quality with 12% vascular discoloration when observed at five locations in 2021. Skin color and skin color uniformity were both rated above average.

**Canada Rose (CO00277-2R)**: This Colorado State University selection had excellent skin color but a variable tuber shape in 2021. It had an above average US#1 yield of 371 cwt/A and total yield of 438 cwt/A. Fourteen percent vascular discoloration was observed in 2021, as well as a scab score of 1.2, above the trial average. Canada Rose had a smaller vine type and earlier vine maturity. It will be further evaluated in 2022 as seed availability only allowed for one trial location in 2021.

*Round White*

**Volare:** This variety had the highest yield in 2021with 679 cwt/A US#1 tubers and a total yield of 741 cwt/A. It produced 91% A-sized tubers, significantly higher than the trial average. It had an attractive type and skin, with an above average skin waxiness rating. However, when evaluated at two locations, it had a high percentage of internal defects, including ten percent hollow heart, 15% vascular discoloration, 35% internal brown spot, and five percent brown center. Further evaluation will determine if the defects persist across years or if Volare is able to grow successfully in Michigan.

**NYQ112-5:** This Cornell University selection had an average yield of 493cwt/A US#1 tubers and 587 cwt/A total yield, both above the trial average. This variety produced 83% A-sized tubers, which were round with thin skin. It had good internal quality with only seven percent vascular discoloration. This variety had a larger vine size and mid to full season vine maturity. It had smooth skin with a higher-than-average waxiness rating.

Table of Contents

**NDAF102629C-4:** This variety was evaluated at six locations in Michigan in 2021. It produced larger tubers, with 90% A-sized tubers and an average yield of 385 cwt/A US #1 tubers. It had good internal quality with three percent or less of internal defects. The specific gravity of 1.070 was above the trial average. This variety had a very large vine type and mid-season vine maturity. NDAF102629C-4 had a round tuber type and moderately deep apical eyes.

**Ashley**: When evaluated at four locations in 2021 this variety had a bright appearance and thin skin, with an above average waxiness rating. It had an average US#1 yield of 380 cwt/A and total yield of 468 cwt/A. The size profile was consistent with the trial average, with 18% B-sized tubers and 88% A-sized tubers. Fifteen percent vascular discoloration was observed in 2021, higher than the trial average. The common scab rating was 0.8, consistent with the trial average in 2021.

*Novelty*

**Blackberry:** This Michigan State University selection had purple skin and flesh, and an above average yield of 481 cwt/A US #1 tubers. It produced 75% A sized tubers and 22% B sized tubers. Blackberry had no internal defects but was only evaluated at three locations in 2021. The purple skin was a uniform dark color, but severe silver scurf was observed. Some tubers had chimeral eyes with white pigmentation, while most other tubers had consistent purple skin. This variety was also evaluated as a processing variety in the 2021 Box Bin trial, where it will undergo monthly storage sampling to determine chip quality.

Table of Contents

# Table 1. 2021 Chip Processing Variety Descriptions

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| Atlantic | Wauseon x B5141-6 (Lenape) | 1.6 | Above average yield, high percentage A-sized tubers, below average specific gravity, high incidence hollow heart |
| Betty | SunRain | 1.7 | Low yield, smaller tuber size profile, good internal quality, average stem end defect |
| Blackberry (MSZ109-10PP) | COMN07-W112BG1 x MSU200-5PP | 2.0 | Average yield, purple skin and flesh, smaller size profile, lower specific gravity, good internal quality |
| Corsica | Parkland Seed Potatoes | 1.0 | Very low yield, smaller size profile, high specific gravity, thin skin, light yellow flesh |
| Kelly | SunRain | 1.1 | Average yield, very long shape, higher incidence pickouts and misshapen tubers, average specific gravity |
| Lady Liberty (NY152) | B38-14 x Marcy | 0.9 | Above average yield, lower specific gravity, good internal quality, attractive round type, light netted skin |
| Lamoka (NY139) | NY120 x NY115 | 0.7 | Below average yield, flattened oval type, average specific gravity, good internal quality, bright thin skin |
| Mackinaw (MSX540-4) | Saginaw Chipper x Lamoka | 0.7 | Above average yield, good internal quality, deeper apical eyes, flattened oval type |
| Petoskey (MSV030-4) | Beacon Chipper x MSG227-2 | 0.7 | Below average yield, heavy netted skin, round type, above average specific gravity |

Table of Contents

*(2021 Processing varieties cont.)*

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| Snowden (W855) | B5141-6 x Wischip | 1.0 | Average yield, early maturity, mid-season storage, reconditions well in storage, medium to high specific gravity |
| AC11494-6W | A05158-3C x 00-3115-11 | 0.8 | Very low specific gravity, smaller size profile, lower yield, good internal quality, round blocky type |
| AF6526-3 | Pike x AF5040-8 | 1.0 | Smaller size profile and lower yield, very high specific gravity, large vigorous vine, inconsistent tuber type |
| AF6526-7 | Pike x AF5040-8 | 2.5 | Bright appearance, moderate common scab, poor fresh chip quality, high proportion A-sized tubers, average yield |
| AF6527-3 | Pike x MSH228-6 | 1.0 | Very high specific gravity, good fresh chip quality, good internal quality, flattened oval tuber type |
| AF6543-2 | MSR061-1 x MSH228-6 | 1.5 | Very high incidence of hollow heart, large vine type, low yield, average specific gravity |
| AF6550-2 | NDAF102629C-4 x AF5040-8 | 2.5 | Good internal quality, high specific gravity, moderate common scab, below average yield, light netted skin |
| AF6582-1 | AF2376-5 x WAF10192-3 | 2.0 | Oval flattened type, moderate common scab, above average yield, smaller tuber size profile, good internal quality |

**Table of Contents**

*(2021 Processing varieties cont.)*

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| AF6598-6 | MSM171-A x Lamoka | 1.5 | Poor fresh chip quality, good internal quality, blocky type, above average yield, below average specific gravity |
| AF6603-5 | NY121 x MSR127-2 | 2.0 | Deeper apical eyes, moderate common scab and stem end defect, high specific gravity, above average yield |
| BNC718-1 | Peter Wilcox x Chieftain | 1.0 | High percentage A-sized tubers and high yield, low specific gravity, moderate vascular discoloration, moderate stem end defect |
| BNC811-22 | NC308-2 x Atlantic | 1.8 | Smaller tuber size profile, average specific gravity, severe hollow heart, below average yield |
| BNC816-3 | Lamoka x NC41-1 | 1.0 | Excellent internal quality, pointed tubers, average yield, below average tuber size profile, deeper eyes |
| BNC821-9 | NC41-1 x NC182-5 | 1.5 | Above average yield, moderate hollow heart, poor appearance, high percentage A sized tubers |
| CO11037-5W | BC0894-2W x Nicolet | 0.3 | Oval type, variable shape, earlier vine maturity, below average yield, higher percentage pickouts |
| CO12235-3W | AC00206-2W x AC03433-1W | 0.2 | Thin skin, bright appearance, smaller type, good internal quality, full season maturity, below average specific gravity |

**Table of Contents**

*(2021 Processing varieties cont.)*

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| CO12293-1W | CO02024-9W x ND7519-1 | 2.5 | High yield, good internal quality, moderate common scab, uniform type, light skin, full season maturity |
| COOR13270-2 | Winterset x CO02024-9W | 1.5 | Lowest yield in 2021, very small tuber size profile, even split of A and B sized tubers, above average specific gravity, good internal quality |
| COTX12235-2W | AC00206-2W x AC03433-1W | 0.7 | Smaller size profile, below average specific gravity, earlier vine maturity, some pear shaped tubers |
| MSAA311-1 | Elkton x Atlantic | 1.2 | Heavy netted skin, deeper eyes, average yield, below average specific gravity, moderate hollow heart |
| MSAA076-4 | MSR127-2 x MSS297-3 | 1.0 | High total yield but smaller size profile with many B sized tubers, good internal quality, high specific gravity, earlier vine maturity |
| MSAA076-6 | MSR127-2 x MSS297-3 | 1.2 | Deeper eyes, light netted skin, moderate internal brown spots, above average yield, blocky round type |
| MSAA217-3 | Beacon Chipper x Atlantic | 1.5 | Severe hollow heart, very high specific gravity, full season maturity, attractive round uniform type |
| MSAA232-4 | Lamoka x Manistee | 0.0 | Non uniform type, light netted skin, above average yield, high specific gravity, severe hollow heart |

**Table of Contents**

*(2021 Processing varieties cont.)*

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| MSAA252-7 | NY148 x MSQ089-1 | 1.2 | Highest yield in 2021, deeper eyes, large blocky type, moderate vascular discoloration, average specific gravity |
| MSAA260-3 | MSQ086-3 x Atlantic | 1.3 | Uniform round type, average yield and specific gravity, moderate internal defects, earlier vine maturity |
| MSAA309-15 | Atlantic x Lamoka | 0.8 | Slight skinning, moderate growth crack, below average yield, large vine type, earlier vine maturity |
| MSAA328-4 | Boulder x MSR169-8Y | 0.5 | Very low yield, excellent internal quality, above average specific gravity, good fresh chip quality |
| MSAA570-3 | MSV313-1 x Lamoka | 0.6 | Larger flattened type, high yield, average specific gravity, higher incidence pickouts |
| MSAFB605-4 | NY148 x MSV241-2 | 2.0 | Very high yield, attractive blocky round type, moderate common scab, good fresh chip quality, below average specific gravity |
| MSAFB609-12 | NY148 x MSQ086-3 | 1.4 | Light thin skin, trace pointed tubers, average yield and specific gravity, excellent internal quality, moderate vine type |
| MSAFB635-15 | NYH15-5 x MSS297-3 | 1.0 | Round type, average yield, smaller size profile, higher specific gravity, medium netted skin |

**Table of Contents**

*(2021 Processing Varieties cont.)*

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| MSBB012-1Y | Beacon Chipper x MSR169-8Y | 0.0 | Blocky round type, below average yield, very low specific gravity, marginal fresh chip quality |
| MSBB047-1 | Lamoka x MST096-2Y | 0.0 | Moderate stem end defect, below average specific gravity, average yield, thin skin, earlier vine maturity |
| MSBB058-1 | NY148 x MSR127-2 | 1.5 | Small round type, very high specific gravity, excellent internal quality, moderate vine type |
| MSBB058-3 | NY148 x MSR127-2 | 0.5 | Very high yield, low specific gravity, moderate vascular discoloration, full season maturity |
| MSBB079-2 | MSS927-1 x MSR127-2 | 0.3 | Average yield and specific gravity, good fresh chip quality, excellent internal quality, variable skin finish |
| MSBB221-1 | Snowden x MSQ086-3 | 0.0 | Medium netted skin, slight growth crack, above average yield, below average specific gravity, excellent internal quality |
| MSBB230-1 | NY148 x MSQ089-1 | 2.5 | Uniform blocky type, smaller size profile, below average yield, high specific gravity, severe common scab |
| MSBB230-2 | NY148 x MSQ089-1 | 0.0 | High yield, average specific gravity, excellent internal quality, uniform type, sticky stolons, smaller vine type |
| MSBB610-13 | NY148 x MST096-2Y | 0.8 | Bright thin skin, average specific gravity, marginal fresh chip score, excellent internal quality, below average yield |

**Table of Contents**

*(2021 Processing Varieties cont.)*

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| MSBB614-15 | Saginaw Chipper x MSR127-2 | 0.7 | Heavy netted skin, blocky oval type, below average yield, moderate hollow heart and vascular discoloration |
| MSBB625-2 | MSW242-1 x MSS297-3 | 1.0 | Moderate skinning and heat sprouting, above average yield and specific gravity, severe internal brown spot |
| MSBB626-11 | Saginaw Chipper x Kalkaska | 1.1 | Deeper eyes, round type, average yield and specific gravity, moderate hollow heart, moderate vine type |
| MSBB634-8 | Lady Liberty x MSR169-8Y | 0.6 | Blocky round type, slight skinning, below average yield and specific gravity, smaller vine type |
| MSBB635-14 | Lady Liberty x MSS297-3 | 1.5 | Severe sticky stolons, compressed shape, above average yield, severe vascular discoloration, below average specific gravity |
| MSCC058-1 | MSK061-4 x Manistee | 1.0 | Average yield, severe vascular discoloration, round type, trace growth crack, average specific gravity |
| MSCC248-2 | Saginaw Chipper x Elkton | 0.0 | Significant growth crack and alligator hide, below average yield and specific gravity, excellent internal quality |
| MSCC376-01 | MSR127-2 x Manistee | 0.2 | Heavy netted skin, consistent size profile, below average yield, average specific gravity, excellent internal quality |

**Table of Contents**

*(2021 Processing Varieties cont.)*

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| MSDD085-13 | NY148 x MSR127-2 | 1.2 | Smaller size profile, flattened tuber type, average specific gravity, good fresh chip quality, good internal quality |
| MSDD271-11 | AF4648-2 x MSR127-2 | 0.0 | Flat oval type, prominent eyes, below average yield, low specific gravity, moderate stem end defect |
| MSW474-1 | MSN190-2 x MSP516-A | 0.6 | Darker netted skin, deeper eyes, high yield, average specific gravity, excellent internal quality |
| MSY022-2 | MSS176-1 x MST096-2Y | 0.7 | Inconsistent shape, larger type, above average yield, mid-season maturity, marginal fresh chip quality |
| MSZ242-07 | MSR169-8Y x MSU383-A | 0.5 | Slight shatter bruise, below average yield, very high specific gravity, excellent internal quality, low stem end defect incidence |
| MSZ242-13 | MSR169-8Y x MSU383-A | 0.5 | Large blocky round type, above average yield, very high specific gravity, slight growth crack |
| NDTX112203AB-1W | | 2.0 | Bright skin, less uniform type, below average yield and specific gravity, smaller size profile, full season maturity |
| NDTX113030C-3W | Dakota Diamond x ND7212-1 | 0.5 | Less uniform type, smaller size profile, lower yield and specific gravity, moderate hollow heart, full season maturity |

**Table of Contents**

*(2021 Processing Varieties cont.)*

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| NDTX14362AB-1W | ND102809AB-2 x ND028984B-1 | 0.5 | Very high yield, low specific gravity, excellent internal quality, uniform round type, thin light skin, full season vine maturity |
| NY163 (L7-2) | NYE50-8 x NYE48-2 | 0.8 | Average yield, above average specific gravity, thinner light skin, pink eyes, good fresh chip quality |
| NY165 (M8-5) | NY148 x NYF48-4 | 1.3 | Very high yield, average specific gravity, good fresh chip quality, darker netted skin, deeper apical eyes |
| NY168 | NY148 x E48-2 | 1.5 | Above average yield and specific gravity, moderate skinning, purple pigmentation around eyes, mid-season maturity |
| NY172 (Q29-1) | Lady Liberty x F31-3 | 1.3 | Blocky oval type, slight sticky stolons, high yield, below average specific gravity, moderate hollow heart, early vine maturity |
| NY173 (Q38-4) | J110-12 x F31-3 | 1.3 | Light skin, deeper eyes, slight hollow heart and vascular discoloration, above average yield, very early vine maturity |
| NY174 | NY148 x E48-2 | 0.9 | Very high yield and specific gravity, excellent internal quality, flat oval type, thin skin, mid-season maturity |
| NYOR14Q9-9 | Eva x H25-4 | 2.0 | High yield, average specific gravity, moderate hollow heart, full season maturity, flattened oval type |

**Table of Contents**

*(2021 Processing Varieties Cont.)*

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| NYR101-2 | Snowden x E48-2 | 1.1 | Below average yield, average specific gravity, very early vine maturity, large vine type, light skin, less uniform type |
| NYR1-7 | Andover x Lady Liberty | 1.2 | High yield and specific gravity, moderate internal brown spots, earlier vine maturity, trace alligator hide |
| NYR3-5 | Andover x NY154 | 0.8 | Blocky oval type, high specific gravity, moderate hollow heart, large vine type, above average yield |
| TX17846-1W | CO07070-10W x NDTX091908AB-2W | 0.0 | Smaller size profile, lower yield, marginal fresh chip quality, thin skin, bright appearance, moderate vascular discoloration |
| W12078-76 | Hodag x Lelah | 0.8 | Average yield, high specific gravity, moderate hollow heart, uniform round type, medium netted skin |
| WAF16107-2 | MSX540-4 x Tundra | 2.0 | Below average yield, very high specific gravity, moderate hollow heart, earlier vine maturity |

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

Table of Contents

# Table 2. 2021 Michigan Statewide Chip Processing Potato Variety Trials
## Overall Averages - Thirteen Locations

| | CWT/A | | PERCENT OF TOTAL[1] | | | | | | | RAW TUBER QUALITY[4] (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LINE | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR[2] | OTF CHIP SCORE[3] | HH | VD | IBS | BC | COMMON SCAB RATING[5] | SED SCORE[6] | VINE VIGOR[7] | VINE MATURITY[8] | COMMENTS |
| MSAA252-7[bdh] | 706 | 734 | 97 | 3 | 85 | 12 | 0 | 1.079 | 1.3 | 0 | 23 | 0 | 0 | 1.2 | 0.5 | 3.2 | 2.8 | deeper eyes, larger blocky round type |
| MSAFB605-4[i] | 600 | 652 | 92 | 8 | 92 | 0 | 0 | 1.073 | 1.0 | 0 | 0 | 0 | 0 | 2.0 | 0.6 | 2.5 | 3.5 | med to heavy netted skin, nice blocky round type, uniform, sl skinning |
| NY165[i] | 600 | 662 | 91 | 8 | 91 | 0 | 1 | 1.078 | 1.0 | 0 | 0 | 0 | 0 | 1.3 | 1.4 | 5.0 | 3.0 | flat oval type, darker netted skin, sl deep apical eyes |
| CO12293-1W[h] | 590 | 668 | 88 | 9 | 88 | 0 | 3 | 1.082 | 1.0 | 0 | 0 | 0 | 0 | 2.5 | 0.6 | 3.0 | 4.0 | generally uniform, light skin |
| NY174[adhl] | 568 | 629 | 90 | 7 | 89 | 1 | 3 | 1.086 | 1.1 | 0 | 0 | 0 | 0 | 0.9 | 0.4 | 3.9 | 3.4 | flat oval type, thin skin |
| MSAA570-3[bl] | 561 | 628 | 88 | 4 | 87 | 1 | 8 | 1.081 | 1.3 | 7 | 0 | 0 | 2 | 0.6 | 0.5 | 2.8 | 2.8 | large flattened type, sheep nose |
| MSBB058-3[bck] | 539 | 563 | 96 | 4 | 95 | 1 | 0 | 1.075 | 2.0 | 0 | 20 | 0 | 0 | 0.5 | 0.9 | 2.7 | 4.7 | medium netted skin, slight skinning |
| NDTX14362AB-1W[k] | 532 | 605 | 88 | 11 | 88 | 0 | 1 | 1.069 | 1.5 | 0 | 0 | 0 | 0 | 0.5 | 0.3 | 3.5 | 4.0 | uniform round type, thin light skin |
| Lady Liberty[abcdefghkl] | 525 | 587 | 89 | 10 | 89 | 0 | 1 | 1.077 | 1.2 | 0 | 5 | 1 | 0 | 0.9 | 0.4 | 3.3 | 3.1 | smaller uniform round type, light netted skin |
| BNC718-1[ek] | 524 | 561 | 94 | 3 | 93 | 1 | 3 | 1.067 | 1.5 | 5 | 15 | 0 | 0 | 1.0 | 1.3 | 2.5 | 1.8 | purple skin, light yellow flesh, round type |
| BNC821-9[ek] | 521 | 565 | 93 | 2 | 88 | 5 | 5 | 1.076 | 1.3 | 15 | 0 | 0 | 0 | 1.5 | 0.7 | 2.8 | 4.0 | poor appearance, larger type |
| Mackinaw[abcdefghjklm] | 513 | 556 | 92 | 6 | 91 | 1 | 2 | 1.084 | 1.5 | 0 | 4 | 0 | 0 | 0.7 | 0.6 | 3.5 | 3.0 | slightly flattened round to oval type, deeper apical eyes |
| NY168[bl] | 504 | 612 | 83 | 16 | 83 | 0 | 1 | 1.086 | 1.0 | 2 | 0 | 0 | 0 | 1.5 | 0.9 | 3.5 | 3.3 | moderate skinning, purple pigment around eyes |
| MSBB230-2[a] | 503 | 533 | 94 | 5 | 94 | 0 | 1 | 1.079 | 1.5 | 0 | 0 | 0 | 0 | 0.0 | 1.3 | 2.5 | 3.0 | uniform, round to oval blocky type, sticky stolens, good appearance |
| NYOR14Q9-9[i] | 495 | 554 | 90 | 10 | 89 | 1 | 0 | 1.080 | 1.0 | 10 | 3 | 0 | 3 | 2.0 | 1.0 | 3.5 | 4.0 | pitted scab lesions, flat oval type, med netted skin |
| MSW474-1[abcdefghijklm] | 493 | 580 | 85 | 14 | 85 | 0 | 1 | 1.081 | 1.5 | 0 | 0 | 0 | 0 | 0.6 | 0.4 | 3.6 | 3.5 | deeper apical eyes, darker heavy netted skin, slight sticky stolons |
| MSY022-2[cekl] | 493 | 535 | 92 | 6 | 92 | 0 | 2 | 1.075 | 1.1 | 3 | 8 | 3 | 1 | 0.7 | 0.7 | 3.2 | 3.0 | inconsistent shape, larger type, thinner skin |
| NYR1-7[adegl] | 493 | 540 | 90 | 10 | 90 | 0 | 0 | 1.084 | 1.2 | 2 | 0 | 7 | 0 | 1.2 | 0.5 | 3.4 | 2.5 | trace alligator hide, oval type, lighter skin |
| AF6598-6[g] | 490 | 529 | 92 | 6 | 91 | 1 | 2 | 1.078 | 2.5 | 0 | 0 | 0 | 0 | 1.5 | 1.1 | 5.0 | 2.5 | blocky type, oval type, light netted skin |
| MSBB635-14[h] | 488 | 558 | 87 | 11 | 87 | 0 | 2 | 1.076 | 1.0 | 0 | 30 | 0 | 0 | 1.5 | 0.0 | 2.5 | 3.5 | severe sticky stolons, compressed shape |
| MSAA217-3[h] | 486 | 543 | 90 | 10 | 90 | 0 | 0 | 1.096 | 1.0 | 40 | 0 | 0 | 0 | 1.5 | 0.7 | 4.0 | 4.0 | nice uniform round to oval type, trace skinning |
| MSAA260-3[hl] | 484 | 533 | 91 | 7 | 90 | 1 | 2 | 1.081 | 1.0 | 0 | 8 | 8 | 8 | 1.3 | 0.5 | 3.5 | 2.8 | uniform round blocky type |
| AF6603-5[g] | 484 | 532 | 91 | 8 | 91 | 0 | 1 | 1.089 | 1.0 | 0 | 0 | 0 | 0 | 2.0 | 1.1 | 5.0 | 2.0 | deeper apial eyes, slight sticky solons |
| Blackberry[h] | 479 | 622 | 77 | 22 | 77 | 0 | 1 | 1.063 | 1.0 | 0 | 0 | 0 | 0 | 2.0 | | 2.5 | 4.0 | dark purple skin with some white eyes, moderate silver scurf |
| MSAA076-6[agh] | 474 | 548 | 86 | 13 | 86 | 0 | 1 | 1.086 | 1.2 | 0 | 7 | 20 | 3 | 1.2 | 0.5 | 3.7 | 3.2 | deep apical eyes, light netted skin, blocky round type |
| Kelly[abdfl] | 471 | 656 | 71 | 18 | 71 | 0 | 11 | 1.082 | 1.7 | 4 | 10 | 0 | 0 | 1.1 | 0.7 | 3.5 | 3.2 | long shape, severe knobs and misshapen tubers |
| MSZ242-13[adfghijl] | 466 | 505 | 92 | 4 | 91 | 1 | 4 | 1.095 | 1.3 | 0 | 1 | 2 | 0 | 0.5 | 0.6 | 3.8 | 3.2 | large round blocky type, slight growth crack and knobs |
| NY173[hl] | 465 | 593 | 78 | 21 | 78 | 0 | 1 | 1.079 | 1.3 | 8 | 7 | 0 | 0 | 1.3 | 0.7 | 4.2 | 1.3 | light skin, slight deep apical eyes |
| MSAA232-4[a] | 463 | 500 | 92 | 5 | 91 | 1 | 3 | 1.090 | 1.5 | 40 | 0 | 0 | 0 | 0.0 | 0.8 | 2.5 | 3.0 | non uniform, light netted thin skin, slight deep eyes and eyebrows |
| AF6582-1[g] | 462 | 536 | 86 | 13 | 86 | 0 | 1 | 1.084 | 1.0 | 0 | 0 | 0 | 0 | 2.0 | 0.1 | 5.0 | 1.5 | oval flattened type, light netted skin |
| MSBB625-2[bel] | 461 | 529 | 87 | 9 | 87 | 0 | 4 | 1.085 | 1.7 | 3 | 10 | 54 | 0 | 1.0 | 0.6 | 3.4 | 3.1 | moderate skinning, heat sprouts and knobs |
| **Atlantic[bcek]** | **448** | **486** | **92** | **7** | **92** | **0** | **1** | **1.079** | **1.4** | **38** | **3** | **13** | **0** | **1.6** | **0.5** | **3.4** | **2.9** | **blocky oval type, deep apical yes** |
| NY172[afhl] | 443 | 495 | 90 | 8 | 90 | 0 | 2 | 1.076 | 1.7 | 22 | 0 | 0 | 0 | 1.3 | 0.3 | 3.8 | 2.2 | oval blocky type, slight sticky stolons |
| MSA311-1[kl] | 441 | 490 | 90 | 7 | 90 | 0 | 3 | 1.072 | 1.5 | 18 | 7 | 2 | 0 | 1.2 | 1.0 | 3.3 | 2.4 | heavy netted skin, deeper apical eyes, blocky type |
| MSBB221-1[d] | 441 | 484 | 91 | 7 | 90 | 1 | 2 | 1.076 | 1.5 | 0 | 0 | 0 | 0 | 0.0 | 0.4 | 5.0 | 5.0 | medium netted skin, slight growth crack, nice round type |
| **Lamoka[adfgilm]** | **438** | **477** | **92** | **6** | **88** | **4** | **2** | **1.082** | **1.5** | **0** | **3** | **0** | **0** | **0.7** | **0.9** | **4.0** | **2.5** | **flattened oval type, trace points, bright thin skin** |
| NY163[abcdefghijklm] | 437 | 508 | 85 | 12 | 85 | 0 | 3 | 1.084 | 1.1 | 0 | 2 | 0 | 0 | 0.8 | 0.4 | 3.5 | 2.4 | thinner light skin, pink eyes, attractive chips, trace points |
| NYR3-5[agh] | 436 | 470 | 93 | 5 | 93 | 0 | 2 | 1.085 | 1.8 | 5 | 0 | 0 | 0 | 0.8 | 0.6 | 4.3 | 2.8 | blocky oval type, deep apical yes |
| W12078-76[abcdefghilkm] | 430 | 477 | 91 | 8 | 90 | 1 | 1 | 1.085 | 1.3 | 19 | 3 | 1 | 4 | 0.8 | 0.4 | 3.5 | 2.7 | uniform round type, attractive, medium netted skin |
| MSBB079-2[dh] | 425 | 463 | 92 | 7 | 92 | 0 | 1 | 1.079 | 1.0 | 0 | 0 | 0 | 0 | 0.3 | 0.3 | 3.3 | 3.3 | variable skin finish, attractive shape |
| **Snowden[adfghilm]** | **423** | **475** | **89** | **10** | **87** | **2** | **1** | **1.083** | **1.2** | **6** | **17** | **4** | **1** | **1.0** | **0.3** | **3.9** | **2.5** | **deeper eyes, slight skinning, blocky type** |
| BNC816-3[ek] | 422 | 506 | 83 | 14 | 83 | 0 | 3 | 1.068 | 1.0 | 0 | 0 | 0 | 0 | 1.0 | 0.6 | 4.3 | 2.8 | many pointed tubers, slight deep eyes |
| MSAFB609-12[acdefghjkl] | 418 | 476 | 88 | 11 | 88 | 0 | 1 | 1.082 | 1.4 | 0 | 0 | 0 | 0 | 1.4 | 0.5 | 3.2 | 3.1 | light thin skin, trace points, uniform round type |
| MSAFB635-15[h] | 417 | 502 | 83 | 17 | 83 | 0 | 0 | 1.093 | 1.0 | 0 | 0 | 0 | 0 | 1.0 | 0.1 | 3.0 | 3.0 | medium netted skin, round uniform type |
| MSCC058-01[cdfhl] | 414 | 445 | 93 | 6 | 91 | 2 | 1 | 1.079 | 1.3 | 11 | 31 | 4 | 3 | 1.0 | 0.4 | 3.1 | 3.0 | round appearance, trace growth crack |
| MSBB047-1[a] | 414 | 443 | 93 | 4 | 93 | 0 | 3 | 1.074 | 1.5 | 0 | 0 | 70 | 0 | 0.0 | 1.5 | 3.0 | 2.5 | round to oval blocky type, thin light netted skin |
| MSBB626-11[hl] | 406 | 442 | 92 | 7 | 91 | 1 | 1 | 1.081 | 1.5 | 12 | 0 | 2 | 0 | 1.1 | 1.0 | 3.5 | 3.5 | deeper eyes, round type |

| LINE | CWT/A | | PERCENT OF TOTAL[1] | | | | | | | RAW TUBER QUALITY[4] (%) | | | | | | | | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR[2] | OTF CHIP SCORE[3] | HH | VD | IBS | BC | COMMON SCAB RATING[5] | SED SCORE[6] | VINE VIGOR[7] | VINE MATURITY[8] | |
| AF6526-7[g] | 398 | 424 | 94 | 4 | 94 | 0 | 2 | 1.086 | 2.0 | 10 | 0 | 0 | 0 | 2.5 | 0.4 | 5.0 | 1.5 | bright appearance, thin skin, blocky oval type |
| MSBB610-13[abcegmk] | 393 | 421 | 93 | 6 | 89 | 4 | 1 | 1.078 | 1.8 | 0 | 0 | 0 | 0 | 0.8 | 0.4 | 2.9 | 2.8 | attractive round type, bright thin skin |
| MSBB614-15[dhl] | 388 | 429 | 90 | 7 | 88 | 2 | 3 | 1.079 | 1.2 | 11 | 13 | 0 | 3 | 0.7 | 0.3 | 4.0 | 2.9 | heavy netted skin, blocky oval type |
| MSAA076-04[h] | 380 | 501 | 76 | 23 | 76 | 0 | 1 | 1.086 | 1.0 | 0 | 0 | 0 | 0 | 1.0 | 0.3 | 3.0 | 2.5 | uniform heavy netted skin, nice appearance |
| WAF16107-2[g] | 378 | 428 | 88 | 9 | 88 | 0 | 3 | 1.088 | 1.5 | 30 | 0 | 0 | 0 | 2.0 | 0.4 | 4.0 | 1.5 | round to oval blocky type, medium netted skin |
| MSDD271-11[d] | 371 | 417 | 89 | 6 | 89 | 0 | 5 | 1.064 | 1.5 | 0 | 0 | 0 | 0 | 0.0 | 0.9 | 4.0 | 4.0 | non uniform, flat oval type, prominent eyes |
| MSBB058-1[h] | 370 | 446 | 83 | 16 | 83 | 0 | 1 | 1.096 | 1.0 | 0 | 0 | 0 | 0 | 1.5 | 0.1 | 3.0 | 3.0 | small round type |
| MSCC376-01[cdh] | 370 | 401 | 92 | 4 | 91 | 1 | 4 | 1.081 | 1.3 | 0 | 0 | 0 | 0 | 0.2 | 0.5 | 3.2 | 2.7 | hravy netted skin, consistent size, slight skinning |
| CO11037-5W[dfh] | 368 | 469 | 80 | 8 | 80 | 0 | 12 | 1.076 | 1.0 | 3 | 0 | 7 | 0 | 0.3 | 0.4 | 3.3 | 2.7 | oval type, variable shape, heat knobs |
| AC11494-6W[dlf] | 353 | 454 | 77 | 22 | 77 | 0 | 1 | 1.066 | 1.8 | 6 | 0 | 0 | 0 | 0.8 | 0.4 | 3.2 | 2.7 | round blocky type, medium netted skin, slight sticky stolons |
| MSZ242-07[ah] | 342 | 393 | 87 | 6 | 87 | 0 | 7 | 1.093 | 1.5 | 0 | 0 | 0 | 0 | 0.5 | 0.2 | 3.0 | 3.0 | growth crack in pickouts, slight shatter bruise |
| BNC811-22[ek] | 340 | 466 | 73 | 23 | 73 | 0 | 4 | 1.080 | 2.0 | 35 | 0 | 0 | 5 | 1.8 | 0.6 | 4.8 | 3.8 | smaller size profile, medium netted skin, oval type |
| CO12235-3W[adf] | 340 | 402 | 85 | 12 | 85 | 0 | 3 | 1.072 | 1.5 | 0 | 0 | 3 | 0 | 0.2 | 0.4 | 4.5 | 3.7 | thin skin, bright appearance, smaller type |
| AF6550-2[g] | 334 | 389 | 86 | 12 | 86 | 0 | 2 | 1.090 | 1.5 | 0 | 0 | 0 | 0 | 2.5 | 0.8 | 4.5 | 1.5 | light netted skin, oval type |
| NDTX113030C-3W[k] | 333 | 432 | 77 | 22 | 77 | 0 | 1 | 1.069 | 1.0 | 20 | 0 | 0 | 0 | 0.5 | 0.4 | 3.5 | 4.5 | less uniform type |
| Petoskey[abcdefghlm] | 332 | 390 | 85 | 10 | 85 | 0 | 5 | 1.084 | 1.3 | 2 | 2 | 0 | 0 | 0.7 | 0.7 | 3.6 | 3.2 | heavy netted skin, round type, slight growth crack and knobs |
| AF6543-2[g] | 308 | 366 | 84 | 16 | 84 | 0 | 0 | 1.079 | 1.5 | 50 | 0 | 0 | 10 | 1.5 | 0.2 | 5.0 | 1.5 | oval blocky type, slight netting, less uniform type |
| NYR101-2[ahl] | 301 | 475 | 62 | 36 | 62 | 0 | 2 | 1.082 | 1.2 | 2 | 2 | 0 | 0 | 1.1 | 0.4 | 4.4 | 1.6 | light skin, less uniform type |
| AF6526-3[g] | 285 | 360 | 80 | 19 | 78 | 2 | 1 | 1.089 | 1.0 | 0 | 0 | 0 | 10 | 1.0 | 0.8 | 4.5 | 1.5 | less uniform type, medium netted skin |
| MSAA309-15[dg] | 284 | 320 | 88 | 10 | 88 | 0 | 2 | 1.080 | 1.3 | 0 | 0 | 0 | 5 | 0.8 | 0.4 | 4.5 | 2.5 | slight skinning, moderate growth crack |
| MSCC248-2[a] | 279 | 359 | 78 | 5 | 78 | 0 | 17 | 1.073 | 2.0 | 0 | 0 | 0 | 0 | 0.0 | 1.3 | 2.0 | 2.5 | significant growth crack and alligator hide, not uniform, some shatter bruise |
| MSBB012-1Y[k] | 276 | 313 | 88 | 9 | 88 | 0 | 3 | 1.066 | 2.0 | 0 | 0 | 0 | 0 | 0.0 | 0.5 | 3.0 | 4.0 | blocky, round type, trace pear shapes, med netted skin |
| MSBB230-1[h] | 273 | 346 | 79 | 21 | 79 | 0 | 0 | 1.090 | 1.0 | 0 | 0 | 0 | 0 | 2.5 | 0.1 | 4.0 | 2.5 | small uniform round blocky type, medium netted skin |
| MSBB634-8[hl] | 265 | 303 | 87 | 12 | 87 | 0 | 1 | 1.074 | 1.3 | 0 | 7 | 2 | 7 | 0.6 | 0.9 | 2.3 | 2.8 | blocky round type, slight sheep nose |
| AF6527-3[g] | 260 | 300 | 87 | 10 | 87 | 0 | 3 | 1.092 | 1.0 | 0 | 0 | 0 | 0 | 1.0 | 0.3 | 5.0 | 1.5 | flat oval tuber type, medium netted skin |
| MSDD085-13[hkl] | 247 | 353 | 68 | 31 | 68 | 0 | 1 | 1.078 | 1.0 | 3 | 0 | 0 | 0 | 1.2 | 0.4 | 3.4 | 2.0 | smaller size profile, flattened round type |
| NDTX112203AB-1W[k] | 243 | 352 | 69 | 25 | 69 | 0 | 6 | 1.063 | 1.0 | 0 | 0 | 0 | 0 | 2.0 | 0.6 | 4.0 | 4.0 | bright, slight knobs and growth crack, less uniform type |
| COTX12235-2W[l] | 216 | 416 | 52 | 46 | 52 | 0 | 2 | 1.069 | 1.5 | 3 | 0 | 0 | 0 | 0.7 | 0.4 | 3.0 | 2.5 | smaller size profile, pears and points |
| MSAA328-4[h] | 198 | 213 | 93 | 7 | 93 | 0 | 0 | 1.084 | 1.0 | 0 | 0 | 0 | 0 | 0.5 | 0.0 | 5.0 | 2.0 | less uniform blocky oval tuber type |
| Betty[bcl] | 197 | 343 | 57 | 41 | 57 | 0 | 2 | 1.078 | 1.2 | 0 | 0 | 1 | 0 | 1.7 | 0.7 | 4.0 | 1.8 | less uniform type, inconsistent skin finish |
| Corsica[ck] | 190 | 354 | 55 | 22 | 55 | 0 | 23 | 1.074 | 2.5 | 0 | 0 | 0 | 0 | 1.0 | 1.1 | 3.0 | 3.3 | thinner netted skin, severe knobs, light yellow flesh |
| TX17846-1W[k] | 167 | 273 | 61 | 36 | 61 | 0 | 3 | 1.074 | 2.0 | 0 | 10 | 0 | 0 | 0.0 | 0.6 | 4.0 | 2.5 | thin skin, bright appearance, nice |
| COOR13270-2[h] | 162 | 335 | 48 | 50 | 48 | 0 | 2 | 1.085 | 1.0 | 0 | 0 | 0 | 0 | 1.5 | 0.6 | 2.5 | 3.5 | non uniform tuber type, inconsistent skin |
| **MEAN** | **412** | **482** | **85** | **13** | **84** | **1** | **3** | **1.080** | **1.3** | **6** | **3** | **3** | **1** | **1.1** | **0.6** | **3.6** | **2.9** | |

**2021 Chip Variety Trial Sites**

[a]4-L Farms, Storage Trial
[b]Black Gold Farms, Fresh Trial
[c]Hampton Potato Growers, Fresh Trial
[d]Hampton Potato Growers, Storage Trial
[e]Lennard Ag. Co., Fresh Trial
[f]Lennard Ag. Co., Storage Trial
[g]Main Farms, Storage Trial
[h]Montcalm Research Center Box Bin Trial
[i]Sandyland Farms SNAC Replicated Storage Trial
[j]Sandyland Farms, Set 1 Storage Trial
[k]Walther Farms, Fresh Trial
[l]Walther Farms, Replicated Storage Trial
[m]Verbrigghe Farms, Fresh Chip Trial

**[1]SIZE**

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

**[2]SPECIFIC GRAVITY**

Data not replicated

**[3]OUT OF THE FIELD CHIP COLOR SCORE (SNAC Scale)**

Ratings: 1 - 5
1: Excellent
5: Poor

**[4]RAW TUBER QUALITY (percent of tubers out of 10)**

HH: Hollow Heart
VD: Vascular Discoloration
IBS: Internal Brown Spot
BC: Brown Center

**[5]COMMON SCAB RATING**

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

**[6]SED (STEM END DEFECT) SCORE**

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

**[7]VINE VIGOR RATING**

Date: Variable
Rating 1-5
1: Slow emergence

5: Early emergence (vigorous vines, some flowering)

**[8]VINE MATURITY RATING**

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

| Table 3. Yield , Size Distribution*, Specific Gravity | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Yield (cwt/A) | | Percent Size Distribution | | | | | |
| Entry | US#1 | TOTAL | US#1 | Small | Mid-Size | Large | Culls | Specific Gravity |
| NY165 | 600[a] | 662 | 91 | 8 | 91 | 0 | 1 | 1.078 |
| MSAFB605-4 | 600[a] | 652 | 92 | 8 | 92 | 0 | 0 | 1.073 |
| MSW474-1 | 532[b] | 621 | 86 | 13 | 86 | 0 | 1 | 1.080 |
| MSZ242-13 | 519[bc] | 557 | 93 | 5 | 92 | 1 | 2 | 1.093 |
| NY163 | 511[bc] | 563 | 91 | 8 | 91 | 0 | 1 | 1.083 |
| W12078-76 | 503[bc] | 571 | 89 | 10 | 89 | 0 | 1 | 1.086 |
| NYOR14Q9-9 | 495[bc] | 554 | 90 | 10 | 89 | 1 | 0 | 1.080 |
| **Snowden** | **480[c]** | **536** | **90** | **10** | **90** | **0** | **0** | **1.079** |
| **Lamoka** | **438[d]** | **494** | **89** | **9** | **89** | **0** | **2** | **1.079** |
| **MEAN** | **520** | **579** | **90** | **9** | **90** | **0** | **1** | **1.081** |
| **ANOVA p-value** | **<.0001** | **<.0001** | **<.0001** | **<.0001** | **<.0001** | **0.0184** | **0.0364** | **<.0001** |
| **LSD** | **38.8** | **42.3** | **1.7** | **1.4** | **1.7** | **0.6** | **1.2** | **0.002** |

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

Table of Contents

| Table 4. At-Harvest Tuber Quality. Sandyland Farms, Howard City, Michigan. | | | | |
|---|---|---|---|---|
| | Raw Tuber Quality[1] (%) | | | |
| Entry | HH | VD | IBS | BC |
| NY165 | 0 | 0 | 0 | 0 |
| MSAFB605-4 | 0 | 0 | 0 | 0 |
| MSW474-1 | 3 | 0 | 0 | 0 |
| MSZ242-13 | 0 | 0 | 0 | 0 |
| NY163 | **0** | **0** | **0** | **0** |
| W12078-76 | 27 | 3 | 0 | 17 |
| NYOR14Q9-9 | 10 | 3 | 0 | 3 |
| **Snowden** | **0** | **3** | **0** | **3** |
| **Lamoka** | 0 | 0 | 0 | 0 |
| **MEAN** | **4** | **1** | **0** | **3** |
| **ANOVA P-value** | **<0.0001** | 0.6488 | - | 0.1888 |
| **LSD** | **4.7** | - | - | - |

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

| Table 5. Post-Harvest Chip Quality[1] for the 2021 SNAC Trial at Sandyland Farms | | | | | | |
|---|---|---|---|---|---|---|
| | | SNAC[2] | Specific | Percent Chip Defects[3] | | |
| Rank | Entry | Color | Gravity | Internal | External | Total |
| 1 | NY163 | 2.0 | 1.080 | 3.4 | 0.0 | 3.4 |
| 2 | W12078-76 | 2.0 | 1.086 | 0.9 | 5.1 | 6.0 |
| 3 | MSZ242-13 | 3.0 | 1.092 | 14.5 | 7.3 | 21.8 |
| 4 | NY165 | 3.0 | 1.076 | 21.2 | 12.7 | 33.9 |
| **5** | **Snowden** | **2.0** | **1.084** | **10.4** | **0.8** | **11.2** |
| 6 | MSAFB605-4 | 3.0 | 1.075 | 19.3 | 9.4 | 28.7 |
| **7** | **Lamoka** | **2.0** | **1.079** | **18.0** | **13.8** | **31.8** |
| 8 | MSW474-1 | 3.0 | 1.080 | 21.6 | 20.9 | 42.5 |
| 9 | NYOR14Q9-9 | 3.0 | 1.082 | 18.6 | 16.4 | 35.0 |

[1] Samples collected October 13th and processed by Herr Foods, Inc., Nottingham, PA on October 18th 2021

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

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

Lines are sorted by Herr's ranking: 1(best) to 9 (worst)

Table of Contents

**Table 6. Black Spot Bruise Test for the 2021 SNAC Trial at Sandyland Farms**

| | A. Check Samples[1] | | | | | | | | | B. Simulated Bruise Samples[2] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | # of Bruises Per Tuber | | | | | | Total | Percent Bruise | Average Bruises Per | # of Bruises Per Tuber | | | | | | Total | Percent Bruise | Average Bruises Per |
| Entry | 0 | 1 | 2 | 3 | 4 | 5 | Tubers | Free | Tuber | 0 | 1 | 2 | 3 | 4 | 5 | Tubers | Free | Tuber |
| NY163 | 19 | 5 | 1 | 0 | 0 | 0 | | 76 | 0.3 | 2 | 5 | 9 | 3 | 5 | 1 | | 8 | 2.3 |
| W12078-76 | 17 | 7 | 1 | 0 | 0 | 0 | | 68 | 0.4 | 0 | 7 | 6 | 5 | 6 | 1 | | 0 | 2.5 |
| MSZ242-13 | 15 | 6 | 3 | 1 | 0 | 0 | | 60 | 0.6 | 2 | 3 | 5 | 7 | 5 | 3 | | 8 | 2.8 |
| NYOR14Q9-9 | 20 | 4 | 0 | 1 | 0 | 0 | | 80 | 0.3 | 1 | 5 | 3 | 6 | 8 | 2 | | 4 | 2.8 |
| **Lamoka** | **13** | **9** | **3** | **0** | **0** | **0** | | **52** | **0.6** | **1** | **2** | **5** | **7** | **6** | **4** | | **4** | **3.1** |
| MSAFB605-4 | 12 | 11 | 1 | 1 | 0 | 0 | | 48 | 0.6 | 1 | 1 | 4 | 10 | 5 | 4 | | 4 | 3.2 |
| MSW474-1 | 14 | 7 | 3 | 1 | 0 | 0 | | 56 | 0.6 | 0 | 1 | 3 | 3 | 4 | 14 | | 0 | 4.1 |
| NY165 | 8 | 9 | 6 | 2 | 0 | 0 | | 32 | 1.1 | 0 | 1 | 1 | 1 | 3 | 19 | | 0 | 4.5 |
| **Snowden** | **13** | **7** | **3** | **1** | **1** | **0** | | **52** | **0.8** | **0** | **0** | **0** | **1** | **3** | **21** | | **0** | **4.8** |
| | | | | | | | | | | | | | | | | | | 3.3 |

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

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

Table of Contents

| Table 7A. Pre-Harvest Panel for the 2021 SNAC Trial at Sandyland Farms, Taken on 8/18/2021 | | | | | | |
|---|---|---|---|---|---|---|
| | | | | Canopy | | Average[5] Tuber |
| Entry | Specific Gravity | Glucose[1] % | Sucrose[2] Rating | Rating[3] | Uniform.[4] | Weight |
| NY165 | 1.089 | 0.002 | 0.684 | 100 | 100 | 3.18 |
| MSAFB605-4 | 1.079 | 0.009 | 0.125 | 100 | 100 | 3.77 |
| MSW474-1 | 1.083 | 0.004 | 0.471 | 75 | 100 | 2.45 |
| MSZ242-13 | 1.092 | 0.002 | 1.471 | 100 | 100 | 4.54 |
| NY163 | 1.082 | 0.009 | 0.882 | 75 | 100 | 3.30 |
| W12078-76 | 1.085 | 0.000 | 2.279 | 50 | 100 | 3.05 |
| NYOR14Q9-9 | 1.081 | 0.008 | 1.690 | 75 | 100 | 4.12 |
| **Snowden** | **1.083** | **0.005** | **0.907** | **75** | **100** | **3.62** |
| **Lamoka** | **1.089** | **0.001** | **0.828** | **75** | **75** | **4.59** |

| Table 7B. Pre-Harvest Panel for the 2021 SNAC Trial at Sandyland Farms, Taken on 9/1/2021 | | | | | | |
|---|---|---|---|---|---|---|
| | | | | Canopy | | Average[5] Tuber |
| Entry | Specific Gravity | Glucose[1] % | Sucrose[2] Rating | Rating[3] | Uniform.[4] | Weight |
| NY165 | 1.081 | 0.004 | 0.520 | 75 | 100 | 4.73 |
| MSAFB605-4 | 1.078 | 0.003 | 0.181 | 75 | 100 | 4.71 |
| MSW474-1 | 1.081 | 0.004 | 0.366 | 75 | 100 | 5.19 |
| MSZ242-13 | 1.094 | 0.008 | 0.628 | 100 | 75 | 5.51 |
| NY163 | 1.083 | 0.003 | 0.374 | 75 | 75 | 4.13 |
| W12078-76 | 1.092 | 0.005 | 0.993 | 50 | 75 | 4.51 |
| NYOR14Q9-9 | 1.080 | 0.003 | 0.677 | 75 | 75 | 3.45 |
| **Snowden** | **1.079** | **0.002** | **0.516** | **50** | **75** | **4.63** |
| **Lamoka** | **1.082** | **0.001** | **0.546** | **75** | **75** | **4.28** |

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

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

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

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

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

Table of Contents

# Table 8. 2021 Russet and Tablestock Variety Descriptions

## Russet Variety Descriptions

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| Burbank SEL | Unknown | 0.5 | A selection of Russet Burbank, average US#1 yield due to smaller size profile, average specific gravity, less common scab susceptibility, severe bottlenecking |
| Goldrush | ND450-3Rus x Lemhi Russet | 0.0 | Average yield and specific gravity, good internal quality, no common scab observed in 2021, heavy dark russet skin |
| Lakeview Russet (W9433-1Rus) | Calwhite x A96023-6 | 0.9 | Above average yield, larger size profile, flattened oblong type, mid-season vine maturity, good internal quality |
| Libero | AR 98-0813 x Innovator | 1.0 | Very poor emergence, early vine maturity, smaller tuber size profile with mainly B sized tubers |
| Ranger Russet (A7411-2) | Butte x A6595-3 | 1.8 | Inconsistent tuber shape, slight sticky stolons, common scab susceptibility, moderate vascular discoloration, smaller tuber size profile |
| Reveille Russet (ATX91137-1Rus) | Bannock Russet x A83343-12 | 0.1 | Growth crack in pickouts, attractive skin finish, good internal quality, smaller vine type, larger tuber size profile with higher proportion oversize tubers |
| Russet Norkotah | ND9526-4Rus x ND9687-5Rus | 0.4 | Check variety, moderate skinning, misshapen pickouts, moderate hollow heart, below average specific gravity |

Table of Contents

*(2021 Russet Varieties cont.)*

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| Silverton Russet (AC83064-6) | A76147-2 x A7875-5 | 0.3 | Check variety, slight alligator hide, slight skinning, below average specific gravity, higher proportion oversize tubers |
| Tiger | HZPC | 0.9 | Variable skin finish and tuber shape, moderate hollow heart, mid-season maturity, smaller tuber size profile |
| Vanguard (TX08352-5RUS) | TXA549-1Ru x AOTX98137-1Ru | 0.1 | Moderate alligator hide, attractive skin, below average specific gravity, smaller vine type, above average yield |
| A06030-23 | Premier Russet x A99113-6 | 0.5 | Nice appearance, severe growth cracks in pickouts, moderate hollow heart and vascular discoloration, below average yield and specific gravity |
| A08433-4STO | A02611-1 x AOND95249-1 | 0.6 | Flattened blocky oval tuber type, above average specific gravity, moderate hollow heart, above average yield |
| A09119-4LB | A00472-20LB x Premier Russet | 1.1 | Light russet skin, average specific gravity, below average yield, moderate vascular discoloration, mid-season vine maturity |
| A10071-1 | Targhee Russet x AO02183-2 | 0.4 | Uniform type, darker russet skin, prominent eyes, below average specific gravity, larger vine type, average yield |
| A11737-1LB | A96814-65LB x A05084-11 | 1.0 | Darker russet skin, misshapen pickouts, earlier vine maturity, average specific gravity, below average yield, excellent internal quality |

**Table of Contents**

*(2021 Russet Varieties cont.)*

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| A12114-7 | A06665-10LB x A01025-4 | 0.4 | Smaller tuber size profile, longer tubular shape, average specific gravity, below average yield, good internal quality |
| AC12080-4RU | A05084-1 x ND028673B-2Russ | 1.0 | Moderate alligator hide, inconsistent skin finish, very low specific gravity, below average yield |
| AC12090-3RU | A05124-3LB x A06021-1T | 0.5 | Dark russet skin, poor appearance, very low specific gravity, mid-season maturity, below average yield |
| AF5735-8 | AF3317-15 x AF4342-3 | 1.0 | Smaller long tubular type, very low specific gravity, excellent internal quality, smaller tuber size profile with high proportion B sized tubers |
| AF5762-8 | AF4320-17 x Dakota Trailblazer | 0.0 | Darker russet skin, blocky shape, attractive type, high specific gravity, moderate vascular discoloration, above average yield |
| AF6296-3 | A8469-5 x Dakota Trailblazer | 2.0 | Light russet skin, some misshapen tubers, average specific gravity, higher proportion pickouts |
| AF6298-2 | A8469-5 x Gemstar Russet | 1.5 | Lighter russet skin, less uniform type, high specific gravity, smaller vine type, moderate hollow heart and internal brown spot, average yield |
| AF6340-6 | Caribou Russet x Russet Norkotah | 1.0 | Inconsistent skin finish, attractive tuber type, very high yield, low specific gravity, higher proportion oversize tubers |

**Table of Contents**

*(2021 Russet Varieties cont.)*

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| AF6377-13 | A03921-2 x Gemstar Russet | 0.0 | Moderate skinning, darker russet skin, high specific gravity, moderate brown center, very high yield |
| AOR10063-2 | A98345-1 x Alpine Russet | 1.0 | Highest russet yield in 2021, flattened tubers, misshapen pickouts, severe vascular discoloration moderate internal brown spot, larger vine type |
| CO10085-1RUS | AC03364-5RU x Silverton Russet | 0.9 | Attractive appearance, prominent eyes, very high specific gravity, average yield, mid-season maturity, misshapen pickouts |
| CO12378-1RU | CO06035-3RU x AO02183-2 | 0.2 | Heavy russet skin, slight growth crack, moderate hollow heart, very low yield, smaller tuber size profile |
| COTX08063-2RU | Premier Russet x A99073-1 | 1.0 | Vanguard type, attractive skin finish, above average specific gravity, below average yield, earlier vine maturity |
| W13A11229-1RUS | A01325-1 x A06131-19 | 0.6 | Lighter russet skin, attractive type, above average specific gravity and yield, moderate hollow heart, mid-season vine maturity |

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

**Table of Contents**

# 2021 Yellow Flesh Variety Descriptions

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| Albertine | SunRain | 1.5 | Above average yield, high percentage A sized tubers, below average specific gravity, points and pear shapes in pickouts, moderate common scab susceptibility |
| Allora | Apart x Borwina | 0.9 | Light skin netting, some pointed tubers, high yield, average specific gravity, good internal quality, medium sized vine |
| Ballerina | Parkland Seed Potatoes | 0.5 | Buff skin, below average yield, smaller size profile, excellent internal quality, larger vine type, earlier vine maturity |
| Cascada | Solara x Gala | 0.6 | Smaller tuber type, average total yield, good internal quality, lighter yellow flesh, medium vine maturity |
| Celandine | Franceline x RZ-84-2521 | 0.3 | Very low yield, smaller tuber size profile with mainly B-sized tubers, good internal quality, light yellow skin, bright waxy flesh |
| Christel | Norkia America | 0.9 | Above average yield, good internal quality, average common scab rating, darker yellow flesh, oblong tuber type |
| Columba | Carerra x Agata | 0.3 | Highest yield in 2021, uniform type, bright appearance, moderate heat sprouts, very low specific gravity, lighter yellow flesh |
| Constance | Marabel x AR93-1243 | 0.9 | Average yield, smooth appearance, flattened type, waxy yellow skin, medium yellow flesh color |

Table of Contents

*(2021 Yellow Flesh Varieties Cont.)*

| Entry | Pedigree | 2021 Scab Score* | Characteristics |
|---|---|---|---|
| Corinna | E 99/89/130 x B 02/245/36 | 0.5 | Lightly netted skin, moderate growth cracks, above average yield and consistent tuber size profile, very low specific gravity |
| Danina | SunRain | 1.0 | Very high yield, blocky type, buff skin, darker yellow flesh color, good internal quality, moderately vigorous vine |
| Erika | Marabel x AR 88-156 | 1.0 | Smooth skin, attractive appearance, smaller tuber size profile with mainly B sized tubers, average specific gravity |
| Excellency | Lady Olympia x Red One | 0.8 | Less uniform tuber type, good internal quality, above average specific gravity, below average yield |
| Floridana | SunRain | 0.6 | Above average yield, larger tuber size, inconsistent tuber type, smooth waxy skin |
| Golden Globe (US 624-95) | Berber x 2.6 720-86 | 0.4 | Uniform type, thin light skin, above average yield, good internal quality, average specific gravity |
| Goldfinger | Exquisa x Monalisa | 0.8 | Smooth skin, trace heat sprouts, high yield, lower specific gravity, good internal quality, waxy skin |
| Gourmandine | Charlotte x Estima | 0.6 | Longer flattened tuber type, smaller tuber size profile with mainly B sized tubers, moderate internal brown spot |

**Table of Contents**

*(2021 Yellow Flesh Varieties Cont.)*

| Entry | Pedigree | 2021 Scab Score* | Characteristics |
|---|---|---|---|
| Honey Ryder | SunRain | 0.6 | Attractive appearance, average yield, good internal quality, full season vine maturity, trace heat sprouts |
| Mary Ann | Norkia America | 1.4 | Bright skin, pointed tubers, below average yield with high proportion B sized tubers, good internal quality, moderate common scab, waxy skin and dark yellow flesh |
| Melody | VE74-45 x W72-22-496 | 0.5 | Average yield, high proportion A sized tubers, average specific gravity, moderate internal brown spot, netted skin, growth crack in pickouts |
| Montana | E 99/73/126 x E 99/89/130 | 0.8 | Very low specific gravity, above average yield, good internal quality, full-season vine maturity, oblong type, smooth skin |
| Nectar | Famosa x Red Cara | 1.0 | Light netted skin, pink blushing around eyes, high yield, above average specific gravity, moderate hollow heart, vascular discoloration, and internal brown spot |
| Paroli (24 205-06) | 569 102-99 x 774 105-99 | 0.5 | Attractive waxy skin, larger vine type, good internal quality, above average yield potential, lower specific gravity. |
| Prada | Solanum Int. | 0.6 | Large type, above average yield, lower specific gravity, earlier vine maturity, prominent eyes, good internal quality, longer tuber shape |

**Table of Contents**

*(2021 Yellow Flesh Varieties Cont.)*

| Entry | Pedigree | 2021 Scab Score* | Characteristics |
|---|---|---|---|
| Primabelle | HZPC | 0.5 | Average yield potential, lower specific gravity, good internal quality, lighter yellow flesh, inconsistent shape |
| Queen Anne (05-043-1) | 99-002-14 x Gala | 1.9 | Oval to oblong shape, yellow flesh, yellow skin, shallow eyes, PVY resistance and resistance to Ro1 and Ro4 nematodes, attractive appearance, waxy skin, good internal quality |
| Soprano | Spunta x CMK1990-002-002 | 1.6 | Inconsistent type, pointed tubers, below average yield potential with smaller tubers, average specific gravity, common scab susceptibility |
| Tessa | Carmona x Diplomat | 1.1 | Buff skin, light yellow flesh, below average yield, above average specific gravity, good internal quality |
| Tokio | Norkia America | 1.0 | Flattened round tuber type, low yield, smaller tuber size profile, high specific gravity, moderate vascular discoloration, full season vine maturity |
| Tyson | HZPC | 0.9 | Above average yield, higher specific gravity, slight vascular discoloration, light netted skin, trace heat sprouts |
| Yukon Gold | Norgleam x W5279-4 | 0.7 | Check variety, above average yield potential, severe hollow heart, pink blushing around eyes, blocky type, earlier vine maturity, lighter yellow flesh |

**Table of Contents**

*(2021 Yellow Flesh Varieties Cont.)*

| Entry | Pedigree | 2021 Scab Score* | Characteristics |
|---|---|---|---|
| AORTX09037-1W/Y | Fasan x Ivory Crisp | 0.2 | Average yield potential, higher specific gravity, earlier vine maturity, light netted skin, deeper eyes, lighter yellow flesh |
| MSCC724-1Y | Yukon Gem x MSQ086-3 | 0.8 | Below average yield, average specific gravity, moderate brown center, earlier vine maturity, smaller vine type |
| MSFF247-2Y | MSZ436-2SPL x C88 | 1.0 | Lighter yellow flesh color, deeper eyes, below average yield, excellent internal quality, smaller vine type, earlier vine maturity |
| MSV093-1Y | McBride x MSP408-14Y | 0.7 | High yield, high proportion A sized tubers, average specific gravity, mid-season vine maturity, recessed apical ends |
| MSX156-1Y | MSI005-20Y x Boulder | 0.6 | Very high yield, average specific gravity, full-season vine maturity, blocky larger tuber type, buff skin |
| MSX245-2Y | Manistee x McBride | 0.3 | Netted skin, deeper apical eyes, very high specific gravity, moderate internal brown spot, lighter yellow flesh color |
| ND1241-1Y | AND07358-1Y x Ivory Crisp | 1.5 | Below average yield, buff netted skin, very high specific gravity, good internal quality, larger vine type |
| W15240-2Y | NW64-6 x W9576-11Y | 0.9 | Smaller tuber size profile, lower specific gravity, mid-season vine maturity, oval type, uniform appearance, smooth skin |

**Table of Contents**

*(2021 Yellow Flesh Varieties Cont.)*

| Entry | Pedigree | 2021 Scab Score* | Characteristics |
|---|---|---|---|
| W15248-16Y | | 0.0 | Attractive appearance, below average yield, higher specific gravity, potential common scab resistance, smooth waxy skin, good internal quality |
| W15248-17Y | | 0.5 | Above average yield, lower specific gravity, oval tubers, consistent shape and size, darker yellow flesh |

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

Table of Contents

# 2021 Red Skin Variety Descriptions

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| Canada Rose (CO00277-2R) | Colorado Rose x CO94065-2R | 1.2 | Excellent red skin color, variable tuber shape, above average yield, average specific gravity, moderate vascular discoloration, earlier vine maturity |
| Colorado Rose | NDTX9-1068-11R x DT6063-1R | 1.1 | High yield, average specific gravity, moderate vascular discoloration, moderate skinning, attractive skin color |
| Dark Red Norland | Redkote x ND626 | 0.5 | Check variety, above average yield, larger vine type, earlier vine maturity, prominent eyes, less uniform type |
| Norland RP | Redkote x ND626 | 0.4 | Moderate skinning, inconsistent tuber shape, moderate hollow heart, above average yield, lower specific gravity |
| Ricarda | M99-312 x E93/477 | 0.7 | Marginal appearance, deeper eyes, above average yield and specific gravity, moderate vascular discoloration |
| Rosemara | Norika America | 0.5 | Heavy netted skin, less uniform type, moderate vascular discoloration and internal brown spot, full season vine maturity |
| CO14040-3R | CO99256-2R x CO05211-4R | 0.8 | Small tubers, inconsistent appearance, lower yield and smaller tuber size profile, above average specific gravity, smaller vine type, earlier vine maturity |
| CO14105-1R | CO07322-3R x CO05211-4R | 0.2 | Darker red skin, flattened oval type, below average yield and specific gravity, moderate vascular discoloration, moderate vine type |

Table of Contents

*(2021 Red Skin Varieties Cont.)*

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| CO15205-4R | ND4659-5R x NDC081655-1R | 0.0 | Uniform round type, lighter red skin, slight skinning, higher specific gravity, average yield potential, earlier vine maturity, slight vascular discoloration |
| CO15206-1R | ND8555-8R x CO05228-4R | 0.0 | Very low yield, smaller tuber size profile with mainly B sized tubers, average specific gravity, slight vascular discoloration, very early vine maturity |
| CO15211-5R | NDA050237B-1R x CO05228-4R | 0.2 | Below average yield and specific gravity, attractive skin color, sticky stolons, slight skinning, mid-season vine maturity |
| CO15219-3R | NDC081655-1R x CO05228-4R | 0.3 | Higher specific gravity, below average yield, smaller tuber size profile, less uniform type, skinning, good internal quality |
| CO99076-6R | AC91848-1 x Rio Colorado | 0.8 | Above average yield and specific gravity, moderate vascular discoloration, round type, moderate skinning |
| MSX324-2R | MSN105-1 x Colonial Purple | 0.8 | Growth crack in pickouts, lighter skin color, below average yield, higher proportion misshapen tubers |
| ND13292B-3R | ND081772B-3R x Dakota Jewel | 0.0 | Attractive skin color, below average yield and specific gravity, moderate vascular discoloration, high proportion A sized tubers |
| ND1394-5RY | ABD08168-3PEY x Dakota Jewel | 1.5 | Attractive appearance, lighter skin, light yellow flesh, high yield and specific gravity, good internal quality, common scab susceptibility |

**Table of Contents**

*(2021 Red Skin Varieties Cont.)*

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| ND1466CB-1R | Dakota Ruby x ND050060CB-4R | 0.0 | Attractive red skin color, smaller uniform tuber type, below average yield, moderate hollow heart, smaller vine type and earlier vine maturity |
| NDA050237B-1R | ND028678-1RY x ND028770B-4R | 0.6 | Very high yield, uniform type, slight skinning, full season vine maturity, slight vascular discoloration, below average specific gravity |
| NDAF113484B-1 | ND060570B-1R x ND8555-8R | 0.5 | Round tuber type, deeper eyes, very high yield, below average specific gravity, high proportion A sized tubers |
| RP2009-5R | Real Potatoes | 1.0 | Marginal appearance, lighter red skin, below average yield and specific gravity, smaller tuber size profile, light yellow flesh |
| W15268-89R | | 0.5 | Smooth oval tubers, uniform type, average yield and specific gravity, excellent internal quality, earlier vine maturity |

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

Table of Contents

# 2021 Round White Variety Descriptions

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| Abbot (CMK1998-601-035) | Asterix x RH88-025-050 | 0.8 | Above average specific gravity, slight hollow heart, blocky type, less uniform tuber type, below average yield |
| Algonquin (NY141) | R6-5 x NY115 | 1.3 | Above average yield and specific gravity, moderate brown center, common scab susceptible, larger vine type, blocky tuber type |
| Ashley | HZPC | 0.8 | Below average yield and specific gravity, moderate vascular discoloration, bright appearance with thin, waxy skin |
| Audrey (HZD 07-6093) | Virgo x Parella | 0.6 | Above average yield, blocky tubers with thin skin, slight vascular discoloration and brown center |
| Envol | F68123 x Simcoe | 0.9 | Average yield, above average specific gravity, good internal quality, heavy netted skin, deep eyes, earlier vine maturity |
| Reba (NY 87) | Monona x Allegany | 0.4 | Check variety, average yield potential and specific gravity, blocky oval type, recessed eyes, good internal quality |
| Superior | USDA96-56 x M59.44 | 0.1 | Check variety, below average yield, above average specific gravity, larger vine type, deeper eyes, flattened oval tuber type |
| Volare | Parkland Seed Potatoes | 1.0 | Very high yield, attractive type, severe internal brown spot, moderate hollow heart and vascular discoloration, waxy skin, high proportion A sized tubers |

Table of Contents

*(2021 Round White Varieties cont.)*

| Entry | Pedigree | 2020 Scab Rating* | Characteristics |
|---|---|---|---|
| MSAA174-1 | MSU161-1 x MSQ440-2 | 0.7 | Below average yield and specific gravity, slight brown center, smaller vine type, mid-season vine maturity, flattened blocky tuber type |
| MSBB351-1 | MSS483-1 x MSQ440-2 | 0.4 | Low yield and specific gravity, slight hollow heart, inconsistent tuber type, pink blushing around eyes |
| MSBB375-1 | MSW153-1 x MSN 105-1 | 0.5 | Above average yield and specific gravity, slight vascular discoloration, buff netted skin, blocky oval tuber type |
| MSZ551-1 | MSM182-1 x MSL268-D | 1.5 | Very high yield, above average specific gravity, moderate internal brown spot, vascular discoloration, and brown center, large blocky oval type, buff skin |
| NDAF102629C-4 | ND7519-1 x ND7799C-1 | 0.4 | Above average specific gravity, high proportion A sized tubers, good internal quality, larger vine type, deeper eyes |
| NYQ112-5 | | 0.8 | Above average yield, slight vascular discoloration, larger vine type, thin skin, moderate skinning |
| NYR203-1 | | 0.4 | Non uniform type, pointed tubers, very low specific gravity, moderate hollow heart, waxy skin, below average yield |

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

Table of Contents

# 2021 Novelty Variety Descriptions

| Entry | Pedigree | 2021 Scab Rating* | Characteristics |
|---|---|---|---|
| Blackberry (MSV109-10PP) | COMN07-W112BGA x MSU200-5PP | 0.5 | Dark purple skin with chimeral white eyes, dark purple flesh, misshapen pickouts, good internal quality, smaller tuber size profile |

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

Table of Contents

# Table 9. 2021 Michigan Statewide Russet Potato Variety Trials
## Overall Averages - Nine Locations

| 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 | | | | |
| AOR10063-2[m] | 527 | 671 | 79 | 10 | 79 | 0 | 11 | 1.078 | 0 | 50 | 10 | 0 | 1.0 | 4.5 | | flattened tubers, misshapen pickouts |
| AF6340-6[g] | 476 | 579 | 82 | 7 | 58 | 24 | 11 | 1.054 | 0 | 0 | 0 | 0 | 1.0 | 3.0 | 1.5 | inconsistent skin, attractive type |
| Lakeview russet[abcdegjmn] | 455 | 524 | 86 | 7 | 68 | 18 | 7 | 1.077 | 0 | 1 | 10 | 0 | 0.9 | 3.1 | 3.4 | larger size profile, flattened oblong type |
| A08433-4sto[abcdfgjmn] | 446 | 529 | 79 | 13 | 68 | 11 | 8 | 1.080 | 20 | 1 | 0 | 0 | 0.6 | 3.4 | 3.3 | flat blocky oblong type, slight growth crack |
| AF6377-13[g] | 436 | 555 | 78 | 10 | 57 | 21 | 12 | 1.080 | 0 | 0 | 0 | 20 | 0.0 | 3.0 | 2.5 | moderate skinning, dark russet skin |
| **Silverton Russet[abcdfgjmn]** | **431** | **508** | **84** | **10** | **66** | **18** | **6** | **1.070** | **3** | **6** | **3** | **3** | **0.3** | **3.6** | **2.6** | **slight alligator hide, slight skinning** |
| W13A11229-1RUS[abcdfgkjmn] | 403 | 510 | 75 | 22 | 73 | 2 | 3 | 1.083 | 12 | 7 | 0 | 0 | 0.6 | 3.1 | 3.0 | lighter russet skin, attractive type |
| **Russet Norkotah[abcdfgjmn]** | **387** | **487** | **78** | **14** | **63** | **15** | **8** | **1.071** | **25** | **4** | **0** | **1** | **0.4** | **3.2** | **2.5** | **moderate skinning, misshapen pickouts** |
| Reveille Russet[abcdfgjmn] | 382 | 465 | 79 | 10 | 60 | 19 | 11 | 1.068 | 0 | 5 | 0 | 0 | 0.1 | 2.0 | 3.4 | growth crack in pickouts, attractive skin |
| Vanguard[abcdfgjmn] | 376 | 437 | 84 | 12 | 71 | 12 | 5 | 1.063 | 0 | 2 | 0 | 0 | 0.1 | 2.7 | 2.1 | moderate alligator hide, attractive skin |
| AF5762-8[g] | 372 | 466 | 80 | 11 | 65 | 15 | 9 | 1.080 | 0 | 20 | 0 | 0 | 0.0 | 2.5 | 3.5 | dark skin, attractive type, blocky shape |
| Tiger[abcdfgjm] | 366 | 504 | 72 | 22 | 68 | 4 | 6 | 1.077 | 13 | 2 | 6 | 1 | 0.9 | 3.2 | 3.1 | variable russet skin and tuber shape |
| A10071-1[abcgm] | 357 | 455 | 78 | 16 | 73 | 5 | 6 | 1.068 | 4 | 0 | 2 | 4 | 0.4 | 3.9 | 2.4 | uniform type, darker russet skin, slight prominent eyes |
| AF6298-2[g] | 347 | 418 | 83 | 12 | 74 | 9 | 5 | 1.081 | 10 | 0 | 10 | 0 | 1.5 | 2.0 | 3.0 | light to medium russet russet, non uniform type |
| CO10085-1Rus[abcdegj] | 344 | 471 | 73 | 18 | 69 | 4 | 9 | 1.084 | 3 | 3 | 3 | 0 | 0.9 | 3.2 | 3.3 | nice appearance, misshapen pickouts, prominent eyes |
| Goldrush[abdfjn] | 337 | 422 | 75 | 16 | 63 | 12 | 9 | 1.071 | 7 | 0 | 0 | 0 | 0.0 | 3.1 | 2.4 | heavy dark russet skin, misshapen pickouts |
| A09119-4LB[abfgm] | 323 | 399 | 81 | 11 | 75 | 6 | 8 | 1.074 | 0 | 17 | 1 | 0 | 1.1 | 3.1 | 2.3 | light russet skin, misshapen pickouts |
| Western Russet[bm] | 317 | 411 | 77 | 16 | 76 | 1 | 7 | 1.077 | 0 | 2 | 0 | 0 | 0.5 | 3.9 | 2.5 | deeper eyes, knobs and points in pickouts |
| A11737-1LB[bm] | 316 | 410 | 77 | 17 | 75 | 2 | 6 | 1.074 | 0 | 0 | 0 | 0 | 1.0 | 3.5 | 1.0 | medium russet skin, knobs and points in pickouts |
| Burbank SEL[m] | 315 | 516 | 61 | 16 | 61 | 0 | 23 | 1.070 | 13 | 10 | 0 | 0 | 0.5 | 3.8 | | severe bottlenecks |
| Ranger Russet[m] | 302 | 464 | 65 | 27 | 65 | 0 | 8 | 1.080 | 0 | 20 | 3 | 0 | 1.8 | 3.0 | | inconsistent shape, slight sticky stolons |
| A12114-7[abcdegjmn] | 278 | 371 | 69 | 24 | 66 | 3 | 7 | 1.074 | 1 | 2 | 0 | 0 | 0.4 | 3.3 | 2.3 | smaller size profile, longer tubular type |
| A06030-23[m] | 273 | 348 | 79 | 7 | 63 | 16 | 14 | 1.069 | 27 | 10 | 0 | 3 | 0.5 | 3.2 | | severe growth crack in pickouts, nice appearance |
| COTX08063-2RU[ilm] | 267 | 363 | 73 | 21 | 71 | 2 | 6 | 1.080 | 0 | 4 | 1 | 0 | 1.0 | 3.2 | 1.5 | Vanguard type, attractive skin |
| AC12080-4RU[gh] | 249 | 322 | 78 | 20 | 74 | 4 | 2 | 1.065 | 0 | 5 | 0 | 0 | 1.0 | 3.0 | 2.3 | moderate alligator hide, inconsistent type |
| AF6296-3[g] | 239 | 431 | 56 | 16 | 52 | 4 | 28 | 1.072 | 0 | 0 | 10 | 0 | 2.0 | 3.0 | 3.0 | light skin, misshapen tubers, points and knobs |
| AC12090-3RU[gh] | 231 | 310 | 75 | 19 | 73 | 2 | 6 | 1.064 | 0 | 0 | 0 | 0 | 0.5 | 2.8 | 2.8 | poor appearance, dark russet skin |
| AF5735-8[g] | 194 | 401 | 48 | 47 | 48 | 0 | 5 | 1.066 | 0 | 0 | 0 | 0 | 1.0 | 3.0 | 3.5 | smaller long tubular type |
| CO12378-1RU[abh] | 169 | 270 | 60 | 29 | 60 | 0 | 11 | 1.076 | 37 | 0 | 0 | 0 | 0.2 | 3.2 | 2.3 | heavy russet skin, slight growth crack |
| Libero[g] | | | 15 | 75 | 15 | 0 | 10 | 1.067 | | | | | 1.0 | 3.5 | 1.0 | poor yield and emergence, very few potatoes |
| **MEAN** | **342** | **449** | **73** | **19** | **65** | **8** | **9** | **1.073** | **6** | **6** | **2** | **1** | **0.7** | **3.2** | **2.5** | |

**2021 RUSSET VARIETY TRIAL SITES**

[a]4-L Farms
[b]Elmaple Farms
[c]Horkey Farms
[d]Jenkins Farms
[e]Kitchen Farms Mini Bulk Trial
[f]Kitchen Farms Strip Trial
[g]Lennard Ag. Co. Strip Trial
[h]Lennard Ag. Co. NFPT Trial
[i]Lennard Ag. Co. NFPT Add Ons Trial
[j]Styma Potato Farms
[k]Walther Farms NFPT Trial
[l]Walther Farms NFPT Add Ons Trial
[m]Walther Farms Norkotah Fertility Trial
[n]Verbrigghe Farms

**[1]SIZE**

**Russets**
Bs: < 4 oz
As: 4 - 10 oz
OV: > 10 oz
PO: Pickouts

**[2]SPECIFIC GRAVITY**

Data not replicated

**[3]RAW TUBER QUALITY**

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

**[4]COMMON SCAB RATING**

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

**[5]VINE VIGOR RATING**

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

**[6]VINE MATURITY RATING**

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

# Table 10. 2021 Michigan Statewide Tablestock Potato Variety Trials
## Overall Averages - Seven Locations

| | LINE | CWT/A | | PERCENT OF TOTAL[1] | | | | | SP GR[2] | RAW TUBER QUALITY[4] (%) | | | | COMMON SCAB RATING[5] | VINE VIGOR[7] | VINE MATURITY[8] | YELLOW FLESH | | RED SKIN | | | | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | US#1 | TOTAL | US#1 | Bs | As | OV | PO | | HH | VD | IBS | BC | | | | WAXINESS[7] | FLESH COLOR[8] | WAXINESS[7] | SKIN COLOR[9] | UNIFORMITY[10] | SILVER SCURF[11] | |
| | Columba[abcefj] | 601 | 670 | 90 | 7 | 89 | 1 | 3 | 1.052 | 0 | 7 | 2 | 0 | 0.3 | 3.8 | 1.6 | 3.7 | 2.0 | | | | | heat sprouts, uniform type, bright appearance |
| | MSX156-1Y[di] | 539 | 562 | 96 | 0 | 86 | 11 | 3 | 1.067 | 5 | 0 | 0 | 0 | 0.6 | 3.5 | 3.8 | 2.4 | 2.7 | | | | | blocky large type, buff skin |
| | Danina[cei] | 504 | 610 | 83 | 13 | 83 | 0 | 4 | 1.071 | 3 | 6 | 0 | 0 | 1.0 | 3.3 | 2.9 | 3.3 | 3.5 | | | | | moderate alligator hide, trace pointed tubers |
| | MSV093-1Y[abcdfgj] | 481 | 523 | 92 | 6 | 90 | 2 | 2 | 1.069 | 0 | 0 | 0 | 0 | 0.7 | 3.6 | 3.2 | 2.2 | 2.3 | | | | | medium netted skin, recessed apical ends |
| | Floridana[abcefi] | 471 | 562 | 83 | 13 | 83 | 0 | 4 | 1.064 | 5 | 11 | 0 | 0 | 0.6 | 3.3 | 2.6 | 3.4 | 3.0 | | | | | non uniform type, misshapen pickouts |
| | Goldfinger[acei] | 470 | 630 | 75 | 19 | 75 | 0 | 6 | 1.053 | 0 | 1 | 5 | 3 | 0.8 | 3.4 | 3.2 | 3.8 | 2.9 | | | | | smooth skin, trace heat sprouts |
| | Allora[abcefj] | 458 | 545 | 84 | 11 | 83 | 1 | 5 | 1.068 | 5 | 7 | 0 | 3 | 0.9 | 3.3 | 2.3 | 2.7 | 2.3 | | | | | pointed tubers, light skin netting |
| | Golden Globe[abcdfgj] | 458 | 540 | 85 | 11 | 84 | 0 | 5 | 1.064 | 1 | 0 | 0 | 0 | 0.4 | 3.8 | 2.2 | 3.4 | 2.4 | | | | | uniform type, light thin skin |
| | Nectar[abdfi] | 453 | 580 | 78 | 20 | 78 | 0 | 2 | 1.075 | 24 | 17 | 28 | 0 | 1.0 | 3.2 | 3.8 | 3.1 | 2.5 | | | | | pink blushing around eyes, light netted skin |
| | Christel[ei] | 442 | 575 | 78 | 19 | 78 | 0 | 3 | 1.061 | 0 | 5 | 2 | 0 | 0.9 | 3.4 | 2.8 | 2.9 | 3.4 | | | | | oblong type, trace growth crack |
| | Albertine[acei] | 437 | 547 | 79 | 9 | 79 | 0 | 12 | 1.053 | 5 | 11 | 13 | 3 | 1.5 | 3.8 | 1.8 | 2.9 | 3.1 | | | | | severe points and pear shapes in pickouts |
| | Prada[abcdfgi] | 430 | 532 | 79 | 14 | 79 | 1 | 6 | 1.059 | 3 | 8 | 0 | 1 | 0.6 | 3.4 | 2.0 | 3.0 | 2.3 | | | | | longer type, prominent eyes, marginal appearance |
| | Corinna[acei] | 428 | 494 | 87 | 9 | 87 | 0 | 4 | 1.054 | 0 | 6 | 0 | 0 | 0.5 | 3.0 | 2.4 | 3.1 | 3.0 | | | | | light netting, growth cracks |
| | W15248-17Y[j] | 428 | 490 | 87 | 12 | 87 | 0 | 1 | 1.057 | 0 | 0 | 0 | 0 | 0.5 | 3.0 | 1.5 | 4.0 | 4.0 | | | | | oval tubers, consistent size and shape |
| | Tyson[abcefi] | 421 | 518 | 81 | 10 | 81 | 0 | 9 | 1.070 | 0 | 11 | 2 | 2 | 0.9 | 3.5 | 3.3 | 2.7 | 2.1 | | | | | pointed tubers, light netted skin, trace heat sprouts |
| | MSX245-2Y[bcdi] | 416 | 453 | 91 | 8 | 90 | 1 | 1 | 1.081 | 0 | 1 | 25 | 0 | 0.3 | 3.4 | 3.8 | 1.5 | 1.9 | | | | | deeper apical eyes, netted skin |
| | Montana[acei] | 415 | 559 | 73 | 25 | 73 | 0 | 2 | 1.058 | 0 | 0 | 0 | 3 | 0.8 | 3.2 | 3.1 | 3.6 | 4.2 | | | | | oblong type, lenticel scarring, smooth skin |
| | Primabelle[abcefj] | 404 | 565 | 70 | 24 | 70 | 0 | 6 | 1.052 | 0 | 7 | 3 | 0 | 0.5 | 3.3 | 1.3 | 3.4 | 2.3 | | | | | trace heat sprouts, inconsistent shape |
| | **Yukon Gold[abcefi]** | **403** | **466** | **87** | **4** | **86** | **1** | **9** | **1.079** | **53** | **1** | **0** | **2** | **0.7** | **3.1** | **2.0** | **2.8** | **2.2** | | | | | **blocky tubers, pink blushing around eyes** |
| YELLOW SKIN TYPE | Constance[abcefj] | 402 | 522 | 77 | 19 | 77 | 0 | 4 | 1.068 | 0 | 2 | 5 | 0 | 0.9 | 3.3 | 2.6 | 3.5 | 2.8 | | | | | flattened type, nice smooth appearance |
| | Melody[abcdfgj] | 396 | 490 | 80 | 13 | 80 | 1 | 6 | 1.066 | 13 | 4 | 20 | 0 | 0.5 | 3.0 | 3.3 | 3.0 | 2.6 | | | | | netted skin, growth cracks in pickouts |
| | W15240-2Y[abcefj] | 396 | 510 | 77 | 20 | 77 | 0 | 3 | 1.060 | 0 | 7 | 7 | 0 | 0.9 | 3.2 | 2.3 | 3.8 | 2.8 | | | | | nice appearance, inconsistent tuber type |
| | Honey Ryder[acei] | 392 | 515 | 75 | 17 | 75 | 0 | 8 | 1.056 | 0 | 0 | 3 | 0 | 0.6 | 3.3 | 3.8 | 3.6 | 3.0 | | | | | heat sprouts, attractive appearance |
| | Queen Anne[abcefj] | 381 | 563 | 64 | 34 | 64 | 0 | 2 | 1.058 | 0 | 3 | 0 | 0 | 0.8 | 2.7 | 2.4 | 4.0 | 3.6 | | | | | oblong to long type, smooth skin |
| | Paroli[abcefgi] | 379 | 495 | 77 | 8 | 76 | 1 | 15 | 1.058 | 0 | 2 | 0 | 0 | 0.5 | 4.1 | 2.1 | 3.3 | 3.2 | | | | | growth cracks, light netted skin |
| | AORTX09037-1W/Y[i] | 374 | 480 | 78 | 18 | 78 | 0 | 4 | 1.084 | 0 | 7 | 0 | 0 | 0.2 | 3.7 | 2.2 | 2.2 | 1.8 | | | | | slight growth crack, light netted skin, deep eyes |
| | Cascada[acefi] | 341 | 532 | 64 | 26 | 64 | 0 | 10 | 1.072 | 2 | 3 | 0 | 0 | 0.6 | 3.4 | 3.5 | 3.3 | 4.2 | | | | | smaller tuber type, buff skin |
| | Tessa[bi] | 319 | 381 | 84 | 14 | 84 | 0 | 2 | 1.074 | 2 | 2 | 0 | 0 | 1.1 | 2.9 | 2.3 | 2.1 | 1.9 | | | | | uniform buff skin |
| | MSCC724-1Y[abcdj] | 313 | 370 | 85 | 8 | 84 | 1 | 7 | 1.069 | 4 | 0 | 4 | 26 | 0.8 | 2.6 | 1.9 | 2.7 | 2.5 | | | | | lenticel scarring, trace pointed tubers |
| | W15248-16Y[j] | 311 | 359 | 87 | 13 | 87 | 0 | 0 | 1.083 | 0 | 0 | 0 | 0 | 0.0 | 2.5 | 3.0 | 4.0 | 2.5 | | | | | nice appearance |
| | MSFF247-2Y[j] | 309 | 380 | 81 | 17 | 81 | 0 | 2 | 1.070 | 0 | 0 | 0 | 0 | 1.0 | 2.5 | 2.0 | 3.5 | 1.5 | | | | | deeper eyes |
| | Excellency[abf] | 304 | 451 | 67 | 23 | 67 | 0 | 10 | 1.077 | 0 | 0 | 0 | 0 | 0.8 | 2.3 | 2.5 | 3.2 | 2.8 | | | | | non uniform type, points in pickouts |
| | ND1241-1Y[j] | 266 | 341 | 78 | 20 | 78 | 0 | 2 | 1.091 | 0 | 0 | 0 | 0 | 1.5 | 4.0 | 3.5 | 2.5 | 2.5 | | | | | buff netted skin |
| | Soprano[abefi] | 253 | 454 | 55 | 37 | 55 | 0 | 8 | 1.066 | 0 | 2 | 2 | 0 | 1.6 | 3.2 | 2.3 | 3.5 | 2.1 | | | | | inconsistent type, trace pointed tubers |
| | Ballerina[f] | 250 | 390 | 64 | 29 | 64 | 0 | 7 | 1.061 | 0 | 0 | 0 | 0 | 0.5 | 4.0 | 1.5 | 3.5 | 3.5 | | | | | buff skin type, moderate silver scurf |
| | Mary Ann[ei] | 200 | 367 | 55 | 40 | 55 | 0 | 5 | 1.073 | 0 | 2 | 0 | 0 | 1.4 | 2.1 | 3.8 | 3.9 | 4.0 | | | | | bright skin, pointed tubers |
| | Gourmandine[abefi] | 143 | 386 | 35 | 55 | 35 | 0 | 10 | 1.065 | 0 | 9 | 16 | 0 | 0.6 | 2.4 | 2.6 | 3.8 | 3.1 | | | | | longer flattened type, points in pickouts |
| | Erika[abefi] | 134 | 364 | 34 | 62 | 34 | 0 | 4 | 1.064 | 0 | 3 | 0 | 0 | 1.0 | 2.7 | 1.8 | 3.4 | 2.8 | | | | | attractive appearance, smooth skin |
| | Tokio[j] | 133 | 222 | 60 | 37 | 60 | 0 | 3 | 1.086 | 0 | 20 | 0 | 0 | 1.0 | 3.5 | 4.0 | 2.5 | 2.0 | | | | | flat round to oval tuber type |
| | Celandine[i] | 92 | 272 | 34 | 60 | 34 | 0 | 6 | 1.069 | 0 | 0 | 0 | 0 | 0.3 | 2.7 | 1.7 | 3.5 | 1.5 | | | | | tubular flattened type, bright appearance |
| | **MEAN** | 369 | 482 | 75 | 20 | 74 | 1 | 5 | 1.067 | 3 | 4 | 3 | 1 | 0.8 | 3.2 | 2.6 | 3.2 | 2.7 | | | | | |

| | | CWT/A | | PERCENT OF TOTAL[1] | | | | | | RAW TUBER QUALITY[4] (%) | | | | | | | YELLOW FLESH | | RED SKIN | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LINE | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR[2] | HH | VD | IBS | BC | COMMON SCAB RATING[5] | VINE VIGOR[7] | VINE MATURITY[8] | WAXINESS[7] | FLESH COLOR[8] | WAXINESS[7] | SKIN COLOR[9] | UNIFORMITY[10] | SILVER SCURF[11] | COMMENTS |
| | NDA050237B-1R[abcefgi] | 482 | 542 | 89 | 10 | 87 | 1 | 2 | 1.062 | 0 | 10 | 0 | 1 | 0.6 | 3.1 | 4.0 | | | 3.8 | 3.6 | 4.0 | 2.9 | uniform type, nice skin, slight skinning |
| | NDAF113484B-1[bcefi] | 459 | 528 | 87 | 4 | 87 | 0 | 9 | 1.063 | 0 | 3 | 2 | 4 | 0.5 | 3.2 | 2.6 | | | 3.1 | 3.7 | 3.7 | 3.9 | attractive skin color, round type, deeper eyes |
| | Colorado Rose[abcdfi] | 438 | 533 | 82 | 13 | 82 | 0 | 5 | 1.071 | 2 | 20 | 2 | 2 | 1.1 | 3.0 | 2.6 | | | 3.4 | 3.6 | 3.3 | 3.5 | moderate skinning, attractive skin color |
| | ND1394-5RY[j] | 419 | 442 | 95 | 4 | 95 | 0 | 1 | 1.072 | 0 | 0 | 0 | 0 | 1.5 | 3.0 | 2.0 | | 2.0 | 2.5 | 3.0 | 2.0 | 5.0 | nice overall appearance, light colored skin |
| | CO99076-6R[abcdi] | 411 | 467 | 88 | 8 | 88 | 0 | 4 | 1.070 | 0 | 12 | 0 | 0 | 0.8 | 3.0 | 2.6 | | | 3.5 | 3.9 | 3.8 | 3.6 | round type, attractive skin, moderate skinning |
| | Norland RP[abcefgj] | 405 | 476 | 84 | 13 | 82 | 1 | 4 | 1.060 | 10 | 7 | 1 | 0 | 0.4 | 3.4 | 1.8 | | | 3.0 | 2.9 | 2.6 | 3.3 | moderate skinning, inconsistent shape |
| | Ricarda[acei] | 401 | 503 | 80 | 9 | 80 | 0 | 11 | 1.069 | 0 | 23 | 0 | 3 | 0.7 | 3.8 | 2.5 | | | 3.2 | 2.1 | 3.0 | 2.8 | poor appearance, deeper eyes |
| | **Dark Red Norland[abcefgi]** | **386** | **454** | **85** | **8** | **85** | **0** | **7** | **1.061** | **4** | **4** | **0** | **0** | **0.5** | **3.8** | **1.5** | | | **3.4** | **2.9** | **2.9** | **3.6** | **prominent eyes, less uniform type** |
| | 86735.1[ei] | 377 | 488 | 77 | 14 | 77 | 0 | 9 | 1.072 | 0 | 19 | 17 | 0 | 0.3 | 2.6 | 3.9 | | 2.0 | 2.3 | 2.5 | 4.2 | 3.7 | poor appearance, medium netted skin |
| | Canada Rose (CO00277-2R)[ei] | 371 | 438 | 85 | 12 | 85 | 0 | 3 | 1.068 | 0 | 14 | 0 | 0 | 1.2 | 2.8 | 1.8 | | | 3.4 | 3.6 | 3.8 | 4.4 | excellent color, variable shape |
| RED SKIN TYPE | Rosemara[ei] | 362 | 471 | 77 | 17 | 78 | 0 | 5 | 1.068 | 0 | 19 | 25 | 0 | 0.5 | 3.0 | 3.4 | | 1.5 | 1.8 | 2.1 | 3.1 | 3.0 | heavy netted skin, non uniform type |
| | W15268-89R[j] | 303 | 398 | 76 | 22 | 76 | 0 | 2 | 1.071 | 0 | 0 | 0 | 0 | 0.5 | 3.5 | 1.5 | | | 3.5 | 3.0 | 3.5 | 3.0 | smooth oval tubers, uniform type |
| | CO15205-4R[i] | 299 | 336 | 89 | 11 | 89 | 0 | 0 | 1.076 | 0 | 10 | 0 | 0 | 0.0 | 3.8 | 2.0 | | | 3.8 | 3.7 | 3.3 | 4.3 | uniform round type, lighter skin, slight skinning |
| | CO15211-5R[i] | 239 | 288 | 83 | 15 | 83 | 0 | 2 | 1.062 | 0 | 10 | 0 | 0 | 0.2 | 2.7 | 2.2 | | | 3.3 | 3.8 | 3.5 | 3.5 | nice color, sticky stolons, trace skinning |
| | ND13292B-3R[j] | 236 | 259 | 91 | 7 | 91 | 0 | 2 | 1.062 | 0 | 20 | 0 | 0 | 0.0 | 2.5 | 2.0 | | | 2.5 | 4.0 | 3.0 | 4.0 | nice skin color |
| | RP2009-5R[abefi] | 227 | 391 | 59 | 31 | 59 | 0 | 10 | 1.056 | 0 | 1 | 2 | 2 | 1.0 | 3.1 | 2.3 | | 1.9 | 3.5 | 1.9 | 2.8 | 3.5 | poor appearance, light skin |
| | ND1466CB-1R[i] | 221 | 265 | 83 | 14 | 83 | 0 | 3 | 1.074 | 27 | 0 | 0 | 0 | 0.0 | 1.8 | 1.8 | | | 3.3 | 4.0 | 4.5 | 3.7 | nice color, smaller uniform type |
| | CO14105-1R[i] | 221 | 274 | 81 | 17 | 81 | 0 | 2 | 1.063 | 0 | 13 | 0 | 0 | 0.2 | 2.3 | 3.2 | | | 3.5 | 4.5 | 3.7 | 2.8 | darker red skin, flattened oval type |
| | CO15219-3R[i] | 212 | 312 | 68 | 31 | 68 | 0 | 1 | 1.076 | 0 | 0 | 0 | 0 | 0.3 | 2.7 | 2.8 | | | 3.5 | 3.8 | 3.5 | 3.2 | small tuber type, not uniform, skinning |
| | CO14040-3R[i] | 201 | 339 | 59 | 40 | 59 | 0 | 1 | 1.079 | 0 | 10 | 0 | 0 | 0.8 | 2.5 | 1.5 | | | 4.2 | 3.0 | 3.2 | 3.8 | small tubers, poor appearance |
| | MSX324-2R[bei] | 193 | 255 | 74 | 14 | 74 | 0 | 12 | 1.065 | 0 | 3 | 3 | 0 | 0.8 | 3.6 | 2.0 | | | 2.9 | 2.6 | 2.6 | 3.7 | poor skin color, growth crack in pickouts |
| | CO15206-1R[i] | 169 | 296 | 57 | 43 | 56 | 1 | 0 | 1.071 | 0 | 7 | 0 | 0 | 0.0 | 3.3 | 1.2 | | | 3.5 | 3.0 | 3.0 | 3.8 | poor appearance, small non uniform tubers |
| | **MEAN** | 320 | 398 | 79 | 16 | 79 | 0 | 4 | 1.068 | 2 | 9 | 2 | 1 | 0.5 | 3.0 | 2.3 | | 2.0 | 3.2 | 3.2 | 3.3 | 3.6 | |
| | Volare[ab] | 679 | 741 | 92 | 5 | 91 | 1 | 3 | 1.055 | 10 | 15 | 35 | 5 | 1.0 | 3.3 | 2.3 | 3.3 | | | | | | attractive type and skin |
| | MSZ551-1[bce] | 568 | 623 | 91 | 5 | 88 | 3 | 4 | 1.074 | 3 | 7 | 10 | 7 | 1.5 | 2.5 | 3.5 | 1.7 | | | | | | large blocky oval tuber type |
| | NYQ112-5[cef] | 493 | 587 | 83 | 14 | 83 | 0 | 3 | 1.060 | 0 | 7 | 0 | 0 | 0.8 | 3.7 | 2.8 | 3.5 | | | | | | thin skin, moderate skinning |
| | Audrey[bcefj] | 445 | 536 | 82 | 13 | 82 | 0 | 5 | 1.061 | 0 | 2 | 0 | 2 | 0.6 | 3.1 | 2.4 | 3.0 | | | | | | blocky tubers, thin skin, bright appearance |
| | MSBB375-1[bc] | 441 | 526 | 84 | 6 | 83 | 1 | 10 | 1.075 | 0 | 5 | 0 | 0 | 0.5 | 2.3 | 3.0 | 1.8 | | | | | | blocky oval type, inconsistent skin |
| | Algonquin[abcef] | 438 | 508 | 86 | 5 | 86 | 0 | 9 | 1.074 | 0 | 0 | 2 | 20 | 1.3 | 3.8 | 2.5 | 2.3 | | | | | | non uniform type, blocky type |
| | **Reba[abcefg]** | **416** | **445** | **94** | **4** | **88** | **6** | **2** | **1.068** | **3** | **0** | **0** | **5** | **0.4** | **3.3** | **2.9** | **2.7** | | | | | | **blocky oval type, recessed eyes** |
| ROUND WHITE TYPE | Envol[abcefg] | 412 | 459 | 89 | 7 | 89 | 1 | 3 | 1.071 | 0 | 0 | 0 | 2 | 0.9 | 3.8 | 1.3 | 2.3 | | | | | | heavy netted skin, deep eyes |
| | Abbot[abcefg] | 395 | 476 | 82 | 11 | 81 | 2 | 6 | 1.071 | 8 | 0 | 0 | 0 | 0.8 | 3.6 | 2.1 | 2.2 | | | | | | blocky type, less uniform, heavy skin |
| | NDAF102629C-4[abcefg] | 385 | 420 | 90 | 6 | 90 | 1 | 3 | 1.070 | 0 | 3 | 0 | 2 | 0.4 | 4.1 | 2.6 | 2.5 | | | | | | moderate deep apical eyes, round type |
| | Ashley[bcef] | 380 | 468 | 79 | 18 | 80 | 0 | 2 | 1.062 | 0 | 15 | 0 | 3 | 0.8 | 3.0 | 2.6 | 3.4 | | | | | | bright appearance, thin skin |
| | NYR203-1[abcefj] | 369 | 444 | 83 | 12 | 83 | 0 | 5 | 1.056 | 17 | 10 | 7 | 3 | 0.4 | 3.0 | 2.7 | 3.2 | | | | | | non uniform type, pointed tubers |
| | **Superior[bcef]** | **367** | **429** | **86** | **7** | **86** | **0** | **7** | **1.073** | **3** | **3** | **3** | **0** | **0.1** | **3.4** | **2.3** | **2.0** | | | | | | **deep eyes, flattened oval type** |
| | MSAA174-1[bcd] | 364 | 406 | 87 | 11 | 87 | 0 | 2 | 1.053 | 0 | 0 | 3 | 7 | 0.7 | 2.5 | 3.2 | 2.0 | | | | | | flattened blocky type |
| | MSBB351-1[bcfg] | 336 | 387 | 87 | 7 | 81 | 6 | 6 | 1.054 | 3 | 0 | 0 | 0 | 0.4 | 2.3 | 2.8 | 2.3 | | | | | | inconsistent type, pink blushing around eyes |
| | | 433 | 497 | 86 | 9 | 85 | 1 | 5 | 1.065 | 3 | 4 | 4 | 4 | 0.7 | 3.2 | 2.6 | 2.5 | | | | | | |
| NOVELTY | Blackberry[bce] | 481 | 617 | 75 | 22 | 75 | 0 | 3 | 1.063 | 0 | 0 | 0 | 0 | 0.5 | 3.0 | 3.7 | 0.0 | | 3.0 | 5.0 | 5.0 | 3.7 | chimeral white eyes, misshapen pickouts |
| | **TRIAL MEAN** | **369** | **463** | **78** | **17** | **78** | **1** | **5** | **1.067** | **3** | **6** | **3** | **1** | **0.7** | **3.1** | **2.5** | **2.9** | **2.6** | **3.2** | **3.3** | **3.4** | **3.6** | |

**2021 TABLESTOCK VARIETY TRIAL SITES**

[a]4-L Farms
[b]Horkey Brothers
[c]Jenkins Farms
[d]Kitchen Farms Mini Bulk Trial
[e]Kitchen Farms Strip Trial
[f]Styma Potato Farms
[g]Verbrigghe Farms
[h]Walther Farms Early Generation Selection
[i]Walther Farms Replicated Trial
[j]Walther Farms Strip Trial

**[1]SIZE**

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

**[2]SPECIFIC GRAVITY**

Data not replicated

**[3]RAW TUBER QUALITY**

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

**[4]COMMON SCAB RATING**

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

**[5]VINE VIGOR RATING**

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

**[6]VINE MATURITY RATING**

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

**[7]WAXINESS RATING**

1: Heavy netting, buff
5: Waxy, smooth

**[8]FLESH COLOR**

1: White
5: Dark yellow

**[9]SKIN COLOR**

1: Light pink
5: Dark red

**[10]UNIFORMITY OF SKIN COLOR**

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

**[11]SILVER SCURF**

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

# Table 11. 2021 Russet Potato Variety Trial
# Walther Farms NFPT and Added Lines

**Planting: 4/22/21 Vine Kill: 8/18/21 Harvest: 9/16/21**
**$GDD_{40}$: 3210**

| | CWT/A | | PERCENT OF TOTAL[1] | | | | | | RAW TUBER QUALITY[3] (%) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LINE | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR[2] | HH | VD | IBS | BC | COMMON SCAB RATING[4] | VINE VIGOR[5] | COMMENTS |
| AF6384-2 | 680 | 718 | 95 | 3 | 46 | 49 | 2 | 1.072 | 10 | 0 | 0 | 0 | 1.5 | 3.5 | light skin type, blocky, oblong |
| A15094-11 | 662 | 816 | 82 | 10 | 70 | 12 | 8 | 1.069 | 0 | 0 | 0 | 0 | 2.0 | 4.0 | tubular appearance, done |
| A12327-5VR | 632 | 690 | 92 | 3 | 47 | 45 | 5 | 1.073 | 10 | 10 | 10 | 0 | 0.5 | 4.0 | nice blocky type but less uniform |
| A11887-5adg | 606 | 696 | 87 | 9 | 68 | 19 | 4 | 1.081 | 0 | 40 | 0 | 0 | 1.5 | 4.0 | lighter russet skin, pointed tubers |
| AF5707-1 | 603 | 726 | 83 | 11 | 78 | 5 | 6 | 1.083 | 10 | 0 | 0 | 0 | 2.0 | 3.5 | nice shape and type but too much scab |
| A16117-4 | 599 | 692 | 87 | 5 | 58 | 29 | 8 | 1.088 | 10 | 0 | 0 | 0 | 1.5 | 4.0 | darker russet skin, points |
| A15190-8CR | 594 | 683 | 87 | 4 | 54 | 33 | 9 | 1.079 | 0 | 20 | 0 | 0 | 0.0 | 4.0 | large tubers, points, prominent eyes |
| AOR10071-8 | 576 | 697 | 83 | 15 | 72 | 11 | 2 | 1.085 | 0 | 60 | 0 | 0 | 1.0 | | nice skin finish, blocky, sticky stolons, trace heat knobs |
| AOR15166-2 | 560 | 594 | 95 | 4 | 84 | 11 | 1 | 1.082 | 0 | 10 | 0 | 0 | 1.0 | | light russet skin, attractive shape and appearance |
| AF6338-6 | 554 | 663 | 84 | 8 | 76 | 8 | 8 | 1.081 | 20 | 20 | 10 | 0 | 0.5 | 3.5 | lots of points and pears, medium russet skin |
| AOR10129-1 | 549 | 609 | 90 | 8 | 70 | 20 | 2 | 1.073 | 30 | 0 | 0 | 0 | 2.5 | | anthocyanins on skin, poor skin finish |
| A09136-9LB | 547 | 630 | 87 | 8 | 63 | 24 | 5 | 1.082 | 50 | 0 | 0 | 0 | 2.5 | 5.0 | non uniform type, misshapen pickouts |
| AOR10093-1 | 539 | 658 | 82 | 9 | 51 | 31 | 9 | 1.081 | 0 | 20 | 0 | 0 | 2.5 | | inconsistent shape, severe knobs in pickouts |
| A12305-2adg | 534 | 677 | 79 | 3 | 26 | 53 | 18 | 1.073 | 10 | 0 | 0 | 0 | 2.0 | 3.5 | poor appearance |
| AAF10596-1 | 529 | 642 | 82 | 8 | 61 | 21 | 10 | 1.091 | 20 | 20 | 0 | 0 | 2.5 | 4.0 | deeper eyes, nice skin but poor appearance |
| A15094-13 | 524 | 645 | 81 | 9 | 69 | 12 | 10 | 1.069 | 30 | 10 | 0 | 0 | 0.5 | 3.0 | light russet, misshapen tubers |
| A15041-13 | 521 | 570 | 92 | 2 | 33 | 59 | 6 | 1.074 | 30 | 0 | 0 | 0 | 0.0 | 3.0 | large clunky oblong tubers, darker skin |
| AAF11345-1 | 503 | 543 | 92 | 7 | 68 | 24 | 1 | 1.084 | 0 | 40 | 10 | 0 | 1.5 | 1.5 | blush appearance, heavy eyebrows, nice shape, nice skin |
| A13036-1 | 482 | 520 | 93 | 4 | 66 | 27 | 3 | 1.084 | 10 | 20 | 0 | 10 | 0.0 | 4.5 | nice skin, lots of deep eyes |
| AF5736-16 | 474 | 535 | 88 | 9 | 77 | 11 | 3 | 1.086 | 0 | 0 | 0 | 0 | 0.0 | 3.5 | nice type, flat oblong to long type |
| A12303-4sto | 468 | 596 | 79 | 15 | 69 | 10 | 6 | 1.088 | 10 | 0 | 0 | 0 | 1.0 | 3.0 | nice blocky type, some misshapen pickouts |
| A15008-2TE | 451 | 542 | 83 | 13 | 76 | 7 | 4 | 1.071 | 20 | 30 | 20 | 10 | 0.0 | 4.0 | nice skin, less uniform tubers |
| A15099-10PMTV | 444 | 520 | 86 | 8 | 66 | 20 | 6 | 1.075 | 0 | 50 | 0 | 0 | 1.5 | 4.0 | nice appearance but moderate scab |
| AOR12069-3 | 444 | 531 | 83 | 16 | 60 | 23 | 1 | 1.074 | 10 | 10 | 0 | 0 | 2.5 | | light skin, misshapen pickiouts, trace sticky stolons |
| AFA5661-8 | 441 | 460 | 95 | 5 | 66 | 29 | 0 | 1.075 | 0 | 20 | 0 | 0 | 1.0 | 2.5 | sticky stolons, non uniform russetting, nice type, blocky, oblong |
| AF6086-7 | 440 | 522 | 84 | 11 | 68 | 16 | 5 | 1.081 | 0 | 30 | 0 | 0 | 2.0 | 3.0 | decent appearance, heavy eyebrows |
| AF6377-12 | 424 | 450 | 94 | 4 | 55 | 39 | 2 | 1.071 | 40 | 0 | 0 | 0 | 0.0 | 3.0 | dark russet skin, nice shape |
| W13A11229-1RUS | 423 | 512 | 83 | 16 | 72 | 11 | 1 | 1.075 | 10 | 40 | 0 | 0 | 1.0 | 3.5 | nice appearance, lighter russet skin |
| A14057-4adg | 416 | 494 | 84 | 5 | 66 | 18 | 11 | 1.073 | 0 | 0 | 0 | 0 | 1.0 | 3.5 | slight sticky stolons, points, variable russet skin |
| A13074-1TE | 415 | 506 | 82 | 9 | 59 | 23 | 9 | 1.088 | 0 | 0 | 0 | 0 | 0.0 | 4.5 | blocky oblong type |
| AF6075-8 | 414 | 620 | 67 | 4 | 52 | 15 | 29 | 1.066 | 10 | 0 | 0 | 0 | 0.5 | 3.5 | lots of bottlenecks, long to tubular type |
| A15028-16 | 410 | 495 | 83 | 6 | 74 | 9 | 11 | 1.088 | 40 | 0 | 0 | 10 | 1.0 | 3.0 | medium russet skin, deep eyes, less uniform tubers |
| A09086-1LB | 391 | 542 | 72 | 24 | 70 | 2 | 4 | 1.077 | 0 | 0 | 0 | 0 | 2.5 | 4.5 | lighter russet skin |
| COA15494-8 | 377 | 461 | 82 | 12 | 49 | 33 | 6 | 1.068 | 0 | 0 | 0 | 10 | 0.5 | 4.0 | nice dark russet skin type, flat blocky oblong type |
| AF6110-3 | 365 | 432 | 85 | 6 | 50 | 35 | 9 | 1.075 | 20 | 10 | 0 | 10 | 1.5 | 3.0 | non uniform type, points and knobs |
| COAF13066-1 | 358 | 481 | 74 | 10 | 68 | 6 | 16 | 1.083 | 10 | 20 | 0 | 0 | 0.5 | 2.5 | poor shape, sticky stolons, knobs |
| AF5521-1 | 354 | 392 | 91 | 4 | 49 | 42 | 5 | 1.087 | 10 | 30 | 20 | 0 | 2.0 | 3.0 | nice shape, inconsistent skin |
| A14026-16adg | 346 | 590 | 59 | 22 | 55 | 4 | 19 | 1.086 | 0 | 0 | 50 | 0 | 1.0 | 3.0 | lots of bottlenecks, points, poor shape, light skin |
| AF5750-16 | 329 | 531 | 62 | 26 | 60 | 2 | 12 | 1.073 | 0 | 0 | 0 | 0 | 2.0 | 3.0 | tubular type, bottlenecking, points |
| WAF14006-6 | 327 | 430 | 75 | 6 | 28 | 47 | 19 | 1.067 | 20 | 20 | 20 | 10 | 0.0 | 3.5 | severe alligator hide, big tubers with growth crack |
| A10020-3sto | 323 | 417 | 77 | 16 | 77 | 0 | 7 | 1.073 | 0 | 0 | 0 | 0 | 0.0 | 2.0 | prominent eyes, dark russet skin, flattened shape |
| AOR11027-4 | 309 | 377 | 82 | 14 | 72 | 10 | 4 | 1.074 | 0 | 0 | 0 | 0 | 1.5 | | lighter russet skin |

| LINE | CWT/A | | PERCENT OF TOTAL[1] | | | | | SP GR[2] | RAW TUBER QUALITY[3] (%) | | | | COMMON SCAB RATING[4] | VINE VIGOR[5] | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | US#1 | TOTAL | US#1 | Bs | As | OV | PO | | HH | VD | IBS | BC | | | |
| A13085-2 | 302 | 365 | 83 | 13 | 64 | 19 | 4 | 1.066 | 0 | 0 | 0 | 0 | 0.5 | 4.0 | nice skin, fairly uniform, slightly flattened type |
| COAF11018-10 | 265 | 325 | 82 | 15 | 70 | 12 | 3 | 1.069 | 0 | 0 | 0 | 0 | 0.5 | 2.0 | longer uniform type, medium russet skin, nice appearance |
| A15042-1 | 262 | 373 | 71 | 18 | 64 | 7 | 11 | 1.083 | 0 | 0 | 0 | 0 | 0.5 | 3.0 | oblong type, poor skin finish |
| A15258-1 | 244 | 321 | 76 | 17 | 59 | 17 | 7 | 1.062 | 0 | 0 | 0 | 0 | 0.5 | 3.5 | longer type |
| A07914-4CR | 232 | 360 | 65 | 11 | 60 | 5 | 24 | 1.062 | 40 | 0 | 0 | 0 | 1.0 | 5.0 | tubular non uniform type, inconsistent skin |
| A12304-1sto | 224 | 332 | 68 | 32 | 56 | 12 | 0 | 1.070 | 0 | 0 | 10 | 0 | 0.0 | 3.0 | medium russet skin type, attractive |
| A10635-2VR | 72 | 345 | 21 | 64 | 21 | 0 | 15 | 1.075 | 0 | 30 | 10 | 0 | 1.0 | 4.0 | small size profile, pointed tubers |
| A12314-1sto | 44 | 85 | 52 | 26 | 52 | 0 | 22 | 1.070 | 0 | 0 | 0 | 0 | 0.5 | 2.0 | skin cracking, few tubers |
| NDAF1415Y-2 | 575 | 612 | 94 | 4 | 45 | 49 | 2 | 1.073 | 20 | 0 | 0 | 0 | 2.0 | 3.0 | oblong blocky type, slight alligator hide |
| AF6441-3 | 536 | 600 | 89 | 7 | 59 | 30 | 4 | 1.089 | 10 | 0 | 0 | 0 | 2.0 | 4.0 | moderate skinning, acceptable appearance |
| AF6377-10 | 518 | 565 | 92 | 4 | 33 | 59 | 4 | 1.072 | 10 | 0 | 0 | 0 | 0.5 | 3.0 | nice blocky type, good appearance, almost too big |
| AAF15010-1 | 463 | 591 | 79 | 15 | 73 | 6 | 6 | 1.100 | 10 | 10 | 0 | 0 | 0.5 | 4.0 | nice uniform appearance, medium to dark russet skin |
| NDAF13242B-1 | 458 | 550 | 83 | 10 | 83 | 0 | 7 | 1.087 | 60 | 0 | 0 | 0 | 0.0 | 3.0 | flat blocky tuber type |
| NDTX14247CAB-1W | 427 | 549 | 77 | 23 | 73 | 4 | 0 | 1.069 | 0 | 10 | 0 | 0 | 0.5 | 4.5 | nice appearance |
| NDAF13242B-3 | 406 | 499 | 82 | 16 | 75 | 7 | 2 | 1.091 | 0 | 0 | 0 | 0 | 1.0 | 3.0 | attractive shape |
| NDTX1482YB-1W | 359 | 548 | 66 | 30 | 52 | 14 | 4 | 1.083 | 0 | 0 | 0 | 0 | 1.5 | 4.0 | less uniform shape |
| AF6370-1 | 268 | 379 | 71 | 21 | 60 | 11 | 8 | 1.067 | 0 | 0 | 0 | 0 | 0.0 | 2.0 | flat blocky type, dark russet skin, nice appearance |
| ATX13287-1Ru | 268 | 307 | 87 | 10 | 65 | 22 | 3 | 1.089 | 0 | 30 | 0 | 0 | 0.5 | 3.0 | |
| **Russet Burbank** | **239** | **720** | **33** | **15** | **31** | **2** | **52** | **1.074** | **0** | **0** | **0** | **0** | **0.5** | **3.0** | |
| COTX08063-2Ru | 228 | 344 | 67 | 32 | 60 | 7 | 1 | 1.061 | 0 | 0 | 0 | 0 | 0.0 | 3.0 | nice appearance and skin, smaller type |
| COTX10080-2Ru | 202 | 256 | 79 | 14 | 55 | 24 | 7 | 1.078 | 0 | 50 | 30 | 0 | 1.5 | 3.5 | average appearance, moderate alligator hide |
| AF6075-9 | 190 | 240 | 79 | 8 | 47 | 32 | 13 | 1.055 | 0 | 0 | 0 | 0 | 0.0 | 3.0 | lots of pears and points, nice skin, poor shape |
| ATTX10007-1Ru | 145 | 199 | 73 | 27 | 70 | 3 | 0 | 1.071 | 0 | 0 | 0 | 0 | 1.5 | 2.0 | not uniform |
| AAF12147-6 | 139 | 273 | 51 | 42 | 46 | 5 | 7 | 1.080 | 0 | 0 | 0 | 0 | 0.0 | 3.5 | lenticel scarring, less uniform, light russet skin |
| **MEAN** | **409** | **510** | **79** | **13** | **60** | **19** | **8** | **1.077** | **9** | **10** | **3** | **1** | **1.0** | **3.4** | |

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

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

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

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

**[5]VINE VIGOR RATING**
Date: 6/9/21
Rating 1-5
1: Slow emergence
5: Early emergence (vigorous vine, some flowering)

**FIELD DATA**

| | |
|---|---|
| Planting Date | 4/22/21 |
| Vine Kill Date | 8/18/21 |
| Harvest Date | 9/16/21 |
| Days (planting to vine kill) | 118 |
| Days (planting to harvest) | 147 |
| $GDD_{40}$ MAWN Station | Constantine |
| $GDD_{40}$ (planting to vine kill) | 3210 |
| Seed Spacing | 10" |

Varieties below the dashed line are added lines

# Table 12. 2021 Tablestock Potato Variety Trial
## Walther Farms Early Generation Selection

**Planting: 5/7/21 Vine Kill: 8/21/21 Harvest: 9/30/21**

**$GDD_{40}$: 3220**

| | | CWT/A | | PERCENT OF TOTAL[1] | | | | | | RAW TUBER QUALITY[3] (%) | | | | | | YELLOW FLESH | | RED SKIN | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LINE | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR[2] | HH | VD | IBS | BC | VINE VIGOR[4] | VINE MATURITY[5] | WAXINESS[6] | FLESH COLOR[7] | WAXINESS[6] | SKIN COLOR[8] | UNIFORMITY[9] | SILVER SCURF[10] | COMMENTS |
| YELLOW SKIN TYPE | WAF13058-1 | 461 | 552 | 83 | 5 | 82 | 1 | 12 | 1.075 | 0 | 0 | 0 | 0 | 3.5 | 2.5 | 4.0 | 3.0 | | | | | attractive skin, moderate growth crack |
| | ND1487-1Y | 307 | 457 | 67 | 32 | 67 | 0 | 1 | 1.069 | 0 | 0 | 0 | 0 | 3.5 | 2.0 | 2.0 | 4.0 | | | | | oval type, slight greening |
| | NYT61-3 | 221 | 281 | 79 | 20 | 79 | 0 | 1 | 1.079 | 0 | 0 | 0 | 0 | 2.0 | 3.0 | 3.0 | 3.5 | | | | | nice, bright skin, slight variable shape |
| | NYT61-2 | 211 | 337 | 63 | 35 | 63 | 0 | 2 | 1.079 | 0 | 0 | 0 | 0 | 3.0 | 2.5 | 2.5 | 2.0 | | | | | nice shape, slight pink pigmentation around eyes |
| | NYT61-4 | 88 | 353 | 25 | 75 | 25 | 0 | 0 | 1.084 | 0 | 0 | 0 | 0 | 3.5 | 3.0 | 3.0 | 3.0 | | | | | smooth skin, longer type |
| | **MEAN** | 257 | 396 | 63 | 33 | 63 | 0 | 3 | 1.077 | 0 | 0 | 0 | 0 | 3.1 | 2.6 | 2.9 | 3.1 | | | | | |
| RED SKIN TYPE | CO15127-1R | 128 | 216 | 59 | 34 | 59 | 0 | 7 | 1.082 | 0 | 0 | 0 | 0 | 2.0 | 1.0 | | | 4.0 | 4.0 | 4.0 | 3.0 | good shape, round, small, good color |
| | TX17802-5R | 140 | 280 | 50 | 44 | 50 | 0 | 6 | 1.069 | 0 | 0 | 0 | 0 | 3.0 | 3.0 | | | 3.5 | 3.5 | 4.0 | 1.0 | |
| | ND14324B-7R | 152 | 217 | 70 | 30 | 70 | 0 | 0 | 1.071 | 0 | 0 | 0 | 0 | 1.5 | 3.0 | | | 3.0 | 4.0 | 4.0 | 2.0 | nice shape |
| | ND14325B-7R | 181 | 285 | 63 | 36 | 63 | 0 | 1 | 1.061 | 0 | 0 | 0 | 0 | 2.0 | 2.5 | | | 4.0 | 4.0 | 4.0 | 3.0 | small yield but nice red skin |
| | COTX15111-1R | 193 | 230 | 84 | 12 | 84 | 0 | 4 | 1.075 | 0 | 0 | 0 | 0 | 2.5 | 2.0 | | | 3.5 | 4.0 | 4.0 | 2.0 | nice color and skin, inconsistent shape |
| | ND14220B-9R | 320 | 367 | 87 | 9 | 87 | 0 | 4 | 1.067 | 0 | 0 | 0 | 0 | 2.5 | 1.5 | | | 3.0 | 3.5 | 2.0 | 3.0 | acceptable color |
| | CO15113-1R | 342 | 401 | 85 | 14 | 85 | 0 | 1 | 1.084 | 0 | 0 | 0 | 0 | 3.0 | 2.5 | | | 2.5 | 3.0 | 4.0 | 2.0 | nice shape, acceptable color |
| | COTX15083-1R | 395 | 462 | 85 | 15 | 83 | 2 | 0 | 1.073 | 0 | 0 | 0 | 0 | 3.0 | 2.0 | | | 3.0 | 4.0 | 2.0 | 2.0 | smooth skin, nice color |
| | NDAF12143-1 | 415 | 488 | 85 | 13 | 85 | 0 | 2 | 1.067 | 0 | 0 | 0 | 0 | 3.0 | 2.5 | | | 3.0 | 4.0 | 4.0 | 3.0 | acceptable color, nice eye depth, smooth |
| | **MEAN** | 252 | 327 | 74 | 23 | 74 | 0 | 3 | 1.072 | 0 | 0 | 0 | 0 | 2.5 | 2.2 | | | 3.3 | 3.8 | 3.6 | 2.3 | |
| WHITE | AF5819-2 | 398 | 455 | 88 | 11 | 88 | 0 | 1 | 1.069 | 0 | 0 | 0 | 0 | 3.5 | 3.0 | 2.5 | | | | | | bright, slight deep eyes, round, blocky |
| | **TRIAL MEAN** | **263** | **359** | **72** | **26** | **71** | **0** | **3** | **1.074** | **0** | **0** | **0** | **0** | **2.8** | **2.4** | **2.8** | **3.1** | **3.3** | **3.8** | **3.6** | **2.3** | |

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

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

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

**[4]VINE VIGOR RATING**
Date: 6/22/21
Rating 1-5
1: Slow emergence
5: Early emergence

**[5]VINE MATURITY RATING**
Date: 8/24/21
Rating 1-5
1: Early (vines completely dead)
5: Late (vigorous vines, some flowering)

**[6]WAXINESS RATING**
1: Heavy netting, buff
5: Waxy, smooth

**[7]FLESH COLOR**
1: White
5: Dark yellow

**FIELD DATA**

| | |
|---|---|
| Planting Date | 5/7/21 |
| Vine Kill Date | 8/27/21 |
| Harvest Date | 9/30/21 |
| Days (planting to vine kill) | 112 |
| Days (planting to harvest) | 146 |
| $GDD_{40}$ MAWN Station | Fairgrove |
| $GDD_{40}$ (planting to vine kill) | 3220 |
| Seed Spacing | 10" |

**¨SKIN COLOR**
1: Light pink
5: Dark red

**˝UNIFORMITY OF SKIN COLOR**
1: Highly variable, non-uniform
5: Highly uniform, color throughout

**˝¨SILVER SCURF**
0: No incidence of silver scurf
5: High incidence of silver scurf

## Evaluating New Potato Varieties for Herbicide Sensitivity-2021 MPIC Research Report

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

The potato research team at MSU is continually striving to introduce new potato varieties that have improved agronomic, storability, and processing qualities compared to standard commercial varieties. In recent years, varieties like Silverton Russet have been introduced to the US commercial potato industry with susceptibility to commonly used broadleaf herbicides. In the commercialization process, many growers have experienced yield losses, and therefore significant economic loss, which results in slow variety adoption or even rejection. Many times the developer of new varieties is not aware of all potential weaknesses of a variety and is unable to warn growers of potential management concerns like herbicide sensitivities. To protect the commercial potato industry in Michigan from these unforeseen impacts, the Michigan State University Weed Science and Potato Outreach Programs propose that all potato varieties nearing commercialization be screened for sensitivity to commonly used herbicide treatments. Therefore, objective one of this research was to identify varietal sensitivity to commercially used herbicides prior to release. The following list of advanced chip and russets varieties are nearing commercialization in Michigan: Lady Liberty, Mackinaw, Petoskey, Reveille, and Vanguard. These varieties were compared to the check varieties Atlantic, Lamoka, Snowden, Russet Norkotah, and Russet Silverton.

This study was conducted at the Montcalm Research Center. Four replicate blocks were included in the study consisting of the following advanced chip and russet varieties that are nearing commercialization in Michigan: Lady Liberty, Mackinaw, Petoskey, Reveille, and Vanguard. These varieties will be compared to the check varieties Atlantic, Lamoka, Snowden, Russet Norkotah, and Russet Silverton. The study was planted on 5/28/21. To isolate the impact of herbicide injury on yield and keep a weed free environment a blanket preemergence herbicide application of s-metolachlor plus linuron (trade names Dual/Brawl and Lorox/Linex) was made to control grass and broadleaf weeds. To evaluate injury resulting from postemergence herbicide application rimsulfuron (1 oz/A, trade name Matrix) with and without metribuzin (0.25 lb/A) were applied on 7/12/21.

Figure 1. Variety sensitivity trial 2021

Plot design followed that utilized in the Potato Outreach Program's on-farm variety trials (Figure 1). Herbicide treatments were applied using a $CO_2$ pressurized backpack sprayer calibrated to deliver 187 L $ha^{-1}$ at a pressure of 207 kPa through 11003 AIXR flat-fan nozzles. Percent weed control (0% = no control, 100% = complete control) and potato injury (0% no injury, 100% = complete injury) were evaluated 7, 14, and 21 days after herbicide application and at harvest. The study was harvested 9/8/21. Yield data a presented in Figures 2-4.

Overall, potato varieties varied in their sensitivity to postemergence herbicides. To confirm results from year 1 of this study the study will be repeated again in 2022. The Michigan Potato Industry Commission supported this research.

Table of Contents

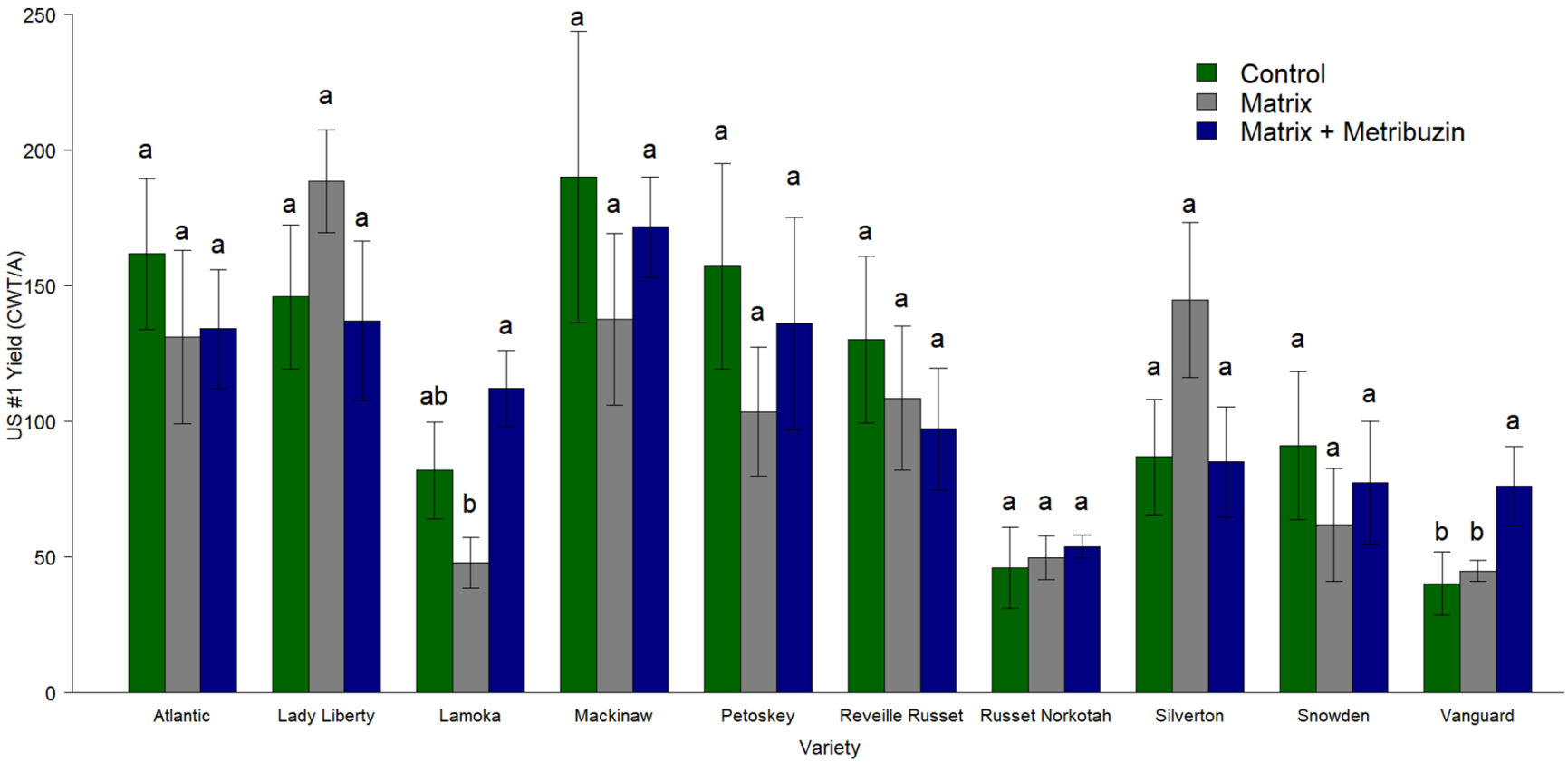


Figure 2. US #1 Yield (CWT/A) for variety sensitivity 2021 trial at the Montcalm Research Center.

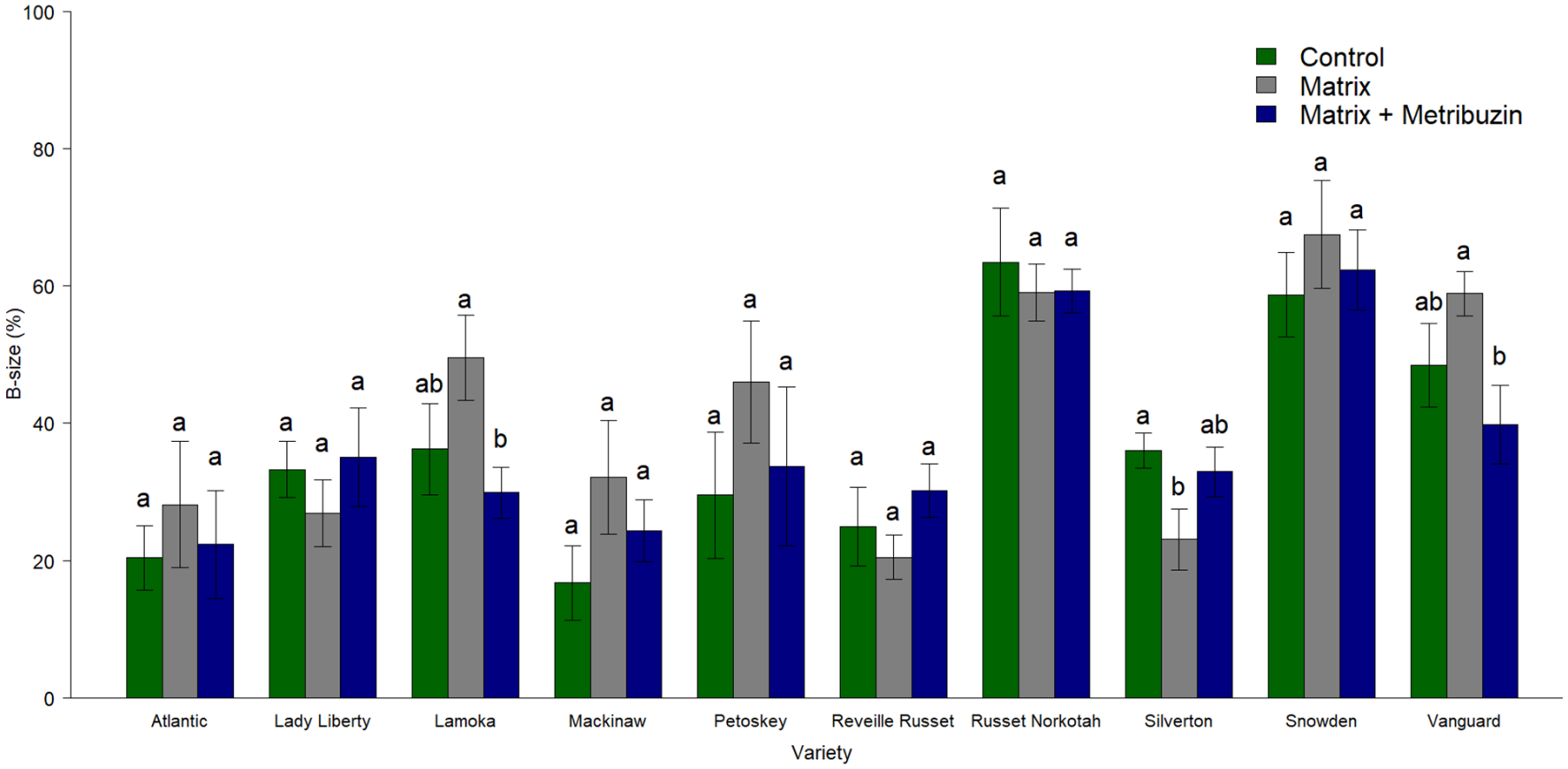


Figure 3. Potato B-size yield (%) for variety sensitivity 2021 trial at the Montcalm Research Center.

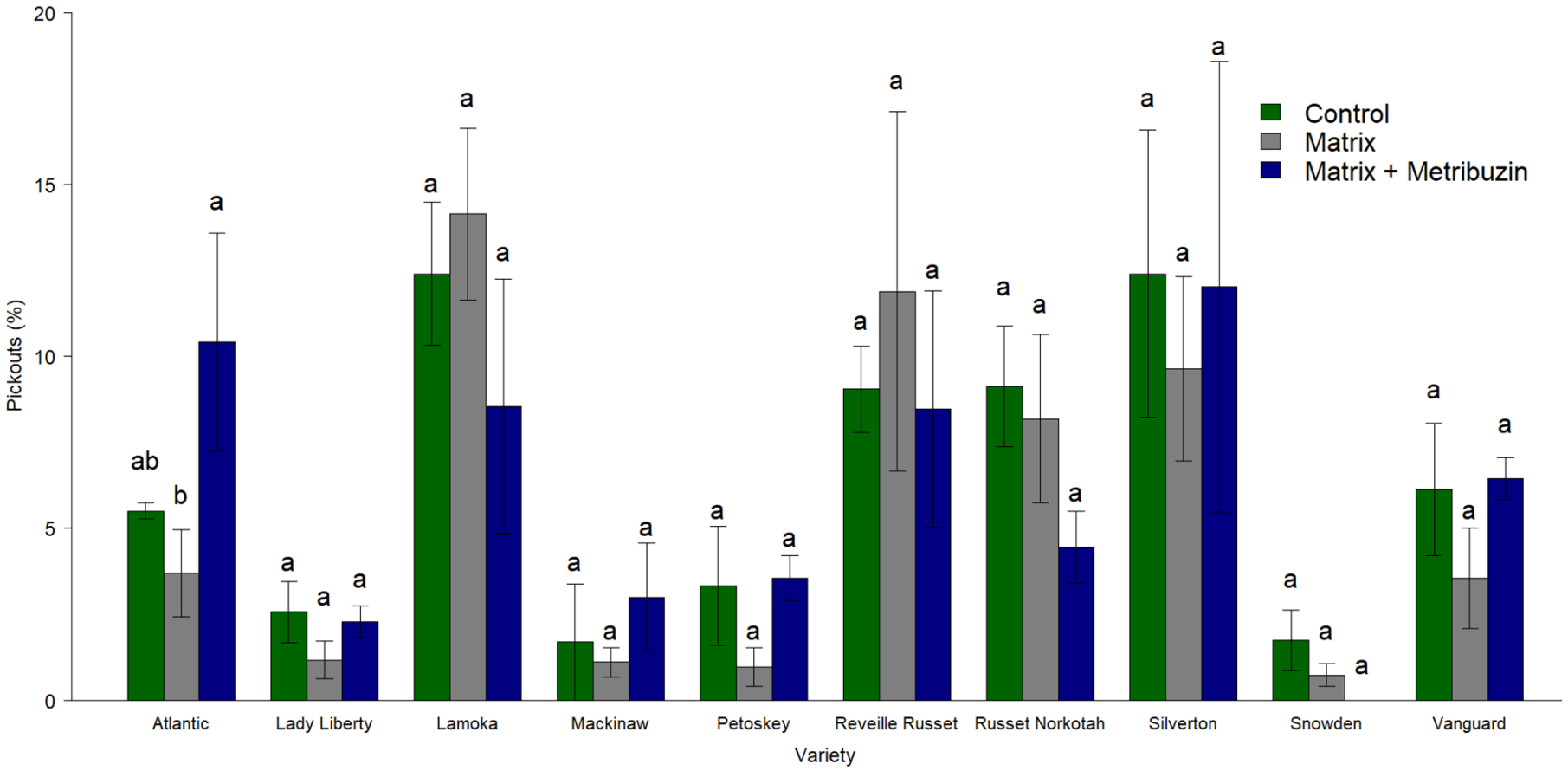


Figure 4. Potato pickouts (%) for variety sensitivity 2021 trial at the Montcalm Research Center.

## Layering soil residual herbicides for troublesome weed control in potatoes-2021 MPIC Research Report

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

Many troublesome weeds (horseweed/marestail, waterhemp, palmer amaranth, common lambsquarters, and foxtails) in MI are shifting emergence patterns from a single early flush in the spring to extended emergence throughout the summer, therefore outlasting preemergence residual herbicide activity. Later emerging weeds can not only have yield impacts, but also be a harvest nuisance. Layering a residual soil-applied herbicide along with the postemergence herbicide pass is one way to maintain a barrier to weeds emerging later in the growing season. Therefore, objective two was to evaluate layering different group 14 (examples Reflex), 15 (examples Outlook/Dual), and 3 (examples Prowl) herbicides at two timings for season long weed control. All treatments except the control provided greater than 90% weed control throughout the duration of this study. Overall, results suggest both group 14, 15, and 3 herbicides provide residual control and layering dual postemergence will improve season long weed control. Treatment rates and plot photos (37 days after application) are presented in the table below. The Michigan Potato Industry Commission supported this research.

Table of Contents

# Michigan State University

**Layering residuals for palmer amaranth control**

Trial ID: P01-21 Location: SJ 298 Trial Year: 2021
Protocol ID: P01-21 Investigator (Creator): Erin Burns
Project ID: Study Director:
Sponsor Contact:

| Trt No. | Treatment Name | Form Conc | Form Type | Rate | Rate Unit | Appl Timing | Appl Code | Rep 1 | 2 | 3 | 4 | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Dual II Magnum | 7.64 | L | 1.33 | pt/a | CRACK | A | 101 | 208 | 305 | 408 | |
| | Lorox DF | 50 | DF | 2 | lb/a | CRACK | A | | | | | |
| | Dual II Magnum | 7.64 | L | 1.33 | pt/a | POST | B | | | | | |
| 2 | Dual II Magnum | 7.64 | L | 1.33 | pt/a | CRACK | A | 102 | 207 | 308 | 405 | |
| | Lorox DF | 50 | DF | 2 | lb/a | CRACK | A | | | | | |
| | Prowl H2O | 3.8 | L | 1.6 | pt/a | POST | B | | | | | |
| 3 | Reflex | 2 | L | 1 | pt/a | CRACK | A | 103 | 209 | 301 | 404 | |
| | Lorox DF | 50 | DF | 2 | lb/a | CRACK | A | | | | | |
| | Matrix | 25 | DF | 1.5 | oz/a | CRACK | A | | | | | |
| | Dual II Magnum | 7.64 | L | 1.33 | pt/a | POST | B | | | | | |
| 4 | Reflex | 2 | L | 1 | pt/a | CRACK | A | 104 | 206 | 303 | 402 | |
| | Lorox DF | 50 | DF | 2 | lb/a | CRACK | A | | | | | |
| | Matrix | 25 | DF | 1.5 | oz/a | CRACK | A | | | | | |
| | Prowl H2O | 3.8 | L | 1.6 | pt/a | POST | B | | | | | |
| 5 | Untreated | | | | | | | 105 | 202 | 304 | 409 | |
| 6 | Valor SX | 51 | WG | 1.5 | oz/a | CRACK | A | 106 | 204 | 309 | 401 | |
| | Matrix | 25 | DF | 1.5 | oz/a | CRACK | A | | | | | |
| | Dual II Magnum | 7.64 | L | 1.33 | pt/a | POST | B | | | | | |
| 7 | Valor SX | 51 | WG | 1.5 | oz/a | CRACK | A | 107 | 205 | 302 | 403 | |
| | Matrix | 25 | DF | 1.5 | oz/a | CRACK | A | | | | | |
| | Prowl H2O | 3.8 | L | 1.6 | pt/a | POST | B | | | | | |
| 8 | Zidua SC | 4.17 | L | 2.5 | fl oz/a | CRACK | A | 108 | 203 | 307 | 406 | |
| | Lorox DF | 50 | DF | 2 | lb/a | CRACK | A | | | | | |
| | Dual II Magnum | 7.64 | L | 1.33 | pt/a | POST | B | | | | | |
| 9 | Zidua SC | 4.17 | L | 2.5 | fl oz/a | CRACK | A | 109 | 201 | 306 | 407 | |
| | Lorox DF | 50 | DF | 2 | lb/a | CRACK | A | | | | | |
| | Prowl H2O | 3.8 | L | 1.6 | pt/a | POST | B | | | | | |

Sort Order: Replicate 1

Table of Contents


Treatment 1


Treatment 2


Treatment 3


Treatment 4


Treatment 5


Treatment 6


Treatment 7


Treatment 8

Treatment 9

Pictures taken 37 days after application

**Evaluation of foliar fungicide timing to manage white mold of potato in Michigan, 2020 and 2021.**

Chris Bloomingdale[1], Jaime Willbur[1], and James DeDecker[2]; [1]Potato and Sugar Beet Pathology Program Dept. Plant, Soil and Microbial Science Michigan State University East Lansing, MI 48824; [2]Upper Peninsula Research & Extension Center Michigan State University Chatham, MI 49816

***Montcalm Research Center (MRC):*** In 2021, a foliar fungicide timing trial was established at MRC in Lakeview, MI and managed by the Potato and Sugar Beet Pathology program (Bloomingdale and Willbur). The trial objective was to determine the most effective timing of fungicide applications for managing white mold in potato. A randomized complete block design, with four replicates, was used. Potato seed were cut from US#1 'Lamoka' tubers and allowed to suberize before planting. The trial was hand-planted 21 May. Plots were two rows wide (34-in. row spacing) by 20 ft long and a 10-in seed spacing was used. Standard grower practices were followed to manage non-target pests. Fluazinam applications (8 fl oz/A) were made 14 Jul (full bloom) and 28 Jul (14-d post-bloom); treatments of full bloom, post-bloom, and full followed by post-bloom applications were compared to a grower standard control. A $CO_2$ powered backpack sprayer, equipped with two TJ 8004XR flat fan nozzles and operating at a boom pressure of 38 psi, was used to apply fungicides at 20 gal/A. To control for late blight, weekly chlorothalonil or mancozeb applications were initiated 1 Jul and applied until vine kill. Apothecia data were collected weekly between 15 Jul and 23 Aug. Disease data were collected 18 Aug and 3 Sep. Twenty stems were arbitrarily rated from both rows and assigned a disease severity (0-3). The severity ratings were: 0 = no disease to 3 = infection girdling mainstem, resulting in wilting and/or death. The ratings were used to calculate a percent disease incidence (DI) and average disease severity of symptomatic plants (DS; 0-3). Disease index (DX) was calculated from the following equation: DX = DI x DS/3. The plots were harvested 22 Sep. On 28 Sep, potatoes were washed then graded for size, weight, specific gravity, and internal defects. A generalized linear mixed model procedure was used to conduct the ANOVA and mean separations at $\alpha$=0.05.

Mean DX values ranged between 81 and 90% at the final rating. All treatments resulted in significantly lower DX values at 18 Aug ($P < 0.01$) but not at Sep 3 ($P > 0.05$) when compared to the grower standard control (Table 1). No significant differences in total or marketable yield were observed ($P > 0.05$). The trial experienced high-water levels because of frequent rain and poor drainage, thus resulting in poor yields. Apothecial observations also indicated that inoculum pressure remained high from full bloom to 28-d post-bloom, supporting the severe disease pressure observed in the trial. However, only the full bloom application appeared to numerically influence disease and yield. To validate these findings, additional timings and combinations may be investigated in the future to identify key growth stages for effective and economical management.

Table 1. White mold, yield, and marketable yield observations in treatments tested in small-plot research at the Montcalm Research Center in Lakeview, MI in 2021.

| No. | Treatment, Rate[z], and Timing[y] | DX (%)[x] Aug 18 | DX (%) Sep 3 | Total Yield (CWT/A) | Marketable Yield (CWT/A) |
|---|---|---|---|---|---|
| 1[w] | Grower standard treated control | 66.7 a | 90.0 | 190.6 | 119.6 |
| 2 | Omega 500F (8 fl oz) full bloom | 40.9 b | 81.0 | 208.6 | 145.7 |
| 3 | Omega 500F (8 fl oz) 14-d post-bloom | 52.5 b | 87.1 | 156.9 | 106.0 |
| 4 | Omega 500F (8 fl oz) full bloom + 14-d post-bloom | 48.4 b | 85.4 | 184.6 | 118.1 |

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

[y] Applications were made on the following dates: full bloom = 14 Jul and 14-d post-bloom = 28 Jul.

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

[w] Treated control.

Table of Contents

***Dale Johnson Farm, Sagola, MI:*** In 2020 and 2021, a foliar fungicide timing trial was conducted on the Dale Johnson Potato Farm in Sagola, MI, managed by the grower with guidance from MSU Extension (DeDecker). The trial objective was to determine the most effective timing of fungicide applications for managing white mold in potato. A completely randomized design with three replicates was used. A commercial potato field with a history of white mold was selected for the trial and planted to the variety Silverton using standard grower practices. Plots were thirty-six rows wide (34-in. row spacing), running the length of the field, to accommodate the grower's self-propelled sprayer. Standard grower practices were followed to manage non-target pests. A John Deere R4038 sprayer, equipped with air-induction flat fan nozzles, was used to apply fungicides at 40 gal/A. To control for late blight, weekly chlorothalonil applications (Bravo Ultrex at 1.25 lbs/A) were made until vine kill. Treatments of full bloom, 14-d post-bloom (2020), and full bloom + 14-d post-bloom (2021) were compared to the grower's standard treated control (chlorothalonil only). In 2020, fluazinam applications (8 fl oz/A) were made 20 Jul (full bloom) and 3 Aug (14-d post-bloom) as a tank mix with chlorothalonil. In 2021, fluazinam applications (8 fl oz/A) were made 28 Jul (full bloom) and 11 Aug (14-d post-bloom) as a tank mix with chlorothalonil. Disease data were collected 27 Aug, 2020 and 31 Aug, 2021. Fifty stems were rated (5 subsamples of 10 stems each) from the center twelve rows of each plot and assigned a disease severity rating (0-3). The severity ratings were: 0 = no disease to 3 = infection girdling main stem, resulting in wilting and/or death. The ratings were used to calculate a percent disease incidence (DI) and average disease severity of symptomatic plants (DS; 0-3). Disease index (DX) was calculated from the following equation: DX = DI x DS/3. A generalized linear mixed model procedure was used to conduct the ANOVA and mean separations at $\alpha$=0.05.

In 2020, DI values ranged between 30.0 and 72.0% and DX values ranged between 12.7 and 38.7%. There were significant differences among mean DI ($P$ = 0.0006) and mean DX ($P$ = 0.01) values of the treatments (Table 1). The best performing single-pass treatment at 14 days post bloom led to a 67% reduction in average disease index over the control. In 2021, DI values ranged between 1.3% and 35.3% and DX values ranged between 0.44% and 16.7%. There were significant differences among mean DI ($P$ = 0.016) and mean DX ($P$ = 0.027) values of the treatments (Table 2). The two-pass treatment at full bloom + 14 days post bloom led to a 97% reduction in average disease index over the control. These results suggest that later fluazinam applications and/or multiple fluazinam applications may be helpful in managing potato white mold, particularly in longer flowering varieties. Possible confounding factors in this study included a) that our full bloom applications were slightly early in 2020 and late in 2021 (1-2 days), and b) wind events that removed many blossoms between the full bloom and post bloom applications. Additional research is needed to confirm our results, and to demonstrate the relationship between white mold control and potato yield and/or quality. The authors thank Dale Johnson for his collaboration on these two years of on-farm research and MPIC for their financial support.

Table 1. White mold observations in treatments tested on-farm in Sagola, MI in 2020.

| No. | Treatment, Rate[z], and Timing[y] | DI (%)[x] | DX (%) |
|---|---|---|---|
| 1[w] | Grower standard treated control | 72.0 a | 38.7 a |
| 2 | Omega 500F (8 fl oz) full bloom | 50.0 b | 25.1 b |
| 3 | Omega 500F (8 fl oz) 14-d post-bloom | 30.0 c | 12.7 c |

[z] All rates, unless otherwise specified, are listed as a measure of product per acre.
[y] Applications were made on the following dates: full bloom = 20 Jul and 14-d post-bloom = 3 Aug.
[x] Column values followed by the same letter were not significantly different based on Student–Newman–Keuls multiple comparisons test ($\alpha$=0.05); if no letter, then the effect was not significant.
[w] Treated control.

Table 2. White mold observations in treatments tested on-farm in Sagola, MI in 2021.

| No. | Treatment, Rate[z], and Timing[y] | DI (%)[x] | DX (%) |
|---|---|---|---|
| 1[w] | Grower standard treated control | 35.3 a | 16.7 a |
| 2 | Omega 500F (8 fl oz) full bloom + 14-d post-bloom | 1.3 b | 0.4 b |

[z] All rates, unless otherwise specified, are listed as a measure of product per acre.
[y] Applications were made on the following dates: full bloom = 28 Jul and 14-d post-bloom = 11 Aug.
[x] Column values followed by the same letter were not significantly different based on Student–Newman–Keuls multiple comparisons test ($\alpha$=0.05); if no letter, then the effect was not significant.
[w] Treated control.

Table of Contents

MICHIGAN STATE UNIVERSITY EXTENSION

AgBioResearch MICHIGAN STATE UNIVERSITY

# Utilizing Envita Microbial Inoculant to Fix Nitrogen and Reduce Fertilizer Application

Kurt Steinke and Andrew Chomas, Michigan State University

See soil.msu.edu for more information

| | |
|---|---|
| **Location**: Montcalm Research Farm | **Tillage**: Conv., 34-in. row |
| **Planting Date**: May 12, 2021 | **Trt's**: See below |
| **Soil Type**: Loamy sand; 1.2 OM; 6.9 pH; 266 ppm P; 132 ppm K; CEC: 4.7 | **Emerge:** June 7 **Hill:** June 16 |
| **Variety**: Lamoka | **Replicated**: 4 replications |

| Treatment | Plant Height (cm) 7/6/2021 | Petiole %N 30 DAE | Petiole %P 30 DAE | Petiole %K 30 DAE | Petiole Mn ppm 30 DAE |
|---|---|---|---|---|---|
| Standard NPK Program | 66 a | 4.4 a | 0.33 a | 9.9 a | 238 ab |
| Standard NPK Program with Envita Application | 66 a | 4.4 a | 0.34 a | 9.9 a | 248 a |
| Standard NPK Program with 50% recommended N | 66 a | 3.6 b | 0.35 a | 10.6 a | 220 bc |
| Standard NPK Program with 50% recommended N and Envita Application | 65 a | 3.6 b | 0.31 a | 10.2 a | 193 c |
| **$LSD_{(0.10)}$[a]** | **NS** | **0.29** | **NS** | **NS** | **27.5** |

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

| Treatment | Tuber Count A's (count/plot) | Yield A's (cwt/A) | Total Yield (cwt/A) | Sp. Gravity |
|---|---|---|---|---|
| Standard NPK Program | 94 a | 236 a | 237 a | 1.08 a |
| Standard NPK Program with Envita Application | 94 a | 244 a | 244 a | 1.08 a |
| Standard NPK Program with 50% recommended N | 83 a | 197 b | 197 b | 1.08 a |
| Standard NPK Program with 50% recommended N and Envita Application | 93 a | 207 b | 207 b | 1.08 a |
| **$LSD_{(0.10)}$[a]** | **NS** | **18.9** | **19.0** | **NS** |

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

Table of Contents

**Summary**: Trial quality was average. All treatments received 20 gpa 10-34-0 banded 2x2 at planting (80 lbs $P_2O_5$/A). Standard NPK program consisted of N applications split into 3 application timings including emergence, hilling, and post-hilling (221 N). Potassium consisted of 200 lb. $K_2O$/A as KCl applied PPI. All treatments received 0.5 T/A gypsum. Treatments receiving 50% total N rate consisted of N applications split into 3 application timings including emergence, hilling, and post-hilling (110 N). Envita-treated plots consisted of 3.2 fl oz/A applied with 5 gpa water in-furrow on the seed. Calcium and magnesium soil test concentrations were not limiting in the current study.
Envita is a naturally occurring bacteria that may establish itself within a plant to fix nitrogen potentially reducing inorganic N application requirements. In the current environment tested, Envita did not appear to influence plant height or petiole N, P, K, and Mn concentrations. The 50% N rate simply reduced petiole N and Mn concentrations with no differences between Envita-treated and untreated at the lower N rate. No differences were observed across treatments regarding tuber counts (A's). Total yield and "A" tuber yield were not significantly affected with Envita application. Again, the 50% N rate simply reduced overall potato yields with no differences between Envita-treated and untreated. Specific gravity was unaffected across treatments in the current study. Further research on microbial inoculants may be warranted but soil physical and chemical properties may also influence the likelihood of observing a crop response. Please visit soil.msu.edu for further details and other field crop research results.

Table of Contents

MICHIGAN STATE UNIVERSITY EXTENSION

AgBioResearch MICHIGAN STATE UNIVERSITY

# Polyhalite as a Source of Polysulfate Fertilizer in Potato Production

Kurt Steinke and Andrew Chomas, Michigan State University

See soil.msu.edu for more information

| | |
|---|---|
| **Location**: Montcalm Research Farm | **Tillage**: Conv., 34-in. row |
| **Planting Date**: May 12, 2021 | **Trt's**: See below |
| **Soil Type**: Loamy sand; 1.2 OM; 6.9 pH; 266 ppm P; 132 ppm K; CEC: 4.7 | **Emerge:** June 7 **Hill:** June 16 |
| **Variety**: Lamoka | **Replicated**: 4 replications |

| Treatment | Tuber Count A's (count/plot) | Yield B's (cwt/A) | Yield A's (cwt/A) | Total Yield (cwt/A) | Sp. Gravity |
|---|---|---|---|---|---|
| Standard-GSP<br>200 lb $K_2O$/A as MOP<br>0.5 T/A Gypsum | 81 ab | 42.6 a | 188 a | 231 bc | 1.08 b |
| Polyhalite w/ MOP<br>100 lb $K_2O$/A as Poly<br>100 lb $K_2O$/A as MOP | 91 a | 51.9 a | 209 a | 261 ab | 1.08 b |
| Polyhalite w/ MOP<br>50 lb $K_2O$/A as Poly<br>150 lb $K_2O$/A as MOP | 90 a | 50.9 a | 169 a | 271 a | 1.08 b |
| No $K_2O$ – Control<br>0.5 T/A Gypsum | 69 b | 42.7 a | 175 a | 218 c | 1.09 a |
| **$LSD_{(0.10)}$[a]** | **14** | **NS** | **NS** | **37.7** | **0.003** |

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

**Summary**: Trial quality was average. All treatments received 20 gpa 10-34-0 banded 2x2 at planting. Nitrogen applications were split into 3 application timings including emergence, hilling, and post-hilling (221 N). Potassium consisted of 200 lb. $K_2O$/A applied PPI; treatments not receiving polysulfate received 0.5 T/A gypsum; total application rates were 245 N, 80 P2O5, and 200 $K_2O$ (lbs/A). Polysulfate is a mined mineral fertilizer source containing 19% S, 14% $K_2O$, 12% Ca, and 4% Mg. Unlike potash (KCl), polysulfate does not contain chloride and the sulfur releases in accordance with mineralization rates of the mineral. In the current study, all treatments receiving $K_2O$ displayed a greater tuber counts (A's) as compared to treatments without $K_2O$. No significant differences across treatments were observed in A or B tuber yields. Total tuber yields with polysulfate were significantly greater than where $K_2O$ was not applied whereas total tuber yields with a standard KCl application were similar to the untreated $K_2O$

Table of Contents

treatment. Utilizing polysulfate as 25% of total $K_2O$ application significantly increased yield compared to standard complete KCl application while increasing polysulfate to 50% of total $K_2O$ applied did not improve total yield. Specific gravity was mostly unaffected by $K_2O$ application other than where $K_2O$ was not applied. Calcium and magnesium soil test concentrations were not limiting in the current study. Further research on utilizing polysulfate as a K source in potato will continue with additional work on storage and fry color proposed. Please visit soil.msu.edu for further details and other field crop research results.

Table of Contents

# Management of *Verticillium dahliae* using bio-fungicides

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## Introduction:

Potato Early Die is caused by an interaction between the root-lesion nematode, *Pratylenchus penetrans*, and the soil-borne fungus *Verticillium dahliae*. In our previous work, we have been successful in evaluating effective management strategies for *P. penetrans*. Work in our lab completed by Cole et al. (2020) determined that incorporating poultry manure or a compost blend (poultry and dairy compost with wood ash) significantly reduced nematodes in both field and lab conditions. However, we did not observe a significant reduction of *V. dahliae* incidence. Therefore, with the funds available through the MPIC grant, we evaluated the effects of different bio-fungicides and synthetic fungicides alone and in combination with composts and manures to manage *V. dahliae*.

## Materials and Methods:

Potato stems collected from a potato field located in Three Rivers, MI in July of 2020. Stem pieces were plated in Verticillium media and incubated for 15 days under darkness. One microsclerotia of *Verticillium dahliae*-like colonies was plated in verticillium media and incubated under the same conditions. After 15 days, DNA was extracted using the DNeasy Plant Pro Kit and it was confirmed that only one of the isolates was *Verticillium dahliae* Kleb. Thus, this isolate was further cultured and used for laboratory and greenhouse experiments.

Sensibility of *V. dahliae* to *Bacillus amyloliquefaciens* str. D747, *Bacillus subtilis*, *Streptomyces lydicus*, *Trichoderma asperellum* + *Trichoderma gamsii*, *Gliocladium catenulatum* Str. J1446, Azoxystrobin and Benzovindiflupyr, was tested under lab conditions. Briefly, 5 micosclerotia of *V. dahliae* was treated with each product. After 72 hours of exposure, microsclerotia was grabbed and plated in Verticillium media. Growth and production of microsclerotia was recorded after 15 days of incubation

Meanwhile, a total of 100 potato seed pieces were planted in the greenhouse. Each pot was inoculated with around $10^6$ *V. dahliae* conidia/ml and treatments were also applied at planting. *V. dahliae* incidence in potato stems was recorded at 30- and 60-days post planting. One stem per pot was collected and taken to the lab for further processing. Stem pieces were disinfected and plated in Verticillium media. Petri dishes were incubated for 15 days under darkness. After 15 days, proportion of *V. dahliae* incidence was determined. Percent of infection and verticillium wilt severity was also recorded.

## Results and conclusions:

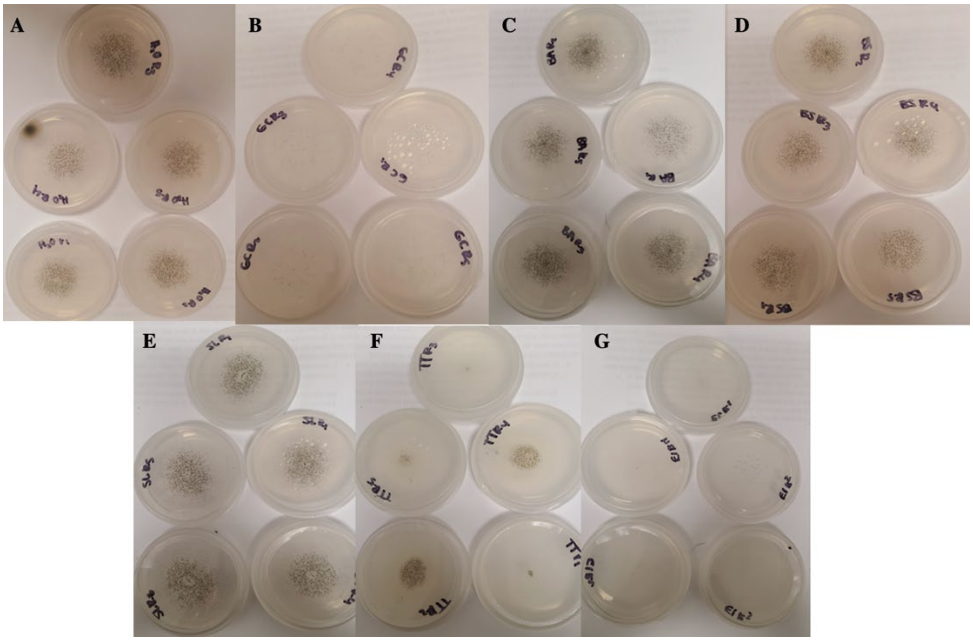
**Objective 1**: Evaluate the effect of bio fungicides and synthetic fungicides under laboratory conditions on *V. dahliae*

Table of Contents

A total of 5 *V. dahliae* microsclerotia were exposed to the respective bio fungicides and controls. After 72 hours of exposure, each microsclerotia was grabbed and plated onto Verticillium agar. After 15 days of incubation under darkness, plates were taken out and with a ruler, we measured the radial growth. We observed neither growth nor production of microsclerotia with Azoxystrobin and Benzovindiflupyr and *G. catenulatum* Str. J1446. Interestingly, out of the *V. dahliae* microsclerotia treated with *T. asperellum* + *T. gamsii*, we observed growth of these *Trichoderma* species on 2 out of the 5 replicates rather than Verticillium, and in 3 out of the 5 replicates, *V. dahliae* growth was lower compared to the other treatments (Table 1).

**Table 1.** Radial growth of *V. dahliae* after 72 h exposure to the respective treatments

| Treatment | Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 |
|---|---|---|---|---|---|
| Water | 3 cm | 2.8 cm | 3 cm | 2 cm | 3 cm |
| Azoxystrobin and Benzovindiflupyr | No growth | No growth | No growth | No growth | No growth |
| *B. amyloliquefaciens* str. D747 | 3 cm | 2.7 cm | 3 cm | 3.1 cm | 2.6 cm |
| *B. subtilis* | 2.5 cm | 3 cm | 2.5 cm | 2.5 cm | 2.7 cm |
| *S. lydicus* | 4.2 cm | 2.8 cm | 4 cm | 4 cm | 2.8 cm |
| *T. asperellum* + *T. gamsii* | Growth of *Trichoderma* | 1.6 cm + *Trichoderma* | 0.5 cm + *Trichoderma* | 1.4 cm + *Trichoderma* | Growth of *Trichoderma* |
| *G. catenulatum* Str. J1446 | No growth | No growth | No growth | No growth | No growth |




**Picture 1.** Radial growth of V. dahliae microsclerotia when treated with biofungicides. **A)** Water (negative control). **B)** *G. catenulatum* Str. J1446. **C)** *B. amyloliquefaciens* str. D747. **D)** *B. subtilis.* **E)** *S. lydicus.* **F)** *T. asperellum* + *T. gamsii.* **G)** Azoxystrobin and Benzovindiflupyr (positive control).

Table of Contents

**Objective 2**: Determine the effectiveness of bio fungicides and synthetic fungicides alone and in combination with compost and manures under greenhouse setting on *V. dahliae*.

20 treatments, each with 5 replicates were evaluated under greenhouse conditions. Russet Norkotah seed pieces were planted on August 27th with 90% sand and 10% topsoil, for a total of 100 pots. Treatments were applied at planting and after 8 days, pots were inoculated with *V. dahliae*. On September 21st and October 21st, stem samples were taken for further processing in the lab. We observed that there was a significant increase of *V. dahliae* infection from September 21st to October 21st, regardless of treatment (Figure 1).

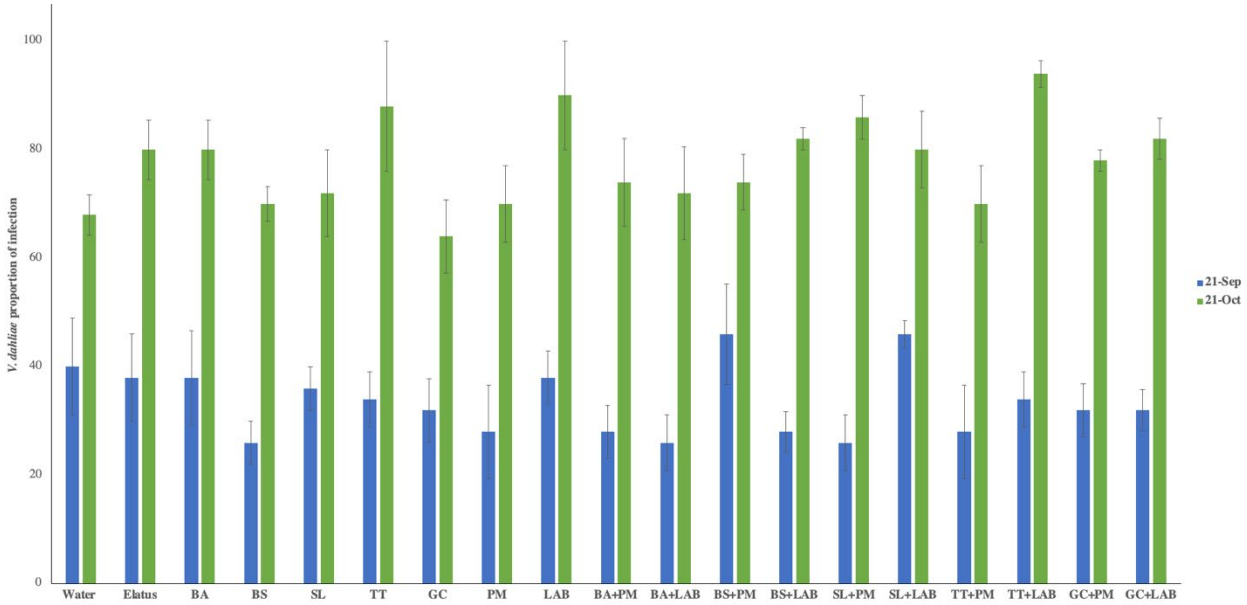
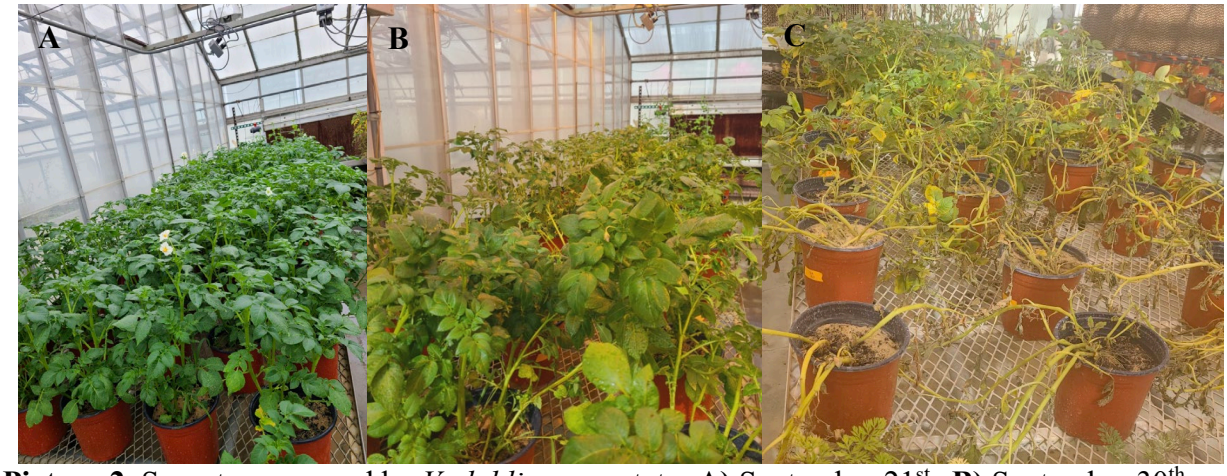



**Figure 1.** *V. dahliae* incidence in potato plants under greenhouse conditions. Blue bars correspond to proportion of infection on September 21st and green bars correspond to October 21st.




**Picture 2.** Symptoms caused by *V. dahliae* on potato. **A)** September 21st, **B)** September 30th and **C)** October 21st.

*Note:* Is important to mention that we hope to conduct the survey to determine the regional grower's perspective on PED and its management on the next potato meeting

Table of Contents

**Acknowledgments**
We would like to thank the Michigan Potato Industry Commission for funding this project.

Table of Contents

**Assessment of SaniDate 5.0 application and varietal resistance for potato postharvest disease management in Michigan, 2022**

Emma Schlachter, Celeste Dmytryszyn, Chris Bloomingdale, Damen Kurzer, Trina VanAtta, David Douches, Ray Hammerschmidt, Chris Long, Jaime F. Willbur; Michigan State University, Department of Plant, Soil and Microbial Sciences

Maintenance of tuber quality over the duration of storage season is important in potato production. In 2021, Michigan produced 20 million cwt of potatoes, with 62% tubers in storage as of December (USDA-NASS, 2021). Postharvest loss occurs each year due to tuber shrinkage and storage disease; in 2020, 8% of stored tubers from December 2019 were reported lost by June the following year. The following experiments were conducted to identify potential management practices to reduce losses to major postharvest diseases.

**Materials and Methods**

i. Assessment of SaniDate 5.0 on storage disease management

Potato cv. Mackinaw was inoculated with *Fusarium sambucinum* (Fusarium dry rot), *Pythium ultimum* (Pythium leak), *Phytophthora erythroseptica* (pink rot), and *Pectobacterium carotovorum* (bacterial soft rot), and potato dextrose broth (PDB) as control. Fungal and oomycete cultures (1/4 strength potato dextrose agar and green pea agar, respectively) were grown at ambient room temperature under an 8-hour photoperiod for approximately two weeks. Spore suspensions were prepared in sterile deionized water at a concentration of $2 \times 10^8$ conidia or sporangia/ml. Bacterial inoculum was grown in PDB to an optical density corresponding to $8.40 \times 10^9$ cfu/ml ($OD_{600}$ = 0.3-0.4). Tubers were washed with two rinses in tap water, one-minute submersion in 10% bleach solution, and one rinse in deionized water, and dried overnight before inoculation. Apical and basal sites were inoculated with 10 µl of inoculum suspensions using a Hamilton glass syringe. Three inoculated tubers were placed in plastic mesh bags and suspended within another mesh bag containing ten non-treated tubers. Samples were suspended in bins 8 and 9 (625 cwt each) in at the MPIC Cargill Potato Demonstrations Storage Facility (95% RH, 48°F) for seven months. Four treatment replicates were arranged at pile depths of 0, 4, 8, and 12-ft. Bin 9 was treated 10 days post-loading with SaniDate 5.0 at 0.95 fl. oz per ton of potatoes via fog application (Gun Valley Ag. & Industrial Services, Inc.). After storage, disease development was assessed by measuring symptomatic tissue with a digital caliper.

ii. Assessment of potato varieties and early-stage germplasm for resistance to storage pathogens

Potatoes from 38 research germplasm and commercial lines were tested for resistance to four major postharvest diseases: Fusarium dry rot (*F. sambucinum*) and pink rot (*P. erythroseptica*), Pythium leak (*P. ultimum*), and bacterial soft rot (*P. carotovorum*). Tubers were washed and inoculated as described above. Treated tubers were incubated for 47 days in a growth chamber at 22°C/71°F. Five tuber subsamples per variety x pathogen combination were inoculated at each of two replicate timepoints. Disease tolerance was assessed by measuring symptomatic tissue with a digital caliper. All data were analyzed in a generalized linear mixed model ANOVA (SAS v. 9.4) and mean comparisons conducted using Fisher's Protected LSD ($\alpha$=0.05).

Table of Contents

## Results and Conclusions

i. Assessment of SaniDate 5.0 on storage disease management

SaniDate 5.0 treatment did not significantly affect progression of Fusarium dry rot or pink rot in Mackinaw tubers ($P > 0.05$). Pythium leak and bacterial soft rot inoculations did not result in significant disease development, however, methods have been optimized and will be evaluated in the 2021-22 storage season.

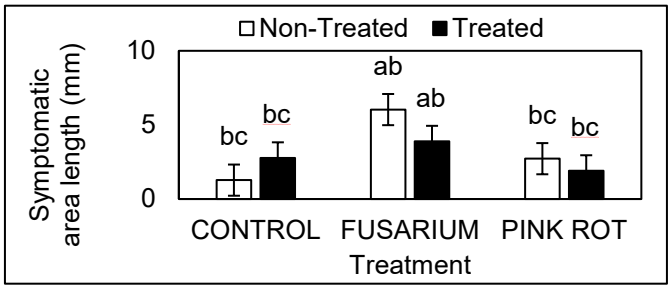



**Figure 1. Mean length of symptomatic area measured on Mackinaw tubers seven months post-inoculation.** Bars with the same letter are not significantly different based on Fisher's Protected LSD (α=0.05).

ii. Assessment of potato varieties and early-stage germplasm for resistance to storage pathogens

Variable responses were observed in postharvest disease assessments of 38 research and commercial entries ($P < 0.05$). Research germplasm MSW474-1, MSZ242-13 (B), and MSBB058-1 consistently show resistance to Fusarium dry rot and pink rot. The best lines exhibited only 10-25% of the symptoms observed in the worst performing entries ($P < 0.05$).

| | Fusarium Dry Rot | | | Pink Rot | |
|---|---|---|---|---|---|
| Variety | Length (mm) | Group | Variety | Length (mm) | Group |
| MSAA570-3 | 5.10 | g | **Petoskey (B)** | **2.19** | **g** |
| NY163 (B) | 6.66 | f-g | **Petoskey (A)** | **6.30** | **e-g** |
| **Snowden (A)** | **8.00** | **fg** | MSAFB635-15 | 4.31 | fg |
| **Snowden (B)** | **9.21** | **e-g** | MSAA260-3 | 5.29 | e-g |
| MSW474-1 (B) | 8.13 | fg | MSAFB605-4 | 6.00 | e-g |
| MSZ242-13 (B) | 8.41 | fg | MSZ242-13 (A) | 6.04 | e-g |
| **Mackinaw (B)** | **26.19** | **b-e** | MSBB058-1 | 6.09 | e-g |
| **Mackinaw (C)** | **9.15** | **e-g** | **Snowden (B)** | **6.60** | **e-g** |
| MSAA076-6 | 9.63 | d-g | **Snowden (A)** | **13.47** | **b-e** |
| **Lamoka** | **10.21** | **d-f** | **Lamoka** | **7.69** | **d-g** |
| **Lady Liberty** | **22.04** | **d-f** | **Lady Liberty** | **8.57** | **d-g** |
| MSAA217-3 | 29.89 | b-d | **Mackinaw (B)** | **13.20** | **c-f** |
| MSAFB605-4 | 38.76 | a-c | **Mackinaw (C)** | **11.62** | **d-f** |
| MSZ219-13 | 38.90 | ab | NY163 (B) | 16.63 | b-d |
| **Petoskey (A)** | **40.53** | **a** | NY166 | 21.96 | a-c |
| **Petoskey (B)** | **8.44** | **e-g** | MSBB610-13 | 22.33 | ab |
| CO11023-2W | 50.84 | a-c | MSZ219-13 | 28.00 | a |

**Table 1.** Fusarium dry rot and pink rot symptom lengths (mm) for the best five (blue) and worst four (red) germplasm lines, compared to five standard varieties (bolded). Labels (A), (B), and (C) indicate field trial locations: A) SNAC trial at Sandyland Farms, B) Montcalm Research Center, C) commercial planting at Sackett Potatoes. Nonlabeled varieties originated from MRC. Means followed by the same letter are not significantly different based on Fisher's Protected LSD (α=0.05).

**Acknowledgements:** We would like to thank our grower cooperators for their continued support in furthering our research. Funding is provided by the Michigan Potato Industry Commission, the Michigan Department of Agriculture and Rural Development Specialty Crop Block Grant, and the USDA National Institute of Food and Agriculture, Hatch project 1020281.

Table of Contents

**Diagnostic optimization of viral detection and characterization for the Michigan seed potato certification program, 2021**

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

Potato virus Y (PVY) is a major concern throughout the US, including the North Central region, and is one of the primary diseases monitored and tested for in the seed certification process. Cost-effective and efficient detection of PVY in early generation potato seed lots will help prevent infected material from entering the production chain and will prevent unnecessary yield and profit loss. The MSU Potato and Sugar Beet Pathology (PSBP) program continues to work with the Michigan Department of Agriculture and Michigan Seed Potato Association seed inspectors to gather strain information from PVY-positive seed lots and also have been collaborating to increase handling capacity, efficiency and optimizing the viral detection and diagnostic protocols used in winter testing. Through this work we continue to: 1) investigate improved detection options to identify accurate, timely, and cost-effective methods for use in the Michigan seed potato certification and 2) monitor PVY strain prevalence in Michigan seed potatoes. The results of this work will help develop standard protocols for high-throughput, in-state tuber testing.

**Materials & Methods:**
Tuber testing methods, which do not require breaking tuber dormancy to sample sprouts or plantlets, were used. General (Mackenzie et al. 2015) and multiplex (Lorenzen et al. 2006, 2010; Chikh-Ali et al. 2013) reverse-transcriptase (RT) high-fidelity polymerase chain reaction (PCR) protocols will be compared to existing plantlet assays involving enzyme-linked immunosorbent assay (ELISA) to validate. In 2021, we selected six Snowden and Lamoka (variable or unreliable symptom expression) and Reveille Russet (reliable expression) seed lots for validation of dormant tuber methods. Samples of 200 tubers were taken from each seed lot. Each variety was sampled from two lots where visual PVY was either present or absent in summer field inspections (Table 1). Dormant tuber RT-PCR testing was conducted on all tubers in 10-tuber subsamples. After treatment with Rindite to break dormancy, subsamples were planted and grown out for standard leaflet ELISA. Subsets of positive samples (from research and commercial testing) will be subject to PVY strain confirmation by RT-PCR.

**Results & Conclusions:**
In 2021, PVY incidence was lower based on summer visual inspections, compared to 2020. In research lots, dormant tuber methods identified higher levels of PVY than estimated from the summer field inspections (Table 1). This could be due to in-field spread, varietal expression, strain differences, or variety by strain interactions, and stain typing is ongoing. Currently, we are conducting standard grow out methods to validate dormant tuber methods. We are also working to optimize a direct real-time RT-PCR assay (Mackenzie et al. 2015) to increase throughput and efficiency.

Table of Contents

**Table 1.** RT-PCR results from seed lots assessed for PVY incidence based on summer field inspections. Results are based on positive PVY detections (%) using dormant tuber methods in 2021 (N=number of 10-tuber subsamples tested).

| Variety | Typical Symptom Expression | N | Visual Summer (Jun-Jul) | Present (+) Absent (-) (Jun-Jul) | Dormant Tuber RT-PCR (Oct-Nov) | Leaflet ELISA Greenhouse (Jan) |
|---|---|---|---|---|---|---|
| Snowden | Unreliable | 20 | 0.06 | + | 3.50 | *In progress* |
| Snowden | Unreliable | 20 | 0.00 | - | 2.84 | |
| Lamoka | Unreliable | 18 | 0.03 | + | 4.81 | |
| Lamoka | Unreliable | 16 | 0.00 | - | 0.00 | |
| Reveille | Reliable | 20 | 0.40 | + | 6.70 | |
| Reveille | Reliable | 20 | 0.00 | - | 2.21 | |

Since 2019, we have developed the capacity to assess the strain types prevalent in Michigan seed growing regions. Our efforts have identified four major PVY strains, including N:Wi (most prevalent), N:O, NTN (tuber necrotic strain), and O. Due to flooding in Florida, the entire 2021-22 Michigan seed certification winter grow-out plots were lost. In place of the standard grow-out, MDARD will offer dormant tuber testing for seed lots intended for recertification and export and will further investigate the PVY strains present in positive samples (N = approx. 20,740 tubers will be tested in 2021-22). Preliminary observations from these samples suggest that $PVY^{N\text{-}Wi}$ remains prevalent, however, $PVY^{NTN}$, $PVY^{N:O}$ were also detected. A second tuber necrotic strain, $PVY^{E}$, has since been confirmed and indicates strain frequencies must be closely monitored to best inform the seed potato industry of potential risks.

We also conducting growth chamber assays using characterized PVY strains with elite potato germplasm using previously reported methods by Gundersen et al. (2019). Based on our assessment of PVY strain populations in Michigan, we have selected four characterized strains (N:Wi, NTN, N:O, O) and obtained them from collaborators at the University of Idaho. Six varieties were selected for preliminary experiments: Lamoka, Snowden, Mackinaw, Petoskey, Lady Liberty and MSZ242-13. These varieties represent current chip varieties used in Michigan and elite experimental varieties originating from the MSU Potato Breeding and Genetics program. We are currently optimizing protocols for maintenance of strains in virus-free *Nicotiana tabacum*. However, these preliminary strain by variety experiments will inform the seed potato industry of the yield and quality impacts that current PVY strains may have on prevalent chip varieties. We plan to increase the number of varieties and modify the strain panels used based on current growing practices and strain population assessments. This information will also confirm robust PVY resistance to multiple strains, further informing and directing future breeding efforts.

**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 UDSA-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.

Table of Contents

# FINAL REPORT

## Improvement of Disease Management in Irrigated Potato Fields using Real-Time Sensor Monitoring Systems

**Submitted to** Michigan Potato Industry Committee

**Submitted by**

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Jill Check[2]

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January 10, 2022

Table of Contents

## Summary

- Two irrigated potato fields in Mecosta and Montcalm County were monitored in 2021. Sensor stations were installed to monitor soil and environmental conditions in an irrigated area and a dryland area of each site.
- Soil moisture sensors were able to track the soil moisture levels in the potato root zone. Data showed the potential use of soil moisture sensors in irrigated potato fields to improve irrigation water use efficiency. In 2022, a sensor-based irrigation scheduling method will be demonstrated in two commercial potato fields to evaluate its benefits, such as saving water and energy, improving yield and quality, and reducing the potential risk of plant disease.
- Apothecia development was monitored weekly in Mecosta and Montcalm County sites. Both locations have a history of white mold pressure, and the precipitation events that occurred at Montcalm may have contributed to the higher apothecia density found. In 2022, field data collection will be continued to support a robust model development for Michigan potato growers to manage infection by white mold.

Table of Contents

## Introduction

Potatoes benefit from irrigation management because of the significant effect of irrigation on both yield and quality. A shallow root zone combined with daily evapotranspiration makes precise irrigation of potatoes difficult. Not watering the potatoes sufficiently can result in yield loss and cause misshapen tubers, vascular necrosis, or hollow heart defects. Improper irrigation schedules or unnecessary irrigation can waste resources, but can also increase the potential risk of plant diseases. Plant disease can substantially reduce yield and quality of product, and even more importantly impact it during the storage, which are negatively affecting the sustainability and economics of production. Potatoes are impacted significantly by diseases, which can also be driven through increased relative humidity and leaf wetness durations, reduced canopy and soil temperatures, or improper irrigation. Some of the most devastating foliar and vine rotting diseases are early blight, late blight, white mold, and bacterial stem rot or blackleg. In tubers, irrigation has been shown to influence black scurf, silver scurf, and common scab diseases. Excessive soil moisture at critical points can drive foliar, vine, or root and tuber infections and promote pathogen development, reproduction, dispersal, and survival. Proper irrigation management is needed to maximize water use efficiency while minimizing the risk of plant disease.

## Field Experimental Setup

Two irrigated potato fields were monitored in 2021. Monitoring fields were located in Mecosta and Montcalm county, MI. LOCOMOS (Low-Cost sensor Monitoring System) stations were used to monitor soil moisture level, soil temperature, leaf wetness duration, temperature, humidity, precipitation, and irrigation. The measurement has been recorded every 15 minutes. In each monitoring field, one LOCOMOS was installed in an irrigated area, and the other station was installed in a dryland area.

Figure 1. Installed LOCOMOS in Mecosta (Left) and Montcalm (Right) County sites.

Table of Contents

## Data Collection

The LOCOMOS sensor data has been monitored in real-time through LOCOMOS IoT (Internet of Things) website (Figure 2). The equations have been embedded into the website to calculate the daily leaf wetness duration, average daily temperature, average daily humidity, and average daily soil temperature. Irrigation and precipitation are also tracked by rain gauges. A graduate student has routinely conducted apothecia counts (Figure 3).

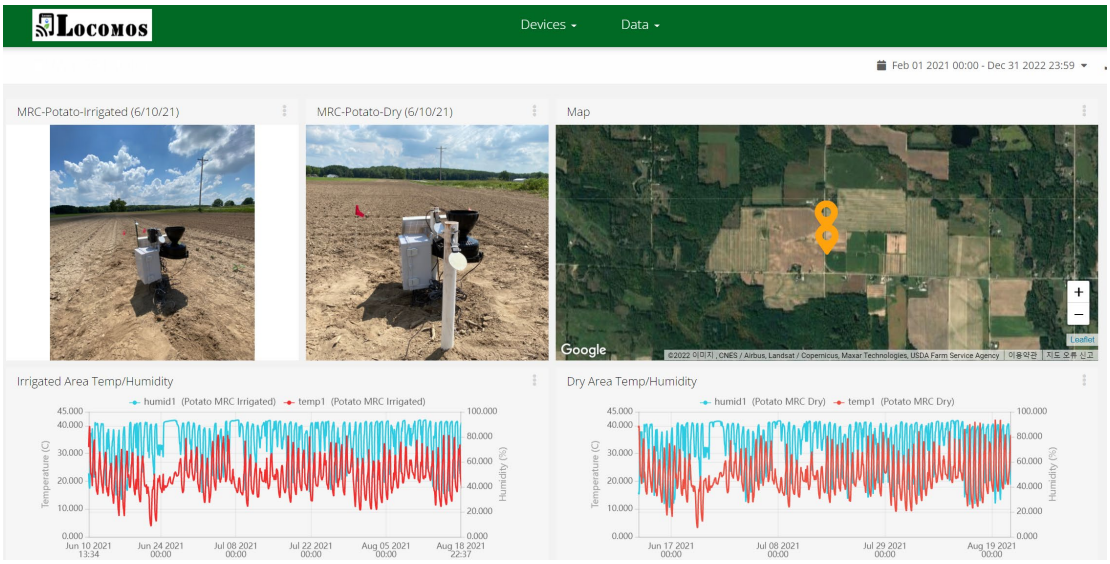



Figure 2. One of the LOCOMOS IoT website interfaces that display the sensor data and algorithm outputs in real-time.

Figure 3. Apothecia (mushrooms) on the soil surface in Mecosta County site.

Table of Contents

**Potential Use of Soil Moisture Sensors to Manage Irrigation in Potato Fields**

Soil moisture sensors were able to track the soil moisture levels at 6 and 12 inch depths in irrigated potato fields. The data shows the potential use of soil moisture sensors to determine when and how much to irrigate for potato production. Figure 4 shows the composite soil water available in irrigated and dryland areas. If the soil water available is greater than the field capacity level, there is an increased risk of water and nitrate leaching below the root zone. In several events, the soil water available level in the irrigated area (blue) was above the field capacity. The team believes that more precise and real-time soil moisture level monitoring can improve irrigation water use efficiency in this potato field. In 2022, the team plans to demonstrate a sensor-based irrigation scheduling method in two commercial potato fields to improve water use efficiency and estimate the evaluate benefits, such as saving water and energy, improving yield and quality, and reducing the risk of plant disease.

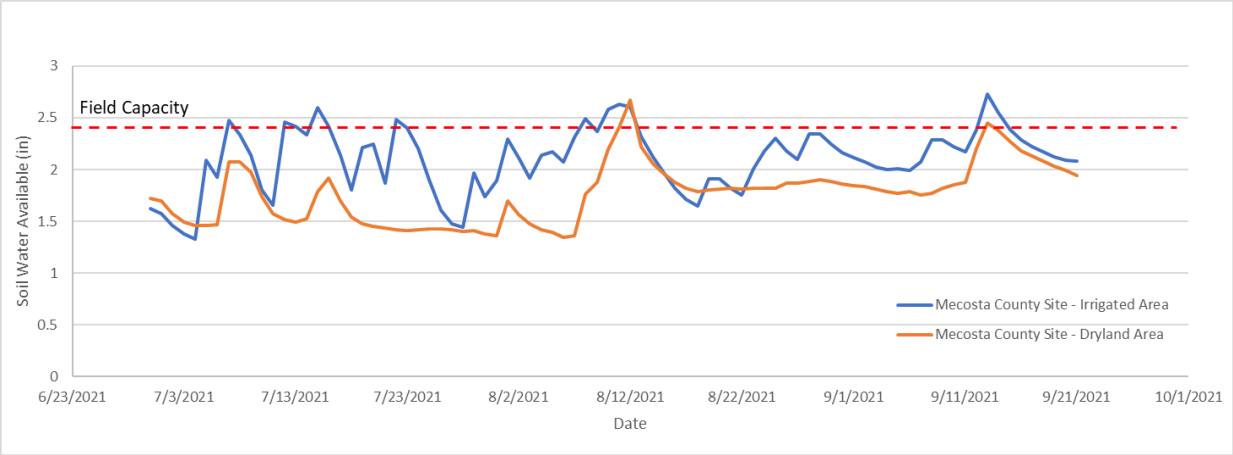



Figure 4. Composite soil water available (0-18 inch soil depth) in irrigated land and dryland area.

Figures 5 and 6 show the average daily soil moisture levels at 6 inch depth in Mecosta and Montcalm County sites. The data shows that average daily soil moisture levels in the irrigated area were generally higher than dryland areas in both Mecosta and Montcalm County sites. Based on the soil moisture data, irrigation was able to maintain the soil moisture levels at optimal condition (8 - 12%) in Mecosta County site throughout the growing season. This confirms the benefits of irrigation, which provides adequate moisture to potatoes.

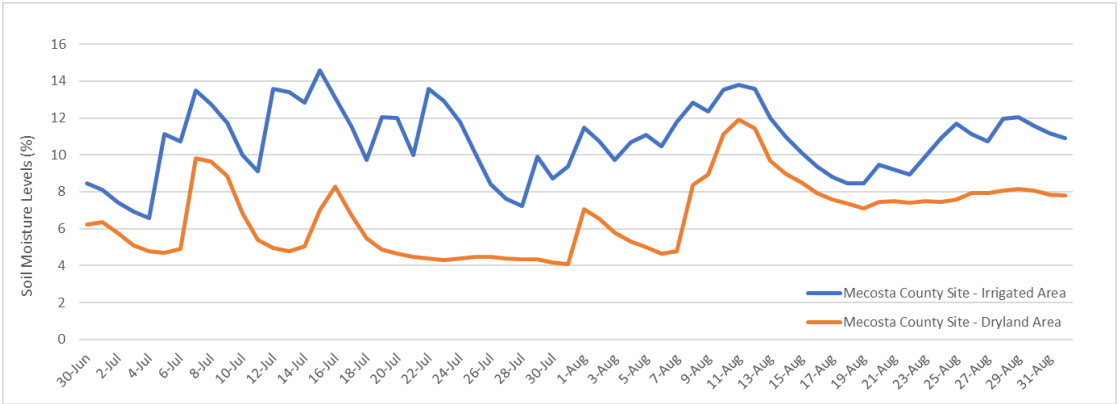



Figure 5. Average daily soil moisture level at 6 inch soil depth in Mecosta County site.

Table of Contents

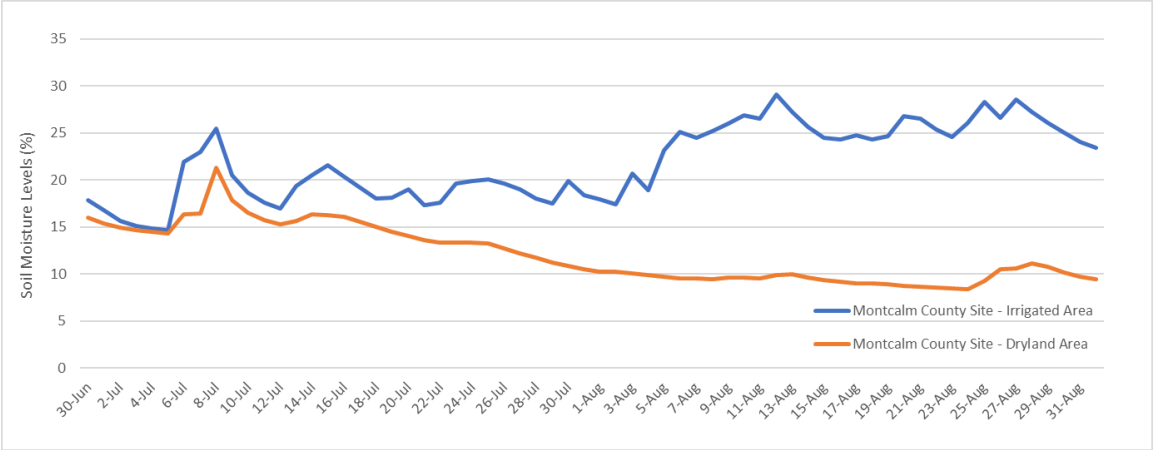



Figure 6. Average daily soil moisture level at 6 inch soil depth in Montcalm County site.

**Disease Monitoring**

Sporecaster is a model used to manage white mold of soybean, caused by *Sclerotinia sclerotiorum*, by predicting the presence of apothecia to optimally time fungicide applications. Potatoes are vulnerable to white mold infection during flowering, and Sporecaster has not been validated for use in potato fields. Monitoring the performance of Sporecaster since its release has shown that it needs refinement for use in irrigated fields. In 2021, data collection began to prepare for the refinement of Sporecaster under irrigation and to assess it's accuracy in irrigated potato fields.

Two irrigated potato fields were monitored weekly for apothecia development. Monitoring took place from 7/9/21 to 8/23/21 for a total of 245 observations. During each site visit, apothecia were counted, and canopy closure was measured. Canopy closure is a major determinant apothecium development and incorporating canopy closure into the model may help capture differences in the timing of apothecia emergence between crops. Weather stations were deployed to capture temperature, relative humidity, precipitation, leaf wetness, soil moisture soil temperature and the timing and magnitude of irrigation events. We were able to distinguish between irrigation and precipitation by installing rain gauges in an irrigated area and a dryland area within the field.

At the Montcalm County site, apothecia density was greatest between the last week of July (7/27) and the second week of August (8/9) (Figure 7). Apothecia density peaked early August (8/2) at 4.05 apothecia/$m^2$. At the Mecosta County site, apothecia density was far lower compared to the Montcalm County site. Apothecia density was low throughout the scouting period (7/9 – 8/19) but peaked mid-July (7/17) at 0.58 apothecia/$m^2$. At Montcalm County, major precipitation events preceded the first findings of apothecia. Both locations have a history of white mold pressure, and the precipitation events that occurred at Montcalm may have contributed to the higher apothecia density found.

At both locations, the model underestimated risk of apothecia throughout the monitoring period with a success rate of 36%. Typically, good models aim for 70-80% accuracy. These results demonstrate a need for further of Sporecaster refinement for irrigated acres and for potato fields. In 2022, field data collection will be continued to support a robust model development for Michigan potato growers to manage infection by white mold.

Table of Contents

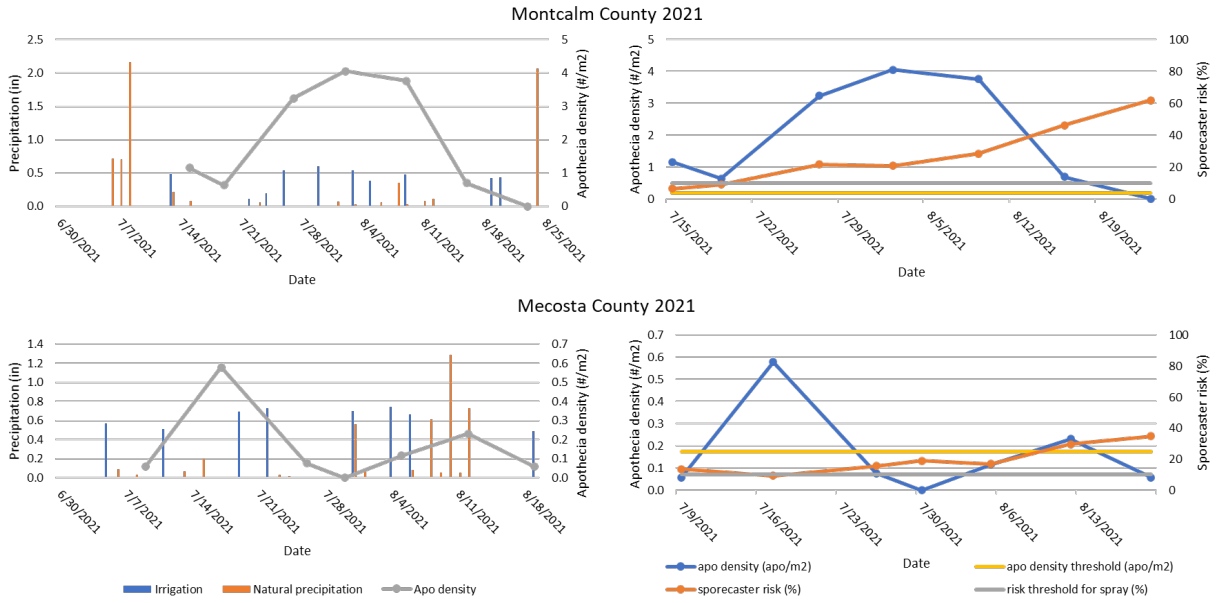



Figure 7. Left; Apothecia density plotted against irrigation (blue) and natural precipitation (orange). Right; Risk of apothecia predicted by Sporecaster (orange) and apothecia density (blue) throughout the monitoring period. The gray line represents the risk threshold recommended for a fungicide spray (10%). The yellow line represents the apothecia density threshold recommended for a fungicide spray (0.13 apothecia/$m^2$).

Table of Contents

# 2020-2021 MICHIGAN POTATO DEMONSTRATION STORAGE ANNUAL REPORT MICHIGAN POTATO INDUSTRY COMMISSION

*Chris Long, Coordinator, Trina VanAtta, and Damen Kurzer*

## Introduction and Acknowledgements

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

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

Table of Contents

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

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

This sixteenth annual Demonstration Storage Report contains the results of the storage work conducted in the facility during the 2020-2021 storage season. Section I, “2020-2021 New Chip Processing Variety Box Bin Report”, contains the results and highlights from our 10-cwt. box bin study. Section II, “2020-2021 Bulk Bin (500 cwt. bin) Report,” shows bulk bin results, including information from commercial processors regarding these new varieties.

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

We wish to acknowledge all the support and investment we receive to operate and conduct storage research. First, we express our gratitude for the partnership we enjoy between the MPIC and Michigan State University. Thank you to the MPIC Storage & Handling Committee for their investment of time, guiding the decisions and direction of the facility. Brian Sackett, Sackett Potatoes; Todd Young, and Chase Young, Sandyland Farms; Jeff Thorlund, Thorlund Brothers Farm; and Karl Ritchie and Brice Stine of Walther Farms for provided the material to fill the bulk bins this year; without their willingness to be involved, we could not have accomplished our objectives. Equal in importance are the processors who invested in this research. They are Mitch Keeney, Jim Fitzgerald and Jack Corriere of UTZ

Table of Contents

Hanover, PA; Chris and Ed Girrback of Great Lakes Potato Chip Co., Traverse City, MI, Jake Lake of Snyder Lance, Hyannis, MA, and Al Lee and Phil Gusmano of Better Made Snack Foods, Detroit, MI. It has been a great pleasure to work with all of you. Special thanks to Butch Riley (Gun Valley Ag. & Industrial Services, Inc.) for his annual investment in the sprout treatment of the storage facility. We would also like to acknowledge a long list of additional contributors who invested much time to help foster a quality storage program: Dr. Dave Douches and the MSU Potato Breeding and Genetics Program, Todd Forbush (Techmark, Inc), Mathew Klein (Farm Manager, MSU Montcalm Research Center), and Tim and Matt Wilkes (Potato Services of Michigan). All played a role in making this facility useful to the Michigan potato industry.

## Overview of the 2020 Production Season

The overall 6-month average maximum and minimum temperatures during the 2020 growing season in central Michigan was approximately average compared to the 15-year average temperatures. May generally had cooler minimum temperatures than average while July had warmer minimum temperatures than average (Table 1). Maximum temperatures were slightly cooler than average in all months excluding May. Extreme heat events were above average in 2020, with 13 hours over three days exceeding 90ºF during the summer (Table 2). This was higher than it has been in the past three years. High nighttime temperatures (over 70ºF) were also above average with 125 hours over 31 days.

Rainfall for April through September was 19.04 inches, 1.17 inches above the 15-year average (Table 3). May and July were rainier than average, each month had more than one inch of additional rainfall than the 15-year average. June and August were drier than average with one inch less of rainfall than the 15-year average.

Table of Contents

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

| | April | | May | | June | | July | | August | | September | | Average | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. |
| 2006 | 62 | 36 | 61 | 46 | 78 | 54 | 83 | 61 | 80 | 58 | 68 | 48 | 72 | 51 |
| 2007 | 53 | 33 | 73 | 47 | 82 | 54 | 81 | 56 | 80 | 58 | 76 | 50 | 74 | 50 |
| 2008 | 61 | 33 | 67 | 40 | 77 | 56 | 80 | 58 | 80 | 54 | 73 | 50 | 73 | 49 |
| 2009 | 56 | 33 | 67 | 45 | 76 | 54 | 75 | 53 | 76 | 56 | 74 | 49 | 71 | 48 |
| 2010 | 64 | 33 | 70 | 49 | 77 | 57 | 83 | 62 | 82 | 61 | 69 | 50 | 74 | 52 |
| 2011 | 53 | 33 | 68 | 48 | 77 | 56 | 85 | 62 | 79 | 58 | 70 | 48 | 72 | 51 |
| 2012 | 58 | 33 | 73 | 48 | 84 | 53 | 90 | 62 | 82 | 55 | 74 | 46 | 77 | 50 |
| 2013 | 51 | 33 | 73 | 48 | 77 | 55 | 81 | 58 | 80 | 54 | 73 | 48 | 73 | 49 |
| 2014 | 55 | 33 | 68 | 45 | 78 | 57 | 77 | 54 | 79 | 56 | 72 | 47 | 72 | 49 |
| 2015 | 58 | 33 | 71 | 48 | 76 | 54 | 80 | 56 | 77 | 57 | 77 | 54 | 73 | 51 |
| 2016 | 53 | 32 | 70 | 45 | 78 | 53 | 82 | 60 | 85 | 60 | 78 | 54 | 74 | 51 |
| 2017 | 61 | 39 | 67 | 44 | 78 | 55 | 81 | 58 | 77 | 54 | 77 | 50 | 74 | 50 |
| 2018 | 55 | 33 | 81 | 46 | 84 | 58 | 88 | 64 | 84 | 63 | 76 | 52 | 78 | 53 |
| 2019 | 55 | 35 | 65 | 45 | 75 | 54 | 84 | 69 | 80 | 55 | 73 | 54 | 72 | 52 |
| **2020** | **56** | **29** | **76** | **35** | **77** | **54** | **81** | **68** | **78** | **60** | **70** | **48** | **73** | **49** |
| 15-Year Average | 57 | 33 | 70 | 45 | 78 | 55 | 82 | 60 | 80 | 57 | 73 | 50 | 73 | 50 |

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

| | Temperatures > 90°F | | Night (10pm-8am) Temperatures > 70°F | |
|---|---|---|---|---|
| Year | Hours | Days | Hours | Days |
| 2015 | 0 | 0 | 114 | 31 |
| 2016 | 10 | 3 | 147 | 31 |
| 2017 | 14 | 3 | 80 | 18 |
| 2018 | 12 | 4 | 123 | 31 |
| 2019 | 5 | 2 | 105 | 20 |
| **2020** | **13** | **3** | **125** | **31** |
| Average | 9 | 3 | 116 | 27 |

Table of Contents

Table 3. The 15-year summary of precipitation (inches per month) recorded during the growing season at the Montcalm Research Center.*

| Year | April | May | June | July | August | September | Total |
|---|---|---|---|---|---|---|---|
| 2006 | 2.73 | 4.45 | 2.18 | 5.55 | 2.25 | 3.15 | 20.31 |
| 2007 | 2.64 | 1.60 | 1.58 | 2.43 | 2.34 | 1.18 | 11.77 |
| 2008 | 1.59 | 1.69 | 2.95 | 3.07 | 3.03 | 5.03 | 17.36 |
| 2009 | 3.94 | 2.15 | 2.43 | 2.07 | 4.74 | 1.49 | 16.82 |
| 2010 | 1.59 | 3.68 | 3.21 | 2.14 | 2.63 | 1.88 | 15.13 |
| 2011 | 3.42 | 3.08 | 2.38 | 1.63 | 2.57 | 1.84 | 14.92 |
| 2012 | 2.35 | 0.98 | 0.99 | 3.63 | 3.31 | 0.76 | 12.02 |
| 2013 | 7.98 | 4.52 | 2.26 | 1.35 | 4.06 | 1.33 | 21.50 |
| 2014 | 4.24 | 5.51 | 3.25 | 3.71 | 1.78 | 2.35 | 20.84 |
| 2015 | 3.71 | 2.96 | 4.79 | 1.72 | 2.42 | 3.90 | 19.50 |
| 2016 | 2.25 | 2.77 | 1.33 | 3.42 | 5.35 | 3.05 | 18.17 |
| 2017 | 4.45 | 1.98 | 6.37 | 0.92 | 1.36 | 0.70 | 15.78 |
| 2018 | 2.04 | 5.51 | 3.64 | 1.19 | 7.73 | 2.65 | 22.76 |
| 2019 | 2.64 | 5.46 | 2.90 | 2.04 | 3.31 | 5.72 | 22.07 |
| **2020** | **3.49** | **4.75** | **1.40** | **4.07** | **2.21** | **3.12** | **19.04** |
| 15-Year Average | 3.27 | 3.41 | 2.78 | 2.60 | 3.27 | 2.54 | 17.87 |

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

Table of Contents

# I. 2020-2021 New Chip Processing Variety Box Bin Report

(Chris Long, Trina VanAtta, Damen Kurzer, and Brian Sackett)

## Introduction

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

## Procedure

In 2020, we evaluated and compared 34 new varieties to the check variety Snowden. Once the varieties were chosen, 1 cwt. of most varieties were planted in a single 34-inch wide row. Some varieties were planted on one half of a row for monthly sampling. Planting occurred on May 7$^{th}$ at the MSU Montcalm Research Center, Entrican, MI. We planted the varieties at a 10" in-row seed spacing. All varieties received the following fertilizer: 273 lb. N/A, 98 lb $P_2O_5$/A and 261 lb $K_2O$/A. The varieties were vine killed after 116 days and allowed to set skins for 21 days before harvest on September 21$^{st}$, 2020, which was 137 days after planting. We did not account for variety maturity in harvest timing due to storage and handling restrictions.

We placed approximately 10 cwt. of each variety in a box bin and stacked the boxes in Bin 7. For varieties sampled monthly, approximately eight trays of tubers were stacked on top of the box bins. The average storage temperature for all the box bins was 54.0ºF for the 2020-2021 season. At harvest, we collected nine, 20 lb. samples from each full row variety for weight loss and pressure bruise evaluation. We describe the varieties, their pedigree and scab ratings in Table 4. We also recorded yield, size distribution, chip quality, and specific gravity at harvest

Table of Contents

in Table 5. We graded the varieties to remove all “B” size tubers and pickouts, ensuring the tubers began storage in good physical condition.

The storage season began September 21st, 2020 and ended June 7th, 2021. Bin 7 was gassed with CIPC on October 18th and February 19th. We began variety evaluations on September 21st, followed by a bi-weekly or monthly sampling schedule until early June. We randomly selected forty tubers from each box every two weeks and sent them to Techmark, Inc. for sucrose, glucose, chip color and defect evaluation. We also evaluated pressure bruising by placing nine pressure sample bags for each variety in one of the bulk bins at the storage facility. We placed three bags at each of 3’, 8’ and 14’ from the pile floor. When that bin was unloaded, we weighed the sample bags and calculated percent weight loss. We evaluated a 25-tuber sample from each of the nine bags for the presence or absence of pressure bruise. We recorded the number of tubers and severity of bruise. All pressure bruises were evaluated for discoloration.

This report is not an archive of all the data that we generated for the box bin trial, but rather a summary of the data from the most promising lines. The purpose of this report is to present a summary of information from the best performing lines from this trial that will be moved along the commercialization process. If more detailed information is desired, please contact Chris Long at Michigan State University in the Department of Plant, Soil and Microbial Sciences for assistance at (517) 355-0277 or longch@msu.edu. Additional data is available on the program website, canr.msu.edu/potatooutreach.

Table of Contents

## Table 4. 2020-2021 MPIC Demonstration Chip Box Bin Variety Descriptions

| Entry | Pedigree | 2020 Scab Rating* | Characteristics |
|---|---|---|---|
| Lady Liberty (Niagara, NY152) | B38-14 X Marcy | 2.5 | Medium netted skin type, smaller round and uniform tuber size profile, good off the farm chip quality, average yield. |
| Mackinaw (MSX540-4) | Saginaw Chipper X Lamoka | 2.0 | Medium netted skin, Lamoka type and appearance, earlier vine maturity, higher specific gravity, smaller tuber size profile. |
| Petoskey (MSV030-4) | Beacon Chipper X MSG227-2 | 2.0 | Round, flattened type, medium netted skin, earlier vine maturity, average yield potential, darker off the farm chip color. |
| Snowden (W855) | B5141-6 X Wischip | 3.0 | Very low yield with high percentage B-sized tubers, lower specific gravity, moderate common scab, earlier vine maturity. |
| COOR13270-2 | Winterset x CO02024-9W | 4.5 | Round to oval type, lighter skin, slight growth crack, full-season maturity, severe common scab, low specific gravity, below average yield. |
| MSAA076-6 | MSR127-2 x MSS297-3 | 1.0 | Flat to round type, slight alligator hide, slight internal brown spot, high percentage A-sized tubers, average yield potential. |
| MSAA217-3 | Beacon Chipper x Atlantic | 2.0 | Medium netted skin, slight pinkeye, high specific gravity, moderate hollow heart, average yield potential. |

Table of Contents

| Entry | Pedigree | 2020 Scab Rating* | Characteristics |
|---|---|---|---|
| MSAA260-3 | MSQ086-3 x Atlantic | 2.5 | High yield potential, slight growth crack, average specific gravity, moderate hollow heart, earlier vine maturity, moderate common scab. |
| MSAA373-3 | NY148 x McBride | 2.0 | Flat round tuber type, high specific gravity, full season maturity, good internal quality, average yield potential. |
| MSAA570-3 | MSV313-1 x Lamoka | 2.5 | Less uniform tuber type, earlier vine maturity, lower specific gravity, smaller tuber size profile and lower yield. |
| MSAFB605-4 | NY148 x MSV241-2 | 1.5 | Uniform round tuber type, heavy netted skin, average specific gravity, high percentage A-sized tubers, average yield. |
| MSAFB609-12 | NY148 x MSQ086-3 | 3.5 | Lower specific gravity, common scab susceptible, average yield, smaller tuber size profile. |
| MSAFB635-15 | NYH15-5 x MSS297-3 | 2.0 | Small, uniform tuber type, medium netted skin, higher specific gravity, above average yield, higher percentage B-sized tubers. |
| MSAFB635-3 | NYH15-5 x MSS297-3 | 2.5 | Round type, lighter skin color, slight hollow heart, moderate common scab, higher yield potential. |
| MSBB058-1 | NY148 x MSR127-2 | 0.5 | Medium netted skin, uniform type, flat to round shape, higher specific gravity, earlier vine maturity, lower yield potential. |

Table of Contents

| Entry | Pedigree | 2020 Scab Rating* | Characteristics |
|---|---|---|---|
| MSBB610-13 | NY148 x MST096-2Y | 1.5 | Attractive appearance, blocky oval type, earlier vine maturity, lower specific gravity, slight internal brown spot. |
| MSV498-1 | Snowden x MSQ283-2 | 0.5 | Heavier skin, deep apical eyes, Manistee type and appearance, moderate hollow heart and vascular discoloration, lower specific gravity, above average yield. |
| MSW474-1 | MSN190-2 x MSP516-A | 2.0 | Round type, medium netted skin, uniform, full season maturity, average yield, good internal quality. |
| MSX225-02 | MSK061-4 x Nicolet | 2.0 | Medium netted skin, round to oval, uniform tubers, smaller tuber size profile, lower yield. |
| MSY156-2 | MSK061-4 x Kalkaska | 2.0 | Small and round tubers, uniform appearance, lower specific gravity, lower yield, good internal quality. |
| MSZ063-2 | MSR148-4 x McBride | 2.0 | Bright smooth skin, earlier vine maturity, average specific gravity, darker off the farm chip color, higher percentage B-sized tubers. |
| MSZ120-04 | Kalkaska x MSQ08603 | 1.5 | Deeper apical eyes, higher percentage A-sized tubers, above average yield, good internal quality. |
| MSZ242-07 | MSR169-8Y x MSU383-A | 1.5 | Non uniform type, slight growth crack, average yield potential, very high specific gravity, lower stem end defect rating. |

Table of Contents

| Entry | Pedigree | 2020 Scab Rating* | Characteristics |
|---|---|---|---|
| MSZ242-09 | MSU169-8Y x MSU383-A | 1.5 | Heavier netted skin, slight alligator hide, average yield potential, higher specific gravity, darker off the farm chip color. |
| MSZ242-13 | MSR169-8Y x MSU383-A | 2.0 | Flattened round to oval type, medium netted skin, very high specific gravity, below average yield. |
| NY163 (L7-2) | NYE50-8 x NYE48-2 | 2.5 | Small tuber size profile, round, lighter skin, moderate common scab, earlier vine maturity, smaller vine type. |
| NY165 (M8-5) | NY148 x NYF48-4 | 2.0 | Uniform round type, netted skin, attractive appearance, full season maturity, below average yield, higher percentage B-sized tubers. |
| NY166 (N16-11) | NY140 x E48-2 | 2.5 | Oval to pear shaped tubers, less uniform type, moderate common scab, smaller tuber size profile, good internal quality. |
| NYOR14Q9-9 | Eva x H25-4 | 3.0 | Flattened oval type, lighter skin, moderate common scab, slight hollow heart, average yield potential. |
| WAF10664-3 | Superior x W6609-3 | 1.0 | Round, uniform tuber type, slight vascular discoloration, low specific gravity, average yield potential. |

*Scab rating based on 0-5 scale; 0 = most resistant and 5 = most susceptible. Common scab data and qualitative descriptions provided by Potato Outreach Program (P.O.P.), MSU Potato Breeding and Genetics Program and other potato breeding programs.

Table of Contents

# Table 5. 2020 Storage Chip Processing Potato Variety Trial
# Montcalm Research Center Chip Box Bin

**Planting: 5/7/20 Vine Kill: 8/31/20 Harvest: 9/21/20 and 9/22/20**

**$GDD_{40}$: 3335**

| | CWT/A | | PERCENT OF TOTAL[1] | | | | | | OTF CHIP | RAW TUBER QUALITY[4] (%) | | | | COMMON SCAB | SED | VINE | VINE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LINE | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR[2] | SCORE[3] | HH | VD | IBS | BC | RATING[5] | SCORE[6] | VIGOR[7] | MATURITY[8] | COMMENTS |
| Lady Liberty | 293 | 336 | 87 | 13 | 87 | 0 | 0 | 1.079 | 1.0 | 0 | 0 | 0 | 0 | 2.5 | 0.4 | 1.0 | 3.0 | med netted skin, smaller round uniform type |
| Mackinaw | 237 | 305 | 78 | 21 | 78 | 0 | 1 | 1.089 | 3.0 | 0 | 0 | 0 | 0 | 2.0 | 0.5 | 2.0 | 2.0 | med netted skin, lamoka type |
| Petoskey | 295 | 338 | 87 | 13 | 87 | 0 | 0 | 1.083 | 2.5 | 0 | 0 | 0 | 0 | 2.0 | 0.9 | 1.0 | 2.0 | round flat type, med netted skin |
| MSZ120-04 | 344 | 389 | 88 | 10 | 88 | 0 | 2 | 1.081 | 2.0 | 0 | 0 | 0 | 0 | 1.5 | 0.5 | 1.5 | 3.5 | deeper apical eyes, misshapen pos |
| MSAA260-3 | 340 | 371 | 92 | 5 | 92 | 0 | 3 | 1.082 | 2.5 | 20 | 0 | 0 | 0 | 2.5 | 1.1 | 2.0 | 2.0 | gc in pos |
| MSV498-1 | 337 | 384 | 88 | 9 | 88 | 0 | 3 | 1.077 | 1.5 | 20 | 10 | 0 | 0 | 0.5 | 0.4 | 1.5 | 2.5 | heavier skin, deeper apical eyes, Manistee type |
| MSAFB635-3 | 325 | 373 | 87 | 12 | 87 | 0 | 1 | 1.081 | 1.5 | 10 | 0 | 0 | 0 | 2.5 | 0.6 | 3.0 | 1.0 | round, ligher skin type |
| MSZ242-07 | 311 | 353 | 88 | 6 | 88 | 0 | 6 | 1.098 | 1.5 | 0 | 0 | 0 | 0 | 1.5 | 0.2 | 1.5 | 3.0 | non uniform type, gc in pos |
| MSAFB635-15 | 302 | 409 | 74 | 25 | 74 | 0 | 1 | 1.091 | 3.0 | 0 | 0 | 0 | 0 | 2.0 | 0.7 | 2.0 | 3.0 | small uniform type, med netted skin |
| MSW474-1 | 288 | 397 | 72 | 28 | 71 | 1 | 0 | 1.083 | 1.5 | 0 | 0 | 0 | 0 | 2.0 | 0.6 | 3.0 | 4.0 | round type, med netted skin, uniform |
| NYOR14Q9-9 | 284 | 340 | 83 | 16 | 83 | 0 | 1 | 1.081 | 2.0 | 10 | 0 | 0 | 0 | 3.0 | 1.2 | 2.5 | 2.0 | flat round to oval type, lighter skin, misshapen pos |
| MSZ242-09 | 283 | 321 | 88 | 7 | 88 | 0 | 5 | 1.087 | 2.5 | 0 | 0 | 0 | 0 | 1.5 | 0.7 | 2.0 | 2.5 | heavier netted skin, less uniform, sl ah |
| MSAFB605-4 | 282 | 304 | 93 | 6 | 93 | 0 | 1 | 1.083 | 1.5 | 0 | 0 | 0 | 0 | 1.5 | 0.6 | 1.5 | 3.5 | uniform round type, heavy netted skin |
| MSAFB609-12 | 281 | 349 | 80 | 20 | 80 | 0 | 0 | 1.079 | 1.5 | 0 | 0 | 0 | 0 | 3.5 | 0.6 | 2.0 | 3.0 | |
| MSAA076-6 | 273 | 332 | 82 | 13 | 82 | 0 | 5 | 1.085 | 1.5 | 0 | 0 | 10 | 0 | 1.0 | 0.4 | 2.0 | 2.5 | flat to round, misshapen pos, sl ah |
| WAF10664-3 | 263 | 314 | 84 | 14 | 84 | 0 | 2 | 1.075 | 1.0 | 0 | 10 | 0 | 0 | 1.0 | 0.6 | 3.0 | 1.0 | round uniform tuber type |
| NY163 | 263 | 332 | 79 | 17 | 79 | 0 | 4 | 1.083 | 1.5 | 0 | 0 | 0 | 0 | 2.5 | 0.6 | 1.5 | 1.5 | small, round, light skin |
| MSAA217-3 | 257 | 280 | 92 | 7 | 92 | 0 | 1 | 1.091 | 1.5 | 20 | 0 | 0 | 0 | 2.0 | 0.7 | 2.0 | 3.0 | sl pinkeye, med netted skin |
| MSAA373-3 | 246 | 307 | 80 | 13 | 80 | 0 | 7 | 1.091 | 3.5 | 0 | 0 | 0 | 0 | 2.0 | 0.6 | 1.5 | 4.0 | flat round tuber type |
| MSX225-02 | 239 | 311 | 77 | 23 | 77 | 0 | 0 | 1.083 | 1.5 | 0 | 10 | 0 | 0 | 2.0 | 0.4 | 3.0 | 3.0 | med netted skin, uniform round to oval |
| MSBB610-13 | 228 | 246 | 93 | 7 | 93 | 0 | 0 | 1.077 | 1.5 | 0 | 0 | 10 | 0 | 1.5 | 0.4 | 2.0 | 1.5 | nice apperance, blocky oval |
| MSZ242-13 | 222 | 256 | 87 | 13 | 87 | 0 | 0 | 1.096 | 2.0 | 0 | 0 | 0 | 0 | 2.0 | 0.3 | 2.0 | 3.0 | flat, round to oval, med net skin |
| MSBB058-1 | 220 | 264 | 83 | 15 | 83 | 0 | 2 | 1.092 | 1.5 | 0 | 0 | 0 | 0 | 0.5 | 0.3 | 2.0 | 1.5 | med netted skin, flat to round, uniform type |
| MSY156-2 | 218 | 274 | 80 | 20 | 80 | 0 | 0 | 1.078 | 2.5 | 0 | 0 | 0 | 0 | 2.0 | 0.8 | 2.5 | 3.5 | small and round, uniform, med netted skin |
| MSAA570-3 | 210 | 266 | 79 | 16 | 79 | 0 | 5 | 1.077 | 2.0 | 0 | 0 | 0 | 0 | 2.5 | 0.7 | 2.0 | 2.0 | less uniform |
| NY165 | 210 | 312 | 67 | 31 | 67 | 0 | 2 | 1.081 | 1.0 | 0 | 0 | 0 | 0 | 2.0 | 0.5 | 2.5 | 4.0 | uniform, round, netted skin, nice appearance |
| NY166 | 203 | 364 | 56 | 41 | 56 | 0 | 3 | 1.080 | 1.0 | 0 | 0 | 0 | 0 | 2.5 | 0.5 | 3.5 | 3.5 | non uniform type, oval to pear shaped |
| MSZ063-2 | 202 | 279 | 72 | 27 | 72 | 0 | 1 | 1.083 | 2.5 | 0 | 0 | 0 | 0 | 2.0 | 0.4 | 1.5 | 1.0 | bright smooth skin |
| COOR13270-2 | 193 | 280 | 69 | 30 | 69 | 0 | 1 | 1.074 | 2.5 | 0 | 0 | 0 | 0 | 4.5 | 0.6 | 3.0 | 4.0 | round to oval, lighter, sl gc |
| **Snowden** | **143** | **244** | **59** | **40** | **59** | **0** | **1** | **1.077** | **2.0** | **0** | **0** | **0** | **0** | **3.0** | **0.4** | **2.0** | **1.0** | |
| **MEAN** | **260** | **321** | **81** | **17** | **81** | **0** | **2** | **1.083** | **1.9** | **3** | **1** | **1** | **0** | **2.1** | **0.6** | **2.1** | **2.6** | |

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

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

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

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

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

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

**[7]VINE VIGOR RATING**
Date: 6/18/20
Rating 1-5
1: Slow emergence
5: Early emergence (vigorous vines, some flowering)

**[8]VINE MATURITY RATING**
Date: 8/31/20
Rating 1-5
1: Early (vines completely dead)
5: Late (vigorous vines, some flowering)

**FIELD DATA**

| | |
|---|---|
| Planting date | 5/7/20 |
| Vine Kill Date | 8/31/20 |
| Harvest Date | 9/21/20 and 9/22/20 |
| Days (planting to vine kill) | 116 |
| Days (planting to harvest) | 137 |
| $GDD_{40}$ MAWN Station | Entrican |
| $GDD_{40}$ (planting to vine kill) | 3335 |
| Seed Spacing | 10" |

## Results: 2020-2021 Chip Processing Box Bin Highlights

## MSZ242-13

This variety has been evaluated by the Potato Outreach Program since 2016. At harvest, the specific gravity was 1.096, above the trial average of 1.083. The US#1 yield was 222 cwt/A, slightly below average (Table 5). Two pre-harvest samples were taken on August 17th and August 31st in which increasing glucose and decreasing sucrose indicated potential chemical immaturity. This variety exhibited mid-season maturity, average common scab incidence, and a higher percentage of US#1 tubers. It had acceptable out of the field chip quality, with a 2.0 chip score and less stem end defect than the trial average. Sucrose concentrations were initially high, gradually decreased through April, and then rose through the end of storage in June. Glucose concentrations were more stable, fluctuating between 0.001% and 0.003% during storage. There were only two samples with undesirable color, both below five percent. Internal chip color was also very good, with only the last sample displaying 7.2% internal color. Most samples had ten percent or less internal defects, and six samples had no defects observed, which mainly occurred in samples taken before February. Techmark noted seven samples with bruising. This variety maintains good chip quality through early June and continues to demonstrate long term storage potential in Michigan. It is being further evaluated in the 2020-2021 Box Bin and Bulk Bin trials.

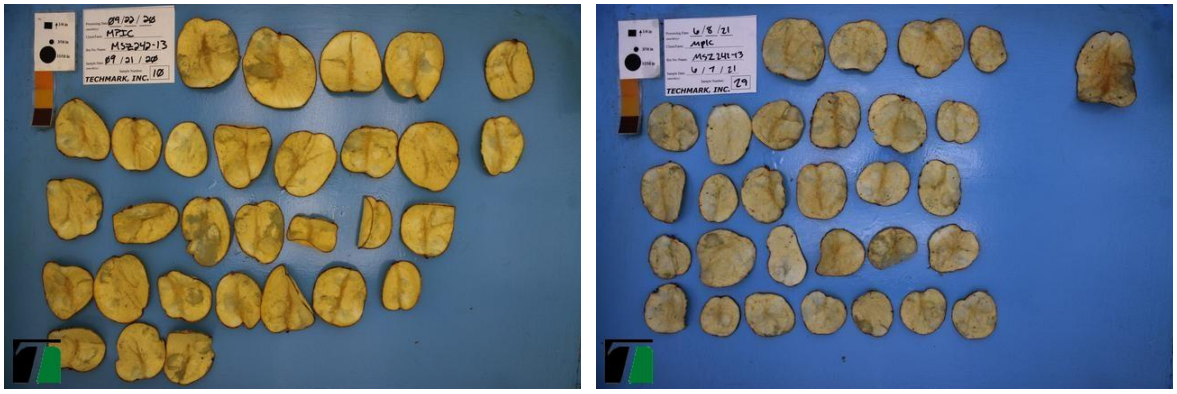



Figure 1. MSZ242-13 chip samples at the first processing date (9/21/20) and last processing date (6/7/21).

Table of Contents

## NY163

This Cornell University variety has been evaluated in 2016, 2019, and 2020 by the Potato Outreach Program. It had an average yield potential of 263 cwt/A US#1 tubers. It also had an average specific gravity of 1.083, but a below average off the farm chip color of 1.5 with an average stem end defect score. Between the two pre-harvest samples, increasing glucose and decreasing sucrose indicated potential chemical immaturity. During initial bin cooling the sucrose concentration began to decrease, reaching its lowest concentration in early March at 0.370 (X10). Sucrose concentration then rose at each sample, ending at 1.275 (X10) on 5/10/21, the final sample date. Glucose remained low and stable until late April, after which it rose in the final three samples. Chip color was excellent during storage, with only one incidence of internal color in late April. However, internal color was initially excellent but then sharply rose in the last two samples, ending at 33.4% internal color defects. Correspondingly, total defects were low during most of storage, but rose in the final chip samples. Chip quality was good from September to early April but quickly decreased through May. This variety will be further evaluated in the 2020-2021 Box Bin trial, as it demonstrates long-term storage potential with minimal chip defects until April.

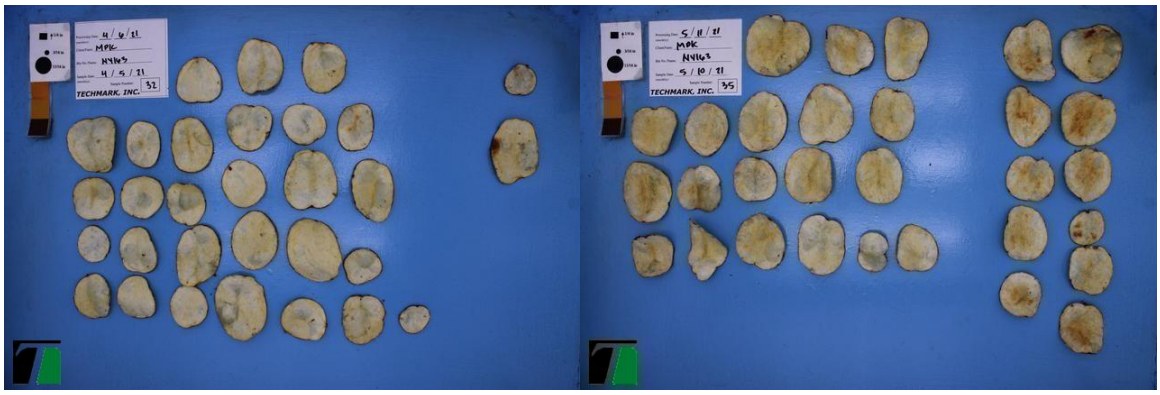



Figure 2. NY163 chip quality on last acceptable sample date, 4/5/21 (left) and last storage sample, 5/10/21 (right).

Table of Contents

## MSAA260-3

This Michigan State University variety was first evaluated by the Potato Outreach Program in 2020. It had an above average US#1 yield of 340 cwt/A and higher than average total yield of 371 cwt/A in the 2020 Box Bin trial. It had 92% A-sized tubers, higher than the trial average of 81%. The specific gravity was slightly lower than the trial average, and the fresh chip score of 2.5 was darker, and therefore less acceptable than average. Twenty percent hollow heart was observed in 2020. This variety produces a smaller vine with earlier vine maturity. Stable glucose and decreasing sucrose indicate chemical maturity at harvest. Sucrose concentrations were initially high in early storage, and while concentrations fluctuated, they followed a generally decreasing trend through late March. After this time, sucrose concentrations rose with each sample, ending at 0.869 (X10) on 5/27/21.Glucose concentrations were generally variable, with high levels observed in late January and late March. Undesirable color and internal color defects were typically below twelve percent at each sample. Total chip defects were initially high, with 75.4% defects observed in late November. Defects were then lower through February, rose again, and finally decreased through early May. Most of the chip defects were stem end defect. MSAA260-3 displays good processing quality though May, and could have storage potential below 54ºF.

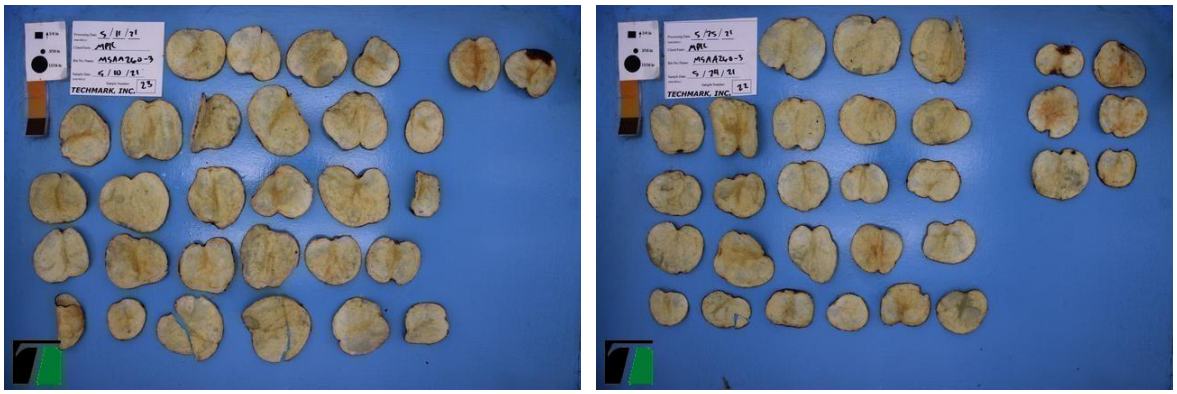


Figure 3. MSAA260-3 chip quality on the last two sample dates, 5/10/21 (left) and 5/24/21 (right)

Table of Contents

## MSAFB635-15

MSAFB635-15 is a University of Maine selection crossed at Michigan State University. It was first evaluated by the Potato Outreach Program in 2020. This variety had a slightly higher than average US#1 yield, 283 cwt/A. It had an above average US#1 yield of 302 cwt/A and very high total yield of 409 cwt/A, the highest total yield in the 2020 Box Bin trial. This variety produced 25% B-sized tubers, suggesting a very high yield potential. The specific gravity of 1.091 was also above the trial average. Off the farm chip quality was marginal, but the stem end defect score was average. Both the vine vigor and vine maturity were average for the trial. Between the two harvest samples, increasing glucose and decreasing sucrose indicated chemical maturity at harvest. During storage, sucrose concentrations followed a U-shaped trend, remaining high through December, decreasing though March, and then rising again through the end of storage in early June. Glucose concentrations rose between April and June, ending with a high of 0.007%. No undesirable color was observed in the 2020-2021 storage season. Total defects were all below ten percent, excluding the last two samples where defects rose to 20%. The last acceptable chip sample was taken on 5/10/21. This variety will be further evaluated in the Box Bin and other on-farm trials in 2021 due to long term storage potential though May.

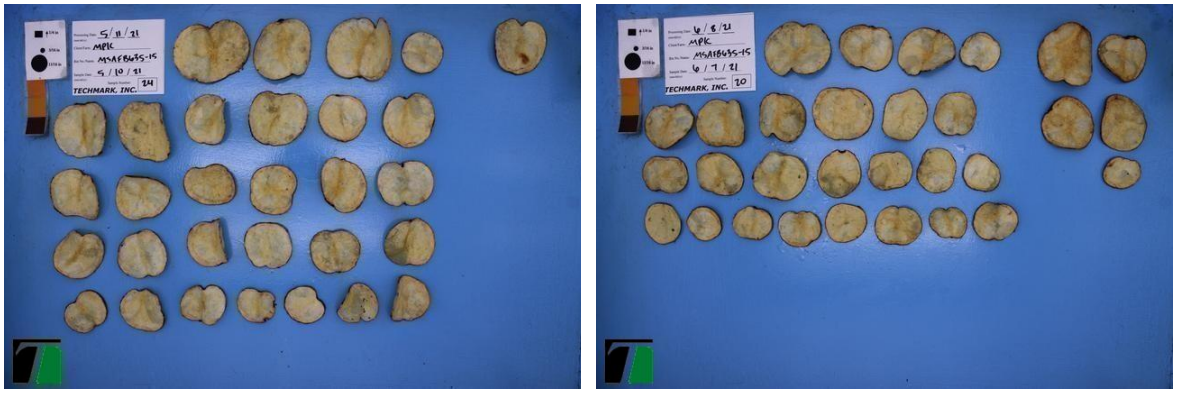



Figure 4. MSAFB635-15 chip quality on last acceptable sample date, 5/10/21 (left) and last storage sample, 6/7/21 (right).

Table of Contents

## Snowden

This variety was included as a commercial standard for the 2020-2021 Box Bin trial. It had the lowest yield in the trial, not typical for Snowden, which generally has an average to above average yield potential. This was likely due to the smaller than average tubers size, with only 59% A-sized tubers and 40% B-sized tubers produced in 2020. Specific gravity was below average at 1.077. Snowden had an average vine size and a very early maturity. It was chemically mature at harvest, with an increasing glucose concentration and decreasing sucrose rating. In storage, sucrose concentrations initially rose through December, then decreased, and finally rose in the last two samples in April. Glucose also rose sharply in the last two samples, ending at 0.006%. Undesirable color was observed at the first and last samples, both under three percent. Internal color was present in the last two samples. Total defects were highest in the first storage sample, early January, early March, and the final sample in late April. Bruising was noted in most samples, and pest pressure was present toward the end of the storage season. Snowden continues to be grown and stored in Michigan, and remains the standard for the Box Bin trials.

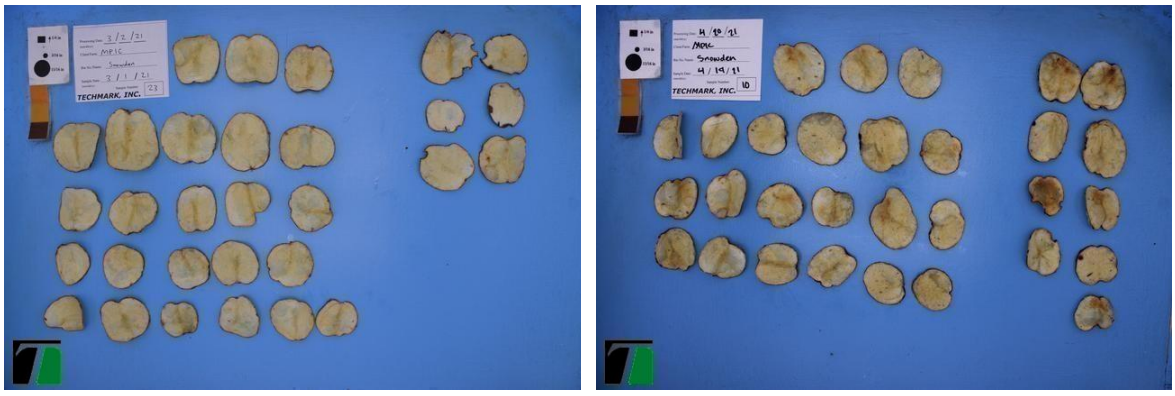


Figure 6. Snowden chip quality on last acceptable sample date, 3/1/21 (left) and last storage sample 4/19/21 (right).

Table of Contents

# II. 2020 - 2021 Bulk Bin (500 cwt. Bin) Report

*(Chris Long, Trina VanAtta, Damen Kurzer, and Brian Sackett)*

## Overview and Objectives

The goals of the MPIC Storage and Handling Committee for the 2020-2021 bulk bin storage season were: 1. To further refine optimal storage profiles for Mackinaw, specifically to understand temperature effect on weight loss and pressure bruise development, 2. To further refine optimal storage profiles for Petoskey, specifically to determine the extent of stem end defects and chip defects when cooled, and 3. To study the effects of two different storage temperatures on MSZ219-13. Bins 8 and 9 were used for a pathology study.

## Procedure

Each bin was filled under contract with potato producers in the state of Michigan. The MPIC paid field contract price for the potatoes to be delivered to the demonstration storage. Pressure bruise samples were collected for each bulk bin and designated bulk bins were filled. The varieties and their storage management strategies were established by the MPIC Storage and Handling Committee. For each bulk bin filled, a corresponding box bin containing 10 cwt. was filled and placed into Bin 7. Bin 7 was held at 54ºF, which in most cases is warmer than the corresponding bulk bin of the same variety. This allowed the committee to see if the warmer storage temperature in the box bin would reduce storage life and provided information as to how the bulk bin tubers might physiologically age. Bulk bins 1 though 4 were gassed with CIPC on November 11$^{th}$ and February 19$^{th}$. DMN was applied to bins 3 and 4 on October 19$^{th}$. Bins 5 and 6 were not treated.

Bulk bin assignments are below:

1 and 2: Mackinaw (Sackett Potatoes)

3 and 4: Petoskey (Walther Farms Cass City)

5 and 6: MSZ219-13 (Thorlund Brothers)

7: Box Bins

8 and 9: Mackinaw Pathology Study (Sackett Potatoes)

Table of Contents

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

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

## Mackinaw Storage Trial (Bin 1 and 2)

Mackinaw, a promising variety from Michigan State University, has commercialization potential in Michigan due to excellent long-term chip quality with tolerance to stem-end defects, resistance PVY and Late Blight, tolerance to common scab and Fusarium, resistance to Rhizoctonia, and a higher specific gravity. The purpose of this bulk bin experiment was to evaluate glucose and sucrose reaction during pile cooling to 48ºF and 46ºF in Bins 1 and 2, respectively. The initial pulp temperature was 46.8ºF in Bin 1 and 49.5 ºF in Bin 2 during bin loading, and temperature in both bins was increased to suberization temperature. The bins were then cooled by direct cooling to 50ºF. The bins were further cooled to 48ºF at a rate of either 0.4ºF per day or 0.6ºF per day. After reaching 48ºF, later cooling occurred at a rate of 0.2ºF per day for Bin 1 until the temperature reached 46ºF, while Bin 2 was held at 48ºF. This strategy and cooling rate is used in all bulk bins, which were cooled from field temperature to suberization temperature, to 50ºF, to the target storage temperature.

Table of Contents

We filled Bin 1 with Mackinaw on October 14th. The seed was planted in Mecosta, MI on May 12th and vine killed on September 14th (125 DAP, $GDD_{40}$ 3420). This field was harvested on October 13th, 154 days after planting. At loading, tubers in Bin 1 were 32% bruise free and tubers in Bin 2 were 36% bruise free. The pulp temperature for tubers at the time of bin loading was 46.8ºF in Bin 1 and 49.5ºF in Bin 2. Both bins were gassed with CIPC on November 12th and February 19th. They were unloaded on June 23rd and shipped to Utz Quality Foods, Hanover, PA, where they were processed on June 24th.

## Results

## Bulk Bin 1, Mackinaw ($GDD_{40}$ 3240, 48ºF)

Mackinaw was grown at Sackett Potatoes (Figures 7A and 7B). The Potato Outreach Program conducted a test dig prior to vine kill, in which ten feet of potatoes were harvested and graded. A US#1 yield of 325 cwt/A and total yield of 398 cwt/A were calculated from this test dig. Specific gravity was 1.088. There were 14.5 tubers per plant, 4.8 tubers per stem, and an average tuber weight of 3.6 oz. Ten percent vascular discoloration was observed. There were 82% A-sized tubers, 18 % B-sized tubers, and no oversize tubers or pickouts.

Pre-harvest samples were taken on 8/17/20 and 8/31/20. Increasing glucose concentrations and decreasing sucrose concentrations indicated possible chemical immaturity. At the second pre-harvest sample, the average tuber size was 3.2 oz. Chip quality out of the field was evaluated on 10/14/20 with two percent total defects observed. Defects are reported by Techmark, Inc, and are determined using slices cut from stem to bud end. On this date, sucrose and glucose concentrations were 1.374 (X10) and 0.023%, respectively. The SFA chip color was 1.0. The target temperature of 48ºF was reached in mid-December.

Mackinaw had an elevated sucrose concentration for most of storage, with concentrations above 1.000 (X10) until late February. After this sample, sucrose was generally below 1.000 (X10), excluding the final sample on 6/23/21 where it was 1.060 (X10). Glucose

Table of Contents

concentrations were generally more stable, and trended lower towards the end of storage, remaining between 0.001% and 0.002% in all samples after March. Undesirable color was observed in two sampled in January and March, both below 8%. Internal color was very good, with only two samples displaying this defect. The first incidence in late November was 3.3%, and the second was in late May at 2.8%. Total defects were variable during storage. Initial chip quality was excellent with two percent defects, but this quickly rose to over 20% in all samples, reaching a high of 62.6% defects in February. After this sample, defects decreased with each subsequent sample, ending with 10.7% defects in June at bin unloading. Figure 8 displays chip images of the first chip sample, sample with the highest incidence of total defects, and the final chip sample in June.

On June 23rd, the Bin was unloaded (Figure 9) and the potatoes were sent to Utz Quality Foods, Hanover PA, on the same day for processing on June 24th. Some sprouting was observed at bin unloading. Sackett Potatoes also evaluated the potatoes on June 23rd and observed a specific gravity of 1.092 and Frito Lay Solids of 18.97. A sample was chipped in the Sackett Potatoes lab and photographed by the Potato Outreach Program (Figure 10). When evaluated at Utz Quality Foods, the processor identified six percent total chip defects and a high specific gravity of 1.093 (Figure 11). Four percent of the defects were internal, and two percent were internal. Utz photographed the raw tubers and noted the presence of stem end defect (Figure 12).

At bin unloading, the average weight loss of tubers was 5.83%. Seven percent of the tubers had bruising with color, while 64% had bruising with no color and 29% were bruise free (Table 6). Mackinaw continues to be a promising variety with commercialization potential in Michigan. It will be further evaluated in the 2021 to 2022 storage season.

Table of Contents


Figures 7A and 7B. The Sackett Mackinaw potatoes used in Bulk Bin 1 at Sackett Potatoes on 7/7/20 (left) and 7/26/20 (right). The Mackinaw plants are on the right side of both images.

Figure 8. Bulk Bin 1 chips on the first sample date (10/14/20), sample with highest defect incidence (2/15/21), and final sample date (6/23/21).

Table of Contents

Figure 9. Mackinaw potataoes in Bin 1 during unloading on 6/23/21. Some sprouting was observed.

Figure 10. Mackinaw from Bin 1 chipped by Sackett Potatoes, 6/23/21.

Table of Contents

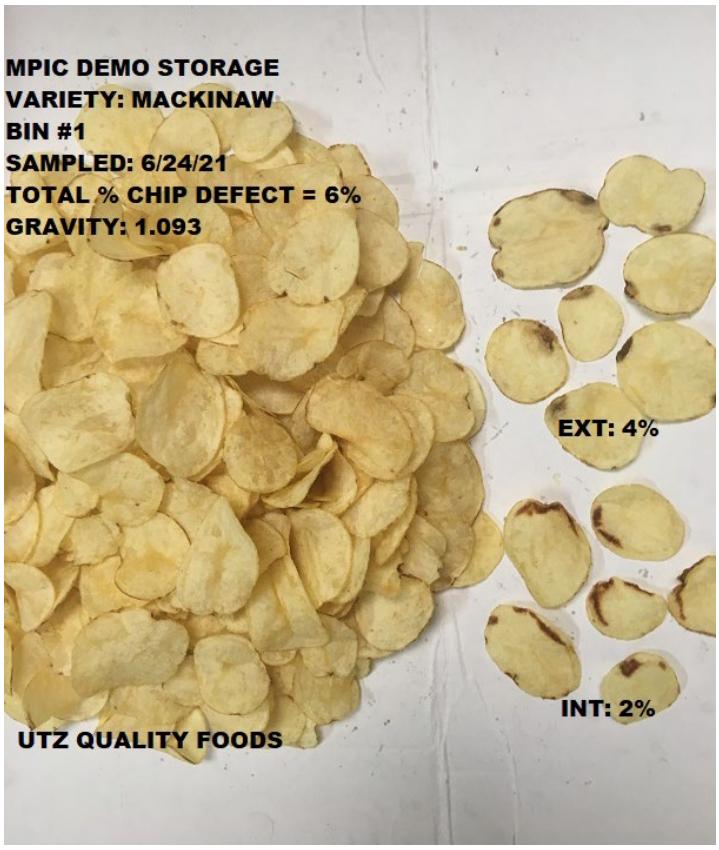



Figure 11. Mackinaw from Bin 1 at Utz Quality Foods, 6/10/20.



Figures 12A and 12B. Mackinaw tubers photographed at Utz (left), cut tubers photographed at Utz displaying stem end defect (right).

Table of Contents

## Bulk Bin 2, Mackinaw ($GDD_{40}$ 3240, 46ºF)

Chip quality out of the field was very good with no defects reported on the first sample date, October 14th. Defects are reported by Techmark, Inc, and are determined using slices cut from stem to bud end. On this date, sucrose and glucose concentrations were 1.413 percent (X10) and 0.002 percent respectively with a pulp temperature of 49.5ºF.

Sucrose levels were elevated as in Bin 1. Concentrations remained elevated between the beginning of storage and February, after which they declined through May. The last three storage samples between late May and June displayed rising sucrose. Glucose concentrations were less variable than in Bin 1, with all concentrations between 0.001% and 0.004%. The target temperature of 46ºF was reached in early January, and the bin was maintained until temperature increased beginning in May, ending at 53.6ºF in late June.

Like Bin 1, Bin 2 had good chip quality for most of storage. There were no instances of undesirable color during storage, and three observations of internal color, all below six percent. Two of these were observed toward the end of storage. Total defects were variable, generally rising through February, when they reached a high of 59.2% total defects on 2/1/21. After this sample total defects generally decreased, ending with 26% at bin unloading. Techmark observed bruising in most samples, as well as slight stem end color from the beginning of storage until March. This suggests that the chip quality may improve over the storage season with the tubers displaying less stem end defect in late storage. In all but one sample, chips in Bin 2 had a higher percentage of total defects than those in Bin 1. This suggests that the slightly warmer storage temperature of 48ºF may be preferable for long term storage.

Bin 2 was unloaded on June 23rd and was also processed at Utz on June 24th (Figure 14). As in Bin 1, a sample was chipped at Sackett Potatoes (Figure 15). Sackett Potatoes observed a specific gravity of 1.086 and Frito-Lay solids of 17.76. Utz Quality Foods found a specific gravity of 1.092, lower than that of Bin 1, and three percent total chip

Table of Contents

defects, slightly lower than Bin 1 (Figure 16A). Utz also photographed the raw tubers prior to chipping (Figure 16B).

At bin unloading, the average tuber weight loss in Bin 2 was 4.97%, very slightly lower than in Bin 1. Five percent of tubers were bruised with color, while 43% were bruised with no color and 52% had no bruising (Table 6).

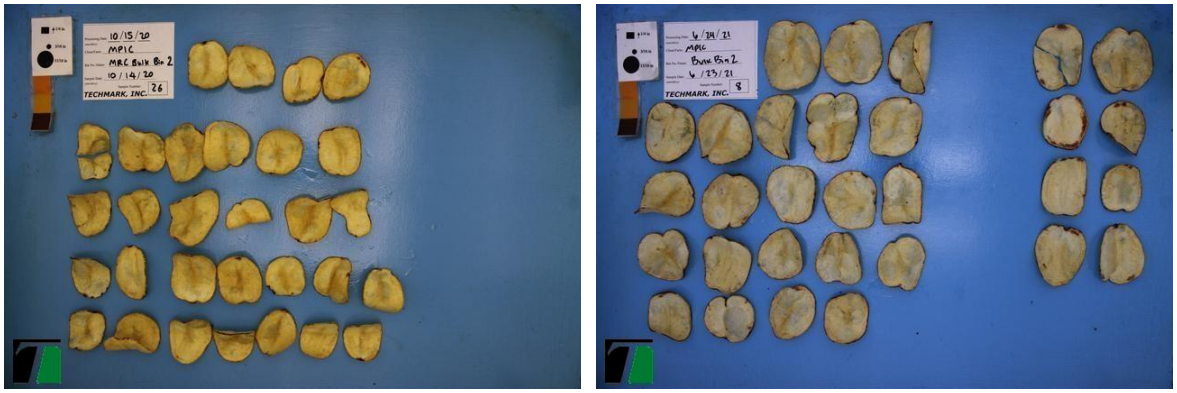
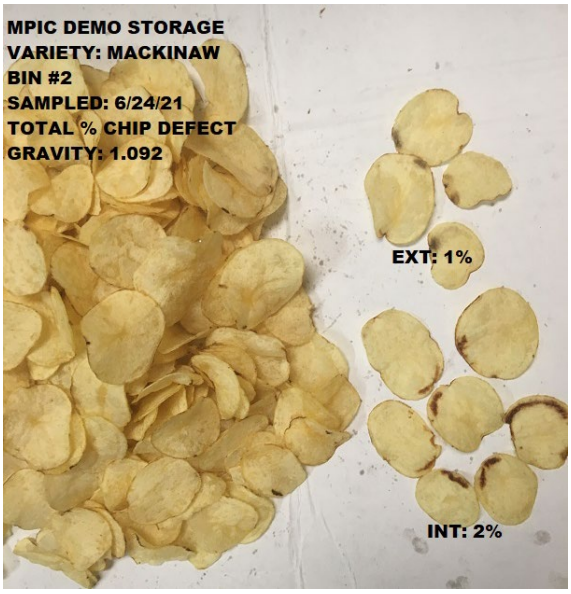



Figure 13. Mackinaw chips from the first (10/14/20) and last (6/23/21) sample dates.

Figure 14. Mackinaw tubers from Bin 2 unloading on 6/23/21.

Table of Contents

Figure 15. Mackinaw from Bin 2 chipped by Sackett Potatoes, 6/23/21.





Figures 16A and 16B. Mackinaw from Bin 2 chipped at Utz Quality Foods on 6/24/21, raw tubers from Bin 2 on 6/24/21.

Table of Contents

| Table 6. 2020-2021 PRESSURE BRUISE DATA<br>Bulk Bin #1 and #2 Mackinaw (Mecosta, MI) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Location[1] | Average Weight Loss (%) | Average Number of External Pressure Bruises Per Tuber[2] | | | | Average % of Total Tuber Number | | |
| | | 0 | 1 | 2 | 3+ | Without Bruise | Bruised (No Color) | Bruised with Color[3] |
| 14' Bin 1 | 4.88 | 8 | 11 | 5 | 1 | 32 | 65 | 3 |
| 8' Bin 1 | 5.79 | 9 | 8 | 6 | 2 | 35 | 63 | 2 |
| 3' Bin 1 | 6.81 | 5 | 10 | 6 | 4 | 20 | 64 | 16 |
| **OVERALL AVERAGES** | **5.83** | | | | | **29** | **64** | **7** |
| 14’ Bin 2 | 4.40 | 15 | 8 | 2 | 0 | 60 | 40 | 0 |
| 8’ Bin 2 | 4.85 | 13 | 9 | 3 | 0 | 53 | 40 | 7 |
| 3’ Bin 2 | 5.68 | 11 | 10 | 4 | 0 | 43 | 49 | 8 |
| **OVERALL AVERAGES** | **4.97** | | | | | **52** | **43** | **5** |

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

| | | | | | |
|---|---|---|---|---|---|
| Loaded | 10/4/2020 (both) | Pulp Temp. (at Filling) | 46.8ºF (1)<br>49.5ºF (2) | | |
| Unloaded | 6/23/2021 (both) | Target Storage Temp. | 48ºF (1)<br>46ºF (2) | End Temp. | 51.8ºF (1)<br>53.6ºF (2) |

## Petoskey Storage Trial (Bins 3 and 4)

This Michigan State University variety has continued commercialization potential in Michigan due to an above average specific gravity, common scab resistance, May storability from 46ºF, and a vine maturity similar to Snowden. The yield potential continues to be lower than that of Snowden, and Petoskey displays poor chip quality in early storage with a higher proportion of chip defects when processed out of the field.

These two bulk bins were filled with potatoes grown by Walther Farms in Cass City, MI (Figure 17). The Potato Outreach Program conducted a ten-foot test dig prior to vine kill and calculated 465 cwt/A US#1 yield and 496 cwt/A total yield. The specific gravity was 1.087 and no internal defects were observed. There were nine tuber per plant and 2.3 tuber

Table of Contents

per stem. The average tuber weight was five ounces. The tuber size profile was 92% A-sized tubers, five percent B-sized tubers, two percent oversize tubers, and one percent pickouts. The potatoes in both bins were planted on April 28th and vines were killed on September 2nd (127 DAP, $GDD_{40}$ 3429). Harvest occurred on October 7th, 162 days after planting. At harvest the pulp temperature was 55.2ºF for both bins. The tubers were in good condition at bin loading, with 68% bruise free tubers in Bin 3 and 80% bruise free tubers in Bin 4. Only one pre-harvest sample was taken on 8/14/20. The specific gravity was 1.087, the glucose concentration was 0.002%, and the sucrose rating was 0.482 (X10). The bins were loaded on October 7th and treated with CIPC on November 12th and February 19th. These bins were designed to study chip quality and potato storability under two different storage protocols.

Figure 17. The Petoskey field (right) at Walther Farms Cass City on 7/1/20.

Table of Contents

## Results

### Bulk Bin 3, Petoskey ($GDD_{40}$ 3429, 46ºF)

The initial target temperature for this bin was 52ºF, which was reached in mid-November by cooling at a rate of 0.2ºF per day, and further cooling to 46ºF at the same rate occurred to increase the longevity of storage as total defects displayed a decreasing trend, suggesting improved chip quality with continued storage. This target temperature was maintained until the bin was unloaded on 5/18/21 with a pulp temperature of 46.0ºF. Petoskey displayed a U-shaped trend in sucrose concentrations with decreasing sucrose concentrations from October to late February. The lowest sucrose rating was observed on 2/15/21, 0.335 (X10). After this sample, sucrose generally increased, with the final sample in May at 0.854 (X10). Glucose concentrations also rose toward the end of storage, rising from readings between 0.002% and 0.003% for most of storage to 0.008% in May. There were four incidences of undesirable color, all below six percent. Internal color was apparent in five samples, three at the beginning of storage, and the remaining two present in the last two storage samples. Total defects were variable, with higher defect incidence observed between the beginning of storage and February. Beginning in March, most total defect percentages were below 12%, excluding the final sample that had 19% total defects.

Petoskey displayed evidence of reconditioning in storage. See Figure 18 for images of marginal chip quality in October and February, improving chip quality in April, and the final chip sample with decreasing chip quality in May. Techmark observed slight to moderate stem end defect in chip samples until February and bruising and dark chips in samples through the end of storage.

Bin 3 was unloaded on May 17th (Figure 19). At unloading, the average tuber weight loss was 5.30%. Twenty eight percent of tubers had no bruising, 57% had bruising with no color, and 16% were bruised with color (Table 7). As in Bin 1 and 2, Sackett Potatoes chipped a sample of tubers (Figure 20). Sackett Potatoes noted a specific gravity of 1.085

Table of Contents

and Frito-Lay solids at 17.58. Utz noted a specific gravity of 1.081. Chip quality was good, with three percent external defects and five percent internal defects for a total of eight percent defects. Figure 21 shows cut tubers prior to chipping and Figure 22 shows finished chips made from Petoskey tubers.

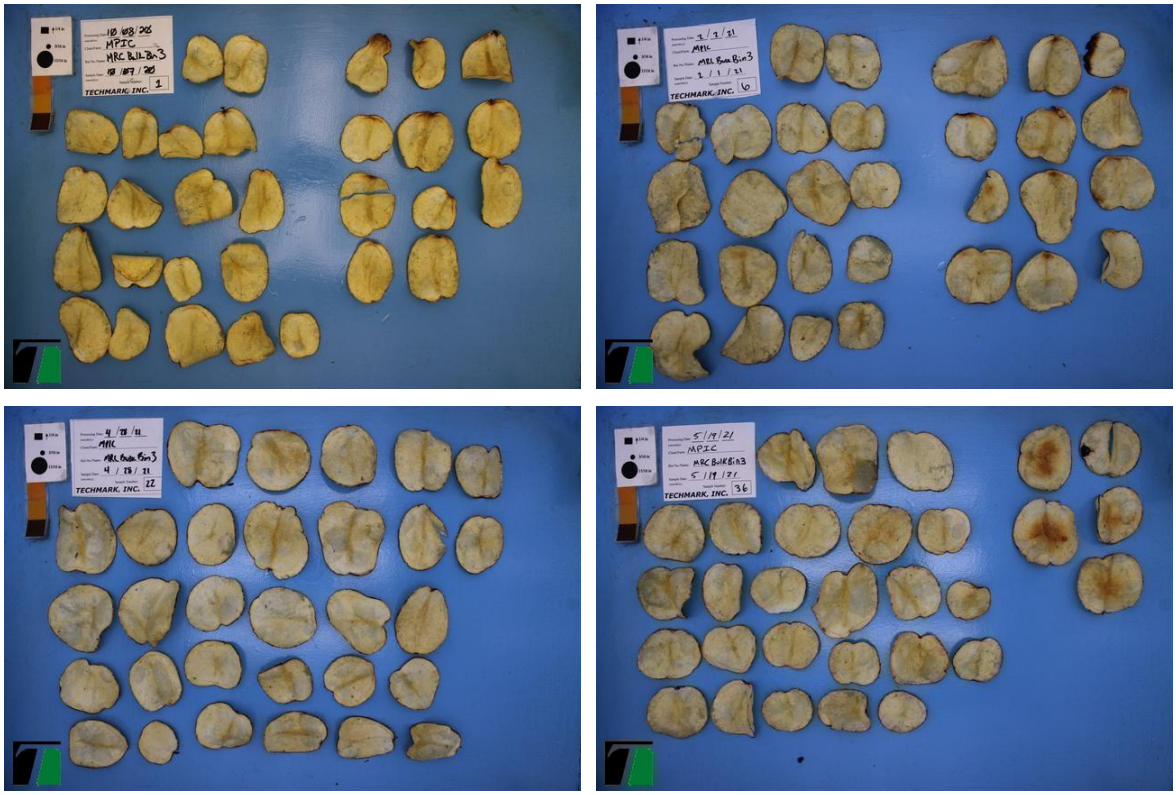


Figure 18. Petoskey chip images on 10/7/20 (top left), 2/1/21 (top right), 4/28/21 (bottom left), and 5/18/21 (bottom right). Chip quality was generally poor from the beginning of storage until February, improved until late April, and then declined slightly at bin unloading.

Table of Contents

Figure 19. Petoskey from Bin 3 unloaded on 5/17/21.

Figure 20. Petoskey from Bin 3 chipped by Sackett Potatoes on 5/17/21

Table of Contents


Figure 21. Petoskey tubers prior to chipping at Utz Quality Foods on 5/20/21.

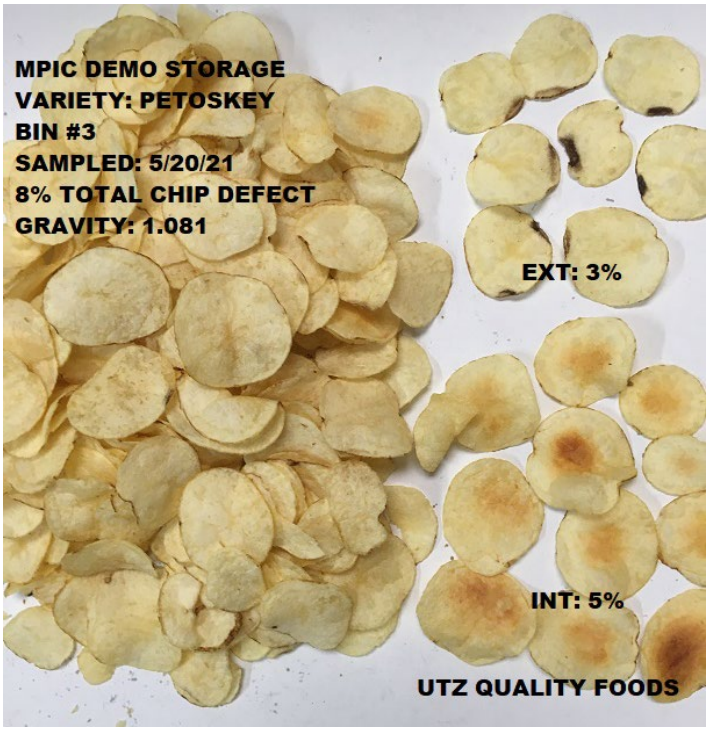



Figure 22. Petoskey tubers after chipping at Utz Quality Foods on 5/20/21.

Table of Contents

## Bulk Bin 4, Petoskey ($GDD_{40}$ 3429, 48ºF)

This bulk bin was initially cooled to 52ºF by mid-November, after which it was further cooled to the target temperature of 48ºF by early December. This temperature was maintained until bin unloading on May 18th. As in Bin 3, sucrose concentrations followed a U-shaped trend with the highest concentrations shortly after bin loading and just before unloading. Concentrations were lowest between March and April. Glucose concentrations remained more stable, between 0.001% and 0.004% for most of the storage season, increasing to 0.003% in the last two samples. There were two samples with undesirable color, both in the middle of the storage season and both below three percent. Internal color was generally low. The three samples with internal color were at 13% or lower. Total defects were consistently high from bin loading to late February, after which they generally decreased. The sample taken on 11/16/20 had 60.1% total defects, the highest observed in Bin 4. The sample taken on 4/5/21 had the lowest total defects, 3.8%, and the final sample had 6.2% defects. See Figure 23 for images of chips at bin loading, November 16th, April 5th, and bin unloading. Slight to moderate stem end defect was present in most chip samples evaluated by Techmark from the beginning of storage until March. Bruising was noted in most of the remaining samples.

Bin 4 was unloaded on May 17th with a pulp temperature of 47.8ºF (Figure 24). A sample was chipped at Sackett Potatoes (Figure 25). Sackett Potatoes calculated a specific gravity of 1.084 and Frito lay solids of 17.40. Utz Quality Foods received and processed the tubers on May 20th. The processor noted a specific gravity of 1.085, three percent internal defects, two percent external defects, and five percent total defects (Figure 26). Petoskey demonstrating reconditioning, or “cleaning up” in storage, where chip quality improves after initially marginal out of the field and early storage performance. The stem end defect observed in both bins was less severe from March to May, suggesting that the defect was not caused by disease and was managed in storage. This variety continues to display mid-season storability, with processing potential between March and May. It will be further evaluated in on farm trials by the Potato Outreach Program and in a bulk bin in 2021.

Table of Contents

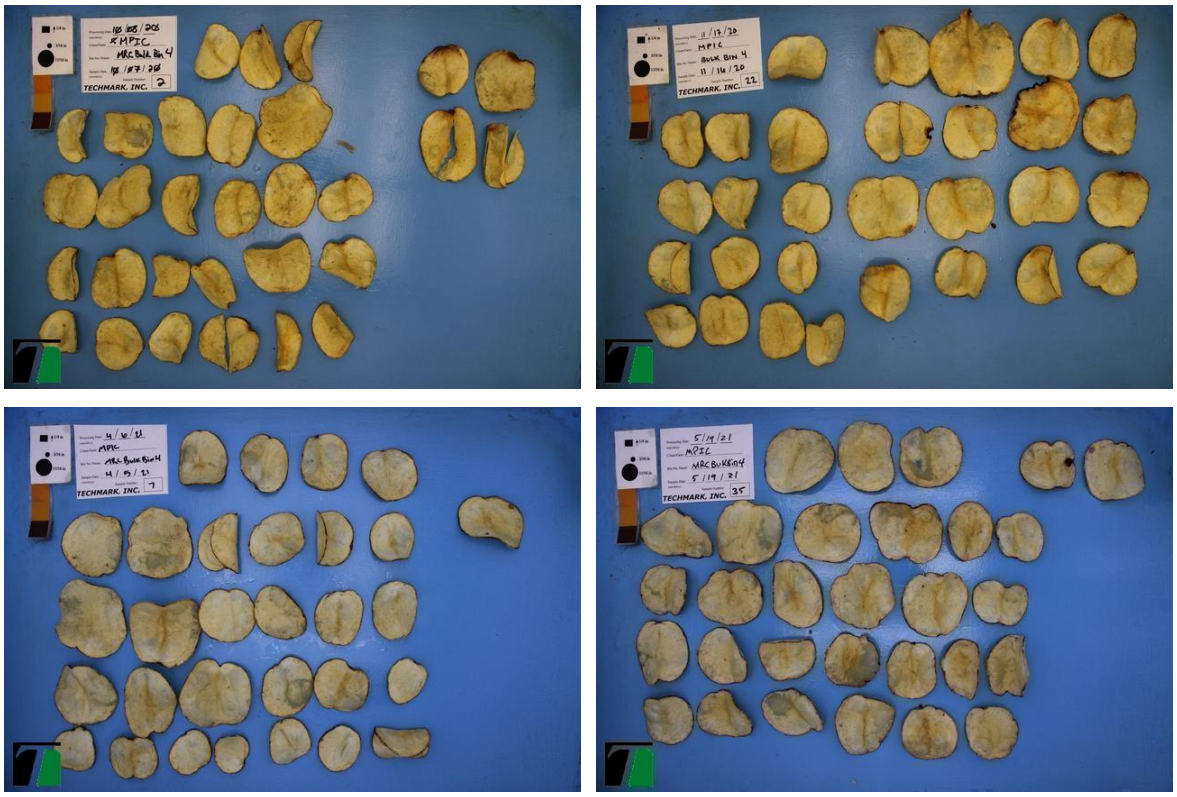



Figure 23. Petoskey from Bin 4 chip samples taken on 10/7/20 (top left), 11/16/20 (top right), 4/5/21 (bottom left), and 5/17/21 (bottom right).

Figure 24. Petoskey from Bin 4 during unloading on 5/17/21.

Table of Contents

Figure 25. Petoskey chipped by Sackett Potatoes on 5/17/21.

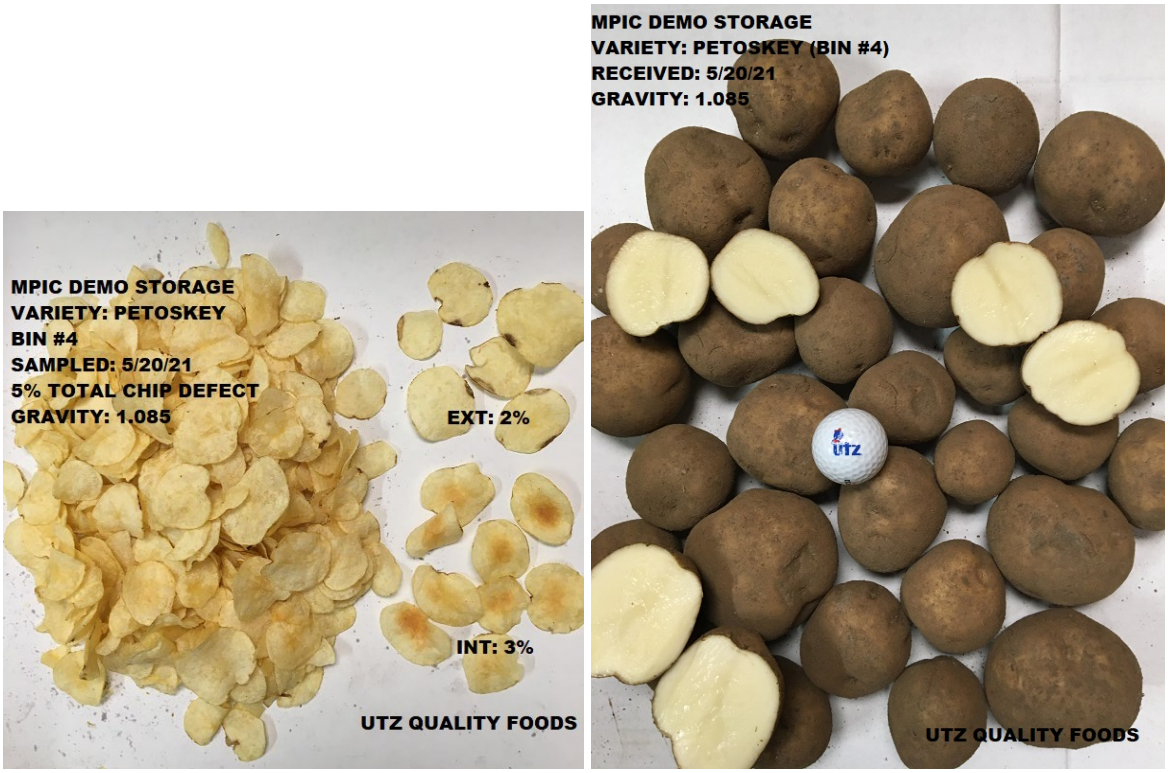



Figure 26. Chipped (left) and raw (right) tubers at Utz Quality Foods on 5/20/21.

Table of Contents

| Table 7. 2020-2021 PRESSURE BRUISE DATA<br>Bulk Bin #3 and #4 Petoskey (Cass City, MI) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Location[1] | Average Weight Loss (%) | Average Number of External Pressure Bruises Per Tuber[2] | | | | Average % of Total Tuber Number | | |
| | | 0 | 1 | 2 | 3+ | Without Bruise | Bruised (No Color) | Bruised with Color[3] |
| 14' Bin 3 | 5.79 | 11 | 8 | 4 | 2 | 44 | 49 | 7 |
| 8' Bin 3 | 4.81 | 7 | 11 | 5 | 3 | 27 | 61 | 12 |
| 3' Bin 3 | 5.30 | 3 | 6 | 10 | 6 | 12 | 60 | 28 |
| **OVERALL AVERAGES** | **5.30** | | | | | **28** | **57** | **16** |
| 14’ Bin 4 | 5.37 | 3 | 12 | 9 | 1 | 13 | 80 | 7 |
| 8’ Bin 4 | 6.17 | 3 | 10 | 8 | 4 | 11 | 84 | 5 |
| 3’ Bin 4 | 7.26 | 0 | 4 | 9 | 12 | 0 | 53 | 47 |
| **OVERALL AVERAGES** | **6.26** | | | | | **8** | **72** | **20** |

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

| | | | | | |
|---|---|---|---|---|---|
| Loaded | 10/7/20(both) | Pulp Temp. (at Filling) | 55.2ºF (both) | | |
| Unloaded | 5/17/21 (both) | Target Storage Temp. | 46.0ºF (3)<br>48.0ºF (4) | End Temp. | 46.0ºF (3)<br>47.8ºF (4) |

## MSZ219-13 (Bins 5 and 6)

This Michigan State University selection has been evaluated by the Potato Outreach Program since 2017. It has an average yield, but a high percentage of A-sized and oversized tubers. It is resistant to common scab with a below average specific gravity and above average incidence of hollow heart. This variety was planted on May 7th at Thorlund Brothers, Greenville, MI. Vine kill occurred on September 14th (130 DAP, 3447 $GDD_{40}$). A ten foot test dig prior to vine kill calculated a US#1 yield of 389 cwt/A and a total yield of 421 cwt/A. The specific gravity was 1.076, and ten percent brown center was observed. There were 7.2 tubers per plant, 3.6 tubers per stem, and the average tuber weight was 5.1 oz. The potatoes were harvested on October 12th, 158 days after planting. At bin loading

Table of Contents

the pulp temperature was 48.7ºF in Bin 5 and 51.5ºF in Bin 6. Tubers were 68% and 48% bruise free, respectively.

Two pre-harvest samples were taken for this variety on August 31st and September 14th. The increasing glucose and sucrose indicate potential chemical immaturity at harvest. Both bins were gassed with CIPC on November 12th. The initial plan for the bins was to cool them to 48ºF and 50ºF, respectively. However, the chip quality and agronomic traits caused the research committee to discontinue evaluation. The average yield and tendency towards larger tubers make this variety less likely to succeed in commercial production in Michigan. Both bins were held at 54ºF to maintain respiration until the potatoes reached an acceptable processing quality.

Figure 27. MSZ219-13 (right) grown at Thorlund Brothers for Bulk Bins 5 and 6 on 7/7/20, 60 days after planting

Table of Contents

## Results

## Bulk Bin 5, MSZ219-13 ($GDD_{40}$ 3447, 48ºF)

The temperature in Bulk Bin 5 was maintained near 54ºF for the duration of storage. The sucrose concentration generally decreased with each sample, beginning at 0.669 (X10) and ending at 0.307 (X10) at bin unloading on November 30th. Glucose concentrations were highest at the October 19th sample, 0.006%. All other samples were either 0.002% or 0.003%. There was no undesirable color observed in 2020. Moderate internal color was present in three out of the five samples, with the first and last sample displaying no internal color. Total defects were above 19% in all samples, with the highest percent defect, 72.3%, in the November 2nd sample. Figure 28 shows the first and last chip samples.

Bin 5 was unloaded on November 30th along with Bin 6, and tubers from both bins were combined in a shipment to Better Made Snack Foods, Detroit MI (Figure 29). The potatoes were processed on December 1st. The specific gravity was 1.078 and the Agtron score was 63. There were 3.1% total defects observed, including 0.3% greening, 1.9% internal defects, and 0.9% external defects. Better Made sent a sample of unsorted chips to the Potato Outreach Program, and staff visually sorted the chips based on defect type (Figure 30). They identified 94% acceptable chips, four percent internal defects, two percent external defects, and slight greening defects that accounted for less than one percent of the sample weight. The higher incidence of defects identified by the Potato Outreach Program does not indicate reduced chip quality, just that some defects were identified by the Potato Outreach Program staff that were still acceptable to the processor. Sackett Potatoes chipped a sample from Bin 5 on November 30th and found a specific gravity of 1.073 and Frito Lay solids of 15.69. The Potato Outreach Program photographed a sample of the chips (Figure 31).

Average tuber weight loss was 2.25% at bin unloading, likely due to the short duration of storage. 76% of tubers were bruise free, 23% were bruised with no color, and one percent were bruised with color (Table 8).

Table of Contents


Figure 28. Bulk bin 5 first chip sample on 10/13/20, and last chip sample on 11/30/20.

Figure 29. Tubers from Bin 5 at unloading on 11/30/20.

Table of Contents

Figure 30. Chips sorted by the Potato Outreach Program received from Better Made. The left side is acceptable chips, the top right is internal defects, middle right is external defects, and bottom right is greening defects.

Figure 31. Chips processed from Bin 5 at Sackett Potatoes on 11/30/20.

Table of Contents

## Bulk Bin 6, MSZ219-13 ($GDD_{40}$ 3447, 50ºF)

This bin displayed performed like Bin 5 in terms of total chip defects, internal color, and undesirable color. Sucrose followed a generally decreasing trend at each sample but was slightly lower than the sucrose concentration in Bin 5. Glucose concentration was consistent with that of Bin 5, ending at 0.002% at bin unloading on November 30th. There was one incidence of undesirable color on November 16th, 8.6%. Internal color was always above nine percent, with the highest incidence in the first sample. Total defects were also elevated, with each sample containing over 33% defects.

This bin was also unloaded on November 30th. As the tubers from Bin 5 and Bin 6 were mixed for processing, no separate data exists for Bin 6. See Bin 5 for results from Better Made Snack Foods. Sackett Potatoes processed a sample from Bin 6 on November 30th and found a specific gravity of 1.077 and Frito lay Solids of 16.2 (Figure 33). Average weight loss in Bin 6 was 2.22%. 83% of tubers were bruise free, 16% were bruised with no color, and one percent was bruised with color (Table 8).


Figure 32. Bulk Bin 6 first chip sample on 10/13/20, and last chip sample on 11/30/20.

Table of Contents

Figure 33. Chips processed from Bin 6 at Sackett Potatoes on 11/30/20.

**Table 8. 2020-2021 PRESSURE BRUISE DATA**
**Bulk Bin #5 and #6 MSZ219-13(Greenville, MI)**

| Location[1] | Average Weight Loss (%) | Average Number of External Pressure Bruises Per Tuber[2] | | | | Average % of Total Tuber Number | | |
|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3+ | Without Bruise | Bruised (No Color) | Bruised with Color[3] |
| 14' Bin 5 | 2.03 | 23 | 2 | 0 | 0 | 91 | 9 | 0 |
| 8' Bin 5 | 1.92 | 17 | 8 | 0 | 0 | 67 | 32 | 1 |
| 3' Bin 5 | 2.80 | 17 | 8 | 0 | 0 | 69 | 29 | 1 |
| **OVERALL AVERAGES** | **2.25** | | | | | **76** | **23** | **1** |
| 14’ Bin 6 | 2.07 | 22 | 3 | 0 | 0 | 89 | 9 | 1 |
| 8’ Bin 6 | 2.44 | 19 | 6 | 0 | 0 | 75 | 24 | 1 |
| 3’ Bin 6 | 2.15 | 22 | 3 | 0 | 0 | 87 | 13 | 0 |
| **OVERALL AVERAGES** | **2.22** | | | | | **83** | **16** | **1** |

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

| | | | | | |
|---|---|---|---|---|---|
| Loaded | 10/13/20(both) | Pulp Temp. (at Filling) | 48.7ºF (5)<br>51.5ºF (6) | | |
| Unloaded | 11/30/20 (both) | Target Storage Temp. | 54.0ºF (both) | End Temp. | 52.8ºF (both) |

Table of Contents

## Mackinaw Storage Pathology Trial (Bins 8 and 9)

Dr. Jaime Willbur used Bins 8 and 9 to study Mackinaw performance after a stressful growing season in 2020 and evaluated the disease susceptibility to various storage pathogens. Commercial applications of SaniDate were also evaluated as method of reducing storage disease incidence. Agronomic data for these bins is identical to that of Bin 1 and 2. For further information on the pathology results from this study, please see the research report from the Willbur lab. This report deals with storge and chip quality.

## Results

## Bulk Bin 8, Mackinaw, ($GDD_{40}$ 3240, 48ºF)

Bulk Bin 8 was loaded on October 14th and cooled to the target temperature of 48ºF by December, where it remained for the duration of storage (Figure 34). CIPC was applied on November 12th and February 19th. Sucrose concentrations remained elevated during storage as in Bins 1 and 2, ending at 0.888 (X10) on June 14th. Glucose was initially high but stabilized between 0.001% and 0.002% by late February. There was one instance of undesirable color, 4.7%, observed on March 1st. Total defects were initially high, but generally decreased beginning in March. The last sample had 21.7% defects. No pressure bruising was conducted on this bin. See Figure 35 for images of the first and last chip sample.

The bin was unloaded on 6/14/21, and the tubers were shipped to Snyder Lance. A sample of potatoes was also chipped at Sackett Potatoes on 6/14/21 (Figure 36). Sackett Potatoes reported a specific gravity of 1.092 and Frito-Lay score of 18.9. The tubers were processed on 6/16/21 at Snyder Lance (Figure 37).

Table of Contents

Figure 34. Loading Bulk Bins 8 and 9 on 10/14/20.

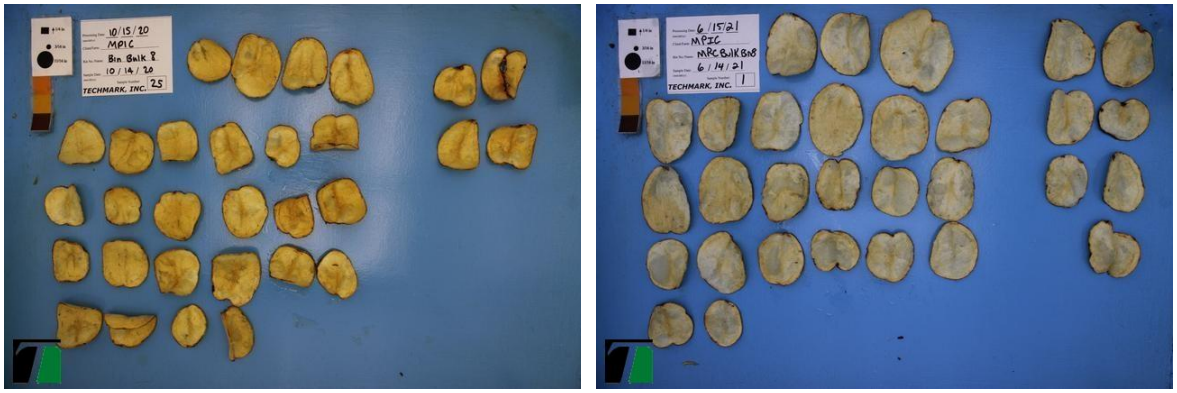



Figure 35. Bulk Bin 8 first chip sample on 10/14/20 and last chip sample on 6/14/21.

Table of Contents

Figure 36. Chips processed from Bin 8 at Sackett Potatoes on 6/14/21.

Figure 37. Chips processed at Snyder Lance on 6/16/21.

Table of Contents

## Bulk Bin #9, Mackinaw, ($GDD_{40}$ 3248, 48ºF)

Bulk Bin 9 was loaded on the same day as Bin 8, 10/14/20 (Figure 34). It had the same target temperature as Bin 8 and reached 48ºF by December 2020. It was held at this temperature until June but rose to 56.4ºF at bin unloading. As in the other three bins of Mackinaw, sucrose concentrations were initially high, but decreased beginning in late February. Sucrose concentrations at bin unloading were lower than those in Bin 8. Glucose concentrations were initially high, but decreased in March, ending the storage season at 0.002%. There was one incidence of undesirable color on 3/1/20, 6.2%. Total defects were initially high, with 62.6% defects on 11/16/20 (Figure 38). Percent defects fluctuated but remained below 50% for the rest of storage. Techmark observed slight to severe stem end defect from the beginning of storage until April and bruising in most samples. At bin unloading, there were 35.6% defects. As in Bin 8, no tuber weight loss or bruising was calculated.

Sackett Potatoes processed a sample of potatoes and calculated a specific gravity of 1.087 and Frito lay solids of 17.98 (Figure 39). The raw tubers were transported to Great Lakes Potato Chips, Traverse City, Michigan (Figure 40). A random sample of cut tubers showed good internal quality with some stem end defect and bruising (Figure 41). The potatoes were cooked, sorted, and bagged (Figure 42). A sample of unsorted chips was sent to the Potato Outreach Program, where staff sorted the chips by defect type. There were 83% acceptable chips, 14% internal defects, two percent external defects, and one percent greening defects (Figure 43).

Figure 38. Chip samples from Bin 9 taken 10/14/20, 11/16/20, and 6/14/21.

Table of Contents

Figure 39. Chips processed from Bin 9 at Sackett Potatoes on 6/14/21.

Figure 40. Raw tubers at Great Lakes Potato Chips on 6/15/21.

Table of Contents


Figure 41. A random sample of cut tubers at Great Lakes Potato Chips showed some stem end defect and bruising.

Figure 42. Cooked, unsorted potato chips from Bin 9 at Great Lakes Potato Chips on 6/15/21.

Table of Contents

Figure 43. Chips sorted by the Potato Outreach Program identified 83% acceptable chips (left), 14% internal defects (top right), two percent external defects (middle right), and one percent greening defects (bottom right).

Table of Contents

# 2020-2021 MICHIGAN RUSSET POTATO STORAGE REPORT MICHIGAN POTATO INDUSTRY COMMISSION

*Chris Long, Coordinator, Trina VanAtta, and Damen Kurzer*

## Introduction and Acknowledgements

Russet potatoes are primarily grown for fresh market use in Michigan or are stored and later sold as tablestock russets for fresh use. There has been industry and commercial interest in exploring storage potential of several standard russet varieties in Michigan to evaluate fry color and sugar defects of commercial varieties after time in storage. There are many variety trials underway in Michigan that are evaluating russet varieties for yield, solids, disease resistance, and desired tuber size profile with the hope of exhibiting the positive attributes of these lines to growers and processors. The information in this report allows the industry to make informed decisions about the value of adopting russet storage practices in Michigan.

Please see the Michigan Potato Demonstration Storage Annual Report for detailed information on the facilities at the Montcalm Research Center and weather data in during the 2020 growing season.

The Ben Kudwa Building, built in 2008, has three independently ventilated, 600 cwt. bulk bins. The first of these bulk bins, bin 7, was converted to box bin storage that holds 36, 10 cwt. box bins to provide storage profiles on early generation potato varieties. The box bin is an entry point into storage profiling that allows the industry to learn about a varieties' physical and chemical storability. All russet storage took place in the box bin from 2020 to 2021. A storage profile consists of monthly sampling of potatoes to obtain: sucrose and glucose levels, Munsell color score, and sugar end defects. With this information, we can create the storage profile of a variety, providing the industry with a clearer picture of where a line can or cannot be utilized. The Michigan potato industry hopes to use these storage profiles to improve in areas such as long-term storage quality, deliverability of product and, ultimately, sustained market share.

The storage facility, and the work done within it, is directed by the MPIC Storage and Handling Committee and Michigan State University (MSU) faculty. The funding and

Table of Contents

for this facility, and the research conducted within it, is largely derived from the MPIC. The committee occasionally receives support for a given project from private and/or public interests.

We wish to acknowledge all the support and investment we receive to operate and conduct storage research. First, we express our gratitude for the partnership we enjoy between the MPIC and Michigan State University. Thank you to the MPIC Storage & Handling Committee for their investment of time, guiding the decisions and direction of the facility. Special thanks to Butch Riley (Gun Valley Ag. & Industrial Services, Inc.) for his annual investment in the sprout treatment of the storage facility. We would also like to acknowledge a long list of additional contributors who invested much time to help foster a quality storage program: Todd Forbush (Techmark, Inc) and Mathew Klein (Farm Manager, MSU Montcalm Research Center).

Table of Contents

# I. 2020-2021 Russet Processing Variety Box Bin Report

(Chris Long, Trina VanAtta, Damen Kurzer, and Brian Sackett)

## Introduction

All russet varieties were stored in trays on top of the boxes in Bin 7. The box design allows air to travel in from a header, or plenum wall, through the forklift holes of each box and up through the potatoes within it. The air continues to flow up through the next box until it reaches the top and is drawn off the top of the chamber. The air is then reconditioned and forced back through the header wall plenums and up through the boxes again. Each tray contains tubers from which we sampled for monthly quality evaluations.

## Procedure

In 2020, we evaluated and compared nine russet varieties to the check variety Russet Burbank. Once the varieties were chosen, .5 cwt. of the varieties were planted in a single 34-inch wide row. Planting occurred on May 7$^{th}$ at the MSU, Montcalm Research Center, Entrican, MI. We planted the varieties at a 10" in-row seed spacing. All varieties received fertilizer in the rates of: 273 lb. N/A, 98 lb $P_2O_5$/A and 261 lb $K_2O$/A. The varieties were vine killed after 116 days and allowed to set skins for 21 days before harvest on September 21$^{st}$ and 22$^{nd}$ 2020; which was 137 days after planting. We did not account for variety maturity in harvest timing due to storage and handling restrictions.

We placed approximately .5 cwt. of each variety in each tray on top of the boxes in bin 7. The average storage temperature for all the box bins (box bin 7) was 54.0ºF for the 2020-2021 season. We describe the varieties, their pedigree and scab ratings in Table 1. We also recorded yield, size distribution, chip quality, and specific gravity at harvest in Table 2. We graded the varieties to remove all "B" size tubers and pick-outs, ensuring the tubers began storage in good physical condition.

The storage season began in September, with the first samples collected on September 21$^{st}$, and ended June 7$^{th}$, 2021. Bin 7 was gassed with CIPC on October 1$^{st}$ and February 19th. We randomly selected forty tubers from each box every month and sent them to Techmark, Inc. for

Table of Contents

sucrose, glucose, and color rating using the Munsell Color Standard "Color Standards for Frozen French Fried Potatoes (Figure 1)."

Please contact Chris Long at Michigan State University in the Department of Plant, Soil and Microbial Sciences for additional information at (517) 355-0277 or longch@msu.edu. Additional data is available on the program website, canr.msu.edu/potatooutreach.


Figure 1. The Munsell Color Scale used to evaluate russet potatoes.

Table of Contents

## Table 1. 2020-2021 MPIC Demonstration Russet Box Bin Variety Descriptions

| Entry | Pedigree | 2020 Scab Rating* | Characteristics |
|---|---|---|---|
| Alverstone Russet | CRE98-200 X Innovator | 3.5 | Light russet skin, good internal quality, average tuber size profile, highest yield in 2020 russet trial. |
| AOR11217-3** | A01010-3 X NDA070929B-# | 0.5 | Very uniform type, heavily netted skin, possible scab tolerance/resistance, earlier vine maturity. |
| Clearwater Russet (AOA95154-1) | Bannock Russet X A8915204 | 1.0 | Attractive medium russet type, higher specific gravity, smaller tuber size profile. |
| Dakota Russet (ND8229-3) | Marcy X AH66-4 | 2.0 | Moderate alligator hide, slight hollow heart, very high specific gravity, below average yield. |
| MN13142-32 | University of Minnesota | 2.0 | Long type with tubular shape, earlier vine maturity and smaller vine type, high specific gravity and above average yield. |
| Pacific Russet** (VO168-3) | NDA8694-3 X Century Russet | 4.0 | Attractive russet skin, smaller type, severe scab, very low gravity, average yield potential. |
| Ranger Russet (A7411-2) | Butte X A6595-3 | 3.5 | Tubular type, very low yield with smaller tuber size profile, good internal quality. |
| **Russet Burbank**** | **Unknown** | **3.0** | **Tubular type, many misshapen tubers, slight brown center, below average yield, mid-season maturity.** |
| Sunset Russet** (TX13590-9RUS) | ND9687-3Ru x ND9852-1Ru | 3.5 | Bottlenecking and misshapen tubers, very high hollow heart, early vine maturity, above average pickouts. |
| Umatilla Russet (AO82611-7) | Butte X A77268-4 | 0.5 | Medium russet skin, heavy eyebrows, good internal quality, common scab tolerance, average yield potential. |

*Scab rating based on 0-5 scale; 0 = most resistant and 5 = most susceptible. Common scab data and qualitative descriptions provided by Potato Outreach Program (P.O.P.), MSU Potato Breeding and Genetics Program and other potato breeding programs.

** Denotes variety sampled monthly. All other varieties sampled bi-weekly.

**Bold font indicates a check variety.**

Table of Contents

# Table 2. 2020 Russet Processing Potato Variety Trial
## Montcalm Research Center

Planting: 5/7/20 Vine Kill: 8/31/20 Harvest: 9/21/20 and 9/22/20

$GDD_{40}$: 3335

| | CWT/A | | PERCENT OF TOTAL[1] | | | | | | RAW TUBER QUALITY[3] (%) | | | | COMMON SCAB | VINE | VINE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LINE | US#1 | TOTAL | US#1 | Bs | As | OV | PO | SP GR[2] | HH | VD | IBS | BC | RATING[4] | VIGOR[5] | MATURITY[8]6 | COMMENTS |
| Alverstone Russet | 250 | 387 | 64 | 34 | 62 | 2 | 2 | 1.076 | 0 | 0 | 0 | 0 | 3.5 | 2.5 | 2.5 | light russet skin |
| MN13142-32 | 220 | 360 | 61 | 34 | 61 | 0 | 5 | 1.086 | 0 | 0 | 0 | 0 | 2.0 | 1.5 | 1.0 | long, tubular |
| Sunset Russet | 190 | 310 | 61 | 22 | 60 | 1 | 17 | 1.072 | 70 | 0 | 0 | 0 | 3.5 | 3.0 | 1.0 | bottlenecking |
| AOR11217-3 | 181 | 298 | 61 | 31 | 59 | 2 | 8 | 1.077 | 0 | 0 | 0 | 0 | 0.5 | 2.5 | 1.5 | very uniform, heavy netted skin, possible scab resistance |
| Pacific Russet | 148 | 244 | 61 | 38 | 60 | 1 | 1 | 1.047 | 0 | 0 | 0 | 0 | 4.0 | 2.5 | 1.5 | nice russet skin, smaller type |
| Dakota Russet | 145 | 226 | 64 | 31 | 64 | 0 | 5 | 1.082 | 10 | 0 | 0 | 0 | 2.0 | 1.5 | 2.5 | mod ah |
| Umatilla Russet | 142 | 287 | 50 | 37 | 50 | 0 | 13 | 1.078 | 0 | 0 | 0 | 0 | 0.5 | 2.0 | 2.0 | heavy eyebrows, med russet |
| Clearwater Russet | 102 | 249 | 41 | 56 | 41 | 0 | 3 | 1.079 | 0 | 0 | 0 | 0 | 1.0 | 1.0 | 1.0 | nice med russet type |
| **Russet Burbank** | **97** | **250** | **39** | **52** | **36** | **3** | **9** | **1.066** | **0** | **0** | **0** | **10** | **3.0** | **3.0** | **3.0** | **tubular, misshapen** |
| Ranger Russet | 84 | 247 | 34 | 56 | 34 | 0 | 10 | 1.079 | 0 | 0 | 0 | 0 | 3.5 | 3.0 | 3.5 | tubular |
| **MEAN** | **156** | **286** | **54** | **39** | **53** | **1** | **7** | **1.074** | **8** | **0** | **0** | **1** | **2.4** | **2.3** | **2.0** | |

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

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

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

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

**[5]VINE VIGOR RATING**
Date: 6/18/20
Rating 1-5
1: Slow emergence
5: Early emergence (vigorous vine, some flowering)

**[6]VINE MATURITY RATING**
Date: 8/31/20
Rating 1-5
1: Early (vines completely dead)
5: Late (vigorous vines, some flowering)

**FIELD DATA**

| | |
|---|---|
| Planting Date | 5/7/20 |
| Vine Kill Date | 8/31/20 |
| Harvest Date | 9/21/20 and 9/22/20 |
| Days (planting to vine kill) | 116 |
| Days (planting to harvest) | 137 |
| $GDD_{40}$ MAWN Station | Entrican |
| $GDD_{40}$ (planting to vine kill) | 3335 |
| Seed Spacing | 10" |

## Results: 2020-2021 Russet Processing Box Bin Highlights

For each of the nine varieties and one standard variety, we summarize storage performance, display images of fried potatoes, and display graphs of glucose and sucrose concentrations compared to Russet Burbank. We also summarize the percentage of excellent (Munsell scores 0 and 1), acceptable (Munsell score 2), and unacceptable (Munsell scores 3 and 4) fries at each sample. Finally, we compare the percent of sugar end defects.

Table of Contents

**Alverstone Russet:** This variety was evaluated twice monthly until June, when the storage season ended. It had a consistently low glucose percentage, with all values at or below 0.01% (Figure 2). Sucrose concentrations were also lower than those of Russet Burbank, and followed a generally U-shaped trend of initially decreasing through November, remaining stable through March, and then increasing through June (Figure 3). Four percent sugar ends were observed in the November 2nd sample (Figure 4). Fry quality was excellent at all samples, with only three samples containing less than ten percent acceptable fries (Figure 5).

**Table 3.** Alverstone Russet bi-monthly fry quality pictures from Techmark Inc.

| Month | | | |
|---|---|---|---|
| 9/21 |  | 11/16 |  |
| 10/19 |  | 11/30 |  |
| 11/2 |  | 12/15 |  |

Table of Contents

| | | | |
|---|---|---|---|
| 1/4 |  | 3/15 |  |
| 1/18 |  | 4/5 |  |
| 2/1 |  | 4/19 |  |
| 2/15 |  | 5/10 |  |
| 3/1 |  | 5/24 |  |

Table of Contents

| | |
|---|---|
| 6/7 |  |

**Figure 2**. Alverstone Russet glucose concentrations for the 2020-2021 storage season compared to Russet Burbank.

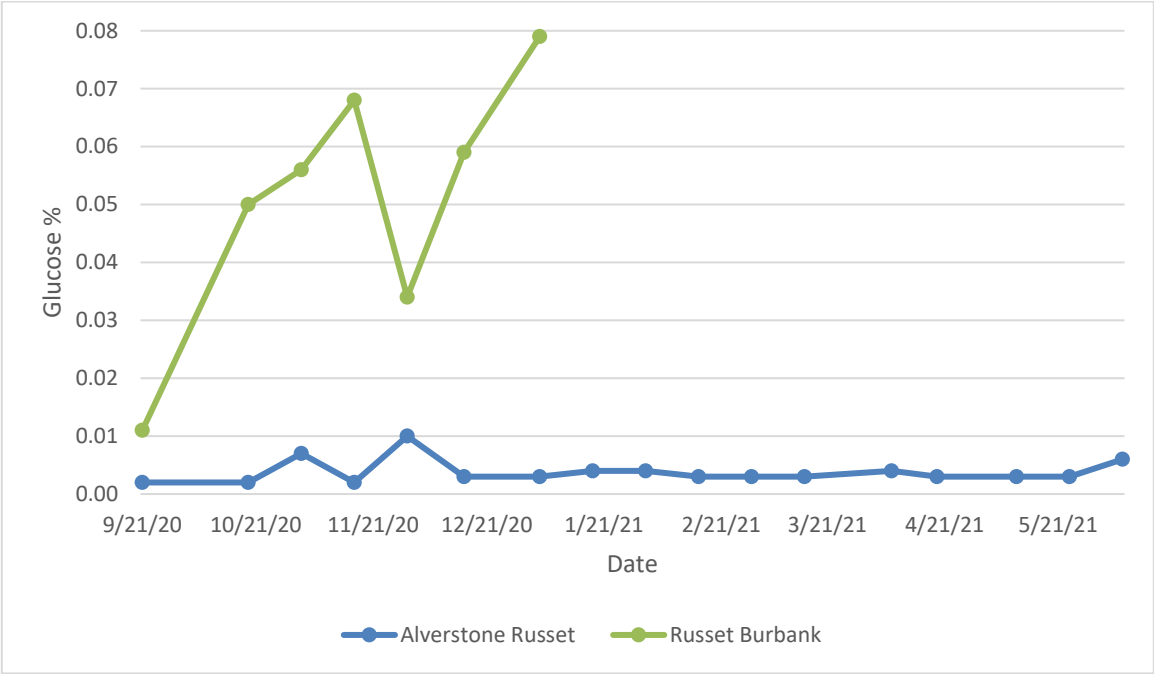



Table of Contents

**Figure 3.** Alverstone Russet sucrose concentrations for the 2020-2021 storage season compared to Russet Burbank.

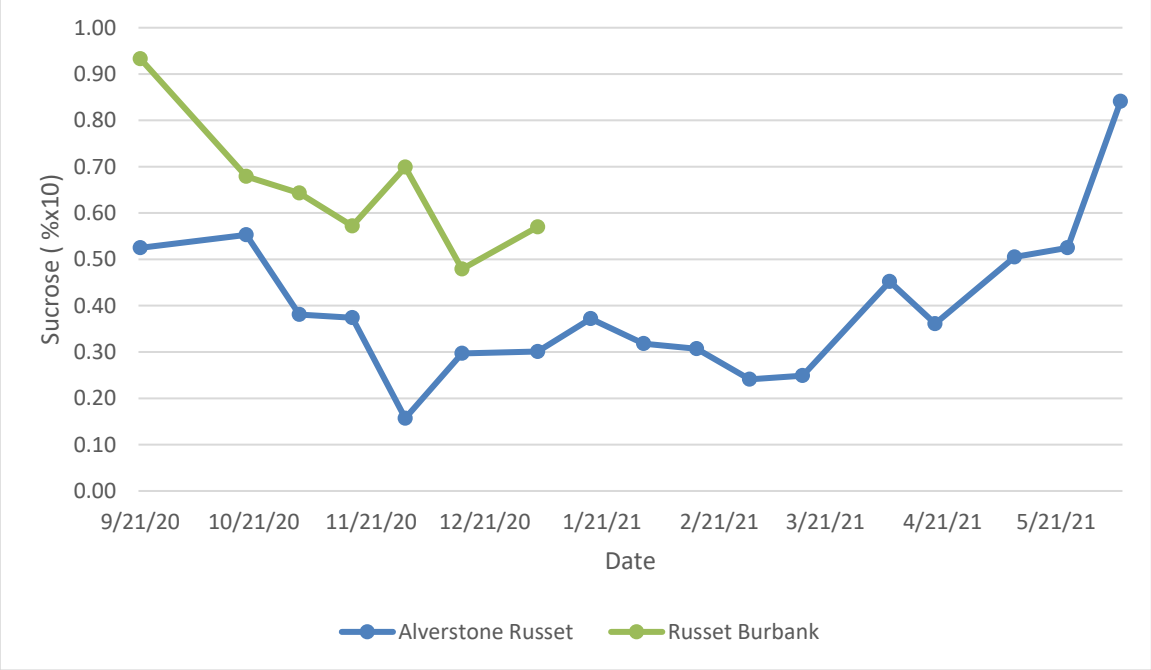



**Figure 4**. Alverstone Russet percent sugar ends for the 2020-2021 storage season compared to Russet Burbank.

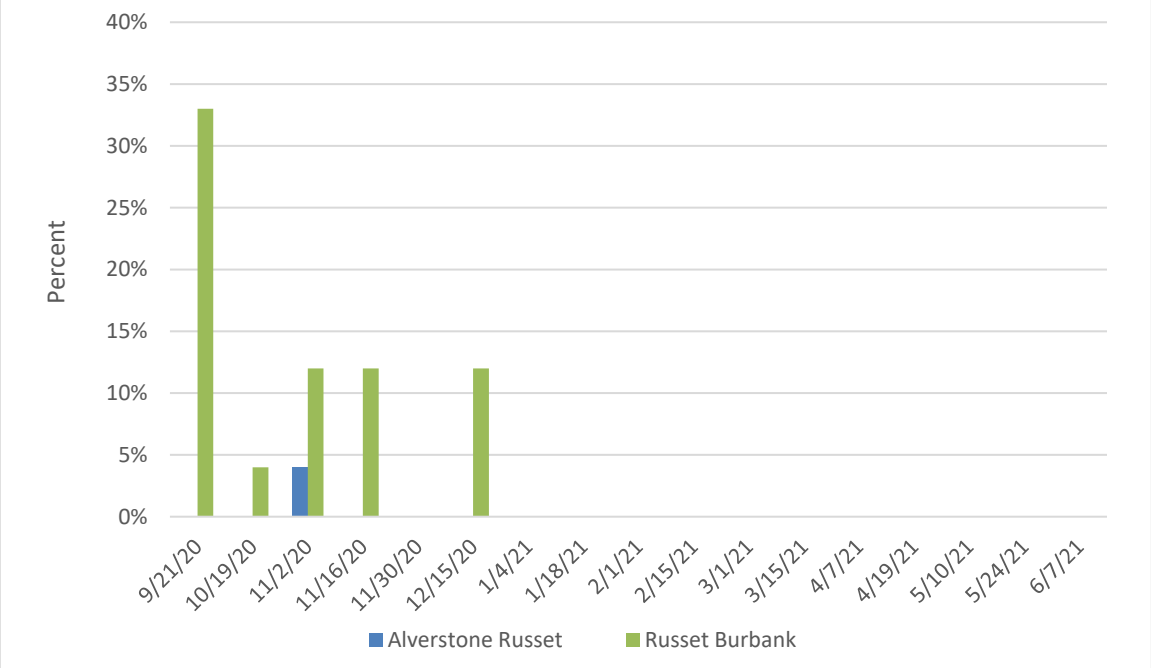



Table of Contents

**Figure 5**. Alverstone Russet percent fry color for the 2020-2021 storage season. Fry quality is: excellent (Munsell scores 0 and 1), acceptable (Munsell score 2), and unacceptable (Munsell scores 3 and 4).

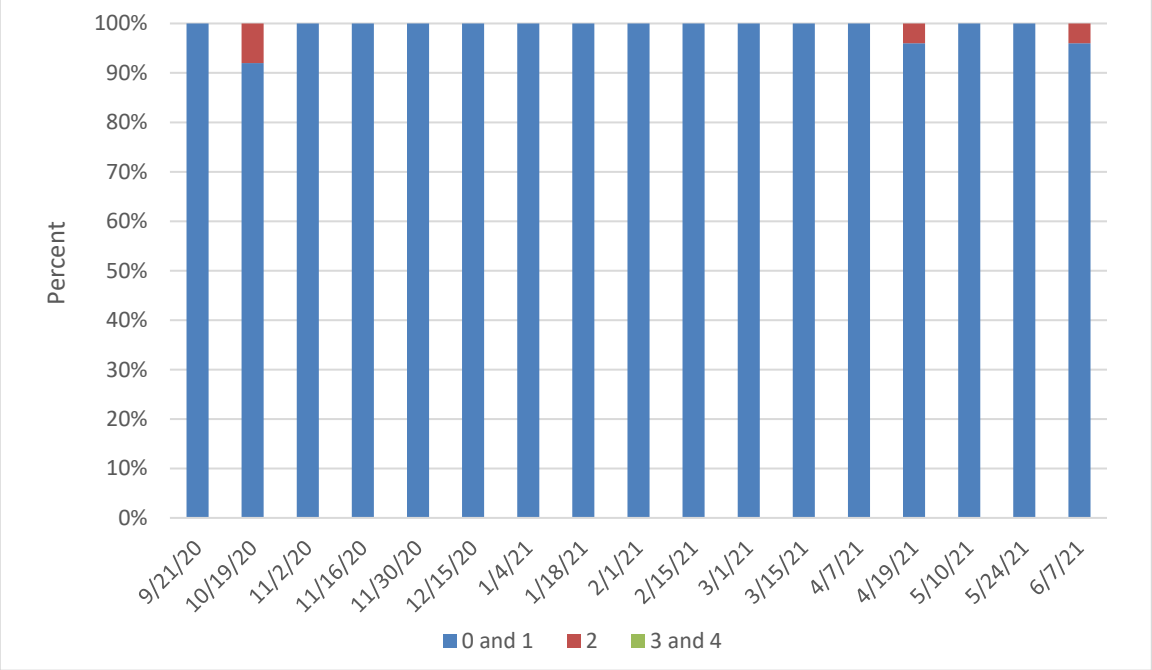



Table of Contents

**AOR11217-3:** This variety was evaluated monthly through May. The storage glucose profile was lower than that of Russet Burbank, but the sucrose concentrations were consistent with those of the check until they rose steeply in April (Figures 6 and 7). Sugar ends were observed in six of the eight samples at 18% or lower (Figure 8). At least half of the fries were rated with excellent color at each sample, but both April samples contained at least four percent unacceptable fries (Figure 9).

**Table 4.** AOR11217-3 monthly fry quality pictures from Techmark Inc.

| Month | | Month | |
|---|---|---|---|
| 9/21 |  | 2/1 |  |
| 11/2 |  | 3/1 |  |
| 11/30 |  | 4/5 |  |

Table of Contents

| | | | |
|---|---|---|---|
| 1/4 |  | 5/10 |  |

**Figure 6**. AOR11217-3 glucose concentrations for the 2020-2021 storage season compared to Russet Burbank.

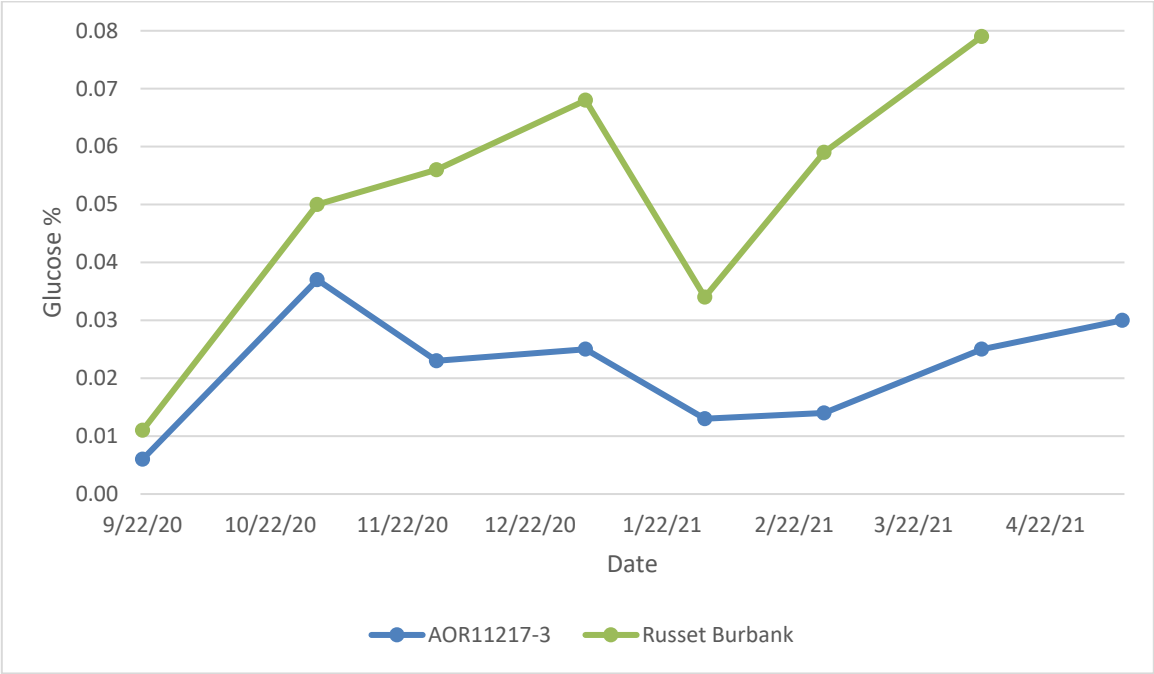



Table of Contents

**Figure 7**. AOR11217-3 sucrose concentrations for the 2020-2021 storage season compared to Russet Burbank.

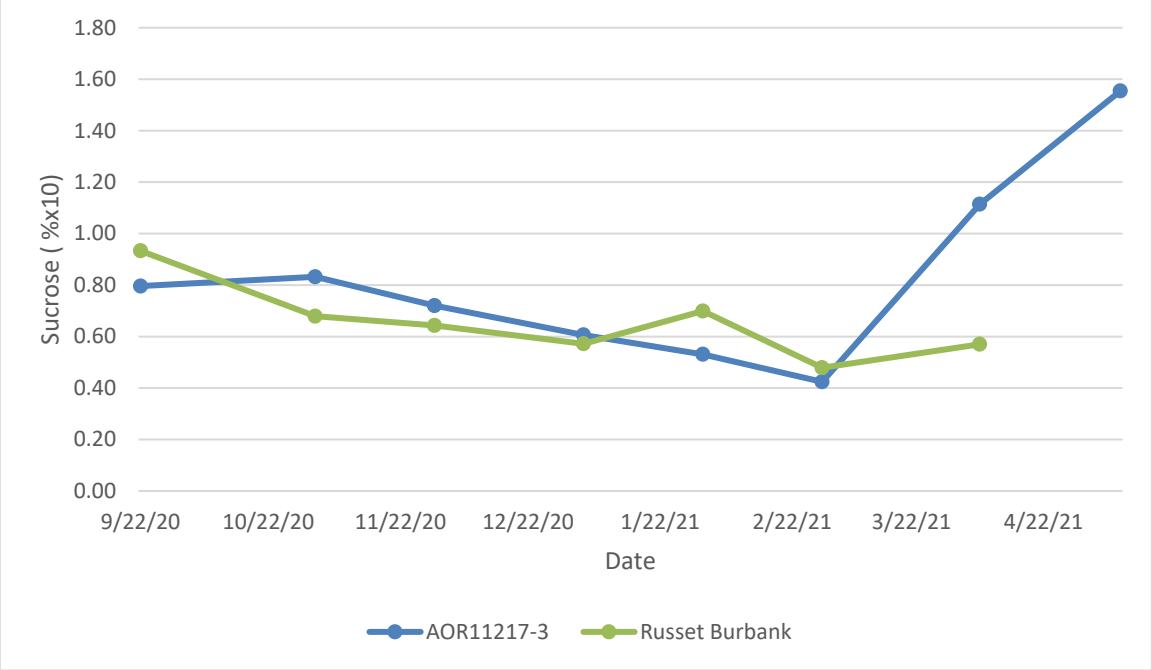



**Figure 8**. AOR11217-3 percent sugar ends for the 2020-2021 storage season compared to Russet Burbank.

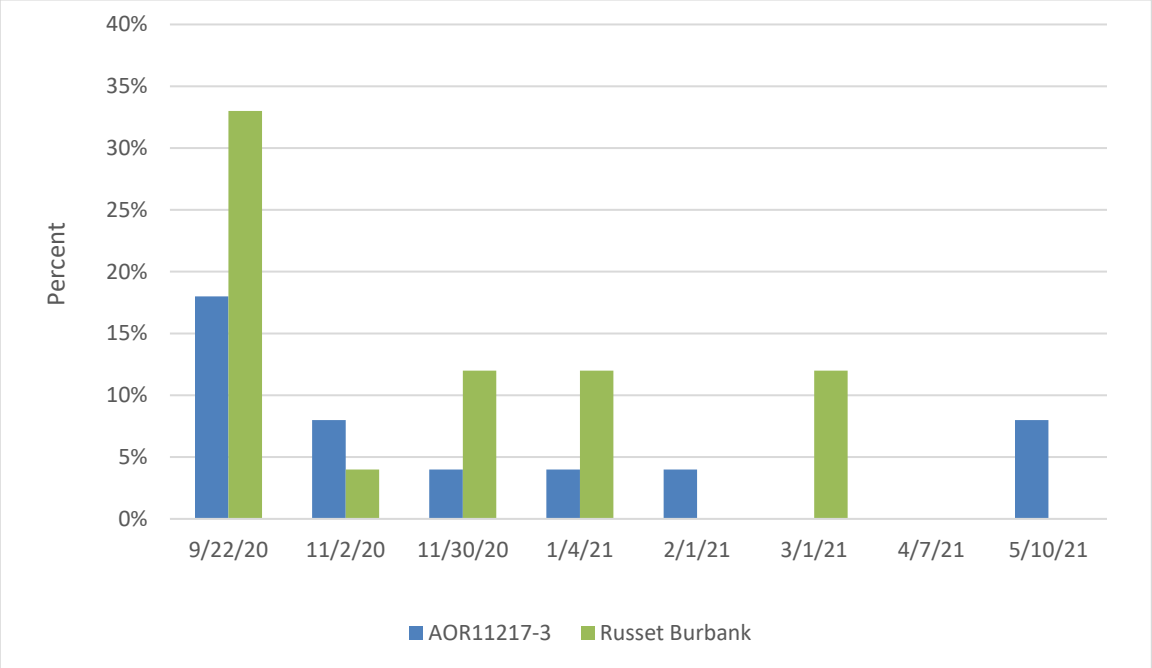



Table of Contents

**Figure 9**. AOR11217-3 percent fry color for the 2020-2021 storage season. Fry quality is: excellent (Munsell scores 0 and 1), acceptable (Munsell score 2), and unacceptable (Munsell scores 3 and 4).

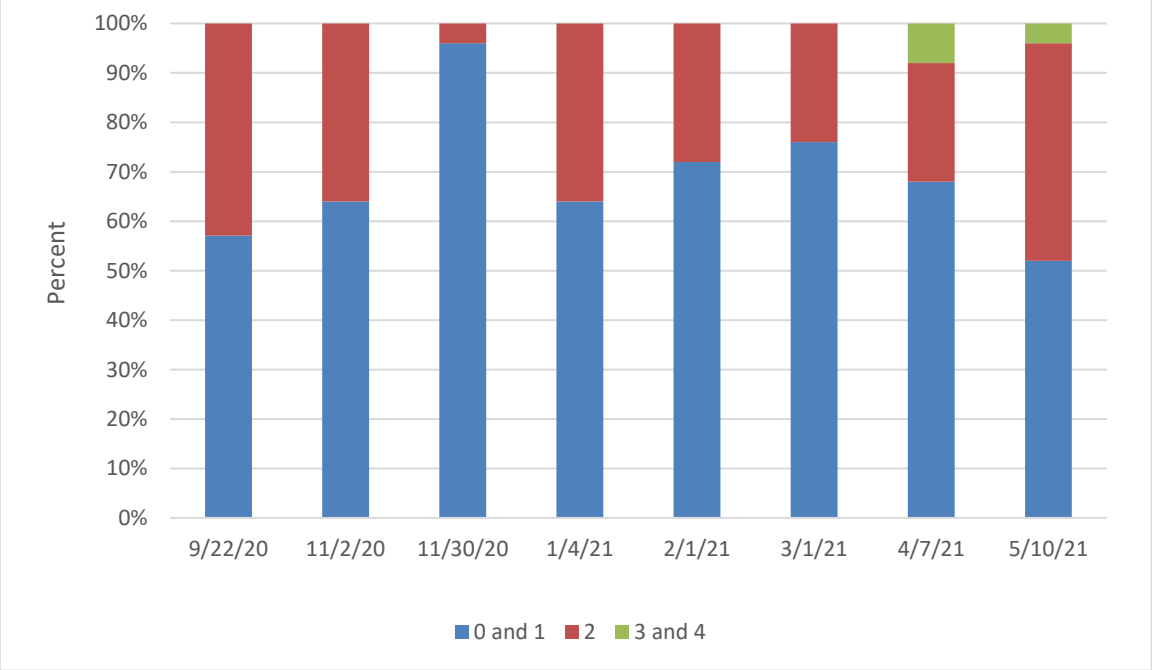



Table of Contents

**Clearwater Russet:** This variety was evaluated bi-monthly through the end of storage. The storage glucose initially fluctuated through November, but then followed a decreasing trend through June, ending at 0.009% glucose (Figure 10). The sucrose profile was consistent with that of Russet Burbank, decreasing though January and then fluctuating until the end of storage (Figure 11). Sugar ends were observed in seven samples, with the first three samples containing at least 10% sugar ends (Figure 12). Fry quality was variable for the first four samples, but improved during storage with the last two samples containing only excellent fries (Figure 13).

**Table 5.** Clearwater Russet bi-monthly fry quality pictures from Techmark Inc.

| Month | | | |
|---|---|---|---|
| 9/21 |  | 11/30 |  |
| 10/19 |  | 12/15 |  |
| 11/2 |  | 1/18 |  |

Table of Contents

| | | | |
|---|---|---|---|
| 11/16 |  | 2/1 |  |
| 2/15 |  | 4/19 |  |
| 3/1 |  | 5/10 |  |
| 3/15 |  | 5/24 |  |
| 4/5 |  | 6/7 |  |

Table of Contents

**Figure 10:** Clearwater Russet glucose concentrations for the 2020-2021 storage season compared to Russet Burbank.

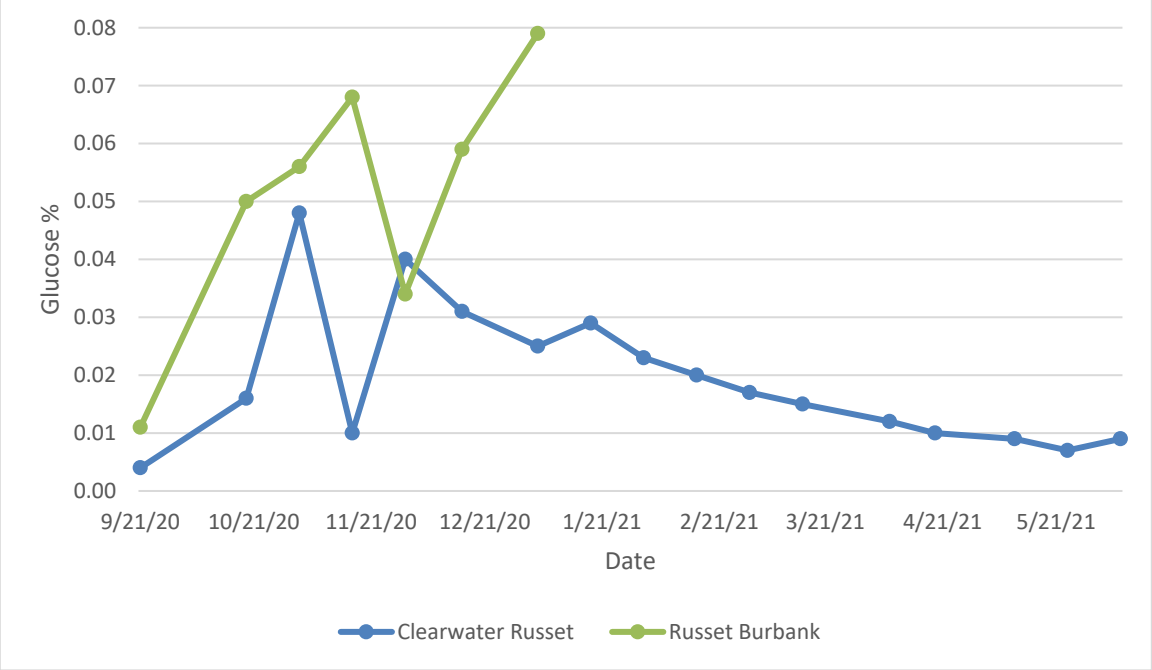



**Figure 11:** Clearwater Russet sucrose concentrations for the 2020-2021 storage season compared to Russet Burbank.

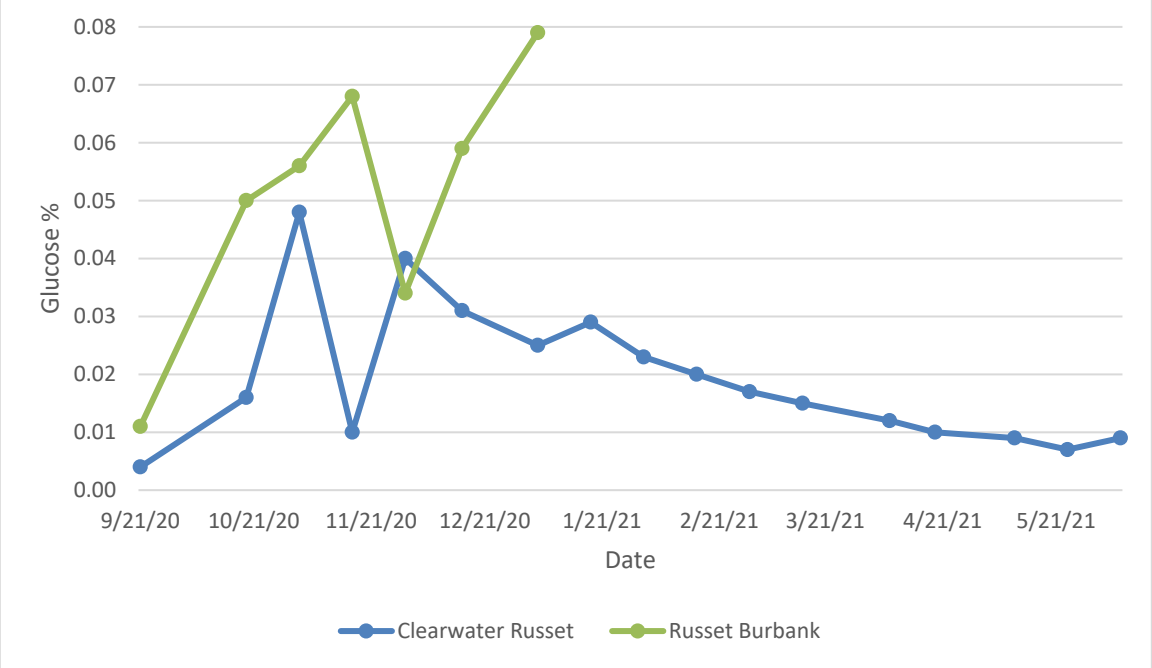



Table of Contents

**Figure 12:** Clearwater Russet sugar end percentages for the 2020-2021 storage season compared to Russet Burbank.

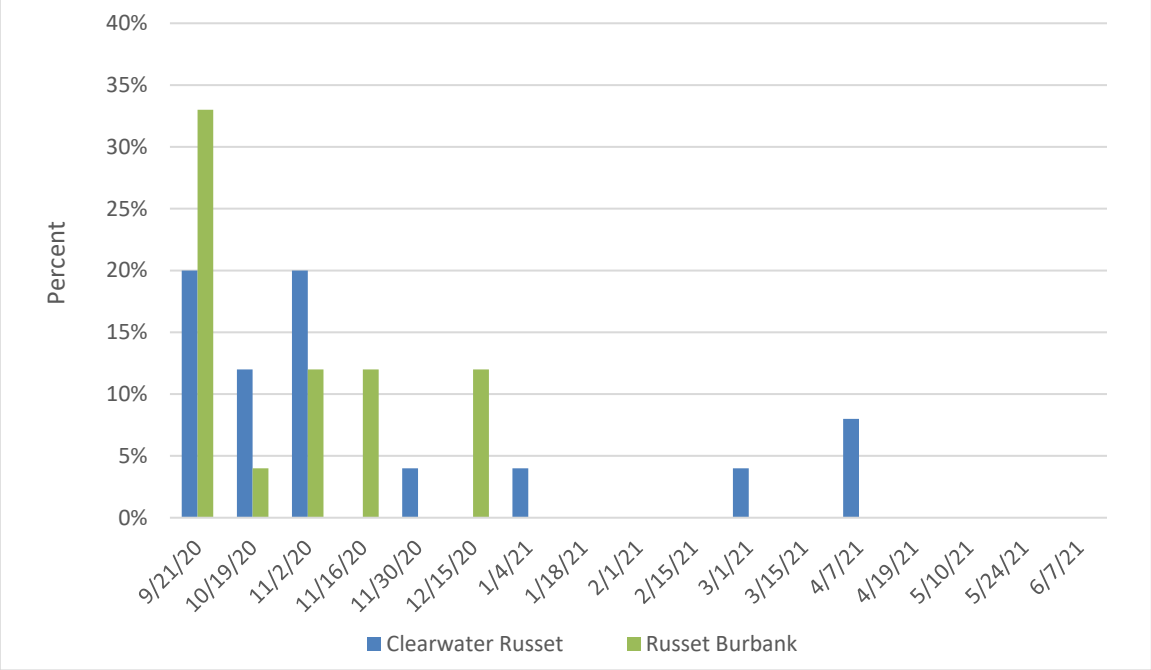



**Figure 13:** Clearwater Russet percent fry color for the 2020-2021 storage season. Fry quality is: excellent (Munsell scores 0 and 1), acceptable (Munsell score 2), and unacceptable (Munsell scores 3 and 4).

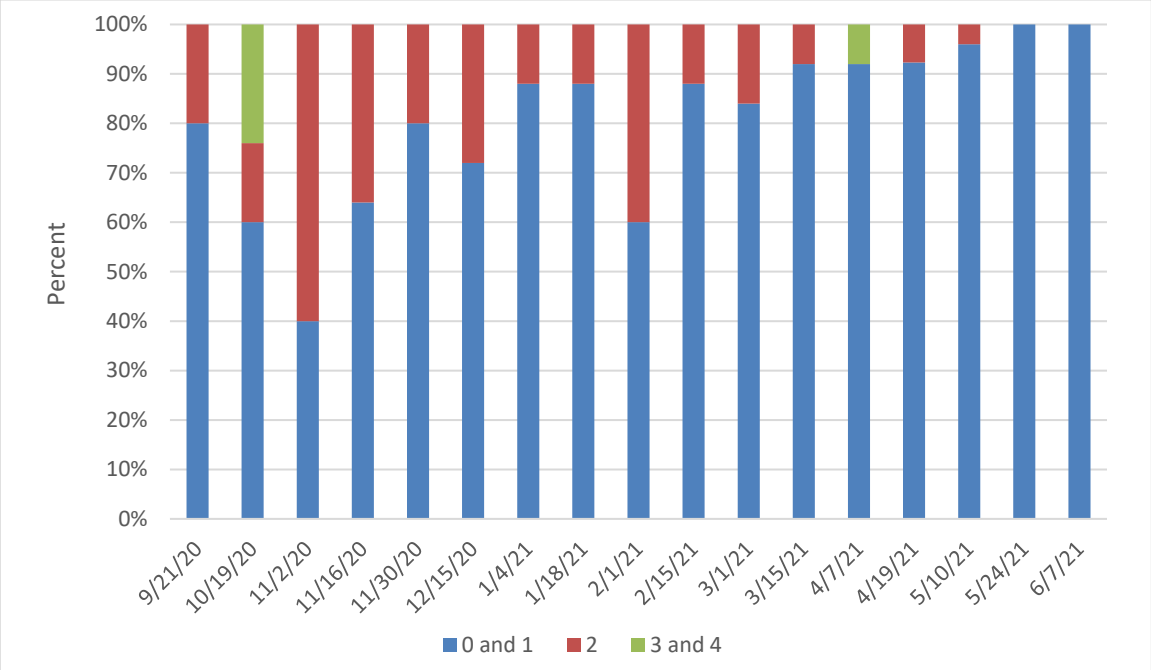



Table of Contents

**Dakota Russet:** This variety was evaluated bi-monthly until June. It had a storage glucose profile like Alverstone Russet, in that is remained low and relatively stable during storage (Figure 14). Sucrose concentrations were more variable, with the lowest concentrations in February and March that then rose though the end of storage (Figure 15). Sugar ends were minimal, with a sample in October and January each displaying less than 10% sugar ends (Figure 16). Fry quality was excellent each month, with all samples containing over 80% excellent fries. Five samples had ten percent or less unacceptable fries (Figure 17).

**Table 6.** Dakota Russet bi-monthly fry quality pictures from Techmark Inc.

| Month | | | |
|---|---|---|---|
| 9/21 |  | 11/16 |  |
| 10/19 |  | 11/30 |  |
| 11/2 |  | 12/15 |  |

Table of Contents

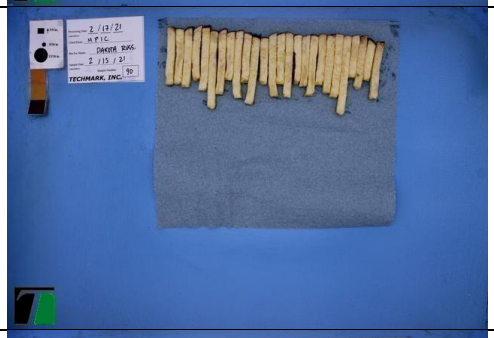
| | | | |
|---|---|---|---|
| 1/4 |  | 3/15 |  |
| 1/18 |  | 4/5 |  |
| 2/1 |  | 4/19 |  |
| 2/15 |  | 5/10 |  |
| 3/1 |  | 5/24 |  |

Table of Contents

| | |
|---|---|
| 6/7 |  |



Table of Contents

**Figure 14:** Dakota Russet glucose concentrations for the 2020-2021 storage season compared to Russet Burbank.

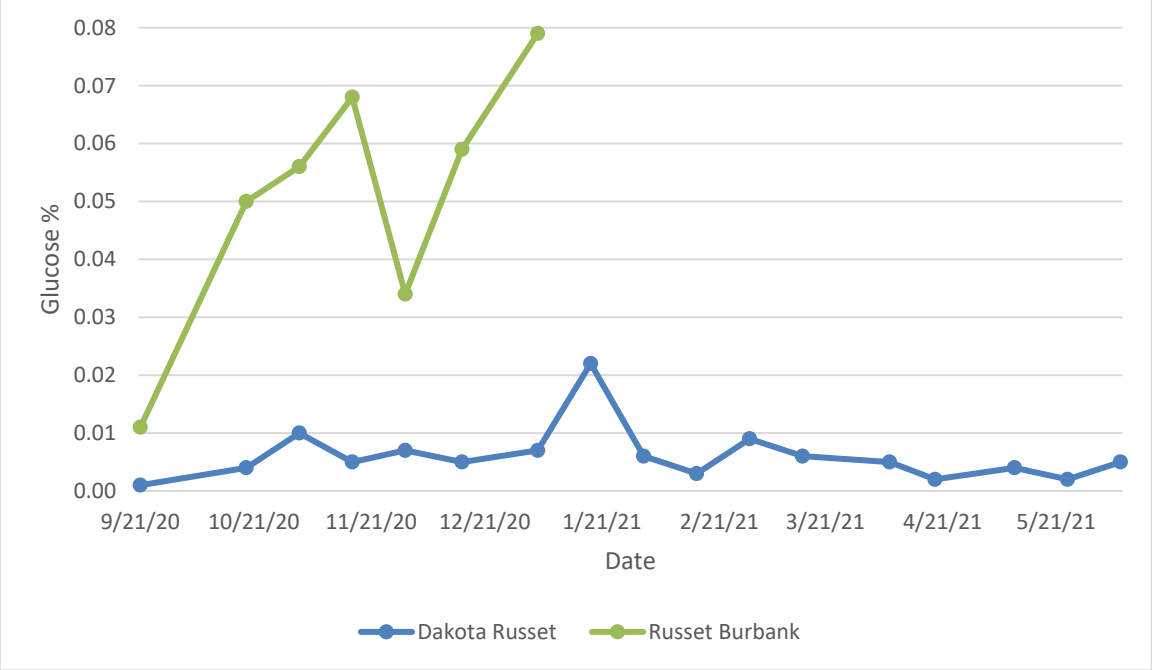



**Figure 15:** Dakota Russet sucrose concentrations for the 2020-2021 storage season compared to Russet Burbank.

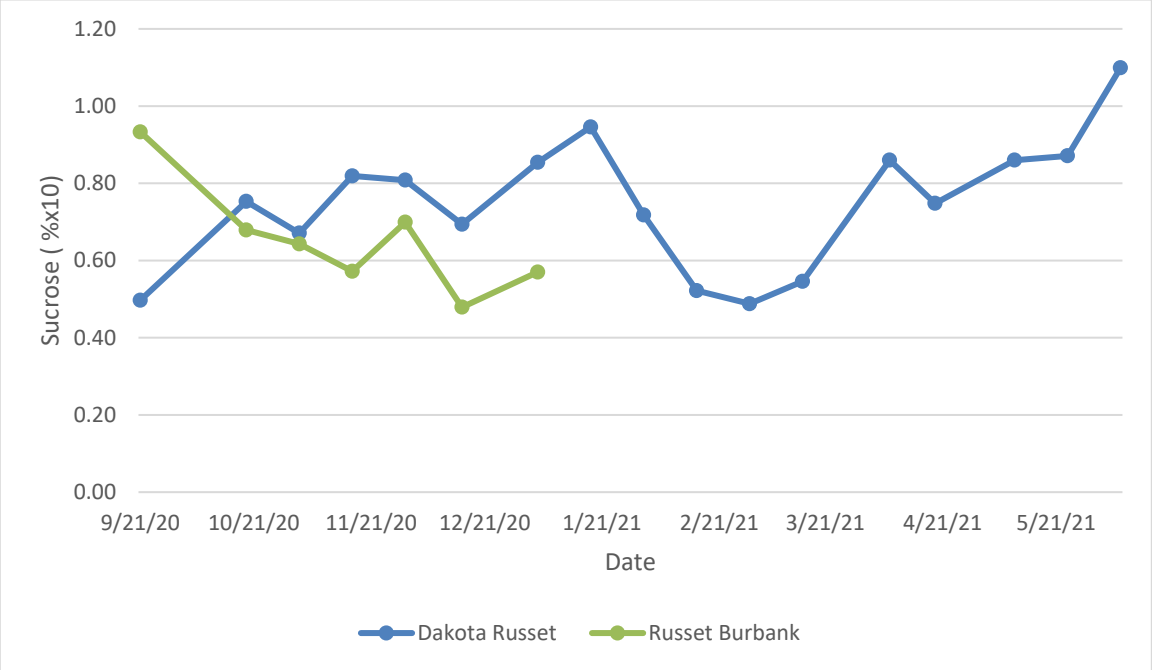



Table of Contents

**Figure 16:** Dakota Russet sugar end percentages for the 2020-2021 storage season compared to Russet Burbank.

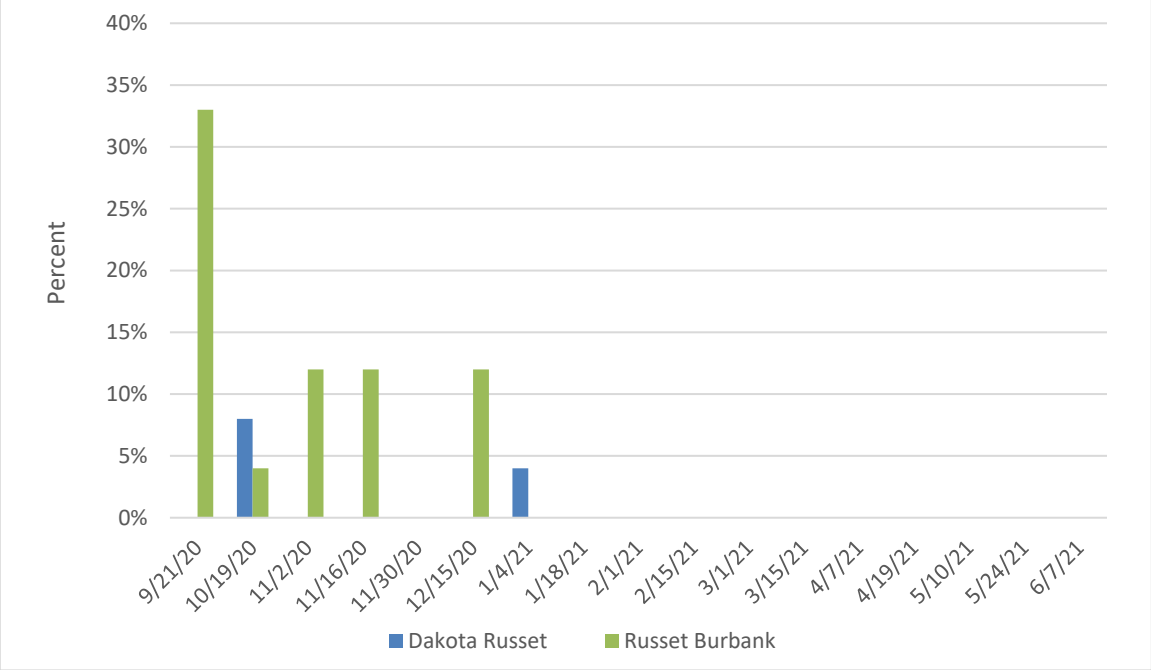



**Figure 17:** Dakota Russet percent fry color for the 2020-2021 storage season. Fry quality is: excellent (Munsell scores 0 and 1), acceptable (Munsell score 2), and unacceptable (Munsell scores 3 and 4).

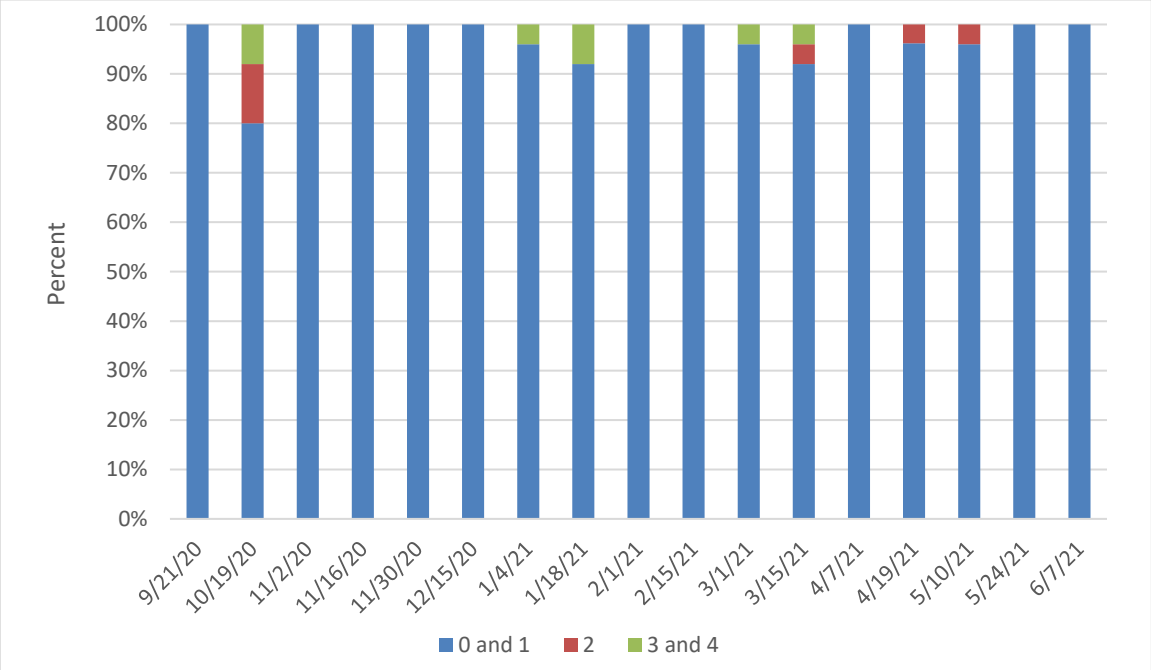



Table of Contents

**MN13142-32:** This variety was evaluated monthly through April. It had a storage glucose profile that rose variably through January and fluctuated through April (Figure 18). The sucrose concentration followed a generally decreasing trend but remained higher than that of Russet Burbank (Figure 19). Seven samples had sugar ends, including the first four samples (Figure 20). Fry quality was excellent to acceptable. The October 19th sample had the worst fry quality with 44% unacceptable fries, while the December 15th sample had the best fry quality with 76% excellent fries (Figure 21).

**Table 7.** MN13142-32 monthly fry quality pictures from Techmark Inc.

| Month | | Month | |
|---|---|---|---|
| 9/21 |  | 11/30 |  |
| 10/19 |  | 12/15 |  |
| 11/2 |  | 1/4 |  |

Table of Contents

| | | | |
|---|---|---|---|
| 11/16 |  | 1/18 |  |
| 2/1 |  | 3/1 |  |
| 2/15 |  | 4/5 |  |

Table of Contents

**Figure 18:** MN13142-32 glucose concentrations for the 2020-2021 storage season compared to Russet Burbank.

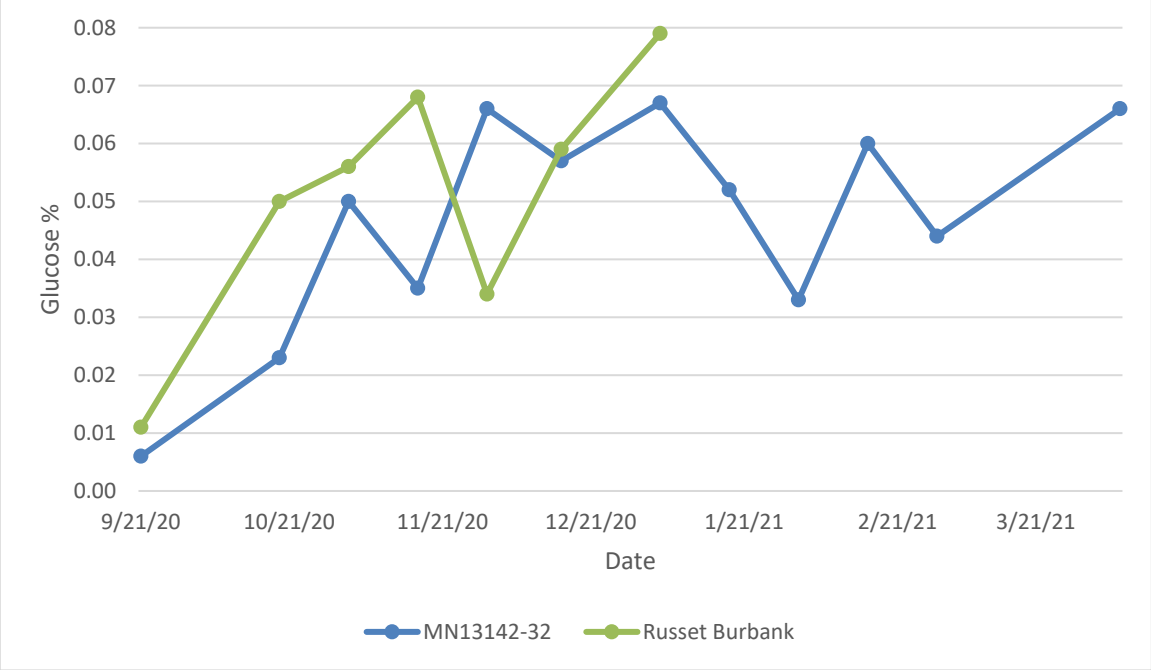



**Figure 19**: MN13142-32 sucrose concentrations for the 2020-2021 storage season compared to Russet Burbank.

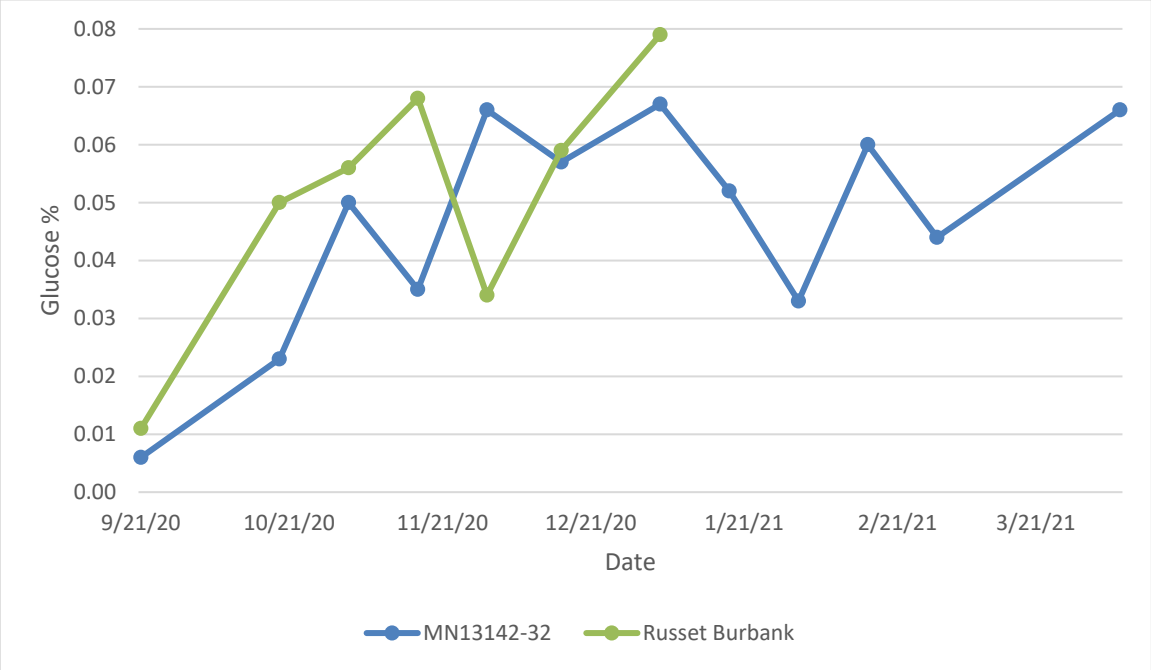



Table of Contents

**Figure 20**: MN13142-32 sugar end percentages for the 2020-2021 storage season compared to Russet Burbank.

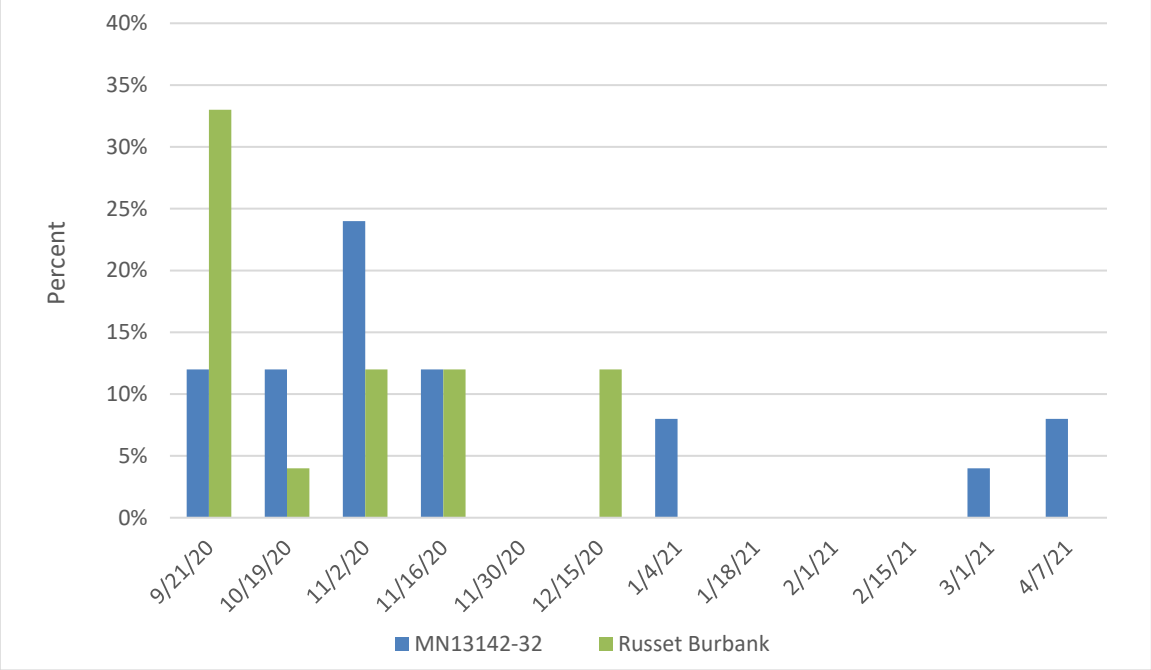



**Figure 21:** MN13142-32 percent fry color for the 2020-2021 storage season. Fry quality is: excellent (Munsell scores 0 and 1), acceptable (Munsell score 2), and unacceptable (Munsell scores 3 and 4).


Table of Contents

**Pacific Russet:** This variety was evaluated monthly through February. Glucose concentrations were higher than those of Russet Burbank in all but one sample (Figure 22). Sucrose concentrations were also higher than those of the check variety in all but the last two samples (Figure 23). Sugar end defects were very high in the variety, with the November sample displaying 52% sugar ends (Figure 24). Fry color was correspondingly marginal to acceptable, with all samples containing less than 60% excellent fries. Each sample contained at least 12% unacceptable fries (Figure 25).

**Table 8.** Pacific Russet monthly fry quality pictures from Techmark Inc.

| Month | | | |
|---|---|---|---|
| 9/21 |  | 1/4 |  |
| 11/2 |  | 2/1 |  |
| 11/30 |  | | |

Table of Contents

**Figure 22:** Pacific Russet glucose concentrations for the 2020-2021 storage season compared to Russet Burbank.

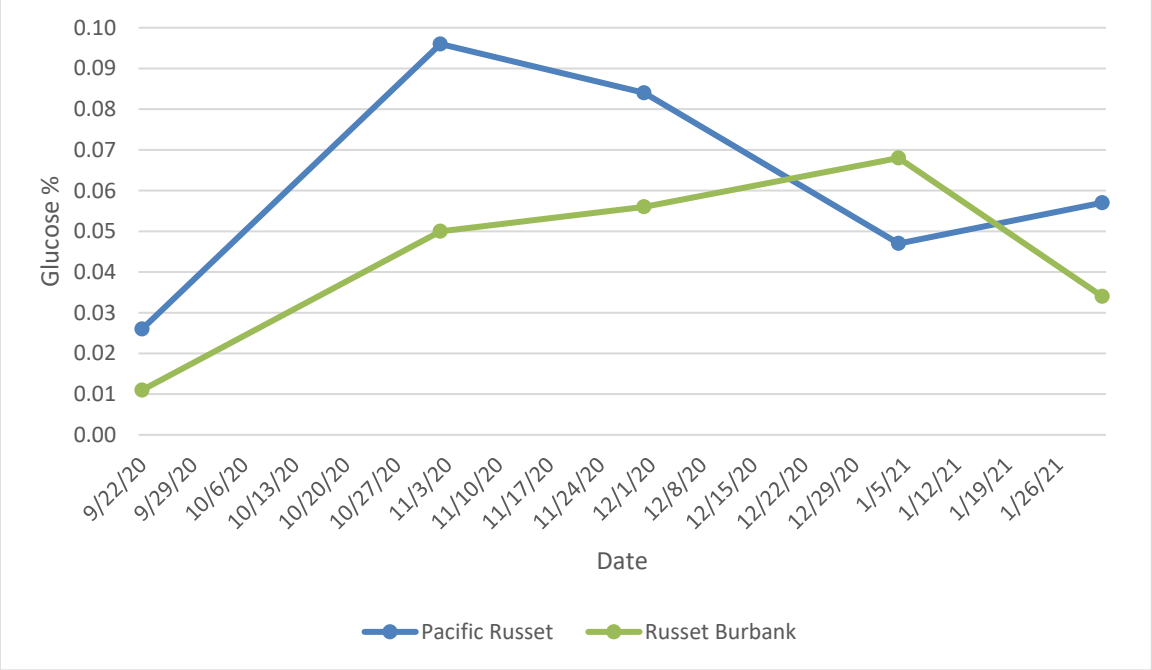



**Figure 23**: Pacific Russet sucrose concentrations for the 2020-2021 storage season compared to Russet Burbank.

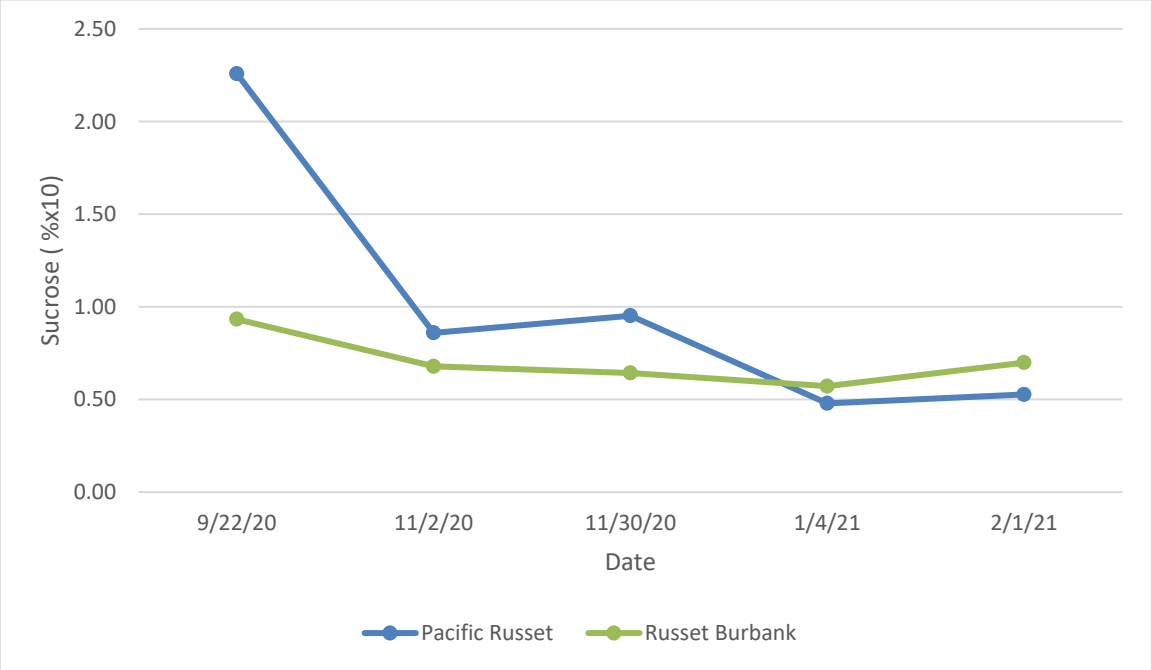



Table of Contents

**Figure 24**: Pacific Russet sugar end percentages for the 2020-2021 storage season compared to Russet Burbank.

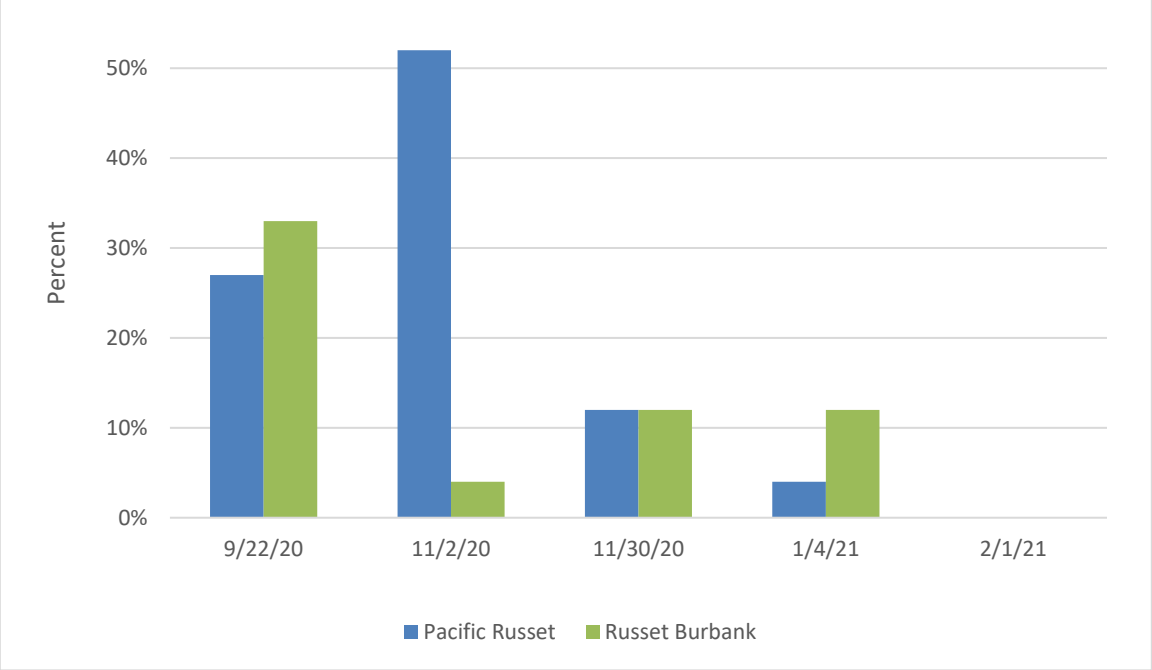



**Figure 25:** Pacific Russet percent fry color for the 2020-2021 storage season. Fry quality is: excellent (Munsell scores 0 and 1), acceptable (Munsell score 2), and unacceptable (Munsell scores 3 and 4).

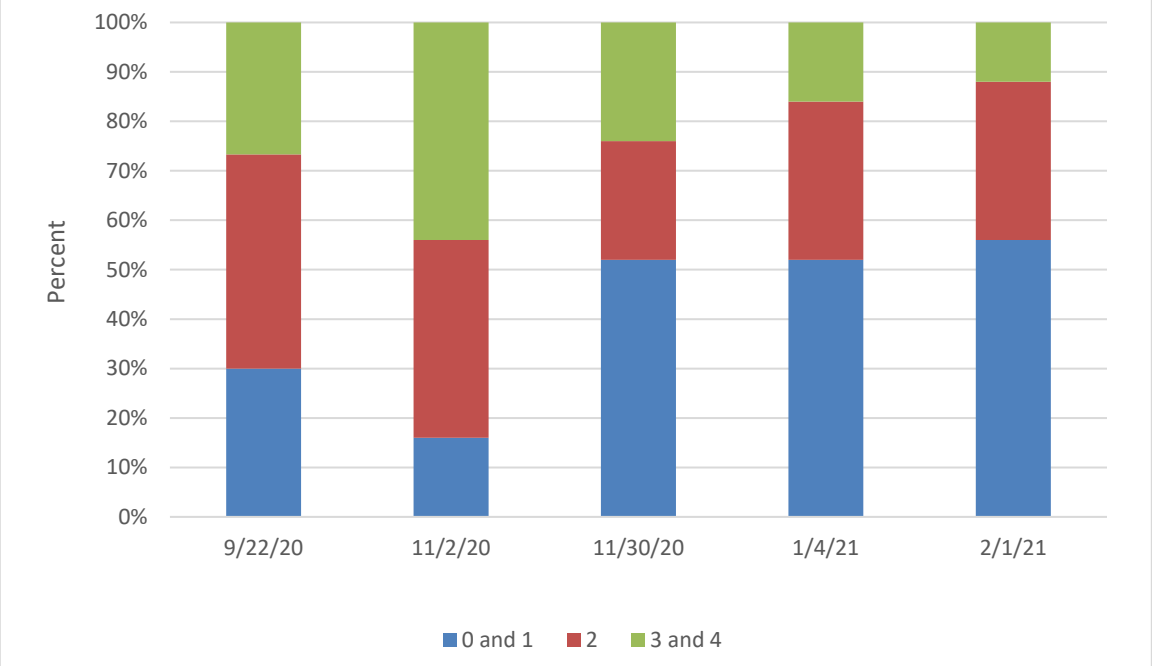



Table of Contents

**Ranger Russet:** This variety was evaluated bi-monthly until February. It had the most variable glucose concentration of all varieties with a range between 0.006% and 0.094% (Figure 26). Sucrose was consistently elevated in storage but followed a generally decreasing trend (Figure 27). Sugar ends were present in the first four and final samples, with the November 2nd sample displaying 32% sugar end defects (Figure 28). Fry color was mainly acceptable, with fewer than 50% excellent chips present in all samples (Figure 29).

**Table 9.** Ranger Russet bi-monthly fry quality pictures from Techmark Inc.

| Month | | | |
|---|---|---|---|
| 9/21 |  | 11/30 |  |
| 10/19 |  | 12/15 |  |
| 11/2 |  | 1/4 |  |

Table of Contents

| | | | |
|---|---|---|---|
| 11/16 |  | 1/18 |  |
| 2/1 |  | | |

**Figure 26:** Ranger Russet glucose concentrations for the 2020-2021 storage season compared to Russet Burbank.

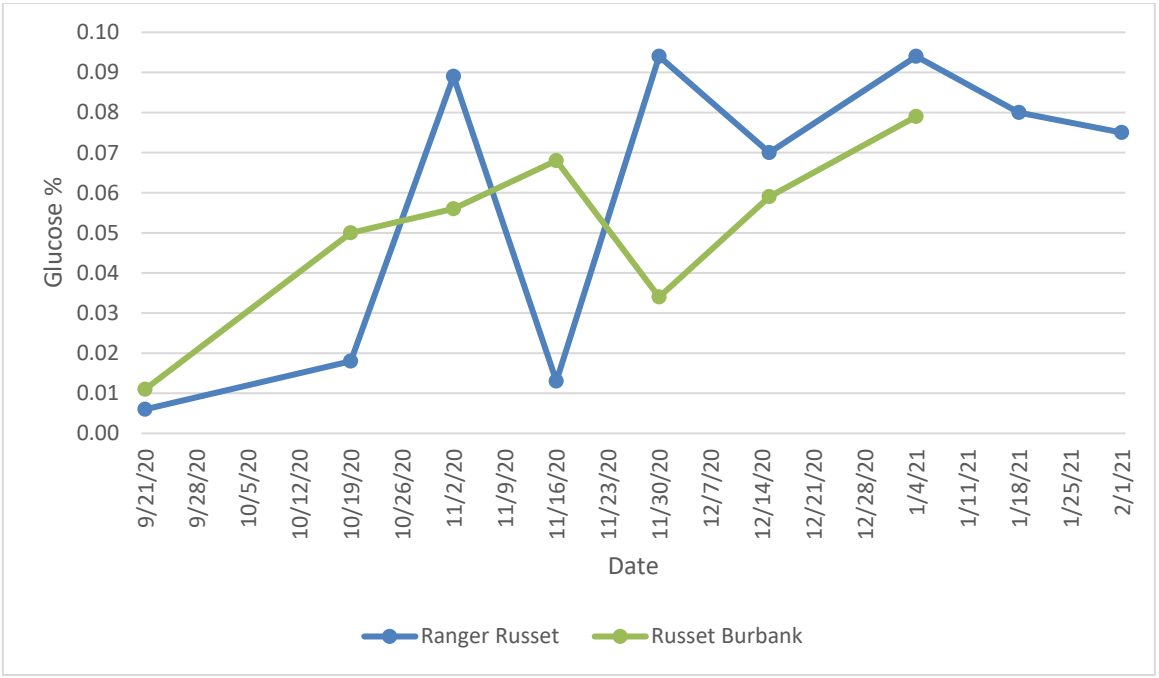



Table of Contents

**Figure 27:** Ranger Russet sucrose concentrations for the 2020-2021 storage season compared to Russet Burbank.

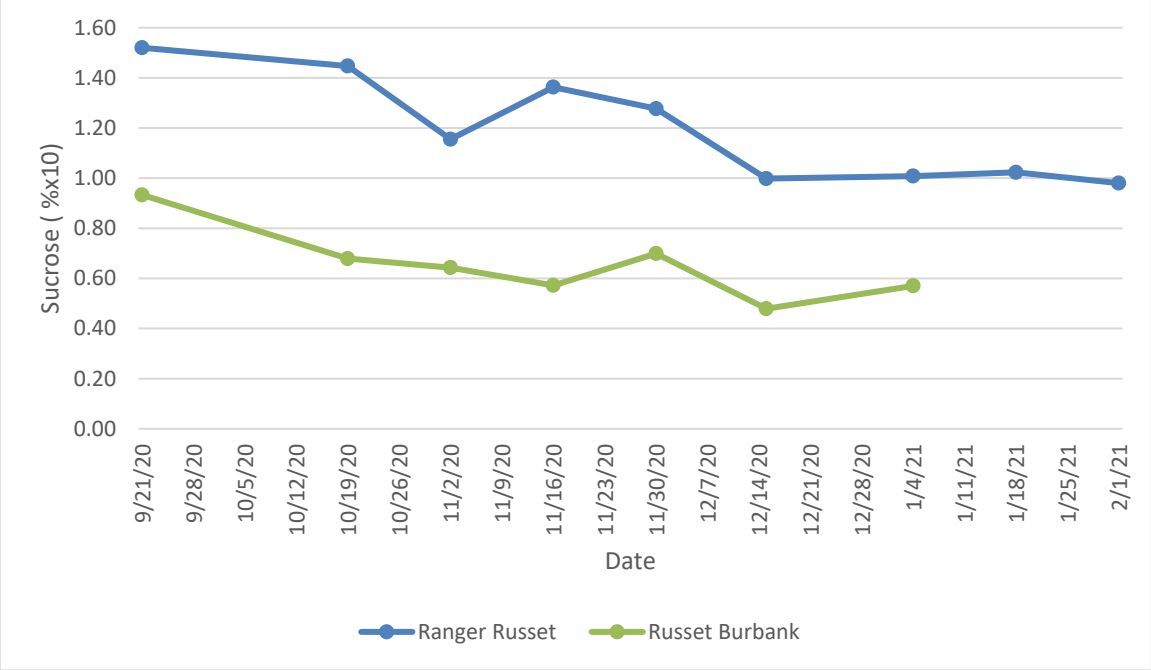



**Figure 28:** Ranger Russet sugar end percentages for the 2020-2021 storage season compared to Russet Burbank.

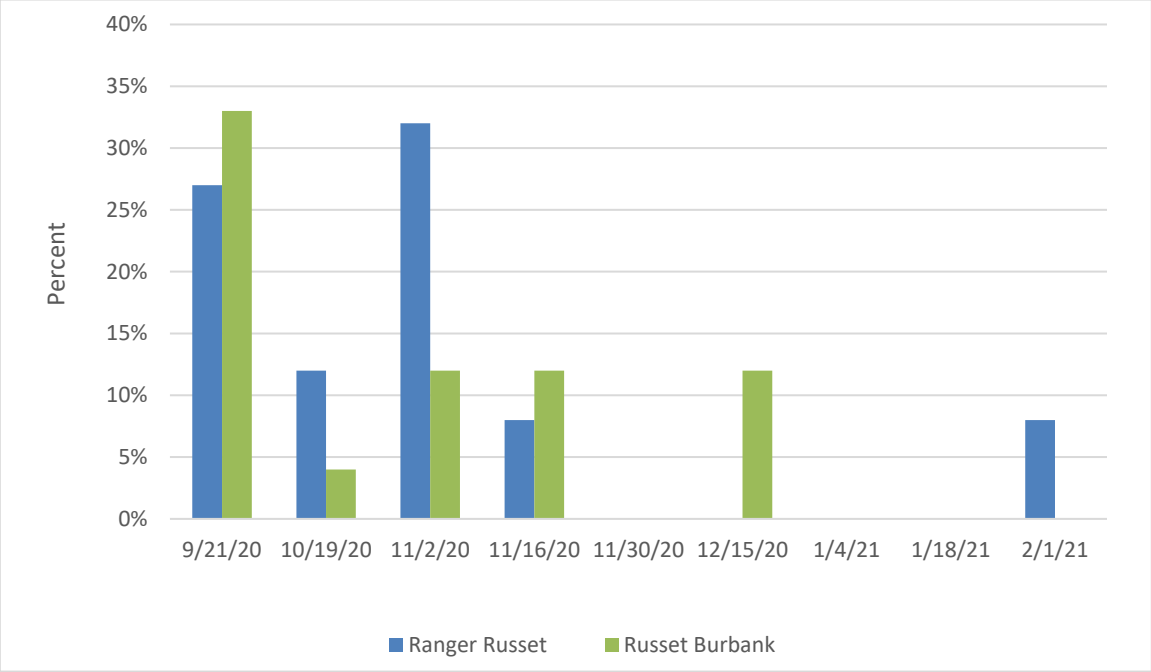



Table of Contents

**Figure 29:** Ranger Russet percent fry color for the 2020-2021 storage season. Fry quality is: excellent (Munsell scores 0 and 1), acceptable (Munsell score 2), and unacceptable (Munsell scores 3 and 4).

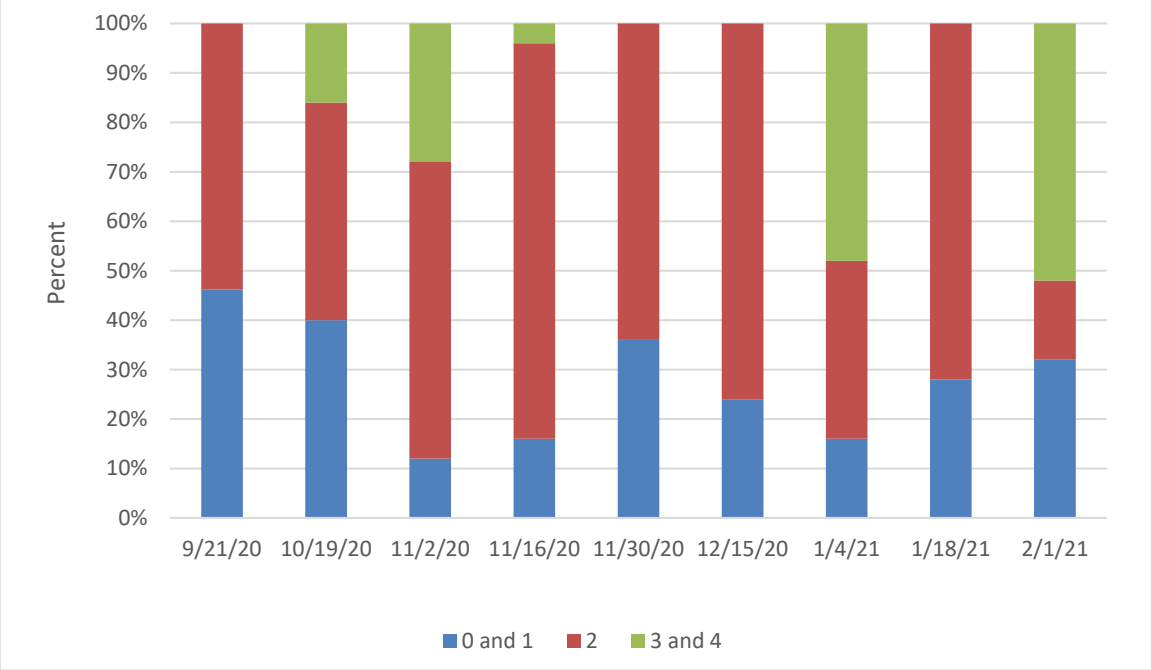



Table of Contents

**Russet Burbank:** This check variety was evaluated monthly until January. See individual varieties for comparisons on sucrose, glucose, and percent sugar defects. Fry color was variable. The February 1st sample had 72% excellent fries and 24% acceptable fries, while the January 4th sample had 76% unacceptable fries and 20% acceptable fries (Figure 30).

**Table 10:** Russet Burbank monthly fry quality pictures from Techmark Inc.

| Month | | | |
|---|---|---|---|
| 9/21 |  | 2/1 |  |
| 11/2 |  | 3/1 |  |
| 11/30 |  | 4/5 |  |
| 1/4 |  | | |

Table of Contents

**Figure 30:** Russet Burbank percent fry color for the 2020-2021 storage season. Fry quality is: excellent (Munsell scores 0 and 1), acceptable (Munsell score 2), and unacceptable (Munsell scores 3 and 4).

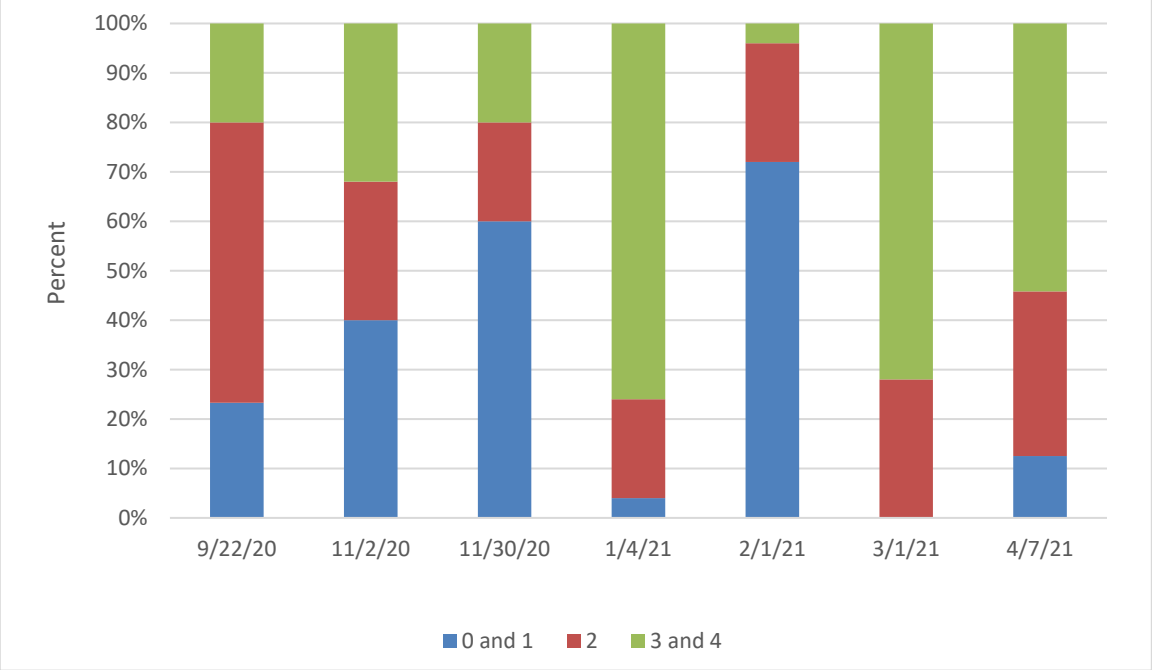



Table of Contents

**Sunset Russet:** This variety was evaluated monthly until February. Glucose concentrations were low and stable during storage, with a range between 0.006% and 0.011% (Figure 31). Sucrose concentrations closely mirrored those of Russet Burbank (Figure 32). Sugar ends were minimal, with three samples displaying the defect, all below 12% (Figure 33). Fry quality was largely excellent, with all samples containing over 60% excellent chips. Two samples contained 17% or less unacceptable chips (Figure 34).

**Table 11.** Sunset Russet monthly fry quality pictures from Techmark Inc.

| Month | | | |
|---|---|---|---|
| 9/21 |  | 1/4 |  |
| 11/2 |  | 2/1 |  |
| 11/30 |  | | |

Table of Contents

**Figure 31:** Sunset Russet glucose concentrations for the 2020-2021 storage season compared to Russet Burbank.

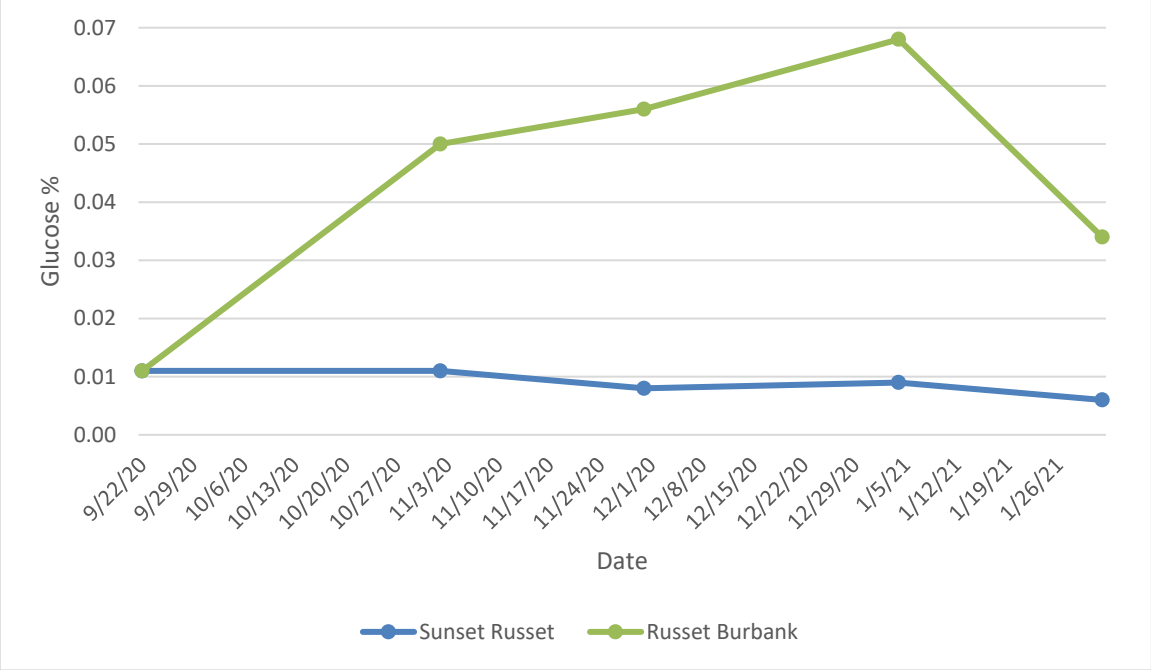



**Figure 32:** Sunset Russet sucrose concentrations for the 2020-2021 storage season compared to Russet Burbank.

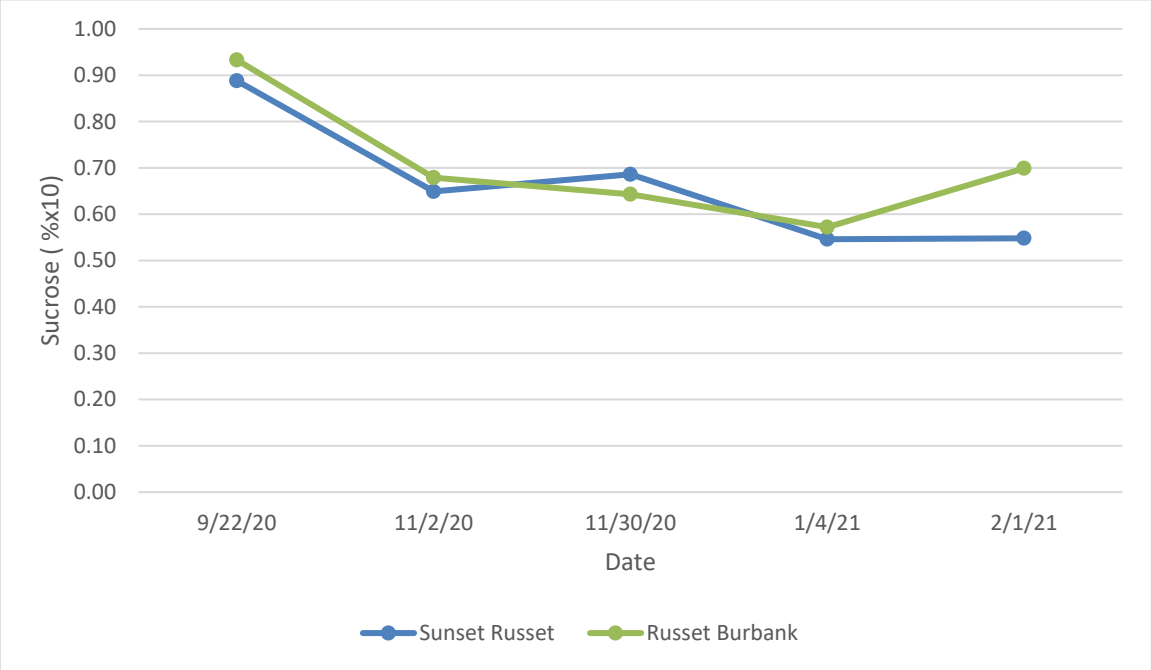



Table of Contents

**Figure 33:** Sunset Russet sugar end percentages for the 2020-2021 storage season compared to Russet Burbank.

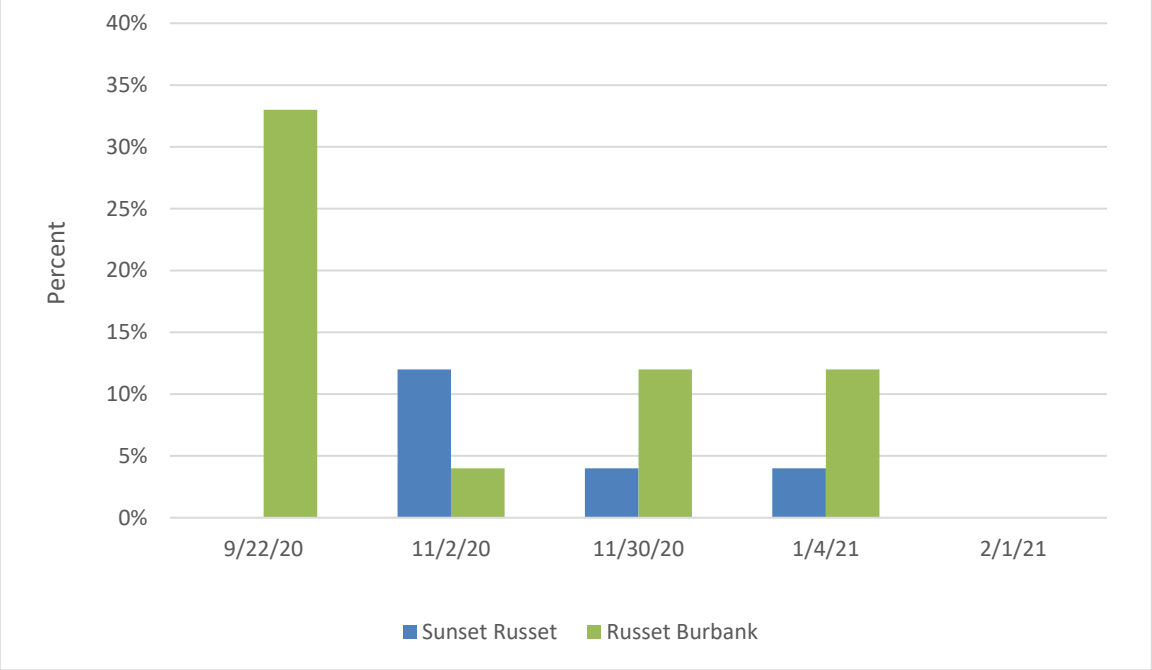



**Figure 34:** Sunset Russet percent fry color for the 2020-2021 storage season. Fry quality is: excellent (Munsell scores 0 and 1), acceptable (Munsell score 2), and unacceptable (Munsell scores 3 and 4).

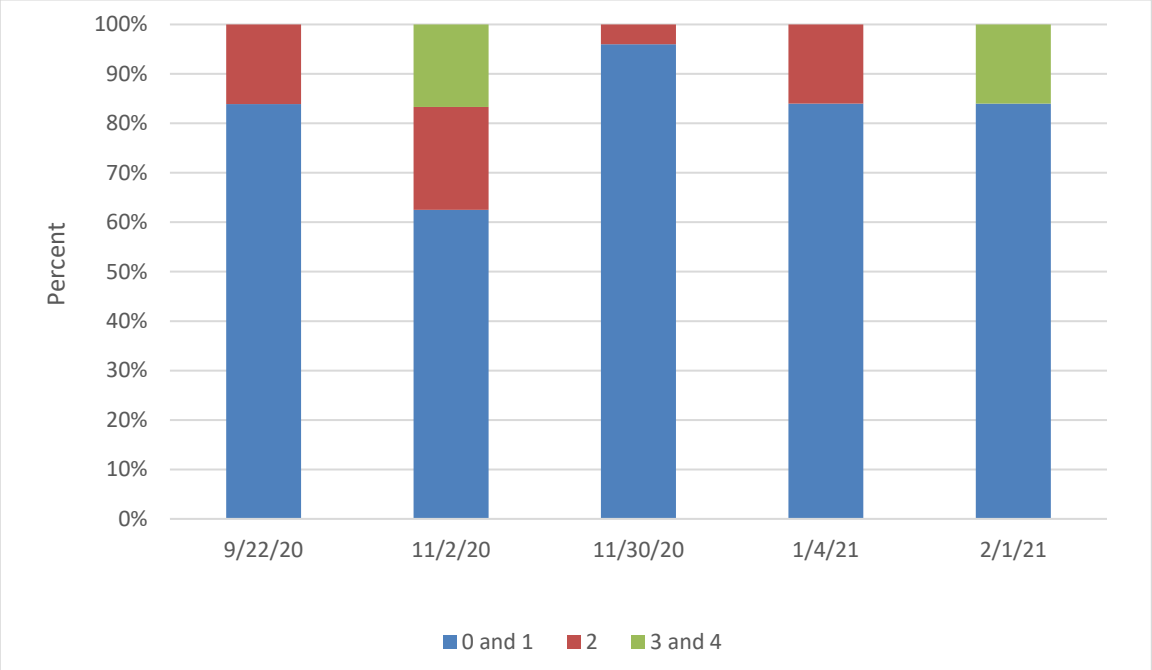



Table of Contents

**Umatilla Russet:** This variety was evaluated bi-monthly through April. It had a variable glucose concentration, typically below that of Russet Burbank (Figure 35). The storage glucose profile was also inconsistent, with stable concentrations through November, a generally decreasing trend through March, and increasing concentrations in the last two samples (Figure 36). Sugar end defects were minimal, with six samples containing 12% or less sugar ends (Figure 37). Eleven our of the 14 samples had over 60% excellent chips, and seven samples had 23% or less unacceptable chips (Figure 38).

**Table 12.** Umatilla Russet bi-monthly fry quality pictures from Techmark Inc.

| Month | | | |
|---|---|---|---|
| 9/21 |  | 11/30 |  |
| 10/19 |  | 12/15 |  |
| 11/2 |  | 1/4 |  |

Table of Contents

| | | | |
|---|---|---|---|
| 11/16 |  | 1/18 |  |
| 2/1 |  | 3/15 |  |
| 2/15 |  | 4/5 |  |
| 3/1 |  | 4/19 |  |

Table of Contents

**Figure 35:** Umatilla Russet glucose concentrations for the 2020-2021 storage season compared to Russet Burbank.

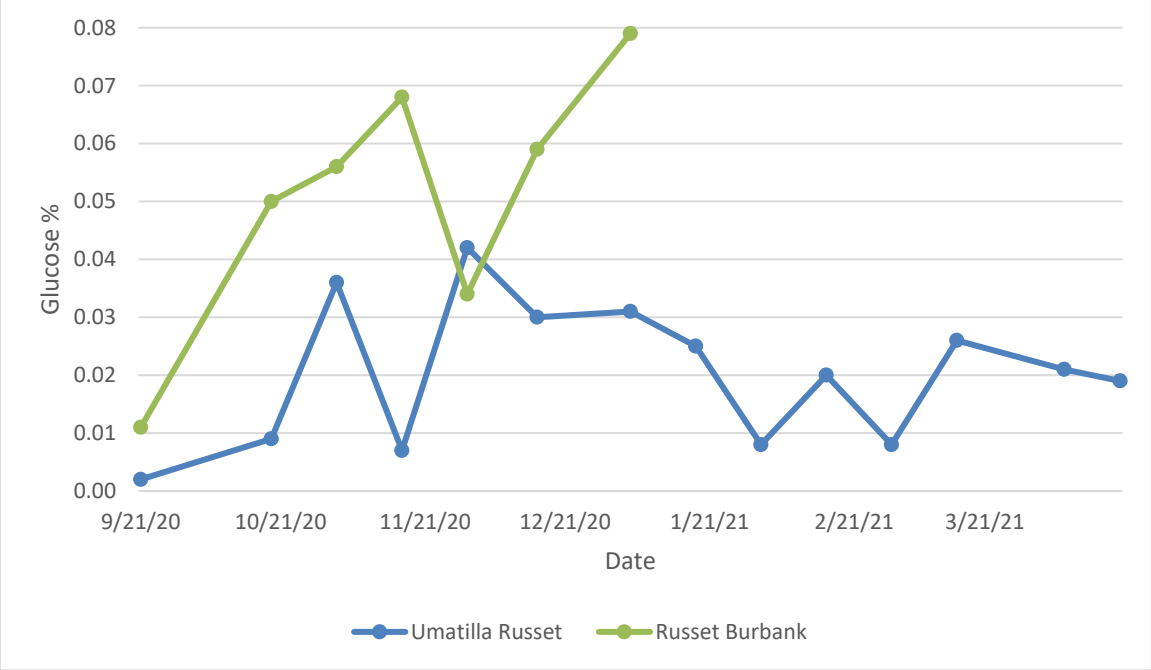



**Figure 36:** Umatilla Russet sucrose concentrations for the 2020-2021 storage season compared to Russet Burbank.

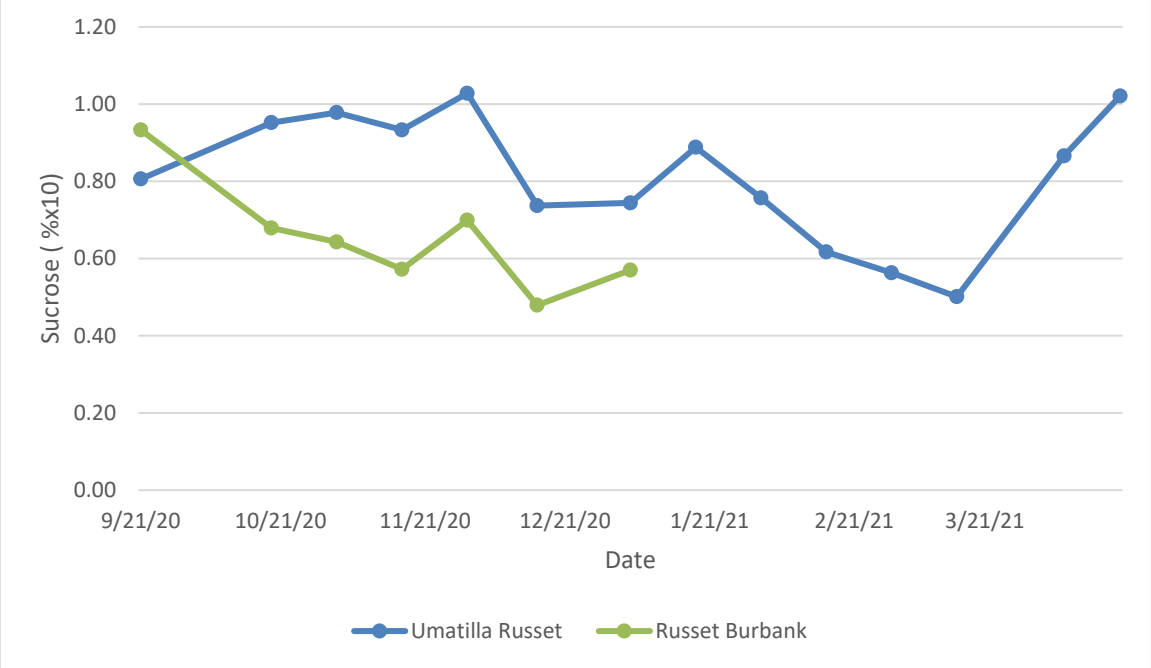



Table of Contents

**Figure 37:** Umatilla Russet sugar end percentages for the 2020-2021 storage season compared to Russet Burbank.

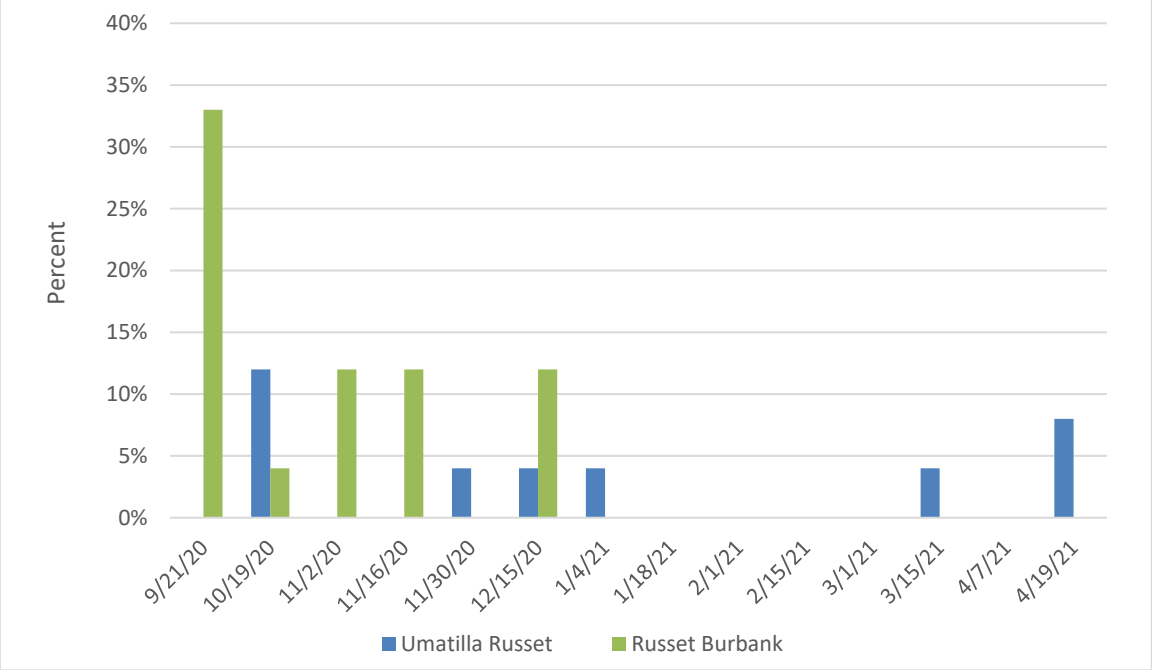



**Figure 38:** Umatilla Russet percent fry color for the 2020-2021 storage season. Fry quality is: excellent (Munsell scores 0 and 1), acceptable (Munsell score 2), and unacceptable (Munsell scores 3 and 4).


Table of Contents