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MICHIGAN POTATOES
MICHIGAN POTATO INDUSTRY COMMISSION

Michigan Potato Industry Commission

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To All Michigan Potato Growers & Shippers:

The Michigan Potato Industry Commission, Michigan State University's AgBioResearch and Cooperative Extension Service are pleased to provide you with a copy of the results from the 2011 potato research projects.

This report includes research projects funded by the Michigan Potato Industry Commission, the USDA Special Grant and special allocations by the Commission. Additionally, the Commission expresses appreciation to suppliers of products for research purposes and special grants to the Commission and researchers.

Providing research funding and direction to principal investigators at MSU is a function of the Michigan Potato Industry Commission's Research Committee.

Best wishes for a prosperous 2012 season.

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2011 MICHIGAN POTATO RESEARCH REPORT

C. M. Long, Coordinator

INTRODUCTION AND ACKNOWLEDGMENTS

The 2011 Potato Research Report contains reports of the many potato research projects conducted by MSU potato researchers at several locations. The 2011 report is the 43rd 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), GREEEN and numerous other sources. The principal source of funding for each project has been noted at the beginning of each report.

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

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

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

Special thanks go to Bruce Sackett for the management of the MSU Montcalm Research Center (MRC) and the many details which are a part of its operation. We also want to recognize Barb Smith at MPIC and Luke Steere, MSU for helping with the details of this final draft.

WEATHER

The overall 6-month average maximum temperature during the 2011 growing season was two degrees lower than the 6-month average maximum temperature for the 2010 season and was one degree lower than the 15-year average (Table 1). The 6-month average minimum temperature for 2011 was one degree higher than the 15-year average. There were 4 days with recorded temperature readings of 90 °F or above in 2011. There were 179 hours of 70 °F temperatures between the hours of 10 PM and 8 AM which occurred over 33 different days, April to September (Data not shown). There was one day in May that the minimum air temperature was below 32 °F. This occurred on May 5th. The average maximum temperature for July 2011, was four degrees higher than the 15-year average (Table 1). In October 2011, during the period from the 13th to the 31st there were only six days with no measureable rainfall. For the period from October 6th to October 9th, the recorded daytime high was 80 ºF or higher four days in a row.

Rainfall for April through September was 14.92 inches, which was 3.5 inches below the 15-year average (Table 2). In October 2011, 1.6 inches of rain was recorded. Irrigation at MRC was applied 8 times from June 30th to September 14th, averaging 0.74 inches for each application. The total amount of irrigation water applied during this time period was 5.95 inches.

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

Year	April Max.	April Min.	May Max.	May Min.	June Max.	June Min.	July Max.	July Min.	August Max.	August Min.	September Max.	September Min.	6-Month Average Max.	6-Month Average Min.
1997	54	31	59	39	79	56	80	57	73	55	69	50	69	48
1998	60	37	75	51	77	56	82	58	81	60	76	52	75	52
1999	59	37	71	48	77	55	84	62	76	56	73	48	73	51
2000	56	34	70	49	75	57	77	56	79	57	70	49	71	50
2001	61	37	70	49	78	57	83	58	72	70	69	48	72	53
2002	56	36	63	42	79	58	85	62	81	58	77	52	73	51
2003	56	33	64	44	77	52	81	58	82	58	72	48	72	49
2004	62	37	67	46	74	54	79	57	76	53	78	49	73	49
2005	62	36	65	41	82	60	82	58	81	58	77	51	75	51
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	37	67	40	77	56	80	58	80	54	73	50	73	49
2009	56	34	67	45	76	54	75	53	76	56	74	49	71	49
2010	64	38	70	49	77	57	83	62	82	61	69	50	74	53
2011	**53**	**34**	**68**	**48**	**77**	**56**	**85**	**62**	**79**	**58**	**70**	**48**	**72**	**51**
15-Year Average	58	35	67	46	78	56	81	59	79	58	73	49	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
1997	2.02	3.13	3.54	2.80	2.71	1.46	15.66
1998	2.40	2.21	1.82	0.40	2.22	3.05	12.10
1999	5.49	5.07	5.82	4.29	5.46	4.03	30.16
2000	3.18	6.46	4.50	3.79	5.28	5.25	28.46
2001	3.28	6.74	2.90	2.49	5.71	4.43	25.55
2002	2.88	4.16	3.28	3.62	7.12	1.59	22.65
2003	0.70	3.44	1.85	2.60	2.60	2.06	13.25
2004	1.79	8.18	3.13	1.72	1.99	0.32	17.13
2005	0.69	1.39	3.57	3.65	1.85	3.90	15.05
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**
15-Year Average	2.56	3.83	3.01	2.82	3.50	2.71	18.42

GROWING DEGREE DAYS

Tables 3 and 4 summarize the cumulative growing degree days (GDD) for 2011. Growing degree days base 50 for May through September, 2011, are in (Table 3) and growing degree days base 40 for May through September, 2011, are in (Table 4). The total GDD base 50 for 2011 was 2393 (Table 3), which is slightly higher than the 10-year average. The total GDD base 40 for 2011 was 3848, remaining above average for the same recorded period 2006-2011 (Table 4).

Table 3. Growing Degree Days* - Base 50°F.

	Cumulative Monthly Totals				
Year	May	June	July	August	September
2002	319	903	1646	2214	2613
2003	330	762	1302	1922	2256
2004	245	662	1200	1639	2060
2005	195	826	1449	2035	2458
2006	283	765	1444	2016	2271
2007	358	926	1494	2084	2495
2008	205	700	1298	1816	2152
2009	247	700	1133	1622	1963
2010	352	857	1561	2231	2531
2011	**299**	**788**	**1512**	**2085**	**2393**
10-Year Average	283	789	1404	1966	2319

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

	Cumulative Monthly Totals				
Year	May	June	July	August	September
2006	532	1310	2298	3180	3707
2007	639	1503	2379	3277	3966
2008	447	1240	2147	2973	3596
2009	519	1264	2004	2800	3420
2010	610	1411	2424	3402	3979
2011	**567**	**1354**	**2388**	**3270**	**3848**
2012					
2013					
2014					
2015					
10-Year Average	552	1347	2273	3150	3753

*2002-2011 data from the weather station at MSU Montcalm Research Center "Enviro-weather", Michigan Weather Station Network, Entrican, MI.)

PREVIOUS CROPS, SOIL TESTS AND FERTILIZERS

The general potato research area utilized in 2011 was rented from Steve Comden, directly to the West of the Montcalm Research Center. This acreage was planted to a field corn crop in the spring of 2010 and harvested fall 2010 with crop residue disked into the soil. In the spring of 2011, the recommended rate of potash was applied, in addition to, 2 tons/A of dried chicken litter. These products were disked into the remaining corn residue. The chicken litter nutrient analysis was 4-3-2-8%Ca with a carbon to nitrogen ratio of 6.9:1. The ground was deep chiseled, disked and direct planted to potatoes. The area was not fumigated with Vapam prior to potato planting, but Vydate C-LV was applied in-furrow at planting. Early potato vine senescence was not an issue in 2011.

The soil test analysis for the general crop area was as follows:

	lbs/A			
pH	P_2O_5	K_2O	Ca	Mg
5.7	306 (153 ppm)	216 (108 ppm)	910 (455 ppm)	158 (79 ppm)

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

Application	Analysis	Rate	Nutrients (N-P_20_5-K_20-Mg)
Broadcast at plow down	0-0-21-10	200 lbs/A	0-0-42-20
	10%B	10 lbs/A	1 lb. B
At planting	28-0-0	26 gpa	80-0-0
	10-34-0	6 gpa	7-22-0
At cultivation	28-0-0	25 gpa	77-0-0
At hilling	46-0-0	200 lbs/A	92-0-0
Late side dress (late varieties)	46-0-0	130 lbs/A	60-0-0

Calcium and Nitrogen were applied July 20th in the form of liquid Calcium Nitrate (with an analysis of 30% Ca and 25% N) for a total application of 7 gpa. The composite nutrient value resulted in 23 lbs actual Ca and 19 lbs of N being applied per acre on the potato production area.

HERBICIDES AND PEST CONTROL

A pre-emergence application of Linex at 1.5 quarts/A and Dual II at 1.33 pints/A was made in late May. A post-emergence application of Matrix at 1.3 oz/A was made in late July.

Admire and Vydate C-LV were applied in-furrow at planting at a rate of 8 fl oz/A and 2 quarts/A, respectively.

Two foliar applications of Vydate C-LV were made on June 25th and July 8th at the rate of 1 quart /A.
Fungicides used were; Bravo, Tanos and Manzate over 11 applications.
Potato vines were desiccated with Reglone in early September at a rate of 2 pints/A.

2011 POTATO BREEDING AND GENETICS RESEARCH REPORT

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INTRODUCTION

At Michigan State University, we are dedicated to developing improved potato varieties for the chip-processing and tablestock markets. The program is one of four integrated breeding programs in the North Central region supported through the Potato Special Grant. At MSU, we conduct a multi-disciplinary program for potato breeding and variety development that integrates traditional and biotechnological approaches. In Michigan, it requires that we primarily develop high yielding round white potatoes with excellent chip-processing from the field and/or storage. In addition, there is 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 Experiment Station, Clarksville Research Center, and MSU Soils Farm), we ship seed to other states and Canadian provinces for variety trials, and we cooperate with Chris Long on grower trials throughout Michigan. 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, and late blight resistance, beetle resistance, specific gravity). The addition of the SolCAP translational genomics project, funded through the USDA, is enhancing our abilities to link genetic markers to important traits (reducing sugars, starch and scab resistance) and then breed them into elite germplasm. The SolCAP project has developed a new set of genetic markers (8,300) called SNPs that are located in the genes. 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 nitrogen use efficiency. Furthermore, the USPB is supporting national early generation trials called the National Coordinated Breeder Trial (NCBT) which will feed lines into the SFA trial and also fast track lines into commercial testing. 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 the breeding of improved chip-processing and tablestock potatoes.

The breeding goals at MSU are based upon 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. We are also developing potato tuber moth resistant lines as a component of our international research project. If these goals can be met, we will be able to reduce the grower's reliance on chemical inputs such as insecticides, fungicides and sprout inhibitors, and improve overall agronomic performance with 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. These include the establishment and expansion of the scab nursery, the development of the Clarksville Research Center for late blight testing, the incorporation of no-choice caged studies for Colorado potato beetle assessment, the Michigan Potato Industry Commission (MPIC)-funded construction of the B.F. (Burt) Cargill Demonstration Storage adjacent to the Montcalm Research Center, new land at the Lake City Experiment Station along with a well for irrigation and expanded land at the Montcalm Research Center and Lake City Experiment Station, the new plot harvester, the development of the grading line at the MSU campus facility, and expansion of the tissue culture operation so that small amounts certified seed of minitubers can be produced. We will also be relocating our research lab in the new Plant Sciences addition on Campus.

PROCEDURE

I. Varietal Development

Breeding, Selection and Variety Evaluation:

The MSU breeding program has been operating for over 20 years and we feel that we have reached a point of "clarity and focus". First, we have the genetic variation to combine tuber shape, skin type, scab resistance and low sugars, yield and storability as well as late blight, PVY and golden nematode resistances. Secondly, we have been able to define more precisely the commercial needs of the new varieties and make better decisions more quickly in the first three years of the breeding program cycle. Third, we have increased our standards for what we consider a commercial selection. Fourth, we have been able to increase our efficiency because we are conducting an integrated selection based upon our disease nurseries, post-harvest evaluations for specific gravity and chip quality and DNA tests. Furthermore, we have also revised the selection scheme so that we have reduced a year from the early generation cycle. The MSU Breeding program continues to test MSU-bred lines in replicated trials (over 160 lines) and on grower farms (15 lines). We also enter 3-4 lines in the North Central regional trials, 2-3 lines in the SFA trials and send many of the advanced breeding lines to Ohio, Pennsylvania, Florida, California, North Dakota, Nebraska, Minnesota, North Carolina, Maine, Washington, Wisconsin, Ontario and Quebec Canada and various international sites for testing. The new NCBT in 2011 allowed us to test the over 40 MSU lines at 8 locations around the country. Through a cooperative effort of MPIC, commercial growers, seed growers, Chris Long, the MSU breeding program and the processors, we are working together to help move the best lines towards larger scale commercial testing and have chip-processing lines evaluated in the Commercial Demonstration Storage facility (500 cwt bins). At this time, we have many advanced selections that have chipping qualities along with scab or late blight resistance, bruise resistance, etc. with commercial potential. Six of these are in commercial seed production (MSL007-B,

MSJ126-9Y, MSH228-6, MSL292-A, MSR061-1 and MSQ070-1). At least 2 can store at temperatures below 50F and maintain low sugars until June.

In 2012 the MSU breeding program will cross elite germplasm to generate and evaluate 60,000 new seedlings for adaptation to Michigan. In the subsequent years these selections are then advanced to 12-hill (year 2), 30-hill (year 3), 50-hill, and 100-hill plots, with increasing selection pressure for agronomic, quality and disease and/or insect resistance parameters. We now have in place field sites for early generation selection for late blight, scab and Colorado potato beetle resistant lines. Early generation evaluation of these key traits increases our effectiveness in identifying commercially valuable advanced selections. From this 3-year early generation evaluation and selection phase of the breeding program we generate over 100 MSU-bred advanced selections that are then to be tested and evaluated under more intensive replicated trials at the Montcalm Research Center. We are also producing the FG1 and FG2 level seed of the most promising selections from the MSU breeding program for in-state grower-cooperator trials, out-of-state trials, North Central Regional trials, national USPB/SFA trials and MSU research farm trials.

Elite clones will be tested for at the Montcalm Research Center for agronomic performance, marketable maturity, chip processing at harvest and in storage, resistance to pitted scab, potato early die and late blight. We place these advanced selections into tissue culture and initiate virus eradication procedures so that virus-free tissue culture plantlets or tuber sources can be made available to the industry. We are moving towards using a commercial NFT mini-tuber production system to produce mini-tubers of our advanced selections.

Currently, the breeding program has in tissue culture about 500 clones in the MSU bank and 80 new candidates that are in process for transfer to tissue culture. We want to continue to work closely with the commercial growers and seed industry to test and provide seed for more intensive evaluation. Through this linkage we hope to identify the breeding selections that have merit to achieve varietal status in Michigan.

There is a need to find a russet table potato that will be profitable and produce quality russets for the eastern market. Currently, the three most desirable potatoes for production and type in Michigan are GoldRush, Russet Norkotah and Silverton Russet. The latter two potatoes suffer as symptomless carriers of PVY. Norkotah also has a weak vine and susceptibility to potato early die. We need a PVY resistant Silverton Russet potato. We are continuing to make more russet crosses and selections in the breeding program to support this new russet market.

Evaluation of Advanced Selections for Extended Storage

With the Demonstration Storage facility adjacent to the Montcalm Research Center, we are positioned to evaluate advanced selections from the breeding program for chip-processing over the whole extended storage season (October-June). Tuber samples of our elite chip-processing selections are placed in the demonstration storage facility in October and are sampled monthly to determine their ability to chip-process from colder (42-48°F) and/or 50°F storage. In addition, Chris Long evaluates the more advanced selections in the 10 cwt. box bins and manages the 500 cwt. storage bins which may have MSU-developed lines.

II. Germplasm Enhancement

To supplement the genetic base of the varietal breeding program, we have a "diploid" (2x = 24 chromosomes) breeding program in an effort to simplify the genetic system in potato (which normally has 48 chromosomes) and exploit more efficient selection of desirable traits. This added approach to breeding represents a large source of valuable germplasm, which can broaden the genetic base of the cultivated potato. The diploid breeding program germplasm base at MSU is a synthesis of seven species: *S. tuberosum* (adaptation, tuber appearance), *S. raphanifolium* (cold chipping), *S. phureja* (cold-chipping, specific gravity, PVY resistance, self-compatability), *S. tarijense* and *S. berthaultii* (tuber appearance, insect resistance, late blight resistance, verticillium wilt resistance), *S. microdontum* (late blight resistance) and *S. chacoense* (specific gravity, low sugars, dormancy and leptine-based insect resistance). Even though these potatoes have only half the chromosomes of the varieties in the U.S., we can cross these potatoes to transfer the desirable genes by conventional crossing methods via 2n pollen.

III. Integration of Genetic Engineering with Potato Breeding

Through transgenic approaches we have the opportunity to introduce new genes into our cultivated germplasm that otherwise would not be exploited. It has been used in potato as a tool to improve commercially acceptable cultivars for specific traits. Our laboratory has now 16 years experience in *Agrobacterium*-mediated transformation to introduce genes into important potato cultivars and advanced breeding lines. We are presently using genes in vector constructs that confer resistance to Colorado potato beetle and potato tuber moth (*Bt-cry3A* and *Bt-cry1Ia1*), late blight resistance via the *RB* gene (from the wild potato species *S. bulbocastanum*) and also a late blight resistance gene we cloned from *S. microdontum*, drought resistance (*CBF1*), PVY, and lower reducing sugars with acid invertase gene silencing, and lastly nitrogen use efficiency from a barley alanine aminotransferase gene.

RESULTS AND DISCUSSION

I. Varietal Development

Breeding

The MSU potato breeding and genetics program is actively producing new germplasm and advanced seedlings that are improved for cold chipping, and resistance to scab, late blight, and Colorado potato beetle. For the 2011 field season, progeny from about 600 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 novelty market classes During the 2011 harvest, over 1,800 selections were made from the 60,000 seedlings produced. All potential chip-processing selections will be tested in January and April 2011 directly out of 45°F (7.2°C) and 50°F (10°C) storages. Atlantic, Pike (50°F chipper) and Snowden (45°F chipper) 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 450 and 80 selections were made, respectively.

Selection in the early generation stages has been enhanced by the incorporation of the Colorado potato beetle, scab and late blight evaluations of the early generation material. We are pushing our early generation selections into tissue culture to minimize PVY issues in our breeding and seed stock. We have also been experimenting with a cryotherapy method to remove viruses. If perfected, we will be able to more predictably remove virus from tissue culture stocks. We should have more to report in 2012.

Chip-Processing

Over 80% of the single hill selections have a chip-processing parent in their pedigree. Our most promising chip-processing lines are MSJ126-9Y (scab resistant), MSL007-B (scab resistance), MSR169-8Y (scab resistant), MSQ086-3, (late blight resistant), MSL292-A, MSR061-1 (scab and PVY resistant) and MSQ070-1 (scab and late blight resistant). Other new promising lines include MSP270-1 (scab resistant), MSP516-A (scab and late blight resistant), MSR036-5 (scab and late blight resistant), MSR127-2 (scab resistant) and MSQ279-1 (scab resistant). We have some newer lines to consider, but we are removing virus from those lines. We are using the NCPT trials to more effectively identify promising new selections.

Tablestock

Efforts have been made to identify lines with good appearance, 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 resistant lines, incorporate resistance to late blight along with marketable maturity and excellent tuber quality, and select more russet and yellow-fleshed lines. We have also been spinning off some pigmented skin and tuber flesh lines that may fit some specialty markets. We released three lines for the specialty market: MSN215-2P (Colonial Purple), MSR226-1RR (Raspberry) and MSQ425-4PY (Spartan Splash). 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. We are also selecting for a dual-purpose russet, round white, red-skin, and improved Yukon Gold-type yellow-fleshed potatoes. Some of the tablestock lines were tested in on-farm trials in 2011, while others were tested under replicated conditions at the Montcalm Research Farm. Promising tablestock lines include MSL211-3, MSQ440-2, MSM182-1, MSL268-D, MSR217-1R and MSS544-1R and MSQ176-5. We have a number of tablestock selections with late blight resistance (MSQ176-5, MSM182-1, and MSL268-D). MSL211-3 has earliness and a bright skin. We are using these russets as parents in the breeding program to combine the late blight and scab resistance. Some newer lines with promise include the high yielding round white line MSQ279-1 (scab resistant) and MSQ440-2 (scab resistant). MSM288-2Y is a bright yellow flesh selection similar in type to Yukon Gold. MSS544-1R is a new scab resistant red skinned table potato. Some new specialty pigmented lines are MSS576-05SPL (red splash) and Michigan Red and Purple Heart. MSQ558-2RR and MSR226-1RR are red fleshed chippers and Midnight is a purple-fleshed chipper. We are developing a seed certification system to direct market the specialty potato seed to the farm market sector.

Early harvest breeding material screen

In 2011, we continued our early harvest observation trial of our breeding lines to learn about the potential to replace Atlantic as an early harvest variety. We harvested the plots at 90 days and observed the yield, tuber size and tuber shape/ appearance. In addition, we measured specific gravity and made chips out of the field. From this trial of over 100 lines, we were able to identify some promising early breeding lines for the out-of-the-field chipping use (MSL292-A, MSQ089-1 and MSQ035-3) and table use (MSM288-2Y, MSU161-1 and MSU379-1). **Table 1** summarizes these results of the lines with the highest merit ratings. Some of these lines are also characterized to have some scab resistance and late blight resistance along with the desirable chipping traits. We will continue to test many of these lines and other selections in 2012.

Table 1 Early Observation Trial: Most promising lines.

Line	Total Weight (lbs.)	Specific Gravity	OTF 8/9/11 SFA Chip Score	Merit[1]	8/8/2011 MAT[2]	Comments
Chip Processing						
AF2291-10	15.3	1.077	1.0	1	4	slightly variable shape
Atlantic	**16.3**	**1.080**	**1.5**	**1**	**3**	
Atlantic	**17.4**	**1.085**	**1, BC**	**1**	**4**	
FL1879	**11.1**	**1.065**	**1.5**	**2**	**4**	
FL1879	**12.3**	**1.067**	**2.5**	**2**	**3**	**large tubers, variable shape, scab**
MSL292-A	17.2	1.080	1.0	1	3	
MSQ035-3	21.1	1.074	1.0	1	3	
MSQ089-1	17.8	1.070	1.0	1	3	
MSR159-02	10.6	1.076	1.0	2	4	
Snowden	**21.3**	**1.080**	**1.0**	**1**	**3**	**many tubers**
MSV241-2	13.8	1.076	1.0	1	3	good shape
MSV307-2	12.8	1.076	1.0	2	2	good yield, uneven shape
MSV355-2	19.7	1.076	1.0	1	2	
MSV383-1	11.6	1.074	1.0	2	4	good shape
MSV502-2	16.4	1.074	1.0	1	3	good size
Tablestock						
MSL211-3	19.2	1.063	-	1	4	
MSM288-2Y	17.6	1.063	-	1	3	smooth shape
Onaway	**19.1**	**1.064**	**-**	**3**	**5**	**poor shape**
MSQ176-5	14.9	1.059	-	1	4	good size, good shape
MSQ341-BY	14.6	1.070	-	1	4	good size, shape
MSQ440-2	10.2	1.050	-	2	5	
Reba	**15.8**	**1.069**	**-**	**1**	**3**	**very little skinning**
Red Norland	**10.8**	**1.053**	**-**	**2**	**2**	**GC**
MSU016-2	15.2	1.086	-	1	3	
MSU161-1	17.8	1.066	-	1	4	good size, smooth skin
MSU379-1	17.6	1.063	-	1	3	good size
MSV429-1	14.5	1.075	-	1	3	some brightness

[1]Merit Rating: 1-Great, 2-Keep, 3-Marginal/Second Chance, 4-Drop
[2]Maturity: 1 - completely dead, 5 - flowering
Planted 5/10/11; Harvested 8/8/11. 90 DAP. 170 lines. 10-hill plots planted in 10 ft plots.

Disease and Insect Resistance Breeding

Scab: In 2011 we had two locations to evaluate scab resistance: a commercial field with a history of severe scab infection and a highly infected site at the Montcalm Research Center in the commercial production area. The commercial site and the new site at the Montcalm Research Center both gave us the high infection levels. Some of results are summarized in **Table 2**. The susceptible checks of Snowden and Atlantic were highly infected with pitted scab. Interestingly, Onaway, a scab resistant check, had some pitted lesions in the on-farm field due to the high disease pressure. Promising resistant selections were MSN215-2P, MSJ126-9Y, MSH228-6, MSL007-B, MSR061-1, MSR169-8Y, MSP270-1, MSR127-2, MSS165-2Y, MSQ279-1 and MSQ440-2. 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. In 2012 we are planning to use the commercial site for primary trait selection in elite chip-processing crosses. The MRC scab site was used for assessing scab susceptibility in our advanced breeding lines and early generation material and is summarized below. All susceptible checks were scored as susceptible.

	Resistant	Susceptible
Fifth year selections:	21	13
Fourth year selections:	49	22
Third year selections:	73	107
Advanced selections:	39	93

Based upon this data, scab resistance is increasing in the breeding program. 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. MSU is now being recognized by peer programs for its scab resistant advanced breeding lines!

In 2011 we collected replicated (4 times) scab infection data from our Montcalm Research Center scab field on 200 progeny from a cross between resistant and susceptible varieties Of the 200 progeny, 27 were highly resistant and 48 were moderately resistant. We will retest the 200 progeny in 2012 as well as the resistant lines in the commercial field. Most importantly, we are also using this field data to conduct genome wide QTL analysis with the SolCAP 8300 Potato SNP data in search of genetic markers linked to scab resistance. We will repeat the study in 2012.

We have been conducting trials in the NFT system to identify the conditions and inoculation method that optimizes tuberization and infection of a scab susceptible cultivar. In Atlantic, as expected, the controls were basically uninfected and the inoculated plants yielded high numbers of infected tubers (92 to 100% infection rates). However, based on the scab index rating, there was no difference in the amount of disease between tubers subjected to inoculated vermiculite (2.4 scab index rating) and those that were drenched in addition to the inoculated vermiculite (2.5 scab index rating). As there was no difference in the amount of disease between the 2 inoculation methods, we will use inoculated vermiculite in subsequent trials but will drench the plants once (3 weeks after the vermiculite is added to the pots) to ensure high concentrations of inoculum.

When we evaluated a series of lines the variation in tuberization made inoculation a challenge--difficult to get the inoculum on at the right time for every plant. Thus, the results were variable--we had one good run but the next run almost no infection was found. The summer temperatures in the greenhouse may have contributed to this variability. We also learned that the tubers tend to tuberize in the rock wool. This makes it difficult to identify when tuberization is initiating (which is important for the timing of the inoculation). We are experimenting with growing the plants without rock wool—so far so good. The plants are growing fine and have developed strong root masses which hold them in place on the felt. This scab research was partially funded by project GREEEN.

Table 2. *Streptomyces* Scab Trial Results from On-Farm trial location.

LINE	SPGR*	SCAB RATING	OTF CHIP
Atlantic	1.067	3.9	1.0
Beacon Chipper	1.073	3.3	1.5
Kalkaska	1.071	1.5	1.5
Liberator	1.077	1.1	1.0
MSH228-6	1.078	2.1	1.0
MSJ126-9Y	1.072	1.6	1.0
MSL007-B	1.071	1.9	1.0
MSL211-3	1.052	2.6	-
MSL292-A	1.068	4.2	1.0
MSN215-2P	1.067	0.9	-
MSP270-1	1.063	0.9	1.5
MSQ070-1	1.081	1.6	1.0
MSQ086-3	1.064	3.0	1.0
MSQ176-5	1.041	3.3	1.5
MSQ279-1	1.066	1.0	1.5
MSQ440-2	1.055	1.6	-
MSR061-1	1.063	2.2	1.0
MSR127-2	1.085	1.6	1.0
MSR169-8Y	1.076	1.0	1.0
MSS165-2Y	1.081	2.2	1.0
Onaway	1.055	2.8	-
Pike	1.077	1.6	1.0
Snowden	1.060	4.0	1.0

Late Blight: Our specific objective was 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. This is a GREEEN-funded project. In 2011 we conducted late blight trials at the Clarksville Research Center. We inoculated with the US22 genotype, but the foliar reaction to the *Phytophthora infestans* was different from all previous years using US8. In some cases lines that were classified as resistant were susceptible. On the other hand, some of the lines with moderate resistance in previous years were highly resistant in 2011. In the 2011 trials, over 50% of the 182 early generation lines were resistant to late blight comprised of 12 sources of late blight resistance (Fig. 1). Of the 146 advanced breeding lines and varieties tested, over 40% were classified as resistant (Fig. 2). Fourteen sources of resistance can be traced in the pedigrees of these resistant lines. This data infers that we have a broad genetic base to combine resistance genes and also should be able to respond to changes in the pathogen. This observation has been supported by R-gene marker analysis in collaboration with Wageningen University. We used marker-assisted selection strategies to combine a resistance QTL through conventional breeding. One approach to breeding for foliar resistance to late blight is to use interploidy (4x-2x) crosses to introgress the late blight resistance from *Solanum microdontum*. Based on 2010 and 2011 data, eight of 10 4x-2x selections were resistant combining resistance from *S. microdontum* and varieties Stirling and Jacqueline Lee. At the diploid level 18 of 30 2x selections were resistant that combine resistance genes from *S. berthaualtii* and *S. microdontum*. With these strategies, we are pyramiding common and unique R-genes for late blight resistance.

A candidate R-gene for late blight resistance was cloned from *S. microdontum*. The sequence of the gene was similar to blb3. The R-gene was cloned into a pBI121-derived vector driven by a constitutive promoter and we have conducted *Agrobacterium*-based transformations. These transformation experiments resulted in over 40 lines that are PCR positive for the candidate R-gene. These lines were propagated and field bioassays were conducted in 2011 for 10 of these lines. A range of resistance was observed. Four lines were classified as resistant with one line having resistance similar to the parent line of the gene. These lines will be further characterized with additional isolates in 2012 and a field trial will be repeated.

An inoculated field trial was conducted at the Clarksville Research Center using a US22 isolate common to the US and Michigan. Sets of three progeny (Spunta-RB x susceptible; Spunta-RB x moderate resistance; Spunta-RB x resistance) were planted in a randomized complete block design with two replications. The progeny were separated in RB+ vs RB- progeny by cross (see figures below). Visual ratings of percent defoliation due to late blight were recorded at least weekly after inoculation occurred and RAUDPCs were calculated for each line. The RB+ progeny from all three crosses had, on average; lower levels of late blight infection. Secondly, the most resistant progeny were found in the crosses to parents with late blight resistance, while the most susceptible progeny were observed within the RB- progeny. This study was conducted in 2010 and repeated in

2011. The 2011 data resulted in lower infection levels compared to the 2010 results. The results of both years suggest that combining the RB gene with current resistance genes in parents may lead to higher levels of late blight resistance. We selected 50 of the most resistant lines from these crosses that contain the RB gene. These will be further tested against more *P. infestans* isolates in 2012 and are candidates for effector testing. We are hoping that with a combination of conventional crossing and transgenic approaches we can create cultivars that can be commercialized by the North American potato industry that have a stronger resistance.

Fig. 1. Foliar Late Blight Reaction in Early Generation Lines

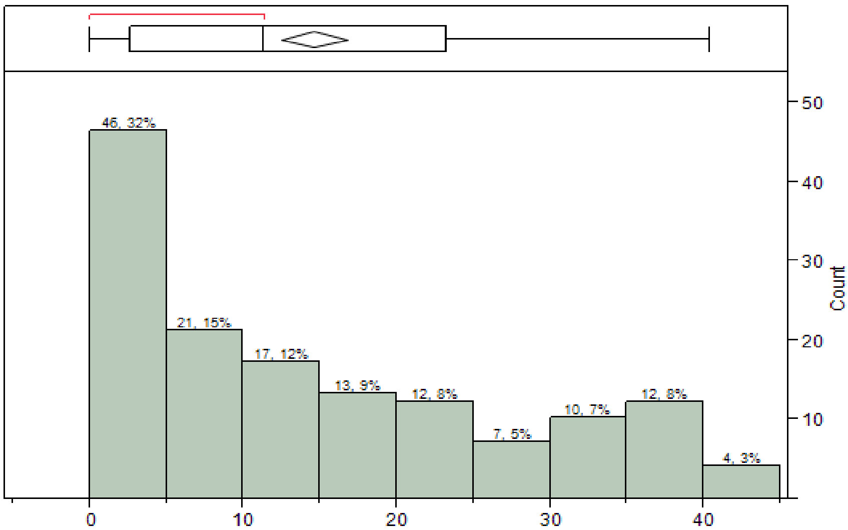


Fig. 2. Foliar Late Blight Reaction in Advanced Breeding Lines

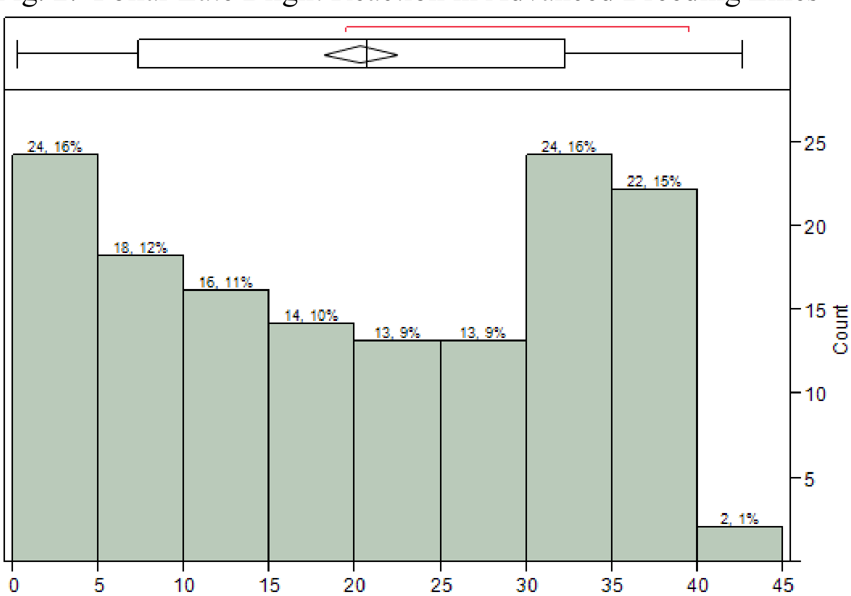
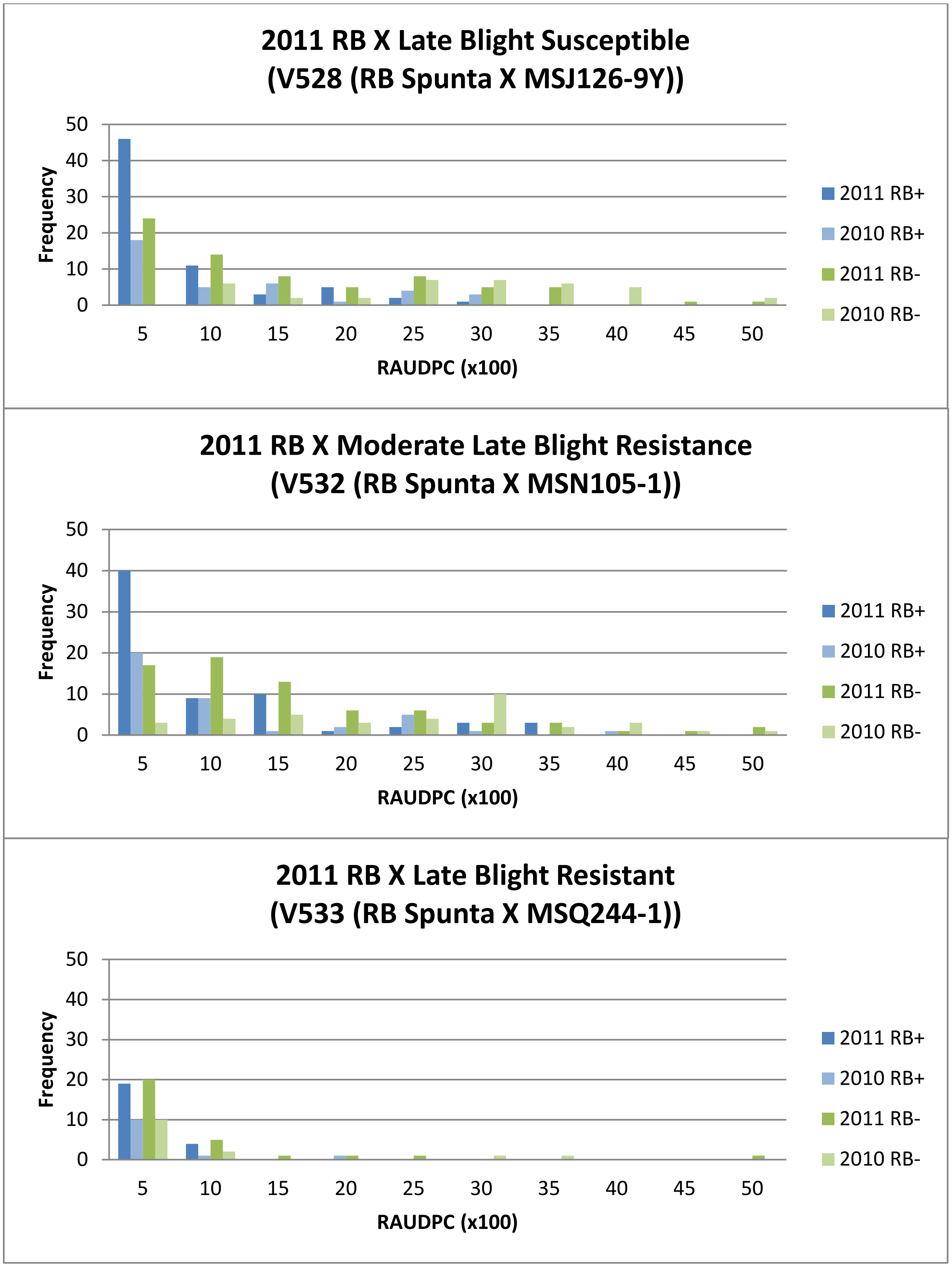


Fig. 3. Distribution for late blight in RB positive and negative progeny



Colorado potato beetle: With support from project GREEEN we conducted detached leaf bioassays on 42 lines with potential Colorado potato beetle resistance and two susceptible check lines. Each line was replicated three times and 10 neonate larvae were placed on the leaves in Petri dishes and evaluated at 4 and 7 days for defoliation and mortality. As expected, the lines that expressed the *cry3A* gene had the least feeding and almost complete mortality. One of our advanced breeding lines that has introgressed leptine-based resistance from *S. chacoense* along with a selection from USDA (ARS10301-1) had the best ranking for defoliation and mortality excluding the *cry3A* lines. We identified these lines and 10 others that will be used in crossing with our advanced germplasm. Some of these lines may also be targeted for volatile characterization. It should also be noted that three lines that expressed the *cry1Ia1* gene also had high larval mortality in the detached leaf bioassays. We can conclude that we have at least three resistance sources to consider in developing resistance varieties if GM potatoes would be accepted in the industry. We also evaluated advanced breeding lines from the breeding program for field defoliation by the Colorado potato beetle. Using the Montcalm Research Center beetle nursery, 40 lines with pedigrees of insect resistance germplasm were evaluated in replicated trials. Five lines showed significant reduction to defoliation. These lines are being used to make further crosses to advance this beetle resistance trait. We feel after 3 rounds of crossing this tetraploid germplasm we are starting to see some advancement in resistance introgressed from the wild species. However, much value would be gained if we could combine resistance mechanisms. For that reason, we need to identify additional sources of beetle resistance. Combining host plant resistance to insects in a commercially acceptable line is a great challenge.

We initiated our Colorado potato beetle resistance screening in 2010 and focused on screening our selections with detached leaf bioassays (no-choice) and screening new genetic material from NRSP-6 for resistance. The new accessions were screened through detached leaf bioassays and screened field cages. Plant resistance can fall into three categories: tolerance, antibiosis, and antixenosis. With a no-choice evaluation we were able to emulate commercial grower conditions and screen directly for antibiosis. Seedlings of plant introductions from *S. berthaultii* (PI 473331), *S. chacoense* (PI 320123), *S. pinnatisectum* (PI 186553) and *S. oplocense* (PI 473368) and potato lines with high and low *Bt-cry3a* expression, *Bt-cry1Ia1* and glycoalkaloid-based resistance were evaluated. In addition, a $2m^3$ cage was constructed over 10 potato plants and 50-80 newly emerged adult beetles were collected at the MRC and placed into each of the cages on MSU campus. These species were compared to the susceptible variety Snowden. The plants were checked weekly for the numbers and life stages of Colorado potato beetles along with beetle behavior (i.e. feeding, walking, resting, mating, position on plant) until adult emergence. Defoliation was recorded weekly from emergence of over-wintered adult beetles through emergence of the second-generation adults. In some cases the beetles clipped the leaves from the plants by chewing the petiole rather than feeding on leaves. We saw this behavior in previous studies when adult beetles were placed in no-choice cages of *cry3A* potato lines. Clearly some accessions are more resistant than other accessions and all are more resistant than Snowden. The 15 best selections were identified and were re-evaluated in 2011. The summary of the 2011detached leaf bioassays are in the table below. Only two lines did not show the resistance phenotype in 2011. The cage study in 2011 gave similar results to 2010. Based upon defoliation and mortality, four of the six accessions had individual lines that may have high levels of resistance to the beetle. We are now attempting to cross these lines to develop mapping and breeding populations.

2011 Wild species CPB- Detached-leaf Bioassay		
Five neonate CPB per DLB; 3 reps per line		
	7 /10 days	
	Mortality	mm2
Line	%	Defolioated
S. opl 1973368-3	93	3
S. pnt 186553-8	73	5
S. chc 458310-17	87	7
S. chc 320287-21	100	12
S. chc 123123-21	70	18
S. chc 458310-5	33	37
S. chc 320287-10	80	42
S. opl 1973368-1	67	50
S. chc 458310-2	47	67
S. chc 123123-15	27	383
S. chc 123123-3	13	433

Russet Table Varieties for Michigan

Our breeding strategy has been to make selected crosses that have a high probability of selecting Norkotah types. We grew out large progenies over the past three years to further increase the probability of finding desirable selections. We will continue to use Silverton, Russet Norkotah, MSE192-8RUS, A95109-1RUS, etc. as parents. Single hill selections were made in the past three years. These early generation selections will be evaluated in 2012 as well as a new set of crosses will be evaluated at Lake City.

Sugar Profile Analysis of Early Generation Selections for Extended Storage: Chip-processing Results From the MPIC Demonstration Commercial Storage (October 2010 - June 2011)

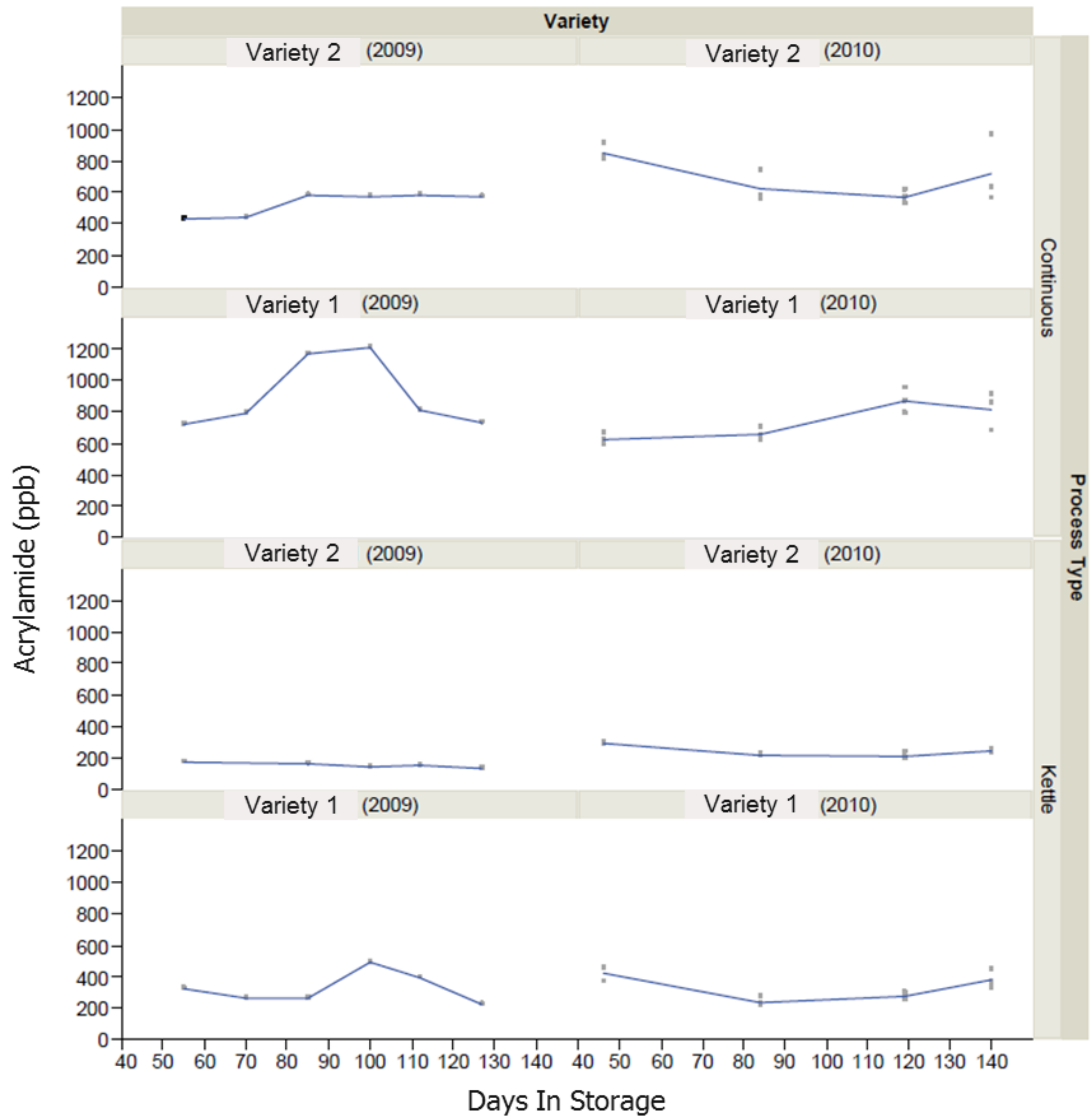
The MSU Potato Breeding Program has been conducting chip-processing evaluations each year on potato lines from the MSU breeding program and from other states. For 12 years we have been conducting a long-term storage study to evaluate advanced breeding lines with chip-processing potential in the Dr. B. F. (Burt) Cargill Potato Demonstration Storage facility directly adjacent to the MSU Montcalm Research Farm to identify extended storage chippers. We evaluated advanced selections from the MSU breeding program for chip-processing over the whole extended storage season (October-June). Tuber samples of our elite chip-processing selections were placed in the demonstration storage facility in October and were sampled 9 times to determine their ability to chip-process from storage.

In October 2010, tuber samples from 14 MSU lines from the Montcalm Research Center and Lake City Experiment Station trials were placed in the bins along with three check varieties. The first samples were chip-processed in October and then 8 more times until June 2011. Samples were evaluated for chip-processing color and defects. **Table 3** summarizes the chip-processing color and scab rating of 14 lines and three check varieties (FL1879, Pike and Snowden) over the 8-month storage season. Most lines chip-processed well from the storage until April as Snowden color was increasing. The lines that chip processed well until June were MSJ147-1, MSL007-B and MSL292-A and MSQ086-3. These lines are highlighted in the table. We are also showing that some of the lines with good chip quality also have scab resistance and/or late blight resistance.

Table 3: 2010-2011 Demonstration Storage Chip Results of Elite MSU Breeding Lines

		10/19/10	11/15/10	12/14/10	1/18/11	2/22/11	3/15/11	4/12/11	5/11/11	6/8/11
		SFA Chip Score Rating Scale 1-5								
Line	**Resistance**	58 F	56 F	50 F	49 F	50 F	51 F	53 F	53 F	53 F
FL1879		1.5	1.5	1.5	1.5	1.0	1.0	1.0	1.5	2.0
MSH228-6	ScabR	1.5	1.0	1.0	1.5	1.5	1.5	1.5	2.0	2.0
MSJ126-9Y	ScabR	1.0	1.0	1.0	1.0	1.5	1.0	1.0	1.0	1.5
MSJ147-1	ScabMR	1.0	1.0	1.0!	1.0!	1.0	1.0	1.5	2.0	3.0
MSL007-B	ScabR	1.5	1.0	1.0	1.0	1.0!	1.0	1.0	1.5	1.5
MSL292-A	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5
MSN148-A	ScabMR	1.0	1.5	1.0	1.0	1.5	1.5	2.5	3.0	3.5
MSP270-1	ScabR	1.0	1.0	1.0	1.0!	1.0!	1.0	1.5	1.5	2.0
MSQ035-3	MR ScabR LBR	2.0	2.0	1.5	1.5	1.5	1.0	2.0	2.0	3.0
MSQ070-1	ScabR-LBR	1.0	1.5	1.0	1.0	1.0	1.5	1.5	1.5	3.0
MSQ086-3	LBR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.5
MSQ279-1	ScabR	1.5	2.0	1.0	1.5	1.5	1.5	1.5	1.0	2.0
MSR036-5	ScabR-LBR	2.5	2.0	1.5	1.5	2.0	2.0	2.0	2.5	3.5
MSR169-8Y	ScabR	1.0	1.5	1.0	1.0	1.0	1.5	1.5	1.0	2.0
MSS026-2Y	-	1.5	1.5	1.0	1.0	1.5	1.0	1.5	1.5	3.0
Pike	**ScabR**	1.0	1.5	1.5	1.5	1.0	1.5	1.5	2.5	1.5
Snowden		1.5	1.5	1.0	1.0	1.5	1.5	2.0	3.0	ND

During the 2009-11 storage season the MPIC/MSU conducted studies to examine acrylamide content in potato chips made from Snowden and three MSU advanced breeding lines stored in the MPIC commercial storage bins in the first year, then Snowden, NY139 and MSJ147-1 in the second year. Samples were collected every two weeks starting in December and continued for a total of 6 dates. The tuber samples were sent to MSU, TechMark and four commercial processors for chip processing in the first year, then only to TechMark and one commercial processor in the second year. The commercial processors processed the potatoes as continuous and kettle chips. The chips were sent to MSU for acrylamide sampling. The ground chip samples were sent to the University of Wisconsin for acrylamide analysis. In the first year from this study we learned that variety, processor and process type (continuous vs. kettle) influences acrylamide levels in the chips. The oil temperature and dwell time were also important. Glucose levels were not as important within the range of values we observed (0.001-0.005%). Kettle chips, fried at lower temperatures, had lower acrylamide levels. One variety had an average of 230 ppb acrylamide in the kettle chips which is below the level required for California. A second study in the first year also looked at more varieties over the storage season, but the chip samples evaluated for acrylamide were processed at TechMark. Variety differences were observed. 2009 was an unusually cool growing season. Many potatoes went into storage as immature tubers. This condition may have had an influence on the reducing sugar content in the tubers. 2010 has been a warm growing season and the tubers matured much faster. In the second year, the replicated study was similar to the first year results; however the acrylamide levels were slightly higher. Again MSJ147-1 has the lowest acrylamide levels, followed by Snowden then NY139, despite all three lines having low glucose levels and similar asparagine levels.



National Coordinated Breeder Trial (NCBT)

2011 was the secod year of the NCBT. 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 NCBT has 8 sites (North: NY, MI, WI, ND and South: NC, FL, MO, CA) in addition to a scab trial in MN. Over 165 lines were tested as 15-hill plots with best performing lines of the previous year being replicated in 2011. The lines were evaluated for tuber type and appearance, yield, specific gravity, chip color and chip defects. Some of the lines are being fast tracked for SFA and commercial trialing. The data is being prepared to be posted on a website database for the public to use. The lines with the best performance will be retested in 2012 and new early generation lines will be added. The MSU lines were more scab resistant than the lines from the programs. Some of the promising lines are MSK061-4, MSM246-B, MSL292-A, MSR061-1, MSL007-B, MSR169-8Y, MSR058-1, MSR127-2, MSR148-4 and MSS165-2Y. Beacon Chipper also showed merit in some of the southern and northern sites.

Variety Release

We released three specialty potatoes: Spartan Splash, Raspberry and Colonial Purple. We are continuing to promote the seed production and testing of Beacon Chipper, a 2005 release. In addition, we are also continuing to promote Michigan Purple, Jacqueline Lee for the tablestock specialty markets. Boulder is being commercially grown in Quebec and they now have interest in Kalkaska based upon 2 years of trials. Lastly, commercial seed of MSJ126-9Y, MSL292-A and MSL007-B are being produced and we will continue to seek commercial testing of these lines. MSL292-A (long-term chipper), MSR061-1 (scab, PVY and late blight resistant chipper), MSL007-B (scab resistant chipper), MSQ086-3 (late blight resistant chipper) and MSQ070-1(scab and late blight resistant chipper) are being fast-tracked for the chip-processing market through the USPB. We also have a focused ribavirin-based virus eradication system to generate virus-free tissue culture lines for the industry. We are also developing the cryotherapy technique to remove virus from tissue culture plants. About 30 lines are in ribaviran treatment at this time to remove PVS and/or PVY. This year, about 80 new MSU breeding lines are being put into tissue culture.

MSU Lines with Commercial Tracking:

MSJ126-9Y

Parentage: Penta x OP
Developers: Michigan State University and the Michigan Agricultural Experiment Station
Plant Variety Protection: To Be Applied For.

Strengths: MSJ126-9Y is a chip-processing potato with an attractive round appearance with shallow eyes. MSJ126-9Y has a medium vine and an early to mid-season maturity. This variety has resistance to *Streptomyces scabies* (common scab) stronger than Pike. MSJ126-9Y also has excellent chip-processing long-term storage characteristics and better tolerance to blackspot bruise than Snowden.

Incentives for production: Excellent chip-processing quality with long-term storage characteristics, common scab resistance superior to Pike, and good tuber type.

MSH228-6

Parentage: MSC127-3 x OP
Developers: Michigan State University and the Michigan Agricultural Experiment Station
Plant Variety Protection: Will be considered.

Strengths: MSH228-6 is a chip-processing potato with moderate resistance to *Streptomyces scabies* (common scab). MSH228-6 also has a promising storage sugar profile and good chip-processing long-term storage characteristics.

Incentives for production: Chip-processing quality with long-term storage characteristics, and moderate common scab resistance with good tuber type.

MSL292-A

Parentage: Snowden x MSH098-2
Developers: Michigan State University and the Michigan Agricultural Experiment Station
Plant Variety Protection: Will be considered.

Strengths: MSL292-A is a chip-processing potato with an attractive round appearance with shallow eyes. MSL292-A has a full-sized vine and an early to mid-season maturity. MSL292-A has above average yield potential and specific gravity similar to Snowden. This variety has excellent chip-processing long-term storage characteristics and a similar to better tolerance to blackspot bruise than Snowden.

Incentives for production: Excellent chip-processing quality with long-term storage characteristics, above average yield, specific gravity similar to Snowden, and good tuber type.

MSL007-B

Parentage: MSA105-1 x MSG227-2
Developers: Michigan State University and the Michigan Agricultural Experiment Station
Plant Variety Protection: Will be considered.

Strengths: MSL007-B is a chip-processing potato with an attractive, uniform round appearance with shallow eyes. This variety has resistance to *Streptomyces scabies* (common scab) stronger than Pike, with a strong, netted skin. MSL007-B was the most highly merit rated line in the National Chip Processing Trial across eight locations in 2010.

Incentives for production: Chip-processing quality with common scab resistance superior to Pike, and a uniform, round tuber type.

MSR061-1

Parentage: MegaChip x NY121
Developers: Michigan State University and the Michigan Agricultural Experiment Station
Plant Variety Protection: Will be considered.

Strengths: MSR061-1 is a chip-processing potato with resistance to common scab (*Streptomyces scabies*) and moderate foliar late blight (*Phytophthora infestans*) resistance. This variety has medium yield similar to Pike and a 1.079 (average) specific gravity and an attractive, uniform, round appearance. MSR061-1 has a medium vine and an early to mid-season maturity.

Incentives for production: Chip-processing quality with common scab resistance similar to Pike, moderate foliar late blight resistance (US8 genotype), and uniform, round tuber type.

II. Germplasm Enhancement

In 2010 we developed genetic mapping populations (both at diploid and tetraploid levels) for late blight resistance, beetle resistance, scab resistance and also for tuber quality traits. We have started to characterize these populations in 2011 and conduct the linkage analysis studies using the SNP genotyping. 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 have used lines with Verticillium wilt resistance, PVY resistance, and cold chip-processing. We are monitoring the introgression of this germplasm through marker assisted selection. Through GREEEN funding, we were able to continue a breeding effort to introgress leptine-based insect resistance using new material selected from USDA/ARS material developed in Wisconsin. We will continue conducting extensive field screening for resistance to Colorado potato beetle at the Montcalm Research Farm and in cages at the Michigan State University Horticulture Farm. We made crosses with late blight resistant diploid lines derived from *Solanum microdontum* to our tetraploid lines. We have conducted lab-based detached leaf bioassays and have identified resistant lines. These lines are being used crosses to further transmit resistance.

III. Integration of Genetic Engineering with Potato Breeding

Potato Translation Initiation Factor 4E (eIF4E) over-expression to obtain resistance to PVY in susceptible potato varieties

USDA/ARS funded project:
Jonathan Whitworth, USDA-ARS, Aberdeen, Idaho and David Douches, Dept. Crop and Soil Sciences, Michigan State University

Research Objectives and Research Plan

Our overall objective **is to conduct studies that will lead to transgenic Russet Norkotah, Silverton Russet, and A95109-1 lines that have PVY resistance conferred by a native resistance gene from potato.** Through gene mapping studies Valkonen's group was able to map the extreme resistance to PVY to Chr. 11 (Hamalainen et al. 1997). A genetic marker has been identified that co-segregates with the extreme resistance to PVY (*Ry_{adg}*) (Kasai et al. 2000). Valkonen's group has also made an effort to clone this PVY resistance gene (a LRR-NBS R-gene), but the over-expressed gene they cloned did not confer resistance and they theorized that another non-cloned R-gene in the hotspot on Chr. 11 may be the actual R-gene that confers resistance. In pepper a PVY resistance gene maps to Chr. 3 and provides natural resistance to PVY that is different than the R-gene resistance on Chr. 11. Ruffel et al. (2005) was able to demonstrate that the *pot-1* gene in tomato (*Solanum lycopersicum*) is an orthologue to the *pvr2* gene in pepper. In transient expression assays, they were able to show that the eIF4E gene (referred to as *pot-1*) accounted for the resistance to PVY in tomato. **Using a comparative genomics approach, we have been able to clone the translation initiation factor 4E (eIF4E) gene from potato that may be the orthologue to the recessive PVY resistance conferred by the *pvr2* locus in pepper (*Capsicum annum*).** Our eIF4E gene, cloned from potato using the tomato *pot-1* primers has an identical sequence length and a 96% sequence homology match to the tomato orthologue that confers PVY resistance in tomato. We hypothesize that the eIF4E gene we cloned is the orthologue of the *pot-1* and *pvr2* PVY resistance genes in tomato and pepper, respectively.

Progress Report

One of the objectives of this research is to test the tomato *pot-1* (*eIF4E*) gene as a source of PVY resistance in potato. RT-PCR and cDNA amplification using gene specific primers allowed amplification of a tomato gene from *S. hirsutum* accession PI247087. The sequence of the cloned gene was identical to the Genbank sequence identified as *pot-1* (AY723736). This sequence was subsequently cloned into the *Agrobacterium* binary vector pSPUD4 which contains a Cauliflower mosaic virus 35S promoter (CaMV 35S) which should express the *pot-1* gene constitutively in plants.

Transformation experiments to introduce the *S. hirsutum* eIF4E gene or the potato gene into the PVY susceptible lines were completed resulting in at least 10 independent clones for each gene. Culturing on medium containing kanamycin and PCR was used to confirm the presence of the transgene in each of the independent clones. We now have

10 lines with the *S. hirsutum pot-1* gene derived from Russet Norkotah, 22 from MSE149-5Y, 30 lines from Classic Russet and over 45 lines from Silverton Russet. Select lines from each of Russet Norkotah and Silverton Russet will be tested by JW this winter. Three PVY strains (O, N NTN) have been selected and increased in tobacco at Aberdeen to use for inoculation of tissue culture potato plants. Tissue culture plants (30 each) of putative PVY resistant potato lines are being sent to JW for the greenhouse PVY evaluation..

PVY resistance to three PVY strains (O, N and NTN) of the MSE149-5Y lines was evaluated by JW in the winter of 2010. The check line was highly infected by all three strains. Of the transgenic lines, 3 lines (89-3, 89-22 and 89-26) demonstrated little to no PVY accumulated in the plants across the three PVY strains. These lines have been increased for seed production so that field studies can be conducted in 2012. We have over 50 lbs. of seed for those trials. The 2011 greenhouse evaluation consisted of a series of Russet Norkotah, Classic Russet and Silverton Russet lines. We identified three Classic Russet lines and one Russet Norkotah line with strong resistance to all three PVY strains. We are focusing on greenhouse minituber increase for these PVY resistant lines this winter. We identified a number of Silverton Russet lines with increased PVY resistance but none with complete resistance to all three PVY strains. We will focus on testing more Russet Norkotah and Silverton Russet lines in 2012.

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2011 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 2011, we tested 165 varieties and breeding lines in the replicated variety trials, plus single observational plots of 228 lines and 167 lines in the National Chip Processing Trial. The variety evaluation also includes disease testing in the scab nursery (MSU Soils Farm, E. Lansing and Montcalm Research Farm, Lakeview) and foliar and tuber late blight evaluation (Muck Soils Research Farm, Bath). The objectives of the evaluations are to identify superior varieties for fresh or processing markets. 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, 45°F (7.2°C) and 50°F (10°C) storage), as well as susceptibilities to common scab, late blight (foliar and tuber), and blackspot bruising are determined.

We would like to acknowledge the collaborative effort of Bruce Sackett, Chris Long and the Potato Breeding Team for getting the research done.

PROCEDURE

Ten field variety trials were conducted at the Montcalm Research Center in Entrican, MI. They were planted as randomized complete block designs with two to four replications. 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. The field experiments were conducted on a sandy loam soil on the Comden ground that was in corn the previous year and in potatoes four years previously. This year the north end of some of the trials incurred some flood damage.

The most advanced selections were tested in the Advanced trial, representing selections at a stage after the Adaptation Trial. The other field trials were the North Central, Russet, Adaptation (chip-processors and tablestock), Preliminary (chip-processors and tablestock), the NCPT and the early and late observational trials. *The early observational trial is discussed in the breeding report.*

2011 was the second year of the National Chip Processing Breeder 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 8 sites (North: NY, MI, WI, ND and South: NC, FL, MO, CA) in addition to a scab trial in MN. A total of 167 lines were tested as 15-hill single observation plots. *The NCPT trial is discussed in the breeding report.*

In each of these trials, the yield was graded into four size classes, incidence of external and internal defects in >3.25 in. (8.25 cm) diameter (or 10 oz. (283.5 g) for Russet types) potatoes were recorded. Samples were taken for specific gravity, chipping, disease tests and bruising tests. Chip quality was assessed on 25-tuber composite sample from four replications, taking two slices from each tuber. Chips were fried at 365°F (185°C). The chip color was measured visually with the SFA 1-5 color chart. Tuber samples were also stored at 45°F (7.2°C) and 50°F (10°C) for chip-processing out of storage in January and March. Advanced selections are also placed in the MPIC B.F. Burt Cargill Commercial Demonstration Storage in Entrican, MI for monthly sampling. The lines in the agronomic trials were assessed for common scab resistance at the nursery at the Montcalm Research Farm. There was very strong scab disease pressure at the new Montcalm Scab Disease Nursery in both 2010 and 2011. The 2011 late blight trial was conducted at the Clarksville Research Center. Maturity ratings (1 early - 5 late) were taken for all variety trial plots in late August to differentiate early and late maturing lines. The simulated blackspot bruise results for average spots per tuber have also been incorporated into the summary sheets.

RESULTS

A. Advanced Trial (Table 1)

A summary of the 16 entries evaluated in the Advanced trial results is given in **Table 1**. Overall, the yields for the Advanced trial (140 days) were above average. The check varieties for this trial were Snowden and Atlantic. The highest yielding lines were Beacon Chipper, MSL292-A, Kalkaska, MSL007-B, MSQ086-3 and the three NY lines Lamoka, NY140 and NY148 (E106-4). Hollow heart and vascular discoloration were the predominant internal defects. Specific gravity was slightly below average with eight lines having a specific gravity equal to or higher than Snowden (1.080): Atlantic (1.085), MSJ147-1 (1.087), Kalkaska (1.080), MSR061-1 (1.081), MSQ070-1 (1.089), NY140 (1.082), Lamoka (1.086) and NY148 (1.093). All entries in the trial had excellent chip-processing quality out of the field, with an SFA score of 1.0. Many of the MSU breeding lines have moderate to strong scab resistance: MSJ126-9Y, MSH228-6, Kalkaska, MSL007-B, MSR061-1, MSR169-8Y and MSQ070-1. Beacon Chipper continues to be consistently high yielding line with good specific gravity, chip quality, and less susceptibility to scab. Two promising chip-processing lines are MSL292-A (chip quality, high yield, good specific gravity, and shows potential as a long-term storage chipper) and MSQ086-3 (good yield and chip quality).

B. North Central Regional Trial Entries (Table 2)

The North Central Trial is conducted in a wide range of environments (6 regional locations) to provide adaptability data for the release of new varieties from Michigan, Minnesota, North Dakota, Wisconsin, and Canada. Twenty-two entries were tested in Michigan in 2011. The results are presented in **Table 2**. The MSU lines MSL211-3, MSL268-D, MSQ440-2, MSM182, MSR169-8Y and MSQ176-5 were the Michigan representatives included in the 2011 North Central Trial. MSL211-3 is an attractive, bright-skinned round to oval white tablestock with moderate late blight resistance and reduced susceptibility to scab. MSL268-D has dual-purpose characteristics; good chip-processing quality and an attractive freshmarket type, combined with late blight resistance, and some early bulking potential. MSM182-1 is a tablestock line with bright-skin, round type combining both late blight and PVY resistance. MSQ176-5 is a late blight resistant tablestock with very uniform, large, round-white tubers and smooth, bright skin. MSQ440-2 is a bright skinned round white tablestock line. MSR169-8Y is a scab resistance chip-processing selection good specific gravity, tuber shape and storability. Due to the field location, the yields were below average in 2011.

C. Russet Trial (Table 3)

We continue to increase our russet breeding efforts to reflect the growing interest in russet types in Michigan. In 2011, 24 lines evaluated after 134 days. The results are summarized in **Table 3**. Russet Burbank, Russet Norkotah, Silverton Russet and GoldRush were the reference varieties used in the trial. The yields were below average with a high percentage of B-sized tubers. The highest yielding lines were A01124-3 and AF3362-1 and A0008-1TE. Overall, the internal quality in the russet trial was above average. Specific gravity measurements were average to below average with Russet Norkotah at 1.064 and Russet Burbank at 1.068. Off type and cull tubers were found in nearly all lines tested, with the highest being Russet Burbank (33%). Canela and A01124-3 had few pickouts.

D. Adaptation Trials (Tables 4 and 5)

The Adaptation Trials are conducted as two separate trials based on market class: chip-processing and tablestock trials. The majority of the lines evaluated in the Adaptation Trial were tested in the Preliminary Trial the previous year. Three reference cultivars (Atlantic, Snowden, and Pike), and 14 advanced breeding lines are reported in the chip-processing trial. The trial was harvested after 134 days and the results are summarized in **Table 4**. All entries had good out-of-the-field chip scores. Specific gravity values were average for the Montcalm Research Farm (Atlantic was 1.085 and Snowden was 1.082). The highest specific gravity was MSS165-2Y, MSR159-02 and MSR127-1. The greatest hollow heart was noted in FL1879 (23%) and A01143-3C (38%) followed by Atlantic (15%). The overall plot yields for this trial were average in

2011 with too many B size. MSQ089-1 and MSQ035-3 were the highest yielding lines with MSR127-1 and MSS165-2Y combining yield potential and high specific gravity and scab resistance.

In the tablestock trial, 7 advanced breeding lines were evaluated with Onaway and Reba as check varieties. The trial was harvested after 120 days and the results are summarized in **Table 5**. In general, the yield was below average in this trial and internal defects were low. Promising and attractive yellow-fleshed table selections are MSM288-2Y and MSQ341-BY. MSS544-1R and MSR217-1R have attractive red color.

E. Preliminary Trials (Tables 6 and 7)

The Preliminary trial is the first replicated trial 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. The chip-processing Preliminary Trial (**Table 6**) had 34 advanced selections and three check varieties (Atlantic, Pike and Snowden). The chip-processing trial was harvested after 127 days. Most lines chip-processed well from the field. Specific gravity values were average with Atlantic at 1.086 and Snowden at 1.083. Fourteen advanced selections had 1.079 or higher specific gravities. The most promising MSU lines are MSV313-2, MSV403-3, MSV241-2, MSV505-2, MSV127-1 and V383-1 combining yield, specific gravity, chip quality and scab resistance. Internal quality was good across all the lines in the trial.

Table 7 summarizes the 30 tablestock lines evaluated in the Preliminary Trial (Onaway and Michigan Purple were the check varieties). This tablestock trial was harvested and evaluated after 120 days. MSU161-1, MSR214-2P, MST386-1P, Purple Heart and Michigan Purple Sport II were the highest yielding lines. On average, the table lines are not high in scab resistance, but we see a higher frequency of late blight resistance. This trial also had a low incidence of internal defects. In addition to traditional round white, red-skinned, and yellow flesh freshmarket categories, there are some unique specialty lines such as Purple Heart (red skin and purple flesh), Midnight II (purple skin with deep purple flesh, the Michigan Purple skin sports, purple skinned lines such as MSR214-2P and MST386-1P . Jingshu 2 was from the Chinese breeding program.

F. Potato Scab Evaluation (Table 8)

Each year, a replicated field trial is conducted to assess resistance to common scab. We have moved the scab testing to two ranges at the Montcalm Research Center where high common scab disease pressure was observed in previous years. This location is being used for the early generation observational scab trial (over 300 lines), the scab variety trial (170 lines) and the national scab trial sponsored by USDA/ARS. *Additionally, we added a replicated On-Farm scab trial (24 lines), which is summarized in the MPIC Research Report.* 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 2011 scab ratings are based upon the Montcalm Research Farm site. **Table 8** categorizes many of the varieties and advanced selections tested in 2011 at the MSU over a three-year period. The varieties and breeding lines are placed into six 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 – 1.8) correlates with <10% infection. Scores of 4.0 or greater are found on lines with >50% infection and severe pitted lesions.

The check varieties Russet Burbank, Russet Norkotah, GoldRush, Red Norland, Red Pontiac, Onaway, Pike, Atlantic, and Snowden can be used as references (bolded in **Table 8**). The table is sorted in ascending order by 2011 rating. This year's results continue to indicate that we have been able to breed numerous lines with resistance to scab. A total of 71 lines, of the 170 tested, had a scab rating of 1.6 (better than or equivalent to Pike) or lower in 2011. Most notable scab resistant MSU lines are MSH228-6, Kalkaska, MSJ126-9Y, MSL007-B, MSN215-2P, MSP270-1, MSR061-1, MSR127-2 and MSR169-8Y; as well as some earlier generation lines MSS297-3, MSS544-1R and MSV383-1, and MSV127-1. The greater number of MSU lines in the resistant and moderately resistant categories indicates we are making progress in breeding more scab resistant lines for the chip-processing and tablestock markets. There are also an increasing number of scab resistant lines that also have late blight resistance and PVY resistance. We also continue to conduct early generation scab screening on selections in the breeding program beginning after two years of selection. Of the 320 early generation selections that were evaluated, over 100 were had resistance ratings (scab rating of $\leq$ 1.5). Scab results from the disease nursery for the advanced selections are also found in the Trial Summaries (**Tables 1-7**).

H. Late Blight Trial (Tables 9, 10 and 11)

In 2011, the late blight trial was planted at the Clarksville Research Center rather than the Muck Soils Research Farm. Over 300 entries were planted in early June for late blight evaluation. These include lines tested in a replicated manner from the agronomic variety trial (160 lines) and entries in the National Late Blight Variety Trial (35 lines) and about 200 entries in the early generation observation plots. The trials were inoculated in early August with a US-22 genotype of *P. infestans*. Late blight infection was identified in the plots within 2 weeks after inoculation. The plots were evaluated 2 times per week over a 50 day period following inoculation. We need to note that the disease reaction in the plots was not as aggressive as previous years. All disease lesions tested were identified as US-22, which would explain the higher disease ratings (susceptibility) on lines with late blight resistance to US-8 (Tollocan-based resistance lines Jacqueline Lee, Missaukee, etc.). In 2011 there were 15 lines from the national late blight trial that had moderate to strong late blight resistance to US-22. For the replicated variety trial 42 lines had moderate to strong late blight resistance, while 67 lines in the early generation observation plots had moderate to strong late blight resistance. These were from various late blight resistance sources (LBR9, Malinche, Kenya Baraka, Monserrat, Torridon, Stirling, NY121, B0718-3, etc.). **Tables 9, 10 and 11** list lines in the foliar resistance and susceptibility categories.

I. Blackspot Bruise Susceptibility (Table 12)

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 12**. 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 2011, the bruise levels were comparable to previous years. The most bruise resistant MSU breeding lines this year from the Advanced trial were MSH228-6, MSQ086-3, MSJ126-9Y, MSR061-1, and MSL292-A. This group is similar to 2010. The most susceptible lines from the Advanced trial were Lamoka, NY148 (E106-4) and Atlantic. The Adaptation Trial MSU lines (Chip and Table) with the least bruising were MSR159-02, MSQ089-1, MSR128-4Y, MSQ279-1 and MSR148-4, MSM288-2Y, MSS544-1R, MSM182-1 and MSR217-1R. MSQ035-3 and MSR127-2 were the most bruise susceptible. Of the earlier generation breeding lines (Preliminary Trials), the most of the lines had little blackspot bruising, while only MSR093-4 showed significant blackspot bruising. The most bruise resistant russet entries were A02062-1TE, Silverton Russet, AF3362-1, GoldRush, CO03187-1RUS, AC00395-2RUS; the most susceptible were Dakota Trailblazer and ND8068-5RUS. The most bruise resistant entries in the US Potato Board/Snack Food Association Trial were MSJ126-9Y, CO00188-4W, W2978-3 and MSR061-1, while NYE106-4 (NY148) was the only entry with more bruising than Atlantic.

Table 1

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

ADVANCED TRIAL
MONTCALM RESEARCH FARM
May 9 to September 20, 2011 (134 days)

LINE	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR	CHIP SCORE[2]	PERCENT (%) TUBER QUALITY[3] HH	VD	IBS	BC	SCAB[4]	MAT[5]	BRUISE[6]	3-YR AVG US#1 CWT/A
Lamoka	371	417	89	10	84	5	1	1.086	1.0	0	20	0	0	1.4	2.0	1.7	-
NY148[LBR]	363	444	82	18	80	2	0	1.093	1.5	0	0	0	0	1.4	3.3	2.7	-
NY140[LBR]	345	422	82	18	77	5	0	1.082	1.0	0	50	0	0	2.5	2.5	1.2	-
MSQ086-3	319	438	73	27	72	1	0	1.076	1.0	0	15	0	0	2.0	3.0	0.2	346*
MSL292-A	307	367	84	16	78	6	0	1.082	1.0	3	28	0	0	2.5	1.8	0.4	287
Kalkaska	294	374	79	21	77	2	0	1.080	1.0	3	13	0	0	1.4	3.0	1.4	325
Beacon Chipper	280	313	89	10	71	18	1	1.078	1.5	5	45	3	0	1.8	3.0	1.3	298
Atlantic	**279**	**337**	**83**	**17**	**77**	**5**	**0**	**1.085**	**1.5**	**13**	**18**	**3**	**0**	**3.0**	**2.3**	**1.5**	**318***
MSL007-B	273	338	81	19	80	0	0	1.078	1.0	0	5	0	0	1.1	2.8	0.8	234
MSH228-6	258	293	88	10	84	4	2	1.077	1.5	15	53	3	0	1.3	3.0	0.2	284
MSQ070-1	249	315	79	21	76	2	0	1.089	1.5	5	23	5	0	1.8	3.3	1.1	272
Snowden	**248**	**309**	**80**	**19**	**79**	**1**	**1**	**1.080**	**1.5**	**3**	**38**	**0**	**0**	**2.4**	**2.5**	**0.8**	**285**
MSJ126-9Y	196	246	80	20	77	2	0	1.074	1.0	0	10	0	0	0.8	2.5	0.1	213
MSR061-1[LBR]	175	261	67	33	66	0	0	1.081	1.0	0	10	0	0	0.9	3.0	0.7	203
MSR169-8Y	169	241	70	30	70	0	0	1.079	1.0	0	10	0	0	0.6	2.5	0.7	-
MSJ147-1	145	227	64	35	62	2	1	1.087	1.0	5	5	0	0	1.4	2.8	1.1	155
MEAN	267	334						1.082						1.6	2.7	1.0	
$HSD_{0.05}$	132	135						0.005						1.5	1.3	* Two-Year Average	

[LBR] Line(s) demonstrated foliar resistance to Late Blight (*Phytopthora infestans*) in inoculated field trials at the MSU Clarksville Horticulture Research Center.

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

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

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

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

[5]MATURITY RATING: August 24, 2011; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

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

Table 2

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

NORTH CENTRAL REGIONAL TRIAL
MONTCALM RESEARCH FARM
May 9 to September 7, 2011 (121 days)

	CWT/A		PERCENT OF TOTAL[1]						CHIP	PERCENT (%) TUBER QUALITY[3]							3-YR AVG US#1
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	SCORE[2]	HH	VD	IBS	BC	SCAB[4]	MAT[5]	BRUISE[6]	CWT/A
Snowden	**295**	**418**	**71**	**29**	**70**	**0**	**1**	**1.085**	**1.5**	**1**	**10**	**1**	**0**	**2.4**	**2.3**	**0.6**	**330**
NorValley	**280**	**369**	**76**	**19**	**71**	**5**	**5**	**1.071**	**1.5**	**2**	**6**	**0**	**0**	**2.3**	**1.8**	**0.5**	**316***
MN19298RY	279	370	75	24	75	0	0	1.066	2.5	0	0	0	0	-	2.0	0.3	210*
MSQ176-5[LBMR]	277	329	84	16	68	16	0	1.063	2.0	6	1	0	0	2.4	1.8	0.1	287
MN02616R	259	369	70	27	69	1	3	1.064	2.0	0	8	0	0	-	1.0	1.0	256*
Atlantic	**259**	**313**	**83**	**15**	**78**	**5**	**2**	**1.085**	**1.5**	**5**	**6**	**1**	**0**	**3.0**	**2.0**	**0.6**	**310**
Red Pontiac	**240**	**320**	**75**	**16**	**72**	**3**	**9**	**1.050**	**3.5**	**0**	**10**	**0**	**0**	**3.4**	**2.5**	**0.2**	**303***
D Red Norland	**233**	**293**	**80**	**18**	**79**	**1**	**2**	**1.054**	**3.0**	**0**	**10**	**0**	**0**	**1.3**	**1.0**	**0.2**	**251**
W2717-5	232	309	75	24	74	1	1	1.085	2.0	1	12	0	0	1.8	1.5	0.6	232*
MSL268-D[LBR]	211	326	65	32	65	0	3	1.076	1.5	0	12	0	0	2.1	2.0	0.5	262
W2310-3	211	274	77	20	77	0	3	1.084	3.5	0	9	1	0	2.6	2.3	0.8	219*
W2978-3	201	295	68	30	67	1	2	1.067	1.0	0	9	0	0	2.3	1.0	0.2	230
W6002-1R	199	298	67	33	67	0	0	1.055	3.5	0	13	0	0	1.9	1.5	0.1	-
MSQ440-2	187	244	77	23	74	3	0	1.052	3.0	0	10	0	0	1.3	2.3	0.3	251*
AND00272-1R	186	337	55	43	55	0	2	1.064	1.0	0	0	0	0	-	2.5	0.1	-
MSL211-3	185	254	73	26	69	4	2	1.061	3.0	0	2	0	0	1.8	1.3	0.2	295*
MN02586	181	308	59	40	58	1	1	1.070	2.5	0	8	0	0	3.3	1.8	0.3	-
MSM182-1[LBR]	175	281	62	37	62	0	1	1.068	2.5	0	4	0	0	2.3	2.3	0.6	248*
ND8555-8R	163	309	53	47	53	0	1	1.062	2.0	0	9	0	0	-	1.0	0.3	277*
MSR169-8Y	158	229	69	29	67	2	2	1.080	1.5	1	6	0	0	0.6	2.5	1.0	-
W6511-1R	109	317	34	60	34	0	5	1.076	2.5	0	10	0	0	2.5	2.0	0.6	-
MN02588	55	141	39	60	39	0	1	1.070	2.5	3	9	0	0	-	3.3	0.5	-
MEAN	208	305						1.069	2.3					2.2	1.9	0.4	
$HSD_{0.05}$	102	109						0.006						1.5	1.6		* Two-Year Average

[LBR] Line(s) demonstrated foliar resistance to Late Blight (*Phytopthora infestans*) in inoculated field trials at the MSU Clarksville Horticulture Research Center.

All the lines in the Round White Trial in 2008 were North Central Regional Trial entries.

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

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

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

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

[5]MATURITY RATING: August 24, 2011; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

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

Table 3

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

RUSSET TRIAL
MONTCALM RESEARCH FARM
May 9 to September 7, 2011 (121 days)

	CWT/A		PERCENT OF TOTAL[1]						PERCENT (%) TUBER QUALITY[2]							3-YR AVG US#1
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	HH	VD	IBS	BC	SCAB[3]	MAT[4]	BRUISE[5]	CWT/A
A01124-3	323	386	84	15	73	11	1	1.075	5	3	1	0	1.5	2.3	0.5	-
AF3362-1	263	328	80	17	65	15	3	1.064	0	4	0	0	1.1	2.0	0.2	-
A0008-1TE	240	306	79	20	70	8	2	1.064	0	4	0	0	0.9	1.0	0.5	-
CO03202-1Rus	220	322	68	30	62	6	2	1.074	8	1	0	0	1.5	3.0	0.9	-
A02062-1TE	207	281	74	23	61	12	3	1.063	0	7	0	0	0.8	2.0	0.2	263*
Canela	206	268	77	22	72	5	1	1.074	0	4	1	0	1.9	2.0	1.2	204*
ND8229-3Rus	200	255	78	18	62	16	3	1.072	0	1	0	0	ND	2.0	1.5	237*
CO99053-3Rus[LBMR]	198	271	73	24	62	12	3	1.074	6	3	0	0	1.9	2.3	0.9	221
GoldRush Russet	**197**	**296**	**66**	**27**	**61**	**6**	**6**	**1.059**	**0**	**4**	**0**	**0**	**0.5**	**2.0**	**0.3**	**222**
AF3317-15[LBMR]	193	311	62	31	62	0	6	1.085	0	0	0	0	1.5	2.8	0.8	-
Dakota Trailblazer[LBMR]	189	269	70	22	59	11	8	1.084	9	5	0	0	ND	2.8	1.8	-
Russet Norkotah	**186**	**278**	**67**	**27**	**63**	**4**	**6**	**1.064**	**0**	**3**	**0**	**0**	**2.5**	**1.0**	**0.6**	**162**
Silverton Russet	184	260	71	28	64	6	2	1.065	0	3	0	0	0.5	3.0	0.3	256
CV00047-3RUS	168	238	70	27	63	8	2	1.067	0	1	0	0	1.3	2.0	0.7	-
AC00395-2Rus	166	291	57	39	52	5	4	1.083	6	3	0	0	1	2.3	0.3	228*
CO03276-5Rus	161	285	56	36	52	5	8	1.068	2	4	0	0	1.1	2.0	0.7	-
CO03308-3Rus	142	219	65	30	62	3	6	1.067	1	5	0	0	0.8	2.8	0.5	-
WV4993-1RUS	135	232	58	39	57	1	3	1.071	1	2	0	0	1.9	1.8	0.4	-
CO03187-1RUS	131	247	53	44	53	0	3	1.065	0	0	0	0	0.1	2.0	0.3	-
Clearwater Russet	121	230	52	43	52	0	5	1.078	1	7	2	0	1.4	3.0	2.2	-
ND8068-5Rus	114	230	50	41	50	0	9	1.070	0	0	0	0	ND	1.5	1.8	-
CO03276-4Rus	98	231	42	57	40	2	0	1.072	2	3	2	0	1.5	1.8	0.4	-
Russet Burbank	**78**	**221**	**35**	**39**	**35**	**0**	**26**	**1.068**	**3**	**1**	**0**	**0**	**2.4**	**2.5**	**0.8**	**101***
W6360-1Rus[LBR]	63	153	41	48	41	0	11	1.074	1	1	0	0	1.9	3.3	0.6	-
MEAN	174	267						1.071					1.3	2.2	0.8	
$HSD_{0.05}$	201	208						0.013					1.5	2.5	* Two-Year Average	

**Not Russet lines

[LBR] Line(s) demonstrated foliar resistance to Late Blight (*Phytopthora infestans*) in inoculated field trials at the MSU Clarksville Horticulture Research Center.

[1]SIZE: B: < 4 oz.; A: 4-10 oz.; OV: > 10 oz.; 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, 2011; 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.

ADAPTATION TRIAL, CHIP-PROCESSING LINES
MONTCALM RESEARCH FARM
May 9 to September 20, 2011 (134 days)

	CWT/A		PERCENT OF TOTAL[1]						CHIP	PERCENT (%) TUBER QUALITY[3]						
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	SCORE[2]	HH	VD	IBS	BC	SCAB[4]	MAT[5]	BRUISE[6]
MSQ089-1	341	396	86	13	84	2	0	1.074	1.0	0	25	0	0	2.1	3.0	0.3
MSQ035-3	329	388	85	15	79	6	0	1.077	1.0	0	10	0	0	1.8	2.8	2.0
FL1879	323	348	93	7	76	17	0	1.076	1.5	23	15	0	0	2.4	2.8	0.9
MSQ279-1	315	352	89	10	81	9	0	1.074	1.0	8	15	0	0	1.0	3.3	0.6
MSR127-2	288	348	83	17	77	6	0	1.087	1.0	0	20	0	0	2.0	3.8	2.1
MSS165-2Y	286	431	66	33	66	1	0	1.090	1.0	3	18	0	0	1.6	2.3	1.1
Snowden	**284**	**385**	**74**	**26**	**73**	**1**	**0**	**1.082**	**1.0**	**0**	**30**	**3**	**0**	**2.4**	**2.5**	**1.0**
CO03243-3W	284	336	84	16	81	4	0	1.079	1.0	5	18	0	0	2.8	3.0	0.5
MSR148-4[LBMR]	283	430	66	34	65	1	0	1.071	1.0	0	30	0	0	1.8	3.0	0.7
Atlantic	**281**	**331**	**85**	**15**	**78**	**7**	**0**	**1.085**	**1.0**	**15**	**10**	**0**	**0**	**3.0**	**2.7**	**1.2**
AC03433-1W	279	325	86	13	82	4	2	1.077	1.0	38	30	0	0	2.9	4.0	0.3
MSR159-02	252	326	77	23	74	4	0	1.089	1.5	0	18	0	0	1.6	3.8	0.3
A01143-3C	235	354	66	24	66	0	10	1.076	1.5	0	13	0	0	1.8	4.3	ND
MSR036-5[LBR]	188	245	76	22	73	3	1	1.079	1.0	3	3	0	0	1.1	3.5	0.9
Pike	**167**	**219**	**76**	**24**	**76**	**0**	**0**	**1.083**	**1.5**	**0**	**13**	**0**	**0**	**1.5**	**3.0**	**0.6**
CO00188-4W	159	258	62	38	62	0	0	1.071	1.0	0	0	0	0	1.4	2.3	0.3
MSR128-4Y	132	216	61	37	60	1	2	1.079	1.0	0	0	0	0	0.0	1.4	0.6
MEAN	260	335						1.079						1.8	3.0	0.8
$HSD_{0.05}$	103	113						0.006						1.5	2.0	

[LBR] Line(s) demonstrated foliar resistance to Late Blight (*Phytopthora infestans*) in inoculated field trials at the MSU Clarksville Horticulture Research Center.

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

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

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

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

[5]MATURITY RATING: August 24, 2011; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

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

Table 5

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

ADAPTATION TRIAL, TABLESTOCK LINES
MONTCALM RESEARCH FARM
May 9 to September 6, 2011 (120 days)

	CWT/A		PERCENT OF TOTAL[1]						PERCENT (%) TUBER QUALITY[2]						
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	HH	VD	IBS	BC	SCAB[3]	MAT[4]	BRUISE[5]
Reba	**315**	**360**	**88**	**12**	**84**	**4**	**0**	**1.075**	**10**	**5**	**0**	**0**	**1.6**	**2.0**	**0.4**
Onaway	**309**	**362**	**85**	**12**	**79**	**6**	**3**	**1.062**	**3**	**13**	**0**	**0**	**2.0**	**1.5**	**0.5**
MSM288-2Y	307	401	77	23	75	2	0	1.068	0	5	0	0	3.0	1.3	0.1
AF2291-10	296	362	82	18	80	1	0	1.088	0	23	0	0	2.0	3.0	0.8
MSQ341-BY	260	301	87	13	82	5	0	1.073	3	8	0	3	1.3	1.8	0.3
MSR157-1Y	199	252	79	19	75	4	2	1.083	10	10	0	0	2.6	2.0	0.6
MSS544-1R	180	294	61	38	60	2	1	1.060	0	8	0	3	1.9	1.3	0.2
MSM182-1[LBR]	168	278	61	38	61	0	2	1.071	0	8	10	0	2.3	2.3	0.3
MSR217-1R	164	208	79	19	77	2	2	1.054	0	5	0	0	2.8	1.5	0.3
MEAN	244	313						1.070					2.2	1.9	0.4
$HSD_{0.05}$	80	85						0.004					1.5	1.0	

[LBR] Line(s) demonstrated foliar resistance to Late Blight (*Phytopthora infestans*) in inoculated field trials at the MSU Clarksville Horticulture Research Center.
[NCR] North Central Regional Entry
[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, 2011; 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.

Table 6

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

PRELIMINARY TRIAL, CHIP-PROCESSING LINES
MONTCALM RESEARCH FARM
May 9 to September 13, 2011 (127 days)

LINE	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR	CHIP SCORE[2]	PERCENT (%) TUBER QUALITY[3] HH	VD	IBS	BC	SCAB[4]	MAT[5]	BRUISE[6]
Boulder	435	448	97	3	63	34	0	1.086	2.0	0	0	0	0	1.9	3.5	1.0
MSQ461-2PP	392	444	88	10	85	3	2	1.075	1.0	0	0	0	0	2.5	2.0	0.2
FL1879	**382**	**414**	**92**	**8**	**78**	**14**	**0**	**1.077**	**1.5**	**3**	**7**	**1**	**0**	**2.4**	**2.5**	**0.5**
MSR109-1	382	416	92	7	62	30	1	1.076	1.5	8	3	0	0	2.1	3.5	0.6
MSV313-2	376	412	91	6	60	31	2	1.085	1.0	1	4	0	0	1.5	3.0	0.7
Missaukee	339	443	77	23	76	0	0	1.081	1.5	0	1	0	0	2.1	3.5	0.2
MSV403-3	338	416	81	18	78	3	1	1.084	1.0	0	2	1	0	0.9	3.0	0.7
MSS483-1[LBMR]	313	414	76	24	76	0	0	1.071	2.5	0	0	0	0	3.1	2.5	0.6
Atlantic	**304**	**359**	**85**	**15**	**83**	**1**	**0**	**1.086**	**1.5**	**0**	**3**	**1**	**0**	**3.0**	**2.0**	**0.5**
MSV434-1Y	300	338	89	11	80	9	0	1.067	1.0	0	3	0	0	1.8	2.0	0.2
MSV434-4	293	327	90	10	79	11	0	1.066	1.0	0	0	0	0	1.3	1.5	0.1
MSV241-2	284	322	88	12	86	3	0	1.087	1.0	3	5	0	0	1.5	3.5	0.7
MSV238-1[LBR]	279	304	92	8	69	23	0	1.070	2.0	2	1	1	0	1.4	3.0	0.2
MSV505-2	276	320	86	14	83	3	0	1.078	1.0	0	5	3	0	-	2.0	0.8
MSR021-2	276	339	81	18	75	7	0	1.062	1.0	0	0	0	0	2.3	2.0	0.2
MSV430-1	275	329	84	16	84	0	0	1.077	1.0	1	0	0	0	2.3	3.0	0.4
Snowden	**268**	**360**	**74**	**26**	**73**	**1**	**0**	**1.081**	**1.0**	**0**	**8**	**1**	**0**	**2.4**	**2.5**	**0.4**
MSV127-1	265	303	88	11	84	4	1	1.080	1.0	0	4	0	0	1.0	2.5	0.4
MSV383-1	258	299	86	13	83	3	0	1.083	1.5	1	2	0	0	0.9	2.0	0.2
MSN190-2	258	370	70	30	70	0	1	1.089	1.0	0	2	0	0	1.9	1.5	0.5
MSV092-2	258	305	84	16	82	3	0	1.080	2.0	0	1	0	0	1.3	3.0	0.1
MSV153-2Y	245	315	78	21	73	5	1	1.078	1.5	0	1	0	0	2.5	3.0	0.3
MSS927-1[LBR]	241	308	78	21	75	3	1	1.075	2.0	0	4	0	0	1.6	2.0	0.2
MSM108-A	241	325	74	25	73	1	1	1.084	1.0	3	4	2	1	2.5	2.5	0.6
MSV307-2	239	274	87	13	82	5	0	1.077	1.5	0	4	0	0	1.5	2.0	0.1
MSV397-2	236	270	87	11	81	6	1	1.071	1.5	0	6	1	0	1.0	2.5	0.4
MSV358-3	233	287	81	18	75	6	0	1.079	1.0	0	3	0	0	1.0	2.0	0.2
MSV498-1	231	306	75	25	74	1	0	1.076	1.5	0	6	0	0	1.5	2.5	0.6
MSS297-1	224	313	72	28	70	2	1	1.075	1.0	0	1	0	0	0.9	1.5	0.2
MSS514-1PP	224	343	65	35	65	0	0	1.063	2.5	0	0	0	0	1.8	2.0	0.2
MSV292-1Y	218	251	87	13	68	19	0	1.061	2.0	0	1	0	0	2.5	2.5	0.2

Table 6

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

PRELIMINARY TRIAL, CHIP-PROCESSING LINES
MONTCALM RESEARCH FARM
May 9 to September 13, 2011 (127 days)

	CWT/A		PERCENT OF TOTAL[1]						CHIP	PERCENT (%) TUBER QUALITY[3]						
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	SCORE[2]	HH	VD	IBS	BC	SCAB[4]	MAT[5]	BRUISE[6]
MSV393-1	207	254	82	18	81	1	0	1.080	1.5	0	2	0	0	1.4	3.5	0.4
MSV331-3	207	232	89	11	75	14	0	1.069	1.0	1	2	0	0	0.8	2.0	0.8
MSR058-1[LBR]	203	301	68	32	68	0	0	1.078	1.5	0	3	0	0	1.0	2.0	0.8
MSR093-4	197	261	75	23	72	4	1	1.076	1.5	0	1	0	1	1.8	3.0	1.5
MSP270-1	194	242	80	20	78	2	0	1.068	1.5	0	3	0	0	0.6	3.0	0.1
MSV344-2	192	232	82	11	78	4	6	1.067	1.5	2	0	1	0	2.1	2.5	0.3
Pike	**185**	**248**	**75**	**25**	**74**	**1**	**0**	**1.081**	**1.0**	**0**	**4**	**0**	**0**	**1.5**	**2.5**	**0.3**
MSV143-1Y	179	262	68	31	64	5	1	1.075	1.5	0	2	0	0	1.4	2.0	0.0
MSV117-1	177	252	70	29	69	1	1	1.079	2.0	1	1	1	0	1.4	2.5	0.3
MSV125-4	173	228	76	24	75	1	0	1.088	1.0	3	1	0	0	0.8	2.5	0.2
MSV355-2	151	186	81	17	77	4	2	1.074		0	3	1	0	1.9	1.0	0.2
MSV396-4Y	123	198	62	38	62	0	0	1.082	1.5	0	3	0	0	1.6	4.0	0.2
MSM102-A	103	145	71	27	70	1	2	1.077	1.0	0	1	0	0	1.4	2.0	0.4
MEAN	254	312						1.077						1.7	2.5	0.4
$HSD_{0.05}$	205	208						0.010						1.5	2.3	

[LBR] Line(s) demonstrated foliar resistance to Late Blight (*Phytopthora infestans*) in inoculated field trials at the MSU Clarksville Horticulture Research Center.

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

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

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

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

[5]MATURITY RATING: August 24, 2011; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

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

Table 7

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

PRELIMINARY TRIAL, TABLESTOCK LINES
MONTCALM RESEARCH FARM
May 9 to September 6, 2011 (120 days)

	CWT/A		PERCENT OF TOTAL[1]						PERCENT (%) TUBER QUALITY[3]						
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	HH	VD	IBS	BC	SCAB[4]	MAT[5]	BRUISE[6]
MI Purple Sport II	378	409	93	7	79	13	0	1.073	0	10	0	0	2.3	1.5	0.2
Purple Heart	323	392	82	17	78	4	0	1.058	0	0	5	0	2.1	2.0	0.3
MSR605-11[LBMR]	314	411	76	22	72	5	2	1.066	5	0	0	0	2.1	4.0	0.2
MSR214-2P[LBR]	300	410	73	27	73	0	0	1.068	0	0	0	0	1.6	3.0	0.0
MST386-1P	299	382	78	11	73	5	11	1.076	0	20	0	0	0.8	3.0	0.4
MSU161-1[LBMR]	293	381	77	23	74	3	0	1.072	0	0	0	0	2.1	3.5	0.2
MI Purple Sport I	288	366	79	18	78	1	4	1.070	0	15	0	0	2.3	2.5	0.3
MSU379-1	267	321	83	15	74	9	2	1.064	0	0	0	0	1.8	2.5	0.1
MI Purple Red Sport	261	301	87	12	73	14	1	1.068	5	5	0	0	2.5	1.0	0.3
MI Purple	**247**	**301**	**82**	**14**	**77**	**5**	**4**	**1.064**	**0**	**15**	**0**	**0**	**2.8**	**1.5**	**0.3**
MSU016-2[LBMR]	244	320	76	24	74	2	0	1.092	5	0	0	0	2.3	3.0	0.6
Onaway	**241**	**313**	**77**	**19**	**76**	**2**	**4**	**1.059**	**0**	**15**	**0**	**0**	**2.0**	**1.0**	**0.6**
MSR606-02	238	339	70	25	64	7	5	1.058	0	5	0	0	2.6	1.0	0.4
MI Purple Sport III	215	261	82	12	74	9	5	1.066	5	15	0	0	1.5	1.0	0.3
MSS108-1	212	295	72	28	72	0	0	1.076	0	0	5	0	1.5	3.0	0.2
MSV307-1	206	258	80	19	79	1	2	1.062	0	10	0	0	1.9	1.5	0.3
MSV282-4Y[LBR]	182	265	69	31	69	0	1	1.076	0	5	0	0	2.1	1.7	0.6
MSN215-2P	169	243	70	27	67	2	4	1.070	0	10	0	0	0.9	2.0	0.3
MSR605-10[LBMR]	166	301	55	35	55	0	9	1.074	0	0	0	0	2.8	3.5	0.1
MSV177-4	163	246	66	33	64	2	1	1.068	0	5	0	0	1.8	1.0	0.2
MSR297-A	162	219	74	26	74	0	0	1.062	0	0	0	0	1.5	2.0	0.3
Jingshu 2	161	296	54	44	54	0	1	1.093	0	0	0	0	2.6	4.0	1.0
Jacqueline Lee[LBMR]	**144**	**359**	**40**	**46**	**40**	**0**	**14**	**1.074**	**0**	**5**	**0**	**0**	**2.6**	**3.0**	**0.6**
Spartan Splash	138	256	54	46	54	0	0	1.063	0	0	0	0	2.3	1.5	0.2
MSV205-4	128	174	74	26	74	0	0	1.077	0	5	0	0	1.1	1.0	0.3
MSR218-AR	119	157	76	24	71	5	0	1.051	0	10	0	0	3.0	1.0	0.2
MSV429-1	110	190	58	40	58	0	2	1.070	0	5	0	0	1.3	1.5	0.2

Table 7

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

PRELIMINARY TRIAL, TABLESTOCK LINES
MONTCALM RESEARCH FARM
May 9 to September 6, 2011 (120 days)

	CWT/A		PERCENT OF TOTAL[1]						PERCENT (%) TUBER QUALITY[3]						
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	HH	VD	IBS	BC	SCAB[4]	MAT[5]	BRUISE[6]
Blackberry	101	181	56	41	56	0	3	1.042	0	0	0	0	3.3	1.5	0.2
Midnight II	82	251	33	64	33	0	3	1.077	0	0	0	0	2.6	2.0	0.1
MSR241-4RY	53	171	31	68	31	0	1	1.069	0	5	5	0	2.5	1.0	0.1
MEAN	207	292						1.069					2.1	2.1	0.3
$HSD_{0.05}$	175	201						0.012					1.5	1.7	

[LBR] Line(s) demonstrated foliar resistance to Late Blight (*Phytopthora infestans*) in inoculated field trials at the MSU Clarksville Horticulture Research Center.

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

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

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

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

[5]MATURITY RATING: August 24, 2011; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

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

2009-2011 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, EAST LANSING, MI

LINE	*3-YR* AVG.*	2011 RATING	2011 WORST	2011 N	2010 RATING	2010 WORST	2010 N	2009 RATING	2009 WORST	2009 N
Sorted by ascending 2011 Rating;										
CO03187-1Rus	-	0.1	1	4	-	-	-	-	-	-
Goldrush Russet	***0.8***	**0.5**	**1**	**4**	**1.0**	**1**	**2**	**1.0**	**1**	**4**
Silverton Russet	***0.9***	0.5	1	4	1.0	1	2	1.3	2	4
MSP270-1	***1.0***	0.6	1	4	1.0	1	2	1.5	2	4
MSR169-8Y	***0.9***	0.6	1	4	1.0	1	2	1.0	1	4
A02062-1TE	-	0.6	1	4	-	-	-	-	-	-
MSJ126-9Y	***1.0***	0.8	2	4	1.0	1	2	1.3	2	4
MST386-1P	***0.9****	0.8	1	4	1.0	1	2	-	-	-
CO03308-3Rus	-	0.8	1	4	-	-	-	-	-	-
Liberator	-	0.8	1	4	-	-	-	-	-	-
MSV125-4	-	0.8	1	2	-	-	-	-	-	-
MSV331-3	-	0.8	1	4	-	-	-	-	-	-
MSN215-2P	***0.9***	0.9	1	4	1.0	1	2	0.8	1	4
MSR061-1	***1.1***	0.9	2	4	1.3	2	2	1.1	2	4
MSS297-3	***0.9***	0.9	1	4	0.9	1	4	1.0	1	4
AO008-ITE	-	0.9	1	4	-	-	-	-	-	-
MSV383-1	-	0.9	1	4	-	-	-	-	-	-
MSV403-3	-	0.9	2	4	-	-	-	-	-	-
MSR058-1	***1.3***	1.0	2	4	1.5	2	2	1.3	2	4
MSQ279-1	***1.1****	1.0	2	4	1.3	2	2	-	-	-
MSP239-1	-	1.0	2	4	-	-	-	-	-	-
MSV127-1	-	1.0	2	4	-	-	-	-	-	-
MSV358-3	-	1.0	2	4	-	-	-	-	-	-
MSV397-2	-	1.0	1	4	-	-	-	-	-	-
MSL007-B	***1.0***	1.1	2	4	1.0	1	2	1.0	1	3
MSR036-5	***1.1***	1.1	2	4	1.0	1	2	1.3	2	4
AC00395-2Rus	***1.1****	1.1	2	4	1.0	1	2	-	-	-
AF3362-1	-	1.1	2	4	-	-	-	-	-	-
CO03276-5Rus	-	1.1	2	4	-	-	-	-	-	-
MSV205-4	-	1.1	2	4	-	-	-	-	-	-
MSV502-2	-	1.1	2	4	-	-	-	-	-	-
MSH228-6	***1.2***	1.3	2	4	1.0	1	2	1.3	2	4
MSQ440-2	***1.3***	1.3	2	8	1.8	2	2	1.0	2	4
A01124-3RUS	***1.4****	1.3	2	4	1.5	2	2	-	-	-
MSQ341-BY	***1.4****	1.3	2	4	1.5	2	2	-	-	-
Dark Red Norland	***1.6****	**1.3**	**2**	**4**	**2.0**	**2**	**2**	**-**	**-**	**-**
CV00047-3	-	1.3	2	4	-	-	-	-	-	-
MSV092-2	-	1.3	2	4	-	-	-	-	-	-
MSV429-1	-	1.3	2	4	-	-	-	-	-	-
MSV434-4	-	1.3	2	4	-	-	-	-	-	-
Kalkaska (MSJ036-A)	***1.4***	1.4	2	4	1.5	2	2	1.3	2	4
MSJ147-1	***1.4***	1.4	2	4	1.3	2	2	1.7	2	3
NY139	***1.7****	1.4	2	4	2.0	2	2	-	-	-

2009-2011 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, EAST LANSING, MI

LINE	*3-YR* AVG.*	2011 RATING	2011 WORST	2011 N	2010 RATING	2010 WORST	2010 N	2009 RATING	2009 WORST	2009 N
Sorted by ascending 2011 Rating;										
Clearwater Russet	-	1.4	2	4	-	-	-	-	-	-
Dakota Diamond	-	1.4	2	4	-	-	-	-	-	-
German Butterball	-	1.4	2	4	-	-	-	-	-	-
MSM102-A	-	1.4	2	4	-	-	-	-	-	-
MSR128-4Y	-	1.4	2	4	-	-	-	-	-	-
MSR161-2	-	1.4	2	4	-	-	-	-	-	-
MSV117-1	-	1.4	2	4	-	-	-	-	-	-
MSV143-1Y	-	1.4	2	4	-	-	-	-	-	-
MSV238-1	-	1.4	3	4	-	-	-	-	-	-
MSV393-1	-	1.4	2	4	-	-	-	-	-	-
NYE106-4	-	1.4	2	4	-	-	-	-	-	-
CO00188-4W	***1.7***	1.5	2	4	1.5	2	2	2.0	2	4
MSR297-A	***1.4***	1.5	2	1	1.0	1	2	1.7	2	3
Pike	***1.4***	1.5	3	4	**1.1**	**2**	**8**	**1.5**	**2**	**8**
MSS108-1	***1.5****	1.5	2	4	1.5	2	2	-	-	-
AF3317-15	-	1.5	2	4	-	-	-	-	-	-
CO03202-1Rus	-	1.5	2	4	-	-	-	-	-	-
CO03276-4Rus	-	1.5	3	4	-	-	-	-	-	-
MSV241-2	-	1.5	2	4	-	-	-	-	-	-
MSV307-2	-	1.5	3	4	-	-	-	-	-	-
MSV313-2	-	1.5	2	4	-	-	-	-	-	-
MSV498-1	-	1.5	2	2	-	-	-	-	-	-
Reba	***2.0***	1.6	2	4	2.5	3	2	2.0	3	8
MSR214-2P	***2.1****	1.6	3	4	2.5	3	2	-	-	-
MSS165-2Y	-	1.6	2	4	-	-	-	-	-	-
MSS927-1	-	1.6	3	4	-	-	-	-	-	-
MSV396-4Y	-	1.6	3	4	-	-	-	-	-	-
MSL308-A	-	1.7	2	3	-	-	-	-	-	-
MSR159-02	***1.7***	1.7	3	8	2.0	2	2	1.5	2	4
A01143-3C	***1.6***	1.8	2	4	1.8	2	2	1.3	2	4
Beacon Chipper	***1.7***	1.8	2	4	2.0	2	2	1.3	2	4
MSL211-3	***2.1***	1.8	2	4	2.2	3	6	2.4	3	4
MSQ035-3	***1.6***	1.8	3	4	1.0	1	2	2.0	2	4
MSQ070-1	***1.4***	1.8	2	4	1.3	2	2	1.3	2	3
MSQ405-1PP	***1.5***	1.8	3	4	2.0	2	2	0.8	1	4
MSS514-1PP	***1.8***	1.8	2	4	2.0	2	2	1.5	3	4
MSR148-4	***2.1****	1.8	2	4	2.5	3	2	-	-	-
MSU379-1	***1.6****	1.8	2	4	1.5	2	2	-	-	-
W2717-5	***2.4****	1.8	3	4	3.0	3	2	-	-	-
MI Purple Red Sport III	-	1.8	3	4	-	-	-	-	-	-
MSR093-4	-	1.8	3	4	-	-	-	-	-	-
MSV177-4	-	1.8	2	4	-	-	-	-	-	-
MSV434-1Y	-	1.8	2	4	-	-	-	-	-	-

Table 8

MICHIGAN STATE UNIVERSITY

POTATO BREEDING and GENETICS

2009-2011 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, EAST LANSING, MI

LINE	*3-YR* AVG.*	2011 RATING	2011 WORST	2011 N	2010 RATING	2010 WORST	2010 N	2009 RATING	2009 WORST	2009 N
Sorted by ascending 2011 Rating;										
CO99053-3Rus	***1.8***	1.9	3	4	2.0	2	2	1.5	3	4
MSS544-1R	***1.2***	1.9	2	4	1.0	1	2	0.8	1	4
Boulder	-	1.9	2	4	-	-	-	-	-	-
Canela	-	1.9	2	4	-	-	-	-	-	-
MSN190-2	-	1.9	3	4	-	-	-	-	-	-
MSV307-1	-	1.9	2	4	-	-	-	-	-	-
MSV355-2	-	1.9	3	4	-	-	-	-	-	-
Purple Haze	-	1.9	2	4	-	-	-	-	-	-
W6002-IR	-	1.9	3	4	-	-	-	-	-	-
W6360-1Rus	-	1.9	3	4	-	-	-	-	-	-
WV4993-1	-	1.9	3	4	-	-	-	-	-	-
MSQ086-3	***2.3***	2.0	3	4	2.3	3	4	2.5	4	4
MSR127-2	***1.3***	2.0	3	4	1.0	1	2	1.0	1	4
MSS582-1SPL	***1.9***	2.0	3	4	2.0	2	2	1.6	3	4
Onaway	***1.9***	**2.0**	**3**	**8**	**2.1**	**3**	**6**	**1.6**	**2**	**8**
AF2291-10	***2.0****	2.0	3	4	2.0	2	2	-	-	-
MSQ131-A	-	2.0	2	4	-	-	-	-	-	-
MSR247-A	-	2.0	2	1	-	-	-	-	-	-
MSR292-A	-	2.0	2	2	-	-	-	-	-	-
MSL268-D	***2.5***	2.1	3	8	3.0	3	2	2.5	4	4
Missaukee (MSJ164-1)	***2.3****	2.1	3	4	2.5	3	2	-	-	-
MSR605-11	***1.8****	2.1	3	4	1.5	2	2	-	-	-
MSU161-1	***2.1****	2.1	3	4	2.0	2	2	-	-	-
German Yellow	-	2.1	3	4	-	-	-	-	-	-
MSQ089-1	-	2.1	3	4	-	-	-	-	-	-
MSR109-1	-	2.1	3	4	-	-	-	-	-	-
MSV282-4Y	-	2.1	3	4	-	-	-	-	-	-
MSV344-2	-	2.1	3	4	-	-	-	-	-	-
Purple Heart	-	2.1	3	4	-	-	-	-	-	-
MSQ425-4YSPL	***2.3***	2.3	3	4	2.5	3	4	2.3	4	4
NorValley	***2.3****	2.3	3	4	2.3	3	2	-	-	-
W2978-3	***2.9****	2.3	3	4	3.5	4	2	-	-	-
Kufri Jeevan	-	2.3	3	4	-	-	-	-	-	-
LBR8	-	2.3	3	4	-	-	-	-	-	-
MI Purple Sport I	-	2.3	3	4	-	-	-	-	-	-
MI Purple Sport II	-	2.3	3	4	-	-	-	-	-	-
MSR021-2	-	2.3	3	4	-	-	-	-	-	-
MSV430-1	-	2.3	3	4	-	-	-	-	-	-
MSM182-1	***2.7***	2.3	3	8	3.0	3	2	2.9	4	4
MSN191-2Y	-	2.3	3	3	-	-	-	-	-	-
MSU016-2	-	2.3	4	3	-	-	-	-	-	-
FL1879	***2.6***	2.4	3	4	3.5	4	2	2.0	3	7
MSQ176-5	***2.4***	2.4	3	4	3.0	3	2	1.8	3	4

Table 8

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2009-2011 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, EAST LANSING, MI

LINE	*3-YR* AVG.*	2011 RATING	2011 WORST	2011 N	2010 RATING	2010 WORST	2010 N	2009 RATING	2009 WORST	2009 N
Sorted by ascending 2011 Rating;										
Snowden	***2.5***	**2.4**	**3**	**4**	**2.9**	**4**	**10**	**2.3**	**3**	**12**
Russet Burbank	***2.2****	**2.4**	**3**	**4**	**2.0**	**2**	**2**	**-**	**-**	**-**
Purple Surprise	-	2.4	3	4	-	-	-	-	-	-
MSQ461-2PP	***1.8***	2.5	3	4	2.0	2	2	0.8	1	4
MSR241-4RY	***2.6***	2.5	3	2	3.5	4	2	1.8	3	4
Russet Norkotah	***2.3***	**2.5**	**3**	**4**	**2.3**	**3**	**4**	**2.0**	**3**	**4**
MSL306-A	-	2.5	3	1	-	-	-	-	-	-
MSM108-A	-	2.5	3	4	-	-	-	-	-	-
MSV153-2	-	2.5	3	4	-	-	-	-	-	-
MSV292-1Y	-	2.5	3	4	-	-	-	-	-	-
NY140	-	2.5	3	4	-	-	-	-	-	-
W6511-1R	-	2.5	3	4	-	-	-	-	-	-
MSR157-1Y	***1.8***	2.6	4	8	1.3	2	2	1.5	2	4
Jingshu 2	***2.8****	2.6	3	4	3.0	4	2	-	-	-
W2310-3	***2.3****	2.6	3	4	2.0	2	2	-	-	-
Cowhorn	-	2.6	3	4	-	-	-	-	-	-
MI Purple Red Sport	-	2.6	3	4	-	-	-	-	-	-
Midnight II	-	2.6	4	4	-	-	-	-	-	-
MSN111-4PP	-	2.6	3	4	-	-	-	-	-	-
MSL292-A	***2.5***	2.8	4	4	2.5	3	2	2.3	3	4
MSR217-1R	***2.2***	2.8	3	4	2.0	2	1	1.8	3	4
MSR226-1RR	***2.3***	2.8	3	4	3.0	3	2	1.0	2	4
CO03243-3W	-	2.8	3	4	-	-	-	-	-	-
Russet Norkotah - CORN #8	-	2.8	3	4	-	-	-	-	-	-
Michigan Purple	-	2.8	3	4	-	-	-	-	-	-
MSL316-EY	-	2.8	3	4	-	-	-	-	-	-
MSR605-10	-	2.8	3	4	-	-	-	-	-	-
Trailblazer	-	2.8	3	4	-	-	-	-	-	-
Jacqueline Lee	***2.9***	2.9	4	4	3.3	4	2	2.5	3	4
MSQ558-2RR	***2.1***	2.9	3	4	2.3	3	2	1.3	2	4
Zongshu 3	***3.2****	2.9	4	4	3.5	4	2	-	-	-
AC03433-1	-	2.9	3	4	-	-	-	-	-	-
MSR606-2	-	2.9	4	4	-	-	-	-	-	-
MSR241-2RY	-	2.9	4	6	-	-	-	-	-	-
Atlantic	***2.8***	**3.0**	**4**	**11**	**2.9**	**3**	**10**	**2.7**	**3**	**8**
MSR219-2R	***2.7***	3.0	4	3	2.5	3	2	2.5	3	2
MSM288-2Y	***3.0****	3.0	3	4	3.0	3	2	-	-	-
MSM191-2Y	-	3.0	3	1	-	-	-	-	-	-
MSR218-AR	-	3.0	3	2	-	-	-	-	-	-
Yukon Gold	-	**3.0**	**4**	**4**	**-**	**-**	**-**	**-**	**-**	**-**
MSR705-2	-	3.1	4	4	-	-	-	-	-	-
MSS483-1	-	3.1	4	4	-	-	-	-	-	-
Belle de Fontenay	-	3.3	4	4	-	-	-	-	-	-

Table 8

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2009-2011 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, EAST LANSING, MI

LINE	*3-YR* AVG.*	2011 RATING	2011 WORST	2011 N	2010 RATING	2010 WORST	2010 N	2009 RATING	2009 WORST	2009 N
Sorted by ascending 2011 Rating;										
Blackberry	-	3.3	4	4	-	-	-	-	-	-
MN02586	-	3.3	4	2	-	-	-	-	-	-
MSM183-1	***3.7****	3.4	4	4	4.0	4	2	-	-	-
Red Pontiac	***3.9****	**3.4**	**4**	**4**	**4.5**	**5**	**2**	**-**	**-**	**-**
Stirling	-	3.5	4	3	-	-	-	-	-	-
H/LSD$_{0.05}$ =		**1.5**			**2.3**			**1.1**		

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.

[LBR] Line(s) demonstrated foliar resistance to Late Blight (*Phytopthora infestans*) in inoculated field trials at the MSU Muck Soils Research Farm.

N = Number of replications.

*2-Year Average. Note 2011 and 2010 Significant difference is Tukey's HSD, 2009 was Fisher's LSD.

Note the 2011-10 Scab Nursery data are from the new scab trial site at the Montcalm Research Farm. 2009 data is from the MSU campus site.

Table 9

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

2011 MSU LATE BLIGHT VARIETY TRIAL
CLARKSVILLE HORTICULTURAL EXPERIMENT STATION

Line Sort:

LINE	N	RAUDPC[1] MEAN
1989-86061	3	6.8
A0008-1TE	3	32.7
A01124-3	3	32.1
A01143-3C	3	25.5
A02062-1TE	3	29.5
AC00395-2RUS	3	18.4
AC03433-1	3	27.6
AF2291-10	3	30.2
AF3317-15	3	7.2
AF3362-1	3	37.7
Atlantic	12	35.0
Blackberry	3	39.6
C00188-4W	3	22.9
C003187-1RUS	3	32.9
C003202-1RUS	3	29.0
C003243-3W	3	27.4
C003276-4RUS	3	38.8
C003276-5RUS	3	31.2
C003308-3RUS	3	25.9
C099053-3RUS	3	7.8
Canela Russet	3	19.5
Chaposa	3	0.3
Clearwater Russet	2	22.9
Colonial Purple	2	36.2
CORN#8	3	16.6
CV00047-3	3	34.4
Dark Red Norland	3	30.5
Enfula	1	6.4
FL1879	3	22.3
German Butterball	3	10.5
German Yellow	3	34.6
Goldrush Russet	3	24.8
Iris	1	0.5
Jacqueline Lee	3	9.5
Jingshu 2	3	20.3
Kufri Jeevan	3	1.9
Lamoka	3	21.2
Michigan Purple	3	40.3
Midnight II	3	21.7
Missaukee	6	12.0
Montanosa	3	10.9
MSL211-3	1	36.9
MSL268-D	6	2.3
MSM171-A	3	11.5
MSM182-1	6	3.2
MSP270-1	3	11.8

RAUDPC Sort:

LINE	N	RAUDPC[1] MEAN	Female	Male
Chaposa	3	0.3		
Muruta	2	0.4		
Iris	1	0.5		
Stirling	6	0.6		
MSV234-1	3	0.8	Malinche	MSN105-1
MSS927-1	3	1.0	ND4350-3	ND7799C-1
MSV282-4Y	3	1.3	Monserrat	MSN105-1
MSV198-2Y	2	1.6	MSM051-3	Malinche
MSR061-1	3	1.9	MegaChip	NY121
NY148	3	1.9		
Kufri Jeevan	3	1.9		
W6360-1RUS	3	1.9		
MSV371-2	3	2.0	MSP459-5	MSG227-2
MSL268-D	6	2.3	NY 103	Jacqueline Lee
MSW206-2P	3	2.8	LBR9	Colonial Purple
MSV289-2P	3	2.8	Montanosa	Colonial Purple
MSR058-1	3	3.2	MegaChip	MSJ319-1
MSR214-2P	3	3.2	ND5084-3R	MSJ317-1
MSM182-1	6	3.2	Stirling	NY121
MSV165-1	3	4.3	Kufri Jeevan	MSL211-3
MSQ176-5	3	4.4	MSI152-A	Missaukee
MSV020-2	2	4.6	Atlantic	MSQ244-1
MSV283-2P	3	4.7	Monserrat	Colonial Purple
NY140	3	4.9		
MSV179-6	2	5.3	LBR8	MSL211-3
MSR036-5	3	5.4	MSL766-1	Liberator
NY121	3	5.7		
MSR605-10	3	6.0	Spunta G2	Missaukee
MSR605-11	3	6.2	Spunta G2	Missaukee
MSV521-3	2	6.3	MSE69.6	MSI152-A
Enfula	1	6.4		
1989-86061	3	6.8		
MSU016-2	3	7.0	Boulder	MSN105-1
MSV342-2	3	7.1	Montanosa	OP
AF3317-15	3	7.2		
MSS483-1	3	7.2	MSM171-A	Missaukee
Trailblazer Russet	3	7.4		
MSU161-1	3	7.7	MSM182-1	MSL211-3
C099053-3RUS	3	7.8		
MSR159-2	3	8.2	MSL766-1	MSJ126-9Y
MSR148-4	3	8.9	MSI152-A	Dakota Pearl
Jacqueline Lee	3	9.5	Tollocan	Chaleur
German Butterball	3	10.5		
MSR606-02	3	10.8	Spunta G2	Jacqueline Lee
Montanosa	3	10.9		
MSR093-4	3	11.1	Torridon	OP

Line Sort:

LINE	N	RAUDPC[1] MEAN
MSQ035-3	3	35.6
MSQ070-1	3	19.5
MSQ086-3	3	34.0
MSQ089-1	3	17.0
MSQ131-A	3	30.5
MSQ176-5	3	4.4
MSQ279-1	3	26.1
MSQ440-2	3	37.8
MSQ461-2PP	3	13.7
MSR021-2	3	34.7
MSR036-5	3	5.4
MSR058-1	3	3.2
MSR061-1	3	1.9
MSR093-4	3	11.1
MSR109-1	2	32.9
MSR128-4Y	3	23.3
MSR148-4	3	8.9
MSR157-1Y	3	33.2
MSR159-02	3	16.1
MSR159-2	3	8.2
MSR161-2	3	13.7
MSR169-8Y	3	28.0
MSR214-2P	3	3.2
MSR217-1R	4	30.3
MSR218-8R	3	29.9
MSR219-2R	1	31.4
MSR241-2RY	3	39.7
MSR297-A	3	14.9
MSR605-10	3	6.0
MSR605-11	3	6.2
MSR606-02	3	10.8
MSS108-1	3	16.5
MSS165-2Y	3	13.1
MSS483-1	3	7.2
MSS582-1SPL	2	32.3
MSS927-1	3	1.0
MST386-1P	3	28.0
MSU016-2	3	7.0
MSU161-1	3	7.7
MSU177-4	3	39.5
MSU278-1Y	3	28.7
MSU379-1	3	19.7
MSV005-2	3	11.7
MSV020-2	2	4.6
MSV092-2	3	26.7
MSV117-1	2	16.0
MSV146-1	3	38.3
MSV153-2	3	18.5
MSV158-2	2	14.2
MSV165-1	3	4.3
MSV179-6	2	5.3

RAUDPC Sort:

LINE	N	RAUDPC[1] MEAN	Female	Male
MSM171-A	3	11.5	Stirling	MSE221-1
MSV005-2	3	11.7	A93157-6LS	MSI152-A
MSP270-1	3	11.8	MSNT-1	MSG227-2
Missaukee	6	12.0		
MSV238-1	3	12.3	Marcy	Missaukee
MSS165-2Y	3	13.1	MSM188-1	MSL159-AY
MSV406-6	3	13.6	MSQ070-1	OP
MSR161-2	3	13.7	Stirling	MSJ126-9Y
MSQ461-2PP	3	13.7	NY120	POROOPG2-16
MSV158-2	2	14.2	King Harry	Missaukee
MSR297-A	3	14.9	MSG004-3	Missaukee
MSV393-1	3	14.9	MSQ070-1	MSG227-2
MSV396-4Y	3	15.5	MSQ070-1	MSJ126-9Y
MSV117-1	2	16.0	Missaukee	MSH228-6
MSR159-02	3	16.1	MSL766-1	MSJ126-9Y
MSS108-1	3	16.5	MSJ126-9Y	Stirling
CORN#8	3	16.6		
MSQ089-1	3	17.0	A91790-13	Missaukee
Red Pontiac	3	17.3		
Silverton Russet	3	17.6		
AC00395-2RUS	3	18.4		
MSV153-2	3	18.5	King Harry	MSG227-2
MSQ070-1	3	19.5	MSK061-4	Missaukee
Canela Russet	3	19.5		
Snowden	6	19.6		
MSU379-1	3	19.7	MSP238-1	Missaukee
Jingshu 2	3	20.3		
Lamoka	3	21.2		
MSV397-2	2	21.6	MSQ070-1	MSJ147-1
Midnight II	3	21.7		
FL1879	3	22.3		
MSV403-3	3	22.7	MSQ070-1	MSN099-B
Clearwater Russet	2	22.9		
C00188-4W	3	22.9		
Russet Burbank	3	23.1		
QSMSU03-01R	2	23.3	Jacqueline Lee	NDTX4034-1R
MSR128-4Y	3	23.3	MSJ167-1	MSJ126-9Y
Tundra	3	23.3		
Goldrush Russet	3	24.8		
A01143-3C	3	25.5		
C003308-3RUS	3	25.9		
MSQ279-1	3	26.1	MSF373-8	Pike
MSV092-2	3	26.7	MSJ126-9Y	MSP239-1
C003243-3W	3	27.4		
W6511-1R	3	27.5		
AC03433-1	3	27.6		
MSR169-8Y	3	28.0	Pike	MSJ126-9Y
MST386-1P	3	28.0	Michigan Purple	Liberator
MSU278-1Y	3	28.7	Torridon	MSL211-3
C003202-1RUS	3	29.0		
A02062-1TE	3	29.5		

Line Sort:

LINE	N	RAUDPC[1] MEAN
MSV198-2Y	2	1.6
MSV234-1	3	0.8
MSV238-1	3	12.3
MSV282-4Y	3	1.3
MSV283-2P	3	4.7
MSV289-2P	3	2.8
MSV331-3	3	35.1
MSV342-2	3	7.1
MSV355-2	3	38.7
MSV371-2	3	2.0
MSV393-1	3	14.9
MSV396-4Y	3	15.5
MSV397-2	2	21.6
MSV403-3	3	22.7
MSV406-6	3	13.6
MSV430-1	3	31.2
MSV434-4	3	34.1
MSV498-1	3	36.1
MSV502-2	3	37.7
MSV521-3	2	6.3
MSW206-2P	3	2.8
Muruta	2	0.4
NorValley	3	35.3
NY121	3	5.7
NY140	3	4.9
NY148	3	1.9
Onaway	3	37.0
Pike	2	32.3
Purple Heart	3	30.7
QSMSU03-01R	2	23.3
QSMSU03-08R	2	42.6
QSMSU03-1R	3	36.5
QSMSU10-2	1	31.1
QSMSU10-9	2	35.6
Red Norland	4	33.7
Red Pontiac	3	17.3
Russet Burbank	3	23.1
Russet Norkotah	2	37.4
Silverton Russet	3	17.6
Snowden	6	19.6
Stirling	6	0.6
Trailblazer Russet	3	7.4
Tundra	3	23.3
W2717-5	3	35.0
W2978-3	3	34.8
W6002-1R	2	30.4
W6360-1RUS	3	1.9
W6511-1R	3	27.5
WV4993-1	3	37.6

RAUDPC Sort:

LINE	N	RAUDPC[1] MEAN	Female	Male
MSR218-8R	3	29.9	NDTX4271-5R	MSK101-2
AF2291-10	3	30.2		
MSR217-1R	4	30.3	NDTX4271-5R	Missaukee
W6002-1R	2	30.4		
Dark Red Norland	3	30.5		
MSQ131-A	3	30.5	Boulder	Missaukee
Purple Heart	3	30.7		
QSMSU10-2	1	31.1	MSN106-2	MSL211-3
MSV430-1	3	31.2	MSQ279-7	MSQ086-3
C003276-5RUS	3	31.2		
MSR219-2R	1	31.4	ND5084-3R	MSJ317-1
A01124-3	3	32.1		
MSS582-1SPL	2	32.3	Purple Haze	MSL211-3
Pike	2	32.3		
A0008-1TE	3	32.7		
MSR109-1	2	32.9	Boulder	MSI111-A
C003187-1RUS	3	32.9		
MSR157-1Y	3	33.2	Jacqueline Lee	MSJ316-A
Red Norland	4	33.7		
MSQ086-3	3	34.0	Onaway	Missaukee
MSV434-4	3	34.1	MSQ283-2	MSJ126-9Y
CV00047-3	3	34.4		
German Yellow	3	34.6		
MSR021-2	3	34.7	MSJ316-A	Missaukee
W2978-3	3	34.8		
Atlantic	12	35.0		
W2717-5	3	35.0		
MSV331-3	3	35.1	NY137	MegaChip
NorValley	3	35.3		
MSQ035-3	3	35.6	MSG227-2	Missaukee
QSMSU10-9	2	35.6	MSN106-2	MSL211-3
MSV498-1	3	36.1	Snowden	Q283-2
Colonial Purple	2	36.2	Michigan Purple	Norland
QSMSU03-1R	3	36.5	Jacqueline Lee	NDTX4034-1R
MSL211-3	1	36.9	MSG301-9	Jacqueline Lee
Onaway	3	37.0		
Russet Norkotah	2	37.4		
WV4993-1	3	37.6		
MSV502-2	3	37.7	Tundra	MSJ126-9Y
AF3362-1	3	37.7		
MSQ440-2	3	37.8	MSK412-1R	Missaukee
MSV146-1	3	38.3	Keuka Gold	Malinche
MSV355-2	3	38.7	Marcy	OP
C003276-4RUS	3	38.8		
MSU177-4	3	39.5	Monticello	L603-319Y
Blackberry	3	39.6		
MSR241-2RY	3	39.7	PoorpG9-3	MN96013-RY
Michigan Purple	3	40.3		
QSMSU03-08R	2	42.6	Jacqueline Lee	NDTX4034-1R

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

Table 10

MICHIGAN STATE UNIVERSITY

POTATO BREEDING and GENETICS

2011 NATIONAL LATE BLIGHT VARIETY TRIAL
CLARKSVILLE HORTICULTURAL EXPERIMENT STATION

Line Sort:

LINE	N	RAUDPC[1] MEAN
A00286-3Y	3	8.4
A00293-2Y	3	19.2
A01010-1	3	44.3
A01025-4	3	36.2
A01143-3C	3	34.7
A02060-3TE	3	26.7
A99326-1PY	3	32.3
A99331-2RY	3	42.1
A99433-5Y	3	7.6
AC99375-1RU	3	8.5
AF2574-1	3	4.9
AF3317-15	3	3.8
AF4122-3	3	2.8
AF4191-2	3	7.5
AF4303-1	3	15.7
AF4329-7	3	11.4
Alpine Russet	3	33.2
ATC00293-1W/Y	3	13.9
AWN86514-2	3	0.9
B0692-4	3	0.8
B0718-3	3	0.6
B1992-106	3	4.7
B2676-2	3	46.8
B2756-7	3	42.3
BNC201-1	3	50.7
BNC202-3	3	15.4
Clearwater Russet	3	33.4
CO00405-1RF	3	57.0
CO01399-10P/Y	3	39.8
LBR1R2R3R4	3	2.5
LBR5	3	24.5
LBR7	3	4.6
LBR9	3	33.4
MSQ176-5	3	8.6
MSR061-1	3	3.0

RAUDPC Sort:

LINE	N	RAUDPC[1] MEAN
B0718-3	3	0.6
B0692-4	3	0.8
AWN86514-2	3	0.9
LBR1R2R3R4	3	2.5
AF4122-3	3	2.8
MSR061-1	3	3.0
AF3317-15	3	3.8
LBR7	3	4.6
B1992-106	3	4.7
AF2574-1	3	4.9
AF4191-2	3	7.5
A99433-5Y	3	7.6
A00286-3Y	3	8.4
AC99375-1RU	3	8.5
MSQ176-5	3	8.6
AF4329-7	3	11.4
ATC00293-1W/Y	3	13.9
BNC202-3	3	15.4
AF4303-1	3	15.7
A00293-2Y	3	19.2
LBR5	3	24.5
A02060-3TE	3	26.7
A99326-1PY	3	32.3
Alpine Russet	3	33.2
LBR9	3	33.4
Clearwater Russet	3	33.4
A01143-3C	3	34.7
A01025-4	3	36.2
CO01399-10P/Y	3	39.8
A99331-2RY	3	42.1
B2756-7	3	42.3
A01010-1	3	44.3
B2676-2	3	46.8
BNC201-1	3	50.7
CO00405-1RF	3	57.0

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

Table 11

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

2011 LATE BLIGHT EARLY GENERATION TRIALS
CLARKSVILLE HORTICULTURAL EXPERIMENT STATION

Line Sort:

LINE	N	RAUDPC[1] MEAN
Chaposa	1	0.1
Enfula	1	0.1
Montanosa	1	0.6
MSS070-B	1	23.8
MSU016-2	1	4.5
MSU128-2	1	35.0
MSU161-1	1	9.6
MSU202-1P	1	33.8
MSV005-2	1	0.4
MSV081-1Y	1	13.0
MSV089-2	1	4.9
MSV146-1	1	37.5
MSV179-6	1	2.6
MSV186-1	1	0.2
MSV198-2Y	1	0.3
MSV234-1	1	2.6
MSV238-1	1	3.0
MSV282-4Y	1	1.2
MSV283-2P	1	0.3
MSV284-1	1	11.9
MSV289-2P	1	2.3
MSV301-2	1	28.0
MSV342-2	1	1.8
MSV371-2	1	2.2
MSV393-1	1	13.3
MSV394-2	1	13.1
MSV396-4Y	1	1.3
MSV397-2	1	17.4
MSV406-6	1	8.0
MSV407-2	1	18.5
MSV430-1	1	14.4
MSV482-6	1	0.2
MSW007-1	1	29.8
MSW019-1	1	21.5
MSW078-1	1	0.7
MSW088-2	1	11.1
MSW092-1	1	0.5
MSW095-2Y	1	6.8
MSW097-5Y	1	0.2
MSW100-1	1	0.4
MSW119-2	1	16.9
MSW119-4	1	39.3
MSW121-5R	1	18.7
MSW121-8	1	6.6
MSW122-3	1	7.2
MSW122-9	1	33.5

RAUDPC Sort:

LINE	N	RAUDPC[1] MEAN	Female	Male
Muruta	1	0.0		
Chaposa	1	0.1		
Enfula	1	0.1		
MSW236-3	1	0.1	Montanosa	MSR036-5
MSV186-1	1	0.2	LBR9	Colonial Purple
MSV482-6	1	0.2	Rosilin Eburu	MSP239-1
MSW097-5Y	1	0.2	LBR9	MSM288-2Y
MSV198-2Y	1	0.3	MSM051-3	Malinche
MSV283-2P	1	0.3	Monserrat	Colonial Purple
MSW100-1	1	0.4	LBR9	MSP292-7
MSW206-2P	1	0.4	LBR9	Colonial Purple
MSV005-2	1	0.4	A93157-6LS	MSI152-A
MSW385-2Y	1	0.4	Torridon	MSN105-1
MSW092-1	1	0.5	MSL106-AY	Montserrat
MSW453-1P	1	0.5	Kenya Baraka	Colonial Purple
MSW237-4Y	1	0.6	Montserrat	MSN191-2Y
Montanosa	1	0.6		
MSW078-1	1	0.7	MSK409-1	Malinche
MSW151-9	1	0.8	Montanosa	MSL211-3
MSW418-1	1	0.8	RB G227-2	MSJ319-1
MSW360-18	1	1.1	MSR061-1	MSN238-A
MSW199-3	1	1.2	Kenya Baraka	MSN105-1
MSW399-2	1	1.2	W2133-1	MSR036-5
MSV282-4Y	1	1.2	Monserrat	MSN105-1
MSW464-3	1	1.3	MSM246-B	MSR102-3
MSV396-4Y	1	1.3	MSQ070-1	MSJ126-9Y
MSW288-2	1	1.6	MSP102-5	MSQ086-3
MSW263-5	1	1.6	MSN105-1	Picasso
MSV342-2	1	1.8	Montanosa	OP
MSW133-5Y	1	1.8	Malinche	MSP292-7
MSV371-2	1	2.2	MSP459-5	MSG227-2
MSV289-2P	1	2.3	Montanosa	Colonial Purple
MSW410-12Y	1	2.4	E69.6	MSN105-1
MSV234-1	1	2.6	Malinche	MSN105-1
MSV179-6	1	2.6	LBR8	MSL211-3
MSW418-2	1	2.6	RB G227-2	MSJ319-1
MSW484-1	1	2.7	MSQ070-1	MSR127-2
MSW470-1	1	2.8	Montserrat	MSL766-1
MSV238-1	1	3.0	Marcy	Missaukee
MSW242-5Y	1	3.7	NY121	Malinche
MSW449-5	1	4.0	Missaukee	MSM288-2Y
MSW198-1Y	1	4.3	MSK498-1	Malinche
MSW242-1	1	4.3	NY121	Malinche
MSU016-2	1	4.5	Boulder	MSN105-2
MSV089-2	1	4.9	MSJ126-9Y	MSI152-A
MSW275-3	1	4.9	MSR036-5	OP

Line Sort:

LINE	N	RAUDPC[1] MEAN
MSW123-3	1	20.2
MSW125-3	1	21.8
MSW126-1	1	12.9
MSW128-2	1	23.1
MSW133-5Y	1	1.8
MSW140-3	1	10.4
MSW145-3P	1	39.1
MSW148-1P	1	40.1
MSW150-2R	1	34.7
MSW151-5	1	6.5
MSW151-9	1	0.8
MSW152-1	1	25.7
MSW153-1	1	7.8
MSW154-4	1	21.4
MSW155-6	1	38.4
MSW168-2	1	22.0
MSW183-2	1	10.2
MSW189-1Y	1	33.5
MSW197-1	1	8.3
MSW198-1Y	1	4.3
MSW199-3	1	1.2
MSW206-2P	1	0.4
MSW229-1P	1	18.0
MSW236-3	1	0.1
MSW237-4Y	1	0.6
MSW242-1	1	4.3
MSW242-5Y	1	3.7
MSW259-5	1	13.5
MSW259-6	1	5.8
MSW263-5	1	1.6
MSW273-3R	1	40.2
MSW275-3	1	4.9
MSW288-2	1	1.6
MSW296-5	1	11.5
MSW296-8	1	32.0
MSW298-4Y	1	37.1
MSW301-1Y	1	9.6
MSW315-1Y	1	14.3
MSW317-5PP	1	40.1
MSW319-1	1	26.5
MSW323-10	1	15.7
MSW324-1	1	5.1
MSW328-1Y	1	16.8
MSW328-2Y	1	15.1
MSW328-4	1	39.7
MSW331-1	1	17.0
MSW336-2	1	7.6
MSW338-3	1	38.1
MSW338-6	1	37.9
MSW343-2R	1	33.8
MSW344-1Y	1	40.4
MSW353-3	1	12.5

RAUDPC Sort:

LINE	N	RAUDPC[1] MEAN	Female	Male
MSW408-1Y	1	5.1	E69.6	Malinche
MSW324-1	1	5.1	MSQ070-1	Marcy
MSW259-6	1	5.8	N073-2	MSR159-2
MSW407-1Y	1	6.1	E69.6	MSL766-1
MSW394-1	1	6.5	W2133-1	MSJ319-1
MSW151-5	1	6.5	Montanosa	MSL211-3
MSW121-8	1	6.6	MSM182-1	NDTX4271-5R
MSW095-2Y	1	6.8	LBR9	MSJ126-9Y
MSW356-3	1	7.0	MSR036-5	White Pearl
MSW122-3	1	7.2	MSM185-1	MSP085-2
MSW336-2	1	7.6	MSQ070-1	W2324-1
MSW366-5	1	7.7	MSR156-7	MSR036-5
MSW153-1	1	7.8	1989-86061	MSI152-A
MSV406-6	1	8.0	MSQ070-1	OP
MSW197-1	1	8.3	MSK409-1	MSR102-3
MSW485-2	1	8.3	MSQ070-1	MSR156-7
QSMSU03-01R	1	9.4	Jacqueline Lee	NDTX4034-1R
MSW301-1Y	1	9.6	Picasso	MSL268-D
MSU161-1	1	9.6	MSM182-1	MSL211-3
MSW432-12	1	9.8	Boulder	MSI152-A
MSW536-2Y	1	9.8	MI Purple Red Sport	MSN105-1
MSW183-2	1	10.2	MSI049-A	MSN105-1
MSW140-3	1	10.4	MegaChip	Missaukee
MSW088-2	1	11.1	Kufri Jeevan	MSM137-2
MSW360-7	1	11.3	MSR061-1	MSN238-A
MSW417-1	1	11.4	MCR150	Pike
MSW296-5	1	11.5	MSP292-7	MSP516-A
MSV284-1	1	11.9	Monserrat	MSP239-1
MSW353-3	1	12.5	MSR036-5	Marcy
MSW126-1	1	12.9	MSM171-A	MSL268-D
MSV081-1Y	1	13.0	MSI152-A	MSJ126-9Y
MSV394-2	1	13.1	MSQ070-1	MSH228-6
MSV393-1	1	13.3	MSQ070-1	MSG227-2
MSW476-4R	1	13.5	MSN230-6RY	NDTX4271-5R
MSW259-5	1	13.5	MSN073-2	MSR159-2
MSW355-3	1	13.6	MSR036-5	W2133-1
MSW315-1Y	1	14.3	POR04PG6-3	MSL211-3
MSV430-1	1	14.4	MSQ279-7	MSQ086-3
MSW328-2Y	1	15.1	MSQ070-1	Lamoka
MSW323-10	1	15.7	MSQ070-1	MSM246-B
MSW328-1Y	1	16.8	MSQ070-1	Lamoka
MSW119-2	1	16.9	MSM171-A	MSR036-5
MSW331-1	1	17.0	MSQ070-1	MSP292-7
MSW537-3	1	17.2	MSM070-1	MSP516-A
MSV397-2	1	17.4	MSQ070-1	MSJ147-1
MSW461-1P	1	18.0	MSM182-1	Colonial Purple
MSW229-1P	1	18.0	Michigan Purple	MSN105-1
MSV407-2	1	18.5	MSQ070-1	MSP239-1
MSW474-1	1	18.5	MSN190-2	MSP516-A
MSW121-5R	1	18.7	MSM182-1	NDTX4271-5R
MSW508-10	1	19.2	MSI152-A	MSN105-2
MSW123-3	1	20.2	MSM171-A	Dakota Diamond

Line Sort:

LINE	N	RAUDPC[1] MEAN
MSW355-3	1	13.6
MSW356-3	1	7.0
MSW360-18	1	1.1
MSW360-4	1	20.4
MSW360-6	1	37.5
MSW360-7	1	11.3
MSW366-5	1	7.7
MSW385-2Y	1	0.4
MSW389-4Y	1	39.7
MSW394-1	1	6.5
MSW399-2	1	1.2
MSW407-1Y	1	6.1
MSW408-1Y	1	5.1
MSW410-12Y	1	2.4
MSW417-1	1	11.4
MSW418-1	1	0.8
MSW418-2	1	2.6
MSW425-2Y	1	34.4
MSW432-12	1	9.8
MSW434-3	1	37.1
MSW449-5	1	4.0
MSW449-7Y	1	32.2
MSW449-8Y	1	23.8
MSW453-1P	1	0.5
MSW455-3	1	20.9
MSW461-1P	1	18.0
MSW464-3	1	1.3
MSW470-1	1	2.8
MSW474-1	1	18.5
MSW476-3R	1	21.2
MSW476-4R	1	13.5
MSW484-1	1	2.7
MSW485-2	1	8.3
MSW500-10	1	30.9
MSW508-10	1	19.2
MSW536-2Y	1	9.8
MSW537-3	1	17.2
MSW537-6	1	20.9
MSW539-7	1	25.6
Muruta	1	0.0
QSMSU03-01R	1	9.4
QSMSU03-08R	1	29.1
QSNDSU07-04R	1	32.7

RAUDPC Sort:

LINE	N	RAUDPC[1] MEAN	Female	Male
MSW360-4	1	20.4	MSR061-1	MSN238-A
MSW455-3	1	20.9	MSL183-AY	MSP516-A
MSW537-6	1	20.9	MSM070-1	MSP516-A
MSW476-3R	1	21.2	MSN230-6RY	NDTX4271-5R
MSW154-4	1	21.4	1989-86061	MSL211-3
MSW019-1	1	21.5	Defender Russet	Stampede Russet
MSW125-3	1	21.8	MSM171-A	MSL211-3
MSW168-2	1	22.0	Beacon Chipper	MSR159-2
MSW128-2	1	23.1	MSM171-A	MSQ176-5
MSW449-8Y	1	23.8	Missaukee	MSM288-2Y
MSS070-B	1	23.8	MN-E65	MSL211-3
MSW539-7	1	25.6	MSM137-2	MSR061-1
MSW152-1	1	25.7	Montserrat	MSL211-3
MSW319-1	1	26.5	MSQ070-1	Eva
MSV301-2	1	28.0	MSN105-1	MSP197-1
QSMSU03-08R	1	29.1	Jacqueline Lee	NDTX4034-1R
MSW007-1	1	29.8	Beacon Chipper	MSR041-5
MSW500-10	1	30.9	Boulder	MSP516-A
MSW296-8	1	32.0	MSP292-7	MSP516-A
MSW449-7Y	1	32.2	Missaukee	MSM288-2Y
QSNDSU07-04R	1	32.7	ND 5781-9R	ND 0390878BV-1R
MSW122-9	1	33.5	MSM185-1	MSP085-2
MSW189-1Y	1	33.5	Missaukee	Yukon Gold
MSU202-1P	1	33.8	Colonial Purple	MSL211-3
MSW343-2R	1	33.8	MSQ440-2	NDTX4271-5R
MSW425-2Y	1	34.4	RH	MSS827-13
MSW150-2R	1	34.7	MI Purple Red Sport	MSN230-6RY
MSU128-2	1	35.0	LBR9	MSL211-3
MSW298-4Y	1	37.1	P408-10Y	MSL211-3
MSW434-3	1	37.1	Boulder	Montserrat
MSV146-1	1	37.5	Keuka Gold	Malinche
MSW360-6	1	37.5	MSR061-1	MSN238-A
MSW338-6	1	37.9	MSQ086-3	MSN105-1
MSW338-3	1	38.1	MSQ086-3	MSN105-1
MSW155-6	1	38.4	391046.22	MSL211-3
MSW145-3P	1	39.1	Michigan Purple	MSL211-3
MSW119-4	1	39.3	MSM171-1	MSR036-5
MSW328-4	1	39.7	MSQ070-1	Lamoka
MSW389-4Y	1	39.7	VC1002-3W/Y	MSL211-3
MSW148-1P	1	40.1	Michigan Purple	P516-A
MSW317-5PP	1	40.1	POR04PG6-3	MSL211-3
MSW273-3R	1	40.2	NDTX4271-5R	MSN105-1
MSW344-1Y	1	40.4	Q425-4Y Red Splash	MSL211-3

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

2011 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 per TUBER
ADVANCED TRIAL									
MSJ126-9Y (26)	1.080	24	2					92	0.1
MSH228-6	1.077	21	4					84	0.2
MSQ086-3	1.076	20	4	1				80	0.2
MSL292-A	1.082	16	8	1				64	0.4
MSR061-1	1.081	12	10	2	1			48	0.7
MSR169-8Y	1.079	13	7	4	1			52	0.7
MSL007-B	1.078	13	7	3	1	1		52	0.8
Snowden	**1.080**	**11**	**7**	**5**	**1**			**46**	**0.8**
MSQ070-1	1.089	9	9	4	2	1		36	1.1
MSJ147-1	1.087	8	6	9	1			33	1.1
NY140	1.082	6	9	3	1		1	30	1.2
Beacon Chipper	1.078	6	8	9	2			24	1.3
Kalkaska	1.080	7	5	9	4			28	1.4
Atlantic	**1.085**	**6**	**5**	**9**	**5**			**24**	**1.5**
Lamoka	1.086	2	6	15	2			8	1.7
NY148	1.093	2	5	7	1	4	6	8	2.7
RUSSET TRIAL									
A02062-1TE	1.063	20	5					80	0.2
AF3362-1	1.064	19	6					76	0.2
Goldrush Russet	1.059	19	7					73	0.3
Silverton Russet	1.065	19	5	1				76	0.3
CO03187-1RUS	1.065	18	7					72	0.3
AC00395-2Rus	1.083	19	4	2				76	0.3
WV4993-1RUS	1.071	15	10					60	0.4
CO03276-4Rus	1.068	18	4	2	1			72	0.4
A01124-3	1.075	17	7	1	1			65	0.5
A0008-1TE	1.064	14	9	2				56	0.5
CO03308-3Rus	1.067	14	9	2				56	0.5
W6360-1Rus	1.074	14	8	3				56	0.6
Russet Norkotah	**1.064**	**13**	**9**	**3**				**52**	**0.6**
CO03276-5Rus	1.068	13	10	2	1			50	0.7
CV00047-3RUS	1.067	11	10	3				46	0.7

2011 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 per TUBER
Russet Burbank	**1.068**	**10**	**11**	**1**	**2**			**42**	**0.8**
AF3317-15	1.085	10	10	5				40	0.8
CO99053-3Rus	1.074	12	6	5	2			48	0.9
CO03202-1Rus	1.074	12	8	1	3	1		48	0.9
Canela Russet	1.074	7	7	6	3			30	1.2
ND8229-3Rus	1.072	3	13	5	1	1	1	13	1.5
Dakota Trailblazer	1.084	4	9	5	3	4		16	1.8
ND8068-5Rus	1.070	4	5	11	3	2		16	1.8
Clearwater Russet	1.078		8	8	5	3	1	0	2.2
NORTH CENTRAL REGIONAL TRIAL									
MSQ176-5	1.063	22	3					88	0.1
W6002-1R	1.055	22	3					88	0.1
AND00272-1R	1.064	21	3					88	0.1
Dark Red Norland	**1.054**	**20**	**4**					**83**	**0.2**
MSL211-3	1.061	21	5					81	0.2
Red Pontiac	**1.050**	**20**	**5**					**80**	**0.2**
W2978-3	1.067	19	5					79	0.2
MN02586	1.070	15	3	1				79	0.3
W2310-3	1.084	19	7					73	0.3
ND8555-8R	1.062	18	7					72	0.3
MN19298RY	1.066	21	6	1				75	0.3
MSQ440-2	1.052	18	6	1				72	0.3
MN02588	1.070	13	3	3				68	0.5
NorValley	1.071	13	12					52	0.5
MSL268-D	1.076	14	9	2				56	0.5
MSM182-1	1.068	14	9	1	1			56	0.6
W2717-5	1.085	12	11	2				48	0.6
W6511-1R	1.076	12	12	2				46	0.6
Atlantic	**1.085**	**13**	**7**	**4**				**54**	**0.6**
Snowden	**1.085**	**13**	**8**	**4**				**52**	**0.6**
MN02616R	1.064	11	7	4	3			44	1.0
MSR169-8Y	1.080	8	8	8				33	1.0
ADAPTATION TRIAL, CHIP-PROCESSING LINES									
MSR159-2	1.089	19	5	1				76	0.3
CO00188-4W	1.071	18	7					72	0.3
AC03433-1W	1.077	17	8					68	0.3

2011 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 per TUBER
MSQ089-1	1.074	18	4	2				75	0.3
CO03243-3W	1.079	16	9	3				57	0.5
Pike	**1.083**	**14**	**9**	**1**	**1**			**56**	**0.6**
MSR128-4Y	1.079	13	10	2				52	0.6
MSQ279-1	1.074	14	6	4				58	0.6
MSR148-4	1.071	13	8	2	2			52	0.7
MSR036-5	1.079	12	5	7	1			48	0.9
FL1879	1.076	10	9	5	1			40	0.9
Snowden	**1.082**	**11**	**6**	**5**	**3**			**44**	**1.0**
MSS165-2Y	1.090	6	14	3	1		1	24	1.1
Atlantic	**1.085**	**10**	**5**	**7**	**2**	**1**		**40**	**1.2**
MSQ035-3	1.077	6	7	2	3	3	3	25	2.0
MSR127-2	1.087	1	7	4	4		2	6	2.1
ADAPTATION TRIAL, TABLESTOCK LINES									
MSM288-2Y	1.068	22	3					88	0.1
MSS544-1R	1.060	20	5					80	0.2
MSM182-1	1.071	13	6					68	0.3
MSQ341-BY	1.073	19	4	2				76	0.3
MSR217-1R	1.054	18	6	1				72	0.3
Reba	**1.075**	**15**	**9**	**1**				**60**	**0.4**
Onaway	**1.062**	**14**	**9**	**2**				**56**	**0.5**
MSR157-1Y	1.083	15	6	4				60	0.6
AF2291-10	1.088	7	9	3				37	0.8
PRELIMINARY TRIAL, CHIP-PROCESSING LINES									
MSV143-1Y	1.075	22	1					96	0.0
MSP270-1	1.068	22	3					88	0.1
MSV307-2	1.077	22	3					88	0.1
MSV434-4	1.066	22	3					88	0.1
MSV092-2	1.080	21	3					88	0.1
MSV355-2	1.074	22	4					85	0.2
MSQ461-2PP	1.075	21	4					84	0.2
MSR021-2	1.062	21	4					84	0.2
MSS514-1PP	1.063	21	4					84	0.2
MSS927-1	1.075	21	4					84	0.2
MSV238-1	1.070	21	4					84	0.2
MSV292-1Y	1.061	21	4					84	0.2

2011 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 per TUBER
MSV358-3	1.079	22	3	1				85	0.2
MSV125-4	1.088	21	3	1				84	0.2
Missaukee	1.081	20	5					80	0.2
MSV434-1Y	1.067	20	5					80	0.2
MSV383-1	1.083	20	6					77	0.2
MSS297-1	1.075	19	6					76	0.2
Pike	**1.081**	**20**	**3**	**2**				**80**	**0.3**
MSV153-2Y	1.078	19	4		1			79	0.3
MSV117-1	1.079	18	6	1				72	0.3
MSV344-2	1.067	18	6	1				72	0.3
MSM102-A	1.077	9	5					64	0.4
MSV393-1	1.080	18	6		1			72	0.4
MSV397-2	1.071	17	7	1				68	0.4
MSV127-1	1.080	15	7	1				65	0.4
Snowden	**1.081**	**16**	**7**	**2**				**64**	**0.4**
MSV430-1	1.077	16	7	2				64	0.4
MSN190-2	1.089	14	9	2				56	0.5
Atlantic	**1.086**	**12**	**10**	**1**				**52**	**0.5**
FL1879	1.077	15	8	3				58	0.5
MSM108-A	1.084	13	7	3				57	0.6
MSV498-1	1.076	14	9	3				54	0.6
MSR109-1	1.076	13	8	2	1			54	0.6
MSS483-1	1.071	14	7	3	1			56	0.6
MSV313-2	1.085	12	10	1		1		50	0.7
MSV241-2	1.087	14	6	4	1			56	0.7
MSV403-3	1.084	12	10	1	2			48	0.7
MSV505-2	1.078	9	11	4				38	0.8
MSV331-3	1.069	10	12	1	2			40	0.8
MSR058-1	1.078	10	10	4	1			40	0.8
Boulder	1.086	7	12	4	2			28	1.0
MSR093-4	1.076	2	11	9	3			8	1.5
PRELIMINARY TRIAL, TABLESTOCK LINES									
MSR214-2P	1.068	25						100	0.0
MSR241-4RY	1.069	23	2					92	0.1
MSU379-1	1.064	23	2					92	0.1
Midnight II	1.077	22	2					92	0.1

2011 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 per TUBER
MSR605-10	1.074	20	3					87	0.1
Blackberry	1.042	21	4					84	0.2
Spartan Splash	1.063	21	4					84	0.2
MSR218-AR	1.051	20	4					83	0.2
MSR605-11	1.066	21	3	1				84	0.2
MSU161-1	1.072	20	5					80	0.2
MSV177-4	1.068	20	5					80	0.2
MSS108-1	1.076	20	3	1				83	0.2
MSV429-1	1.070	19	5					79	0.2
MI Purple Sport II	1.073	20	4	1				80	0.2
MSR297-A	1.062	17	6					74	0.3
MI Purple Red Sport	1.068	19	7					73	0.3
MI Purple Sport I	1.070	19	5	1				76	0.3
MSV205-4	1.077	19	5	1				76	0.3
Colonial Purple	1.070	17	5	1				74	0.3
MI Purple Sport III	1.066	18	6	1				72	0.3
Purple Heart	1.058	18	6	1				72	0.3
MSV307-1	1.062	18	6	1				72	0.3
Michigan Purple	1.064	17	8					68	0.3
MST386-1P	1.076	17	7	1				68	0.4
MSR606-02	1.058	15	9	1				60	0.4
Jacqueline Lee	1.074	13	10	2				52	0.6
MSV282-4Y	1.076	13	8		2			57	0.6
MSU016-2	1.092	18	2	3	1		1	72	0.6
Onaway	**1.059**	**11**	**12**	**2**				**44**	**0.6**
Jingshu 2	1.093	10	8	4	3			40	1.0
USPB/SFA TRIAL CHECK SAMPLES (Not bruised)									
MSJ126-9Y	1.068	24	1					96	0.0
W2978-3	1.065	23	2					92	0.1
CO00188-4W	1.068	20	5					80	0.2
ND8331C5-2	1.081	18	5					78	0.2
CO00197-3W	1.071	20	6					77	0.2
MSL292-A	1.074	19	6					76	0.2
Snowden	**1.075**	**17**	**9**					**65**	**0.3**
MSR061-1	1.078	13	7					65	0.4
NY140	1.079	17	7	1				68	0.4

2011 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 per TUBER
ND8305-1	1.085	15	10					60	0.4
W4980-1	1.073	16	8	1				64	0.4
W5015-12	1.085	15	9	1				60	0.4
ND7519-1	1.078	13	12					52	0.5
NY148	1.087	12	12	1				48	0.6
Atlantic	**1.087**	**9**	**12**	**4**				**36**	**0.8**
Tundra	1.083	11	9	4	1			44	0.8

USPB/SFA TRIAL BRUISE SAMPLES

ENTRY	SP GR	0	1	2	3	4	5+	PERCENT (%) BRUISE FREE	AVERAGE SPOTS per TUBER
CO00188-4W	1.068	21	4					84	0.2
MSJ126-9Y	1.068	20	5					80	0.2
W2978-3	1.065	19	6					76	0.2
MSR061-1	1.078	17	8					68	0.3
CO00197-3W	1.071	15	10					60	0.4
ND7519-1	1.078	15	9	1				60	0.4
ND8331C5-2	1.081	15	5	3	1			63	0.6
Snowden	**1.075**	**13**	**10**	**1**	**1**			**52**	**0.6**
NY140	1.079	12	9	4				48	0.7
MSL292-A	1.074	12	6	5	1			50	0.8
W4980-1	1.073	11	8	6				44	0.8
Tundra	1.083	9	13	4				35	0.8
W5015-12	1.085	6	12	5				26	1.0
ND8305-1	1.085	5	16	3	1			20	1.0
Atlantic	**1.087**	**11**	**5**	**3**	**4**	**1**		**46**	**1.1**
NY148	1.087	5	9	7	2	2		20	1.5

* Twenty or twenty-five A-size tuber samples were collected at harvest, held at 50 F at least 12 hours, and placed in a six-sided plywood drum and rotated ten times to produce simulated bruising. Samples were abrasive-peeled and scored 10/26/2011.
The table is presented in ascending order of average number of spots per tuber.

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2011 On-Farm Potato Variety Trials

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Introduction

On-farm potato variety trials were conducted with 13 growers in 2011 at a total of 17 locations. Ten of the locations evaluated processing entries and seven evaluated fresh market entries. The processing cooperators were Crooks Farms, Inc. (Montcalm), Walther Farms, Inc. (St. Joseph), Lennard Ag. Co. (St. Joseph), County Line Potato Farms, Inc. (Allegan), Main Farms (Montcalm), Sackett Potatoes (Mecosta), Michigan State University (MSU) Montcalm Research Center (Montcalm). The United States Potato Board/Snack Food Association (USPB / SFA) chip trial was at Sandyland Farms, LLC (Montcalm). Fresh market trial cooperators were Crawford Farms, Inc. (Montcalm), Elmaple Farms (Kalkaska), R & E Farms (Presque Isle), Horkey Bros. (Monroe), T.J.J. VanDamme Farms (Delta), Krummrey & Sons, Inc. (Ingham) and Walther Farms, Inc. (St. Joseph).

Procedure

There were six types of processing trials conducted this year. The first type contained 13 entries which were compared with the check varieties Snowden, Pike and FL1879. This trial type was conducted at Main Farms, Lennard Ag. Co. and County Line Farms. Varieties in these trials were planted in 100' strip plots. Seed spacing in each trial was grower dependent, but in general ranged from 9.5 to 11 inches. The second type of processing trial, referred to as a "Select" trial, contained six lines which were compared to the variety in the field. In these trials, each variety was planted in a 15' row plot. Seed spacing and row width were 10" and 34", respectively. These trials were conducted on Crooks Farms, Inc. (Montcalm). The third type was a processing variety trial where each plot consisted of three, 34" wide rows which were 15' long. Only the center row was harvested for the yield evaluation from each of four replicates. This trial was conducted at Walther Farms, Inc. (St. Joseph). At Walther's, 20 varieties were compared to the check varieties Snowden, Pike and FL1879. The plots were planted at 10" in-row spacing. The fourth type was the Box Bin trial at the Montcalm Research Center in Montcalm County, MI. This trial contained 20 varieties compared against the check variety Snowden. Each of the 21 varieties were planted in a single 34" wide row, 600' long with 10" in-row seed spacing. A single 23' yield check was taken to evaluate each clone. The fifth type of chip trial consisted of large multiple acreage blocks of four newly commercialized or soon to be commercialized varieties. Agronomic and production practices for these varieties were based on each individual grower's production system. The varieties and growers were: Sandyland Farms (Montcalm), Lamoka (NY139); Sackett Potatoes (Mecosta), Lamoka (NY139) and MSQ070-1;

Lennard Ag. Co. (Branch), Lamoka (NY139) and MSH228-6; Walther Farms (St. Joseph), Nicolet (W2133-1) and MSQ070-1.

The USPB / SFA chip trial was the 6th chip processing trial type. For procedural details on this trial, reference the 2011 annual report published by the United States Potato Board.

Within the fresh market trials, there were 29 entries evaluated. There were 5 to 18 lines planted at each of the following locations: Delta, Ingham, Kalkaska, Monroe, Montcalm, Presque Isle and St. Joseph counties. The varieties in each trial ranged from mostly round white varieties to mostly russet varieties. These varieties were generally planted in 100' strip plots. A single 23' yield check was taken to evaluate each clone in these strip trials. Seed spacing varied from 8 to 12 inches depending upon grower production practices and variety. The second fresh pack trial type was the Russet Select Trial. The select russet trials were planted at three locations (Elmaple Farm (Kalkaska), Montcalm Research Center (Montcalm) and Walther Farms, (St. Joseph)). At Elmaple Farms, each russet variety was planted in one, three row plot, that was thirty feet long with 34" wide rows and 11-12" in-row spacing. A yield determination was made on 23 feet of the center row. At Walther Farms, Inc. (St. Joseph), three row plots, replicated four times were evaluated. The plots were 15' long by 34" wide and seed spacing was 12". Only the center row was harvested and evaluated. Each select trial varied in the number of varieties tested.

Results

A. Processing Variety Trial Results

A description of the processing varieties, their pedigree and scab ratings are listed in Table 1. The overall averages from nine locations across Allegan, Montcalm and St. Joseph counties are shown in Table 2.

Processing Variety Highlights

A01143-3C; is an Aberdeen Idaho chip processing selection with average yield potential and good long term chip quality from storage. In 2011, it had a 396 cwt./A US#1 yield with a 1.078 average specific gravity (Table 2). The overall size profile of the variety was smaller, with 8 percent "B" size tubers and 82 percent "A's". This variety exhibits slight common scab susceptibility and appears to have a very late vine maturity. Heat sprouts were also observed.

AF2291-10; this selection has been developed at the University of Maine. This variety appears to chip process well from out of the field and early to mid-season storage. It's yield potential was good, producing 438 cwt./A US#1 in 2011 (Table 2). The average specific gravity of this line was 1.080. Four tubers with hollow heart were observed in 60 cut tubers. The overall tuber type of this variety is not very uniform. This line has some common scab tolerance and appears to exhibit a mid-season maturity (Table 1).

CO00188-4W; this selection is from the University of Colorado. It has a below average yield (Table 1), but has good common scab tolerance and late season chip quality and storability.

Lamoka (NY139); this is a Cornell University developed clone. This variety continues to exhibit a strong yield and good size profile. In the 2011 processing potato variety trials, Lamoka yielded 433 cwt/A US#1 over eight locations with a 92% marketable yield average (Table 2). The specific gravity of this clone was four points above the trial average at 1.080. No hollow heart was noted in 110 cut tubers. Vine maturity for this variety appeared to be medium-late to late. This variety, over four years of on-farm trialing, has a 415 cwt./A US#1 yield. Lamoka continues to chip process well out of mid to late season storage at 48 ºF.

MSH228-6; this Michigan State University selection yielded slightly below the trial average in 2011 at 393 cwt./A US#1 (Table 2) and expresses common scab tolerance (Table 1). This variety, over five years of on-farm trialing, has a 364 cwt./A US#1 yield. Some internal vascular discoloration has been noted over the years in finished chips from storage as well as edge browning due to Pinkeye.

MSL007-B; is an MSU selection with a heavy netted skin, uniform tuber type and common scab tolerance (Table 1). In 2011, it yielded above average at 430 cwt./A US#1 (Table 2). Chip quality appears to be good from mid-season storage, but some stem end defect has been observed in finished chips from various regions of the state. This variety, over four years of on-farm trialing, has a 371 cwt./A US#1 yield.

MSL292-A; is a Michigan State University developed variety. In 2011, MSL292-A had an average yield at 427 cwt./A US#1 (Table 2). This variety had 90 percent marketable yield and a slightly below average specific gravity at 1.074. Raw internal tuber quality was good and tuber type was very uniform and round. Pitted scab was noted in some plots. MSL292-A exhibited excellent chip quality out of the field and from storage in 2011 and early 2012. MSL292-A, over four years of on-farm trialing, has a 425 cwt./A US#1 yield.

MSQ070-1; is an MSU clone with common scab and late blight tolerance. In 2011 on-farm trials, this variety yielded only 310 cwt./A US#1 with a 1.083 specific gravity. There were three tubers with hollow heart observed in 80 cut tubers (Table 2). This variety had a vine maturity that was later than Snowden. Tuber type was very uniformly round and chip quality was good from mid-season storage. This variety appeared to set well and could benefit from a slightly wider in-row seed spacing of 11 inches. Vine lateness and sticky stolons are detrimental to this varieties' success. MSQ070-1, over three years of on-farm trialing, has a 339 cwt./A US#1 yield.

MSQ086-3; is an MSU selection with a uniform tuber type, early bulking potential and slight common scab tolerance (Table 1). In 2011, it's average yield across four locations was 552 cwt./A US#1 with 89 percent of the total tuber yield being marketable (Table 2). The specific gravity was below average at 1.070. Chip quality appears to be good from out of the field.

MSQ089-1; is a Michigan State University developed variety. In 2011, MSQ089-1 had an average yield at 439 cwt./A US#1 (Table 2). This variety had 90 percent marketable yield and a below average specific gravity at 1.069. Raw internal tuber quality was good and tuber type was uniform and round. This variety has moderate scab tolerance. Chip quality out of the field and from storage in 2011 and early 2012 was good.

MSQ279-1; is an MSU clone with common scab tolerance. In 2011 on-farm trials, this variety yielded below average at 387 cwt./A US#1 with a 1.071 specific gravity. There were three tubers with hollow heart observed in 50 cut tubers (Table 2). Tuber type was generally uniformly round and chip quality was good from mid-season storage.

MSR036-5; this Michigan State University selection yielded below the trial average in 2011 at 244 cwt./A US#1 (Table 2), but does express common scab tolerance (Table 1). Some internal vascular discoloration was noted in the finished chips from storage as well as general sugar accumulation. This variety does not appear to have any commercial potential.

MSR061-1; is an MSU developed variety with common scab tolerance, resistance to PVY and foliar late blight resistance (Table 1). This variety is a below average yielding line with an average specific gravity (Table 2).

MSR157-1Y; is an MSU selection with a yellow flesh (Table 1). In 2011, it yielded below the trial average at 351 cwt./A US#1 (Table 2). Chip quality appears to be good from mid-season storage.

MSR159-2; is a Michigan State University developed variety. In 2011, MSR159-2 had a below average yield at 347 cwt./A US#1 (Table 2). This variety had an 81 percent marketable yield and an above average specific gravity at 1.083. Raw internal tuber quality was a concern with 12 out of 60 cut tubers exhibiting hollow heart.

MSR169-8Y; is an MSU clone with common scab resistance. In 2011 on-farm trials, this variety yielded only 299 cwt./A US#1 with a 1.076 specific gravity. Sixteen percent, on average, of the tubers were “B” size. There was 1 tubers with hollow heart observed in 60 cut tubers (Table 2). This variety has a uniform yellow flesh. Tuber type was uniformly round and chip quality was good from mid-season storage.

MSS165-2Y; is an MSU selection with a uniform tuber type, high yield potential and common scab tolerance (Table 1). In 2011, it’s average yield across five locations, was 488 cwt./A US#1 with 86 percent marketable tubers and 11 percent “B” size (Table 2). The specific gravity was above average at 1.085. Chip quality appears to be good. Tuber flesh is very yellow.

NY140; this is a Cornell University developed clone. This variety exhibits a strong yield and good tuber size profile. In the 2011 processing potato variety trials, this selection yielded 520 cwt./A US#1 over five locations with a 92% marketable yield average (Table 2). The specific gravity of this clone was one point below the trial average at 1.075. Six tubers with hollow heart were noted in 50 cut tubers. Vine maturity for this variety appeared to be medium-late. This variety shows some common scab susceptibility.

NY148 (NYE106-4); this Cornell University developed clone exhibited a strong yield, good size profile and common scab tolerance. In 2011, NY148 yielded 487 cwt./A US#1 over five locations with an 89% marketable yield average (Table 2). The specific gravity of this clone was nine points above the trial average at 1.085. No hollow heart was noted in 50 cut tubers. Vine maturity for this variety appeared to be late. NY148 chip quality does not appear to be as good as Lamoka.

W2978-3; this clone was developed at the University of Wisconsin and has exhibited an average yield, early bulking potential with a low average specific gravity. In 2011, W2978-3, when averaged across four Michigan trial locations, yielded 386 cwt./A US#1 with one hollow heart being observed in 40 cut tubers (Table 2). The size profile and the specific gravity were both below the trial average. This variety was susceptible to common scab.

W4980-1; is a University of Wisconsin variety with average yield potential. In 2011, it yielded 424 cwt./A US#1 with a 1.074 specific gravity (Table 2). Two percent hollow heart was observed in this variety when averaged over five locations. Slight pitted and surface scab susceptibility was also noted. Chip quality from mid-season storage appears to be good.

W5015-12; is a University of Wisconsin developed variety. In 2011, it yielded 400 cwt./A US#1 with a 1.081 specific gravity (Table 2). Two tubers with hollow heart were observed in 20 cut tubers when this variety was averaged over two locations. Pitted and surface scab susceptibility was noted.

B. <u>USPB / SFA Chip Trial Results</u>

The Michigan location of the USPB / SFA chip trial was on Sandyland Farms, LLC in Montcalm County in 2011. Table 3 shows the yield, size distribution and specific gravity of the entries when compared with Atlantic and Snowden. Table 4 shows the at-harvest raw tuber quality results. Table 5 shows the out of the field chip quality evaluations from samples processed and scored by Herr Foods, Inc., Nottingham, PA and Table 6 provides the blackspot bruise susceptibility of each entry. Table 7 provides a pre-harvest panel for each of the 16 varieties in the trial. This table compares tuber specific gravity, percent glucose and sucrose ratings taken on August 31st, 2011 for each variety.

USPB / SFA Chip Trial Highlights

NY140 and Atlantic topped the yield table in 2011 followed by W2310-3, NY148 (NYE106-4) and Snowden (Table 3). NY140 and Atlantic had the largest percentage of recorded oversize tubers in the trial (Table 3). MSL292-A, CO00188-4W, W4980-1, W2978-3, MSJ126-9Y and CO00197-3W had very low specific gravities. The varieties in the 2011 trial that displayed the greatest potential for commercialization were NY140, W2310-3, NY148 (NYE106-4) and MSL292-A. Yield potential and specific gravity were good for W2310-3 and NY148 (NYE106-4) (Table 3). MSL292-A had the highest AGTRON score at Herr Foods on October 12th at 69.4 (Table 5). Atlantic, NY148 (NYE106-4), W5015-12 and ND8305-1 showed the greatest susceptibility to blackspot bruise (Table 6). CO00188-4W and W4980-1 were very mature on August 31st which was approximately one week prior to vine kill (Table 7).

C. Fresh Market and Variety Trial Results

A description of the freshpack varieties, their pedigree and scab ratings are listed in Table 8. Table 9 shows the overall yield averages for the seven freshpack locations: Delta, Ingham, Kalkaska, Monroe, Montcalm, Presque Isle and St. Joseph Counties.

Fresh Market Variety Highlights

One round white, one yellow flesh and five russet lines are worthy of mention from the 2011 on-farm variety trials. They are MSQ440-2 (the round white), MSM288-2Y (the yellow flesh variety), and the russets, A0008-1TERus (Teton Russet), A01124-3Rus , A02062-1TERus, AF3362-1 and Dakota Trailblazer.

MSQ440-2; this Michigan State University variety has a bright tuber appearance and moderate common scab tolerance (Table 8). In the 2011 freshpack variety trials, this clone had a 304 cwt./A US#1 yield with a 1.061 specific gravity (Table 9). There were no hollow heart in 50 cut tubers, but some vascular discoloration was observed. Tuber size distribution was good with 90 percent of the tubers being marketable. The skin type of this variety is smooth and bright and the tubers are uniform in shape. The vine maturity is mid-season. This variety, over two years of on-farm trialing, has a 292 cwt./A US#1 yield.

MSM288-2Y; this Michigan State University variety has uniform tuber type with a nice yellow flesh. The tubers have pink eye color similar to Yukon Gold. In 2011, MSM288-2Y yielded 372 cwt./A US#1 with a medium vine maturity (Table 9). The total yield of this variety was reported as 443 cwt./A. The percentage of the total tuber yield that was “B” sized was 13 and the specific gravity was 1.074. This variety also expresses common scab susceptibility.

A0008-1TERus (Teton Russet); this is a USDA Aberdeen, ID developed variety. In 2011, over 6 locations, this varieties' average yield was 292 cwt./A US#1. Twenty-three percent of the total yield was "B" sized tubers (Table 9). Marketable yield was 68 percent of the total. The specific gravity was 1.070 and 11 of 90 cut tubers exhibited hollow heart. Vine maturity was medium-early. This variety, over three years of on-farm trialing, has a 313 cwt./A US#1 yield. A0008-1TERus appears to perform much better agronomically in northern climates and will be tested more specifically north of Lansing, MI.

A01124-3Rus; this University of Idaho selection had a 325 cwt./A US#1 yield, an average specific gravity of 1.074 and 16 of 90 tubers exhibited hollow heart (Table 9). The tuber's appearance was long and blocky with a nice russeted skin. Vine maturity was medium.

A02062-1TERus; this is a USDA Aberdeen, ID developed variety. Across seven locations in 2011, this variety on average yielded 304 cwt./A US#1 with a 1.074 specific gravity with only 4 tubers exhibiting hollow heart out of 100 cut (Table 9). This variety has a very nice skin type and tuber shape. As a result of a smaller tuber set per plant, a 9.5 -10 inch in-row seed spacing is recommended. This variety, over two years of on-farm trialing, has a 374 cwt./A US#1 yield.

AF3362-1Rus; this University of Maine selection had a 334 cwt./A US#1 yield, an average specific gravity of 1.073 and zero out of 80 tubers exhibiting hollow heart (Table 9). The tuber appearance was long and blocky with a nice russeted skin. Vine maturity was early. This variety appears very promising for the early russet market.

Dakota Trailblazer; is a variety developed at North Dakota State University. Averaged over two locations, this variety yielded 415 cwt./A US#1 which placed it as the top yielding russet in 2011. The specific gravity was very high at 1.093. Six tubers with hollow heart were reported in 30 cut tubers. Vine maturity was late. Tuber type was extremely blocky. Common scab susceptibility was observed at one location this season.

Table 1

2011 MSU Processing Potato Variety Trials

Entry	Pedigree	2011 Scab Rating*	Characteristics
Atlantic	Wauseon X B5141-6 (Lenape)	3.0	High yield, early maturing, high incidence of internal defects, check variety, high specific gravity
Lamoka (NY139)	NY120 X NY115	1.4	High yield, mid-late season maturity, medium specific gravity, oval to oblong tuber type, low internal defects
Pike (NYE55-35)	Allegany X Atlantic	1.5	Average yield, early to mid-season maturity, small tuber size profile, early storage check variety, some internal defects, medium specific gravity
Snowden (W855)	B5141-6 X Wischip	2.4	High yield, late maturity, mid-season storage check variety, reconditions well in storage, medium to high specific gravity
A01143-3C	COA95070-8 X Chipeta	1.8**	Average yielding, scaly buff chipper; smaller tuber size, late maturity
AF2291-10	SA8211-6 X EB8109-1	1.8	Early blight resistant clone with good chipping quality, medium-late vine maturity, round to oblong, white netted tubers, specific gravity similar to Atlantic
CO00188-4W	A90490-1W X BC0894-2W	1.5	Below yield potential. small tuber size, minimal grade defects, medium-early maturity, high specific gravity, some ability to recondition out of 40º F
FL1879	Snowden X FL1207	2.4	High yield, late maturity, large tuber type, late season storage, medium specific gravity, check variety
MSH228-6	MSC127-3 X OP	1.3	Average yield, mid-late season maturity, blocky flat tuber type, shallow eyes, medium specific gravity
MSL007-B	MSA105-1 X MSG227-2	1.1	Average yield, early to mid-season maturity, uniform tuber type, medium specific gravity, scab tolerant
MSL292-A	Snowden X MSH098-2	2.8	Above average yield, scab susceptible, late blight susceptible, medium-high specific gravity, long storage potential, uniform tuber type
MSQ070-1	MSK061-4 X Missaukee (MSJ461-1)	1.8	Round tuber type, late maturity, scab tolerance and late blight resistant, high specific gravity, strong vine and roots
MSQ086-3	Onaway X Missaukee (MSJ461-1)	2.0	Round tuber type, high yield potential, early maturity, low internal defect, moderate scab tolerance.

*Scab rating based on 0-5 scale; 0 = most resistant and 5 = most susceptible. ** = 2010 Data

Table 1 continued

Entry	Pedigree	2011 Scab Rating*	Characteristics
MSQ089-1	A91790-13 X Missaukee (MSJ461-1)	2.1	Above average yield, uniform round tubers, medium maturity, good internal quality, average specific gravity
MSQ279-1	Boulder X Pike	1.0	High yield, large round tubers, good internal qualities, below average specific gravity
MSR036-5	MSL766-1 X Liberator	1.1	Below average yield, uniform round tuber type, medium maturity, average specific gravity
MSR061-1	Mega Chip (W1201) X NY121	0.9	Below average yield, round tuber type with netted skin, low reducing sugars, PVY resistant, moderate late blight resistance
MSR157-1Y	Jacqueline Lee (MSG274-3) X MSJ316-A	2.6	High yielding, medium maturity, average specific gravity, yellow flesh
MSR159-2	MSL766-1 X MSJ126-9Y	1.7	Average yield, average specific gravity, medium late maturity
MSR169-8Y	Pike X MSJ126-9Y	0.6	Below average yield, medium maturity, yellow flesh, average specific gravity, common scab resistant
MSS165-2Y	MSM188-1 X MSL159-AY	1.6	High yield, above average specific gravity, medium late maturity, uniform round tuber type, heavy netted skin, yellow flesh, good internal tuber quality
NY140	NY121 x NY115	2.5	Late season, dual purpose chip and table stock. High yields of large tubers, lightly textured skin. Resistant to race Ro1 of the golden nematode and moderately resistant to race Ro2.
NYE106-4	NY128 x Marcy	1.4	Late season, high gravity, scab-resistant chip stock
W2978-3	Monticello X Dakota Pearl	2.3	Above average yield potential, early bulking, medium early vine maturity, scab susceptible
W4980-1	B0692-4 X W1355-1	2.0	Medium-early maturity for off the field chipping, moderate yield potential, low set
W5015-12	Brodick X W1355-1	3.0	High tuber set and yield, medium-late vine maturity, uniform size tubers, tubers tend toward flat shape, very flat in some environments

*Scab rating based on 0-5 scale; 0 = most resistant and 5 = most susceptible. ** = 2010 Data

Table 2

2011 Processing Potato Variety Trial
Overall Average - Nine Locations
Allegan, Montcalm, St. Joseph Counties

NUMBER OF LOCATIONS	LINE	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR	CHIP SCORE[3]	TUBER QUALITY[2] HH	VD	IBS	BC	TOTAL CUT	VINE VIGOR[4]	VINE MATURITY[5]	COMMENTS	Chip Comments	5-YR AVG US#1 CWT/A
2	**FL1879**	**640**	**679**	**94**	**4**	**77**	**17**	**2**	**1.072**	**1.5**	**9**	**4**	**0**	**0**	**20**	**3.3**	**3.0**	**sl pinkeye, tr black leg, pitted scab**	**sl SED**	**499**
4	MSQ086-3	552	626	89	10	86	3	1	1.070	1.0	1	2	0	0	40	2.8	3.5	sl scab, gc and misshapen tubers in pickouts, bright appearance	sl SED	552*
5	NY140	520	564	92	6	86	6	2	1.075	1.1	6	16	3	0	50	3.2	3.6	moderate pitted scab, misshapen tubers in pickouts	moderate SED	520*
5	MSS165-2Y	488	567	86	11	81	5	3	1.085	1.2	3	8	1	0	50	3.1	3.4	tr scab, heavy netted skin, knobs and misshapen tubers in pickouts, yellow flesh	sl SED	488*
5	NYE106-4	487	545	89	10	86	3	1	1.085	1.1	0	3	4	0	50	3.1	4.0	tr surface scab, heavy set, bright netted skin	sl SED	487*
5	**Snowden**	**453**	**506**	**89**	**10**	**85**	**4**	**1**	**1.079**	**1.0**	**9**	**12**	**4**	**1**	**80**	**3.5**	**3.5**	**tr pitted scab, misshapen tubers in pickouts**	**tr SED**	427
7	MSQ089-1	439	487	90	10	88	2	0	1.069	1.3	0	20	7	2	70	3.6	3.0	sl scab, misshapen tubers in pickouts, nice round type	sl SED	439*
6	AF2291-10	438	501	87	9	85	2	4	1.080	1.3	4	18	2	2	60	3.1	2.9	heat sprouts gc and misshapen tubers in pickouts, tr scab, tr pinkeye	tr SED	441**
8	Lamoka	433	467	92	7	87	5	1	1.080	1.0	0	18	4	0	110	3.5	3.0	heat sprouts and points in pickouts, tr surface scab	tr SED	417****
9	MSL007-B	430	493	87	12	83	4	1	1.075	1.0	1	7	3	1	120	2.5	3.1	heavy netted skin, uniform round tubers, tr scab, oblong tubers in pickouts	moderate SED	371****
6	MSL292-A	427	469	90	9	86	4	1	1.074	1.0	0	14	3	1	90	3.1	2.6	slight pitted scab, misshapen tubers in pickouts	sl SED	425****
5	W4980-1	424	472	90	9	87	3	1	1.074	1.1	1	13	19	0	50	3.8	2.8	slight pitted scab, gc and misshapen tubers in pickouts, slight pinkeye	moderate SED	424*
2	W5015-12	400	493	81	19	79	2	0	1.081	1.0	2	6	1	0	20	4.0	3.5	pitted scab, small tuber type	clean	449***

Table 2 continued

NUMBER OF LOCATIONS	LINE	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR	CHIP SCORE[3]	TUBER QUALITY[2] HH	VD	IBS	BC	TOTAL CUT	VINE VIGOR[4]	VINE MATURITY[5]	COMMENTS	Chip Comments	5-YR AVG US#1 CWT/A
5	A01143-3C	396	486	82	8	79	3	10	1.078	1.1	0	7	6	1	80	3.7	4.5	heat sprouts knobs gc and misshapen tubers in pickouts, tr surface scab, pitted scab, pinkeye	tr SED	355***
6	MSH228-6	393	429	88	10	79	9	2	1.073	1.2	20	14	1	5	90	3.5	3.2	oblong flat tubers, severe pinkeye, misshapen tubers and gc in pickouts	sl SED	364
5	MSQ279-1	387	414	93	5	80	13	2	1.071	1.5	3	3	5	0	50	3.2	3.5	sl pinkeye, sl surface scab, sheep nose and gc in pickouts	moderate SED	385***
4	W2978-3	386	465	83	17	83	0	1	1.068	1.3	1	8	0	0	40	3.5	1.7	moderate scab, misshapen tubers in pickouts	sl SED	388**
6	MSR157-1Y	351	400	87	10	86	1	3	1.075	1.2	1	20	0	1	60	2.5	2.7	yellow flesh, tr surface scab, gc and pear shaped pickouts	moderate SED	351*
6	MSR159-2	347	409	81	14	78	3	5	1.083	1.2	12	10	5	0	60	2.7	3.6	tr scab, misshapen tubers in pickouts	sl SED	347*
4	**Pike**	**327**	**370**	**88**	**11**	**84**	**4**	**1**	**1.074**	**1.0**	**0**	**7**	**3**	**1**	**40**	**2.5**	**2.3**	**tr scab, misshapen tubers in pickouts**	**tr SED**	351
5	MSQ070-1	310	412	75	20	75	0	5	1.083	1.0	3	6	3	1	80	2.7	4.1	sl surface scab, misshapen tuber and heat sprouts in pickouts	sl SED	339***
6	MSR169-8Y	299	361	82	16	81	1	2	1.076	1.1	1	6	0	0	60	2.6	3.2	tr surface scab, light yellow flesh, misshapen tubers in pickouts	tr SED	299*
4	CO00188-4W	297	398	71	28	71	0	1	1.071	1.0	0	3	0	0	40	4.0	1.2	small round tubers, sl scab, misshapen tubers in pickouts	clean	323***
4	MSR061-1	286	356	79	20	79	0	1	1.075	1.3	1	15	0	0	70	3.1	2.3	heavy netted skin, sl pitted scab	sl SED	279***
4	MSR036-5	244	304	79	16	74	5	5	1.075	1.3	2	10	1	0	40	3.3	3.2	slight surface scab, misshapen tubers in pickouts, slight pinkeye	moderate SED	244*
	MEAN	**406**	**467**	**86**					**1.076**											

tr = trace, sl = slight, N/A = not applicable, SED=stem end defect, gc=growth crack

[1]SIZE
Bs: < 1 7/8"
As: 1 7/8" - 3.25"
OV: > 3.25"
PO: Pickouts

[2]TUBER QUALITY (number of tubers per total cut)
HH: Hollow Heart
VD: Vascular Discoloration
IBS: Internal Brown Spot
BC: Brown Center

[3]CHIP COLOR SCORE - Snack Food Association Scale
(Out of the field)
Ratings: 1 - 5
1: Excellent
5: Poor

[4]VINE VIGOR RATING
Date Taken: N/A
Ratings: 1 - 5
1: Slow Emergence
5: Early Emergence (vigorous vine, some flowering)

[5]VINE MATURITY RATING
Date Taken: N/A
Ratings: 1 - 5
1: Early (vines completely dead)
5: Late (vigorous vine, some flowering)

*One-Year Average
**Two-Year Average
***Three-Year Aver
****Four-Year Average

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**
NY140	491	571	90	9	84	6	1	1.079
Atlantic	**415**	**483**	**89**	**8**	**81**	**8**	**3**	**1.087**
W2310-3	357	411	90	8	85	5	2	1.083
NYE106-4	345	434	79	21	76	3	0	1.087
Snowden	**342**	**418**	**82**	**18**	**78**	**4**	**0**	**1.075**
W5015-12	318	444	72	28	70	2	0	1.085
MSL292-A	291	340	86	14	81	5	0	1.074
CO00188-4W	252	367	69	31	69	0	0	1.068
W4980-1	242	342	71	28	66	5	1	1.073
ND7519-1	240	316	77	22	75	2	1	1.078
W2978-3	216	361	60	40	60	0	0	1.065
ND8331C5-2	212	351	60	37	60	0	3	1.081
MSJ126-9Y	205	265	78	20	75	3	2	1.068
MSR061-1	202	298	69	30	67	2	1	1.078
ND8305-1	177	277	64	34	64	0	2	1.085
CO00197-3W	157	271	58	38	58	0	4	1.071
MEAN	**279**	**372**	**75**	**24**	**72**	**3**	**1.3**	**1.077**

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

Table 4. At-Harvest Tuber Quality. Sandyland Farms, Howard City, Michigan.					
	Internal Defects[1]				
Entry	**HH**	**VD**	**IBS**	**BC**	**Total Cut**
NY140	1	5	0	0	30
Atlantic	**12**	**1**	**0**	**1**	**30**
W2310-3	0	0	1	0	30
NYE106-4	0	1	0	0	30
Snowden	**2**	**5**	**1**	**0**	**30**
W5015-12	3	1	0	0	30
MSL292-A	5	0	0	0	30
CO00188-4W	0	1	0	0	30
W4980-1	0	0	1	0	30
ND7519-1	0	2	3	1	30
W2978-3	0	0	0	0	30
ND8331C5-2	0	0	0	0	30
MSJ126-9Y	1	1	0	0	30
MSR061-1	0	1	1	0	30
ND8305-1	3	0	0	0	30
CO00197-3W	1	0	0	0	30

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

Table 5. 2011 Post-Harvest Chip Quality[1].						
	Agtron	**SFA[2]**	**Specific**	**Percent Chip Defects[3]**		
Entry	**Color**	**Color**	**Gravity**	**Internal**	**External**	**Total**
NY140	55.1	3	1.078	29.3	3.5	32.8
Atlantic	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
W2310-3	60.5	3	1.072	19.2	6.9	26.1
NYE106-4	57.9	3	1.080	23.1	4.7	27.8
Snowden	**62.2**	**2**	**1.071**	**5.4**	**8.0**	**13.4**
W5015-12	57.3	3	1.074	9.7	22.3	32.0
MSL292-A	69.4	2	1.071	2.7	3.4	6.1
CO00188-4W	59.2	3	1.075	5.5	16.3	21.8
W4980-1	61.1	3	1.076	5.6	16.1	21.7
ND7519-1	58.4	3	1.074	12.2	7.9	20.1
W2978-3	58.7	4	1.064	29.2	7.5	36.7
ND8331C5-2	60.2	2	1.076	3.7	5.9	9.6
MSJ126-9Y	55.2	2	1.067	23.2	3.3	26.5
MSR061-1	57.0	2	1.073	8.9	7.4	16.3
ND8305-1	54.3	2	1.083	2.0	18.9	20.9
CO00197-3W	56.1	3	1.069	22.4	11.8	34.2

[1] Samples collected at harvest October 12th and processed by Herr Foods, Inc., Nottingham, PA on October 17, 2011 (5 days).

Chip defects are included in Agtron and SFA samples.

[2] SFA 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.

N/A = Not Available

Table 6. Black Spot Bruise Test																			
	A. Check Samples[1]									**B. Simulated Bruise Samples[2]**									
								Percent	**Average**									**Percent**	**Average**
	# of Bruises Per Tuber						**Total**	**Bruise**	**Bruises Per**	**# of Bruises Per Tuber**						**Total**	**Bruise**	**Bruises Per**
Entry	**0**	**1**	**2**	**3**	**4**	**5**	**Tubers**	**Free**	**Tuber**	**0**	**1**	**2**	**3**	**4**	**5**	**Tubers**	**Free**	**Tuber**
NY140	17	7	1				25	68	0.4	12	9	4				25	48	0.7
Atlantic	**9**	**12**	**4**				**25**	**36**	**0.8**	**11**	**5**	**3**	**4**	**1**		**24**	**46**	**1.1**
W2310-3	11	9	4	1			25	44	0.8	9	13	4				26	35	0.8
NYE106-4	12	12	1				25	48	0.6	5	9	7	2	2		25	20	1.5
Snowden	**17**	**8**					**25**	**65**	**0.3**	**13**	**10**	**1**	**1**			**25**	**52**	**0.6**
W5015-12	15	9	1				25	60	0.4	6	12	5				23	26	1.0
MSL292-A	19	6					25	76	0.2	12	6	5	1			24	50	0.8
CO00188-4W	20	5					25	80	0.2	21	4					25	84	0.2
W4980-1	16	8	1				25	64	0.4	11	8	6				25	44	0.8
ND7519-1	13	12					25	52	0.5	15	9	1				25	60	0.4
W2978-3	23	2					25	92	0.1	19	6					25	76	0.2
ND8331C5-2	20	5					25	80	0.2	15	5	3	1			24	63	0.6
MSJ126-9Y	24	1					25	96	0.0	20	5					25	80	0.2
MSR061-1	13	7					20	65	0.4	17	8					25	68	0.3
ND8305-1	15	10					25	60	0.4	5	16	3	1			25	20	1.0
CO00197-3W	20	6					26	77	0.2	15	10					25	60	0.4

[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 at least 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 7. Pre-Harvest Panels, 8/31/11

Entry	Specific Gravity	Glucose[1] %	Sucrose[2] Rating	Canopy Rating[3]	Canopy Uniform.[4]	Number of Hills	Number of Stems	Average[5] Tuber Weight
NY140	1.078	0.001	0.314	80	85	3	11	4.56
Atlantic	**1.084**	**0.002**	**0.630**	**80**	**85**	**4**	**18**	**4.54**
W2310-3	1.078	0.005	0.370	65	70	4	13	4.43
NYE106-4	1.074	0.002	0.376	85	80	3	15	2.43
Snowden	**1.074**	**0.001**	**0.656**	**65**	**80**	**4**	**19**	**3.29**
W5015-12	1.081	0.002	0.445	80	70	2	11	2.81
MSL292-A	1.070	0.001	0.576	40	75	3	11	3.76
CO00188-4W	1.062	0.002	0.378	5	95	3	16	2.55
W4980-1	1.066	0.001	0.366	15	45	3	13	2.44
ND7519-1	1.073	0.002	0.987	30	75	3	16	3.18
W2978-3	1.067	0.006	0.796	45	80	2	12	2.12
ND8331C5-2	1.082	0.002	0.808	50	75	3	13	2.52
MSJ126-9Y	1.069	0.001	0.798	50	85	3	17	3.30
MSR061-1	1.081	0.001	0.348	75	80	3	14	2.97
ND8305-1	1.083	0.002	0.430	50	60	3	19	3.14
CO00197-3W	1.072	0.006	1.200	70	75	3	12	2.43

[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 8

2011 MSU Tablestock Potato Variety Trials

Entry	Pedigree	2011 Scab Rating*	Characteristics
Canela Russet (AC92009-4Rus)	A83043-12 X A8784-3	1.9	Average yield, oblong blocky russet, medium to late maturity, good tuber dormancy, above average specific gravity, tolerant to pythium leak and pink rot
Clearwater Russet (AOA95154-1)	Bannock Russet X A89512-4	1.4	Medium-late maturing, with oblong-long tubers that have medium-russet skin, exhibit excellent fry color out of storage, suitable for both processing and fresh market use
Dakota Trailblazer (AOND95249-1Russ)	A98163-3LS X A8914-4	2.8	High yield of uniform tubers; resistance to sugar ends, cold induced sweetening, verticillium wilt, and good field resistance to foliar late blight.
Onaway	USDA X96-56 X Katahdin	2.0	High yield, early maturity, round tuber type, low specific gravity, smooth skin, white flesh, medium deep eyes, few internal defects, check variety
Reba (NY 87)	Monona X Allegany	1.6	High yield, bright tubers, low incidence of internal defects, mid to late season maturity, medium – low specific gravity
Red Norland	ND 626 X Red Kote	1.3	Early maturity, medium yield, low specific gravity, smooth round to oblong tubers, medium red skin color
CORN #8	Russet Norkotah Line Selection	2.8	Above average yield, early to mid-season maturity, tubers are white flesh, long to slightly oblong, medium to heavy russetted skin, eyes are shallow, numerous and well distributed tuber set, medium specific gravity
Silverton Russet (AC83064-6)	A76147-2 X A 7875-5	0.5	High yield, oblong to long blocky tuber type, medium russet skin, masks PVY, medium specific gravity, possible Sencor & Linuron susceptibility
A0008-1TE (Teton Russet)	Blazer Russet X Classic Russet	0.9	Medium yield, nice blocky tuber type, white flesh, medium russet skin, early maturity, low specific gravity, fusarium dry rot tolerance
A01124-3Rus	Bannock Russet X A94020-3	1.0	Medium yield, early to mid-season maturity, medium specific gravity, heavy russeting, nice uniform blocky tuber appearance

*Scab rating based on 0-5 scale; 0 = most resistant and 5 = most susceptible.

Table 8 continued

Entry	Pedigree	2011 Scab Rating*	Characteristics
A02062-1TERus	A97201-4 X A97299-1	0.8	Long tuber type, medium-heavy russeting, higher U.S. No. 1 yields and larger tuber size than Russet Norkotah
AC00395-2Rus	A95523-12 X Summit Russet	1.0	Oblong-long tuber, processing potential, high yield potential, resistant to blackspot and enzymatic browning, late maturity, high specific gravity
AF3317-15	AWN86514-2 X Reeves Kingpin	1.5	A long russet with late blight resistance and potential for fresh market and processing
AF3362-1	Reeves Kingpin X Silverton Russet	1.1	A long russet with good yields, processing potential and generally good appearance
CO03187-1Rus	Rio Grande Russet X A9304-3	0.1	Long tuber type, processing potential, resistant to blackspot and enzymatic browning, very early maturing, high specific gravity
CO03202-1Rus	AC96010-3Rus X Canela Russet	1.5	Long tuber type, processing potential, high yield potential, resistant to blackspot and enzymatic browning, long dormancy, medium maturing, high specific gravity
CO03276-4Rus	CO35086-8Rus X Blazer Russet	1.5	Oblong tuber type, processing potential, resistant to blackspot and enzymatic browning, high specific gravity, early maturing
CO03276-5Rus	CO35086-8Rus X Blazer Russet	1.1	Long tuber type, processing potential, resistant to blackspot and enzymatic browning, high specific gravity, medium maturing
CO03308-3Rus	CO96109-7Rus X Silverton Russet	0.8	Long tuber type, processing potential, resistant to blackspot and enzymatic browning, high specific gravity, medium maturing
CO99053-3Rus	AC91014-2 X Silverton Russet	1.9	High yield, medium to late maturity, large vine, medium specific gravity, uniform blocky tubers, medium russeting, nice appearance, blackspot bruise resistant
MSL211-3	MSG301-9 X Jacqueline Lee (MSG274-3)	1.8	Round to oval tubers, smooth bright appearance, moderate late blight resistance, good yield
MSM288-2Y	MSG145-1 X MSA097-1Y	3.0	A bright yellow flesh selection similar in type to Yukon Gold.

*Scab rating based on 0-5 scale; 0 = most resistant and 5 = most susceptible.

Table 8 continued

Entry	Pedigree	2011 Scab Rating*	Characteristics
MSQ176-5	MSI152-A X Missaukee (MSJ461-1)	2.4	High yield potential, uniform round tuber type, bright appearance, late blight resistance, good bulking
MSQ341-BY	MSJ126-9Y X NY120	1.3	Above average yield potential, nice round shape, good yellow flesh color, smooth skin type, common scab tolerant
MSQ440-2	MSK214-1R X Missaukee (MSJ461-1)	1.3	Uniform round tubers, very bright white skin, common scab resistant
MSR217-1R	NDTX4271-5R X Missaukee (MSJ461-1)	2.8	Attractive dark red skin, round tuber type
MSS544-1R	CO93037-6R X MNR-8RR	1.9	Attractive dark red skin, round tuber type, common scab resistance
W6002-1R	B1491-5 X W1100R	1.9	Good skin color, very uniform tubers with good market appeal, good skin set, medium-high yield
W6360-1Rus	AWN 86514-2Rus X W1839-3Rus	1.9	Excellent tuber shape in most years, late blight resistance, high specific gravity, processing potential, late maturity, smaller tuber size, moderate yield potential due to very late maturity
W6511-1R	Kankan X W2275-9R	2.5	Dark red skin color holds in storage, oblong tuber shape, high tuber set

*Scab rating based on 0-5 scale; 0 = most resistant and 5 = most susceptible.

Table 9

2011 Freshpack Potato Variety Trial

Overall Averages - Seven Locations

Delta, Ingham, Kalkaska, Monroe, Montcalm, Presque Isle, & St. Joseph

NUMBER OF LOCATIONS	LINE	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR	TUBER QUALITY[2] HH	VD	IBS	BC	TOTAL CUT	VINE VIGOR[3]	VINE MATURITY[4]	COMMENTS	5-YR AVG US#1 CWT/A
4	**Reba**	**454**	**493**	**92**	**5**	**75**	**17**	**3**	**1.077**	**2**	**2**	**1**	**1**	**40**	**3.4**	**2.9**	**large tuber type, tr scab**	**432**
2	Dakota TrailBlazer	415	502	83	11	67	16	6	1.093	6	1	0	0	30	2.5	4.0	nice blocky type, uniform shape and size, sl scab	415*
4	MSM288-2Y	372	443	84	13	80	4	3	1.074	5	2	2	0	40	3.8	2.3	misshapen tubers and gc in pickouts, sl scab	372*
4	**Onaway**	**370**	**427**	**86**	**9**	**77**	**9**	**5**	**1.063**	**0**	**13**	**1**	**0**	**40**	**4.0**	**2.4**	**misshapen tubers in pickouts, tr scab**	**373**
4	MSQ176-5	362	430	83	14	72	11	3	1.066	11	6	2	1	40	2.9	3.4	misshapen tubers and gc in pickouts, pitted scab, uniform round tubers	410***
5	AF3362-1Rus	334	394	79	14	55	24	7	1.073	0	9	4	0	80	3.6	2.5	misshapen tubers and knobs in pickouts, tr glassy end, uniform type	334*
6	A01124-3Rus	325	403	75	19	66	9	6	1.074	16	1	2	0	90	2.1	2.9	misshapen tubers and gc in pickouts	323**
5	**Silverton Russet**	**324**	**409**	**73**	**22**	**59**	**14**	**5**	**1.072**	**2**	**2**	**0**	**1**	**80**	**3.9**	**3.5**	**misshapen tubers in pickouts, no scab, nice blocky type**	**382**
3	W6002-1R	313	392	80	19	77	3	1	1.064	0	5	0	0	30	3.8	2.0	uniform round type, good red color, tr scab	313*
4	MSQ341-BY	310	365	85	13	82	3	2	1.077	0	20	9	5	40	3.3	2.6	yellow flesh, round tuber type, slight pitted scab	310*
7	A02062-1TERus	304	370	78	14	59	19	8	1.074	4	5	4	2	100	2.3	3.2	misshapen tubers in pickouts, tr glassy end, nice russet type	374**
5	MSQ440-2	304	337	90	9	84	6	1	1.061	0	13	3	0	50	2.9	2.5	uniform tubers, bright white skin, tr scab	292**
1	**NorWis**	**296**	**306**	**97**	**2**	**68**	**29**	**1**	**1.059**	**0**	**2**	**0**	**0**	**10**	**3.5**	**2.0**	**gc in pickouts, tr scab**	**296***
6	A0008-1TERus	292	395	68	23	58	10	9	1.070	11	1	1	1	90	2.3	2.2	gc, heat sprouts, and misshapen tubers in pickouts, tr scab	313***
2	CO03276-5Rus	292	433	55	37	47	8	8	1.077	2	7	0	0	30	2.3	2.6	tubular type, tr glassy end, tr scab	292*
5	CO99053-3Rus	290	406	65	28	57	8	7	1.080	6	4	0	0	80	3.1	4.0	Silverton like type and skin	398****
3	**Red Norland**	**290**	**365**	**79**	**17**	**75**	**4**	**4**	**1.058**	**0**	**5**	**0**	**0**	**30**	**3.8**	**1.7**	**misshapen tubers and gc in pickouts, no scab**	**326****
5	MSL211-3	289	361	80	16	76	4	4	1.069	0	2	0	0	50	3.9	2.3	misshapen tubers and gc in pickouts, bright white skin	329**
2	CO03308-3Rus	288	389	60	30	47	13	10	1.070	3	1	1	7	40	2.4	3.3	misshapen tubers in pickouts	288*

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan State University AgBioResearch

Compost Effects on Weed Competition, Seed Production, and Potato Yield

A.J. Lindsey, K.A. Renner, W.J. Everman

Location:	MSU Montcalm Research Center	**Tillage:**	Conventional
Planting Date:	May 17, 2010; May 20, 2011	**Weeds:**	Hairy nightshade; giant foxtail; common lambsquarters
Soil Type:	Sandy loam; 1.0 OM; pH 6.8	**Cultivar:**	Snowden
Replicated:	4 times	**Population:**	10.5" seed spacing, 34" rows

Table 1. Potato yield and specific gravity as influenced by weed competition and compost.

	POTATO YIELD AND QUALITY			
	Marketable (A)	Undersize (B)	Total	Specific Gravity
	cwt/acre			
Weed species				
c. lambsquarters	130c	42	172c	1.076
giant foxtail	210b	49	260b	1.076
hairy nightshade	200b	51	250b	1.075
weed-free	250a	46	300a	1.075
Compost rate				
0 t compost/acre	185b	47	230b	1.077a
15 t compost/acre	200ab	46	245ab	1.075b
30 t compost/acre	210a	47	260a	1.074b

Table 2. Weed seed production as affected by compost application

	WEED SEED PRODUCTION PER PLANT			
	0 t compost/acre	15 t compost/acre	30 t compost/acre	**$LSD_{0.05}$**
c. lambsquarters	111,500	88,800	89,600	38,800
giant foxtail	6,200	6,400	6,100	4,300
hairy nightshade	10,300	14,000	11,700	7,500

Summary: The objective was to observe the effect of high compost rates on weed competition and potato yield. Growers that have access to compost may use it to improve soil health and increase tuber yields. However, compost may also increase weed competition and seed production. Snowden potatoes were grown under 0, 15, or 30 t compost/acre under weed-free conditions, and in competition with common lambsquarters, giant foxtail, and hairy nightshade. Compost did not increase biomass or weed seed production of any weed species. Giant foxtail and hairy nightshade at 1.6 plants per foot of row reduced yield by 20%; common lambsquarters reduced yield by 45%. Giant foxtail and hairy nightshade decreased yield by reducing tuber bulking, but common lambsquarters reduced tuber set and bulking. Potato yield increased 5 to 15% and specific gravity decreased in compost treatments. Elevated soil potassium levels in the composted treatments led to the yield increase and the decrease in specific gravity.

Late-Season Weed Control in 'FL 1922' Potatoes

A.J. Lindsey, W.J. Everman, C.L. Sprague

Location:	MSU Montcalm Research Center	**Tillage:**	Conventional
Planting Date:	May 17, 2010; May 9, 2011	**Herbicides:**	see treatments
Soil Type:	Sandy loam; 1.5 OM; pH 5.8	**Cultivar:**	FL 1922
Replicated:	4 times	**Population:**	12" seed spacing, 34" rows

Table 1. Late-season weed control, potato yield and quality as affect by herbicide and application timing.

		POTATO YIELD AND QUALITY			
Herbicide treatments[a,b] (application timing potato stage)	Common. lambsquarters[c]	Marketable (A)	Undersize (B)	Pickout	Specific Gravity
	% control	cwt/acre			
Prowl H_2O (4" vines); Matrix + NIS (flower)	86	224	26.1	0.00	1.0765
Prowl H_2O (4" vines); Sencor + NIS (flower)	99	200	24.5	0.95	1.0759
Prowl H_2O (4" vines); Matrix + Sencor + NIS (flower)	99	214	26.8	0.00	1.0779
Boundary (4" vines); Matrix + NIS (flower)	90	209	34.0	1.66	1.0764
Boundary (4" vines); Sencor + NIS (flower)	99	203	33.0	0.00	1.0779
Boundary (4" vines); Matrix + Sencor + NIS (flower)	99	203	29.4	0.00	1.0769
Prowl H_2O (4" vines); No application (flower)	67	212	26.7	0.00	1.0765
Boundary (4" vines); No application (flower)	77	201	30.0	0.07	1.0770
No application (4" vines); Matrix + NIS (flower)	86	219	29.1	0.00	1.0775
No application (4" vines); Sencor + NIS (flower)	97	207	28.7	0.27	1.0756
No application (4" vines); Matrix + Sencor + NIS (flower)	99	200	32.4	0.57	1.0767
No application (4" vines); No application (flower)	66	203	34.0	4.06	1.0766
Non-treated	0	191	33.3	1.71	1.0752
$LSD_{0.05}$[d]	15.7	n.s.	n.s.	3.67	n.s.

[a]Herbicide rates (per acre): Prowl H_2O (1.8 pt), Boundary (1.5 pt), Matrix (1 oz), Sencor (0.33 lb), NIS (0.25% v/v).
[b]All plots except non-treated received Dual II Magnum (1.33 pt) + Lorox (1 lb) at potato cracking.
[c]Total weed control was evaluated 42 days after the flowering treatment.
[d]Means within a column greater than the least significant difference (LSD) value are different from each other; n.s. indicates that treatments were not different from each other.

Summary: The objective was to determine the effect of late-season herbicide applications on weed control and potato yield. Herbicide application improved control of common lambsquarters 42 days after flowering, and the addition of a treatment at flowering greatly improved control. Yield and specific gravity were not affected by weed control program. In general, potatoes receiving at least two herbicide applications had greater yield than those with one application. When potatoes did not receive a treatment after cracking, the pickout yield was increased. Because the potatoes experienced both cultivation and hilling, weed pressure may not have been severe enough to significantly decrease yield in the non-treated.

Funding: Industry and MPIC

Evaluation of plow-type and biofungicides programs for common scab control in potatoes, 2011.

W. W. Kirk[1], R. Schafer[1], A. Merlington[1] and J. Hao[1]. [1]Department of Plant Pathology, Michigan State University, East Lansing, MI 48824

Potatoes (cut seed, treated with Maxim FS at 0.16 fl oz/cwt; "FL1833") were planted at the Michigan State University Potato Research Farm, Entrican, MI (sandy soil); 42.3526, -85.1761 deg; elevation 950 ft. on 2 Jun 2011 into four-row by 25-ft plots (ca. 9-in between plants at 34-in row spacing) replicated four times in a split plot with randomized complete block design within the split. The split was done on 5 May 11 and consisted of a moldboard plow to 12" depth along half the width of the plot and a chisel plow to 12" depth along the remainder, for a final total split plot length of 415-ft (5-ft separation between replications). The moldboard plow inverts the soil. Fertilizer was drilled into plots before planting, formulated according to results of soil tests. Additional nitrogen (final N 28 lb/A) was applied to the growing crop with irrigation 45 DAP (days after planting). Weeds were controlled by hilling and with Dual 8E at 2 pt/A 10 DAP and Poast at 1.5 pt/A 58 DAP. Insects were controlled with Admire Pro 2F at 1.25 pt/A at planting, Sevin 80S at 1.25 lb/A 31 and 55 DAP, Thiodan 3 EC at 2.33 pt/A 65 and 87 DAP and Pounce 3.2EC at 8 oz/A 48 DAP. Vines were killed with Reglone 2EC (1 pt/A on 15 Sep). Potato late blight and general foliar diseases were prevented with weekly applications of Bravo WS at 1.5 pt/A from early canopy closure on 29 Jun to 24. Vines were killed with Reglone 2EC (1 pt/A on 22 Sep). Plots (2 x 25-ft row) were harvested on 22 Oct and individual treatments were weighed and graded. Samples of 200 tubers per plot were harvested 30 days after desiccation (approximately 143 DAP). Tubers were washed and assessed for common scab (*S. scabies*) incidence (%) and severity 10 days after harvest. Severity of common scab was measured as an index calculated by counting the number of tubers (n = 200) falling in class 0 = 0%; 1 = 1 - 5%; 2 = 6 -10%; 3 = 11 - 15; 4 >16% surface area of tuber covered with tuber lesions (surface and pitted). The number in each class is multiplied by the class number and summed. The sum is multiplied by a constant to express as a percentage. Indices of 0 - 25 represent 0 - 5%; 26 - 50 represent 6 - 10%; 51 - 75 represent 11 - 15% and 75 - 100 >15% surface area covered with lesions. Meteorological variables were measured with a Campbell weather station located at the farm from 1 Jun to the end of Sep. Maximum, minimum and average daily air temperature (^oF) were 92.8, 45.8 and 66.2 and 3-d with maximum temperature >90^oF (Jun); 94.2, 51.7 and 73.4 and 3-d with maximum temperature >90^oF (Jul); 87.1, 46.6 and 68.5 (Aug); 88.5, 33.9 and 61.1 (Sep). Maximum, minimum and average relative humidity (%) was 98.2, 21.6 and 69.6 (Jun); 98.9, 29.7 and 71.7 (Jul); 98.8, 29.8 and 73.9 (Aug); 98.7, 32.5 and 71.8 (Sep). Maximum, minimum and average daily soil temperature at 4" depth (^oF) was 85.1, 58.0 and 69.7 (Jun); 90.7, 63.5 and 76.0 (Jul); 90.8, 58.9 and 73.1 (Aug); 85.8, 53.0 and 67.1 (Sep). Maximum, minimum and average soil moisture (% of field capacity) was 26.4, 16.4 and 17.8 (Jun); 30.0, 17.2 and 18.4 (Jul); 25.6, 17.6 and 18.6 (Aug); 25.1, 16.9 and 18.1 (Sep). Precipitation was 2.38 in. (Jun), 1.63 in. (Jul), 2.57 in (Aug), 0.84 in. (Sep). Plots were irrigated to supplement precipitation to about 0.1 in./A/4 day period with overhead pivot irrigation.

There was no significant difference between plowing treatments on scab incidence or severity but there was a significant effect on US-1 and total yield (Table 1). The analysis of the main effects indicated that there was a significant difference among biofungicide treatments and the untreated control on incidence and severity of common scab and yield (Table 1). Common scab was severe in the trial and the incidence and severity index in the untreated control plots (both plow-types) was in excess of 80% and 45, respectively (Table 2). Serenade Soil treatments had significantly lower incidence and severity of common scab in comparison with the non-treated control in both plow types (Table 2) however the incidence and severity indices were still in excess of 60% and 28, respectively. Treatments with incidence of scab from 61.4 to 79.5, and 67.4 to 85.8% were not significantly different. Treatments with scab indices from 28.3 to 41.1, 32.2 to 46.9 and 40.0 to 50.0 were not significantly different. Treatments with US-1 yield from 239 to 290, 248 to 302 and 288 to 341 cwt/A were not significantly different. Treatments with total yield from 246 to 301 and 291 to 358 cwt/A were not significantly different. (Table 2). No phytotoxicity was observed in this trial.

Funding: Industry and MPIC

Table 1. Main effects of plow-type and bio-fungicide in-furrow at-planting application on incidence and severity of common scab and yield in potatoes.

Source of variation	Prob > F			
	Scab incidence	Scab severity index[z]	US1-Yield	Total Yield
Plow type	0.3877	0.2494	0.0319	0.0026
Fungicide treatment	0.0276	0.0056	0.0456	0.0945
Interaction	0.8851	0.6435	0.8534	0.8620

[z] Severity of common scab was measured as an index calculated by counting the number of tubers (n = 200) falling in class 0 = 0%; 1 = 1 - 5%; 2 = 6 -10%; 3 = 11 - 15; 4 >16% surface area of tuber covered with tuber lesions (surface and pitted). The number in each class is multiplied by the class number and summed. The sum is multiplied by a constant to express as a percentage. Indices of 0 - 25 represent 0 - 5%; 26 - 50 represent 6 - 10%; 51 - 75 represent 11 - 15% and 75 - 100 >15% surface area covered with lesions.

Table 2. Efficacy of plow-type and bio-fungicide on incidence and severity of common scab and yield in potatoes.

		Common scab incidence and severity				Yield (cwt/A)			
Plow Type	Treatment rate/A	Incidence (%)		Scab Index[z]		US1		Total	
Chisel	Serenade Soil 1.34SC 4pt (A[y])	61.5	b	28.3	c	248	bc	255	b
	Actinogrow 0.0371WP 0.5 lb (A)	76.6	ab	41.1	abc	290	abc	301	ab
	Regalia Max 20SC 2.4 pt (A)	78.0	ab	45.4	ab	263	bc	274	b
	Untreated	85.8	a	46.9	ab	239	c	246	b
Moldboard	Serenade Soil 1.34SC 4pt (A[y])	61.4	b	28.4	c	302	ab	312	ab
	Actinogrow 0.0371WP 0.5 lb (A)	67.4	ab	32.2	bc	341	a	358	a
	Regalia Max 20SC 2.4 pt (A)	79.5	ab	40.0	abc	288	abc	294	ab
	Untreated	84.1	a	50.0	a	271	bc	291	ab

[z] Severity of common scab was measured as an index calculated by counting the number of tubers (n = 200) falling in class 0 = 0%; 1 = 1 - 5%; 2 = 6 -10%; 3 = 11 - 15; 4 >16% surface area of tuber covered with tuber lesions (surface and pitted). The number in each class is multiplied by the class number and summed. The sum is multiplied by a constant to express as a percentage. Indices of 0 - 25 represent 0 - 5%; 26 - 50 represent 6 - 10%; 51 - 75 represent 11 - 15% and 75 - 100 >15% surface area covered with lesions.

[y] Application dates: A= 16 Apr; B= 15 May.

[x] Values followed by the same letter are not significantly different at P = 0.05 (Tukey Multiple Comparison). Varieties were analyzed together as there was no significant difference between varieties in incidence or severity of common scab.

Funding: Industry and MPIC

Seed treatments and seed plus in furrow treatments for control of seed- and soil-borne *Rhizoctonia solani*, 2011.

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Potatoes with *Rhizoctonia solani* (black scurf), 2- 5% tuber surface area infected, were selected for the trials. Potato seed (Dark Red Norland) was prepared for planting by cutting and treating with fungicidal seed treatments two days prior to planting. Seed were planted at the Michigan State University Horticultural Experimental Station, Clarksville, MI (Capac loam soil); 42.8733, -85.2604 deg; elevation 895 ft. on 31 May into two-row by 20-ft plots (ca. 10-in between plants to give a target population of 50 plants at 34-in row spacing) replicated four times in a randomized complete block design. The two-row beds were separated by a 5-ft unplanted row. Dust formulations were measured and added to cut seed pieces in a Gustafson revolving drum seed treater and mixed for 2 min to ensure even spread of the fungicide. Fungicides applied as pre-planting potato seed liquid treatments were applied in water suspension at a rate of 0.2 pt/cwt onto the exposed seed tuber surfaces, with the entire seed surface being coated in the Gustafson seed treater. In- furrow at-planting applications were delivered at 8 pt water/A in a 7 in. band using a single XR11003VS nozzle at 30 p.s.i. Foliar applications were applied with a R&D spray boom delivering 25 gal/A (80 p.s.i.) and using three XR11003VS nozzles per row. Fertilizer was drilled into plots before planting, formulated according to results of soil tests. Additional nitrogen (final N 28 lb/A) was applied to the growing crop with irrigation 45 DAP (days after planting). Previcur Flex was applied at 0.7 pt/A on a seven-day interval, total of four applications, starting one day after inoculation of adjacent plots with *Phytophthora infestans* to prevent spread of potato late blight. Weeds were controlled by hilling and with Dual 8E at 2 pt/A 10 DAP and Poast at 1.5 pt/A 58 DAP. Insects were controlled with Admire 2F at 1.25 pt/A at planting, Sevin 80S at 1.25 lb/A 31 and 55 DAP, Thiodan 3 EC at 2.33 pt/A 65 and 87 DAP and Pounce 3.2EC at 8 oz/A 48 DAP. Vines were killed with Reglone 2EC (1 pt/A on 15 Sep). Plots (20-ft row) were harvested on 15 Oct and individual treatments were weighed and graded. Four plants per plot were harvested 31 days after planting (1 Jul) and the percentage of stems and stolons with greater than 5% of the total surface area affected were counted. Samples of 50 tubers per plot were harvested 14 days after desiccation and assessed for black scurf (*R. solani*) incidence (%) and severity 40 days after harvest. Severity of black scurf was measured as an index calculated by counting the number of tubers (n = 50) falling into each class 0 = 0%; 1 = 1 - 5%; 2 = 6 -10%; 3 = 11 - 15; 4 >15% surface area of tuber covered with sclerotia. The number in each class is multiplied by the class number and summed. The sum is multiplied by a constant to express as a percentage. Indices of 0 - 25 represent 0 - 5%; 26 - 50 represent 6 - 10%; 51 - 75 represent 11 - 15% and 75 - 100 >15% surface area covered with sclerotia. Meteorological variables were measured with a Campbell weather station located at the farm from 1 May to harvest (5 Oct). Maximum, minimum and average daily air temperature (^{o}F) were 91.2, 45.4 and 66.6 and 2-d with maximum temperature >90^{o}F (Jun); 93.2, 53.3 and 74.1 and 3-d with maximum temperature >90^{o}F (Jul); 85.8, 49.6 and 68.9 (Aug); 87.8, 34.8 and 59.1 (Sep); 81.0, 33.1 and 58.5 (to 22 Oct). Maximum, minimum and average relative humidity (%) was 98.2, 25.6 and 69.5 (Jun); 98.2, 28.2 and 69.3 (Jul); 98.7, 30.7 and 73.5 (Aug); 99.1, 33.8 and 75.3 (Sep); 98.9, 25.7 and 64.8 (to 22 Oct). Maximum, minimum and average daily soil temperature at 4" depth (^{o}F) was 88.5, 58.6 and 71.5 (Jun); 100.1, 67.4 and 81.9 (Jul); 88.8, 63.2 and 75.4 (Aug); 82.6, 55.9 and 67.1 (Sep); 64.8, 51.3 and 58.7 (to 22 Oct). Maximum, minimum and average soil moisture (% of field capacity) was 41.3, 38.1 and 39.0 (Jun); 43.7, 36.6 and 39.6 (Jul); 41.3, 36.9 and 38.9 (Aug); 39.1, 35.3 and 37.1 (Sep); 37.5, 36.0 and 36.5 (to 22 Oct). Precipitation was 2.09 in. (Jun), 6.11 in. (Jul), 3.4 in (Aug), 1.02 in. (Sep) and 0.12 in. (to 22 Oct). Plots were irrigated to supplement precipitation to about 0.1 in./A/4 day period with overhead sprinkle irrigation.

Final plant stand was relatively poor in the plots in 2011 and may have been related to the conditions experienced immediately prior to and just after planting when soil conditions were wet prior to planting then became unseasonably warm. No treatment affected final plant stand or the relative rate of emergence (RAUEPC) in comparison to the untreated control. Treatments with US1 and total yield greater than 319 and 327 cwt/A, respectively had significantly higher yield than the untreated control. No treatments had an affect stem number per plant in comparison to the untreated control. Treatments with less than 48.4% incidence of stems with stem canker with greater than 5% of the total surface area affected had significantly less stem canker than the untreated check (50.2%). Treatments with greater than 20.4 stolons per plant were significantly different from the untreated control (18.1 stolons/plant). All treatments had significantly less stolon canker incidence in comparison to the untreated check (43.0%). All treatments had significantly less overall lower stem plant canker in comparison to the untreated check. Treatments with incidence of tuber black scurf less than 32.6% were significantly different in comparison to the untreated check. Treatments with a tuber black scurf severity index of less than 24.2 were significantly different in comparison to the untreated check. Seed treatments and in-furrow applications of fungicides and biofungicides were not phytotoxic.

Funding: Industry and MPIC

Treatment and rate/1000 row feet and rate/cwt potato seed	Final plant stand (%)		RAUEPC[z]		Yield (cwt/A) US1		Total	
Vertisan 1.67EC 0.7 fl oz (B[y])…………	77.0	a[x]	39.0	a	263	bcd	273	cd
Vertisan 1.67EC 1.6 fl oz (B)………….	68.0	a-e	34.7	ab	312	a-d	322	a-d
Aproach 2.08SC 0.5 fl oz (B)………….	69.0	a-e	34.4	ab	289	a-d	296	a-d
Aproach 2.08SC 1.3 fl oz (B)………….	71.5	a-d	35.5	ab	293	a-d	303	a-d
Fontelis 1.67 SC 0.3 fl oz/cwt (A); Vertisan 1.67EC 1.2 fl oz (B)…………	70.0	a-e	37.6	ab	260	cd	269	cd
Fontelis 1.67 SC 0.6 fl oz/cwt (A)……..	70.5	a-e	38.8	ab	319	abc	327	a-d
Fontelis 1.67 SC 0.6 fl oz/cwt (A)	68.5	a-e	32.4	ab	262	bcd	272	cd
Quadris 2.08FL 0.6 fl oz (B)…………....	72.5	abc	34.5	ab	293	a-d	300	a-d
Serenade Soil 1.34SC 4.4 fl oz (B)…….	61.0	e	35.0	ab	291	a-d	305	a-d
Serenade Soil 1.34SC 8.8 fl oz (B)…….	71.0	a-e	36.9	ab	356	a	367	a
Maxim MZ 6.2DS 0.5 lb/cwt (A)……...	74.0	ab	37.9	ab	273	bcd	284	bcd
Actinogrow 0.0371WP 0.3 oz (B)……...	63.5	cde	32.1	b	272	bcd	280	cd
Actinogrow 0.0371WP 0.6 oz (B)…..…	64.5	b-e	37.8	ab	347	a	356	ab
Actinogrow 0.0371WP 0.8 oz (B)……..	66.0	b-e	36.2	ab	334	ab	343	abc
Actinogrow 0.0371WP 0.3 oz + Quadris 2.08FL 0.6 fl oz (B)…….…….	61.5	de	32.2	ab	264	bcd	269	cd
Regalia Max 20SC 8.8 fl oz (B)………..	64.0	b-e	35.0	ab	273	bcd	282	bcd
Untreated Check………………..........	67.0	a-e	34.4	ab	242	d	265	d

Treatment and rate/1000 row feet and rate/cwt potato seed[z]	Stems (31 DAP) Number		Stems (31 DAP) Percent infected[w]		Stolons (31 DAP) No./plant		Stolons (31 DAP) Girdling[v] > 5%		Tuber black scurf Incidence (%)		Tuber black scurf Severity scale (0 - 100)	
Vertisan 1.67EC 0.7 fl oz (B)…….……	6.7	a-d	18.1	de	20.4	bcd	9.1	ef	20.5	c-g	8.5	cde
Vertisan 1.67EC 1.6 fl oz (B)………….	7.2	a-d	15.1	e	18.0	de	5.8	f	16.4	efg	6.4	cde
Aproach 2.08SC 0.5 fl oz (B)………….	7.7	ab	21.6	cd	21.7	abc	10.9	c-f	11.0	g	3.4	e
Aproach 2.08SC 1.3 fl oz (B)………….	7.9	ab	27.8	cd	19.5	b-e	14.5	b-e	12.1	fg	3.9	de
Fontelis 1.67 SC 0.3 fl oz/cwt (A);	7.7	ab	21.6	cd	21.9	ab	9.6	def	20.3	c-g	7.2	cde
Fontelis 1.67 SC 0.6 fl oz/cwt (A)……..	7.4	ab	34.6	bc	21.1	abc	16.9	bcd	16.9	d-g	5.0	cde
Fontelis 1.67 SC 0.6 fl oz/cwt (A)	6.2	bc	26.8	cd	17.7	e	20.7	b	20.0	c-g	6.3	cde
Quadris 2.08FL 0.6 fl oz (B)…………....	7.3	a-d	28.7	cd	21.1	abc	14.9	b-e	20.9	c-g	8.6	cde
Serenade Soil 1.34SC 4.4 fl oz (B)…….	6.2	bc	30.1	cd	20.1	b-e	12.3	c-f	27.4	c-f	11.9	cde
Serenade Soil 1.34SC 8.8 fl oz (B)…….	7.6	ab	31.2	cd	20.9	abc	12.5	c-f	17.3	d-g	6.2	cde
Maxim MZ 6.2DS 0.5 lb/cwt (A)……...	6.3	bc	28.6	cd	19.2	cde	12.7	c-f	23.6	c-g	8.8	cde
Actinogrow 0.0371WP 0.3 oz (B)……...	6.6	a-d	32.0	cd	20.9	abc	17.3	bc	33.4	abc	14.5	bc
Actinogrow 0.0371WP 0.6 oz (B)…..…	5.6	d	48.4	ab	20.9	abc	15.0	b-e	32.6	a-d	13.8	cd
Actinogrow 0.0371WP 0.8 oz (B)……..	5.8	cd	31.1	cd	23.2	a	11.6	c-f	43.8	ab	24.2	ab
Actinogrow 0.0371WP 0.3 oz + Quadris 2.08FL 0.6 fl oz (B)…….…….	7.1	a-d	22.3	c-e	20.4	bcd	12.5	c-f	29.5	b-e	14.4	bc
Regalia Max 20SC 8.8 fl oz (B)………..	8.2	a	32.4	c	20.9	abc	13.9	b-e	10.6	g	4.0	de
Untreated Check………………..........	6.8	a-d	50.2	a	18.1	de	43.0	a	48.3	a	26.1	a

[z] RAUEPC = Relative area under the emergence progress curve measured from planting to 31 days after planting
[y] Application dates: A= 29 May (liquid formulations for seed piece application at 0.2 pt/cwt; B= 31 May (in-furrow)
[x] Values followed by the same letter are not significantly different at $p = 0.05$ (Fishers LSD)
[w] Stems with greater than 5% of area with stem canker due to *Rhizoctonia solani*
[v] Stolons with greater than 5% of area with stolon canker due to *Rhizoctonia solani*

Funding: USDA/ARS, MPIC and MSU GREEEN

Identifying and characterizing resistance from diverse potato germplasm sources to highly aggressive strains of late blight: tuber repsonses.

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Brief Introduction

The objectives of this study were to evaluate the interactions of different cultivars/Advanced Breeding Lines (ABL) of potato between different genotypes of *P. infestans* and storage temperature on tuber late blight development.

Partial Methods

A digital image analysis technique was used to assess tuber tissue infection. The method was previously used and standardized (Kirk et al. 2001; Niemira et al. 1999). The image files were analyzed using SigmaScan V3.0 (Jandel Scientific, San Rafael, CA). The area selection cut-off threshold was set to 10 light intensity units, limiting the determination to the non–dark parts of the image. The average reflective intensity (ARI) of all the pixels within the image gave a measurement of infection severity of the tuber tissue of each sample. The ARI was measured in sections from the apical, middle and basal regions of the tuber. The amount of late blight infected tissue per tuber was expressed as a single value (Mean ARI) calculated as the average ARI of the apical, middle and basal sections evaluated 40 days after inoculation (DAI).

Data Analysis

The presence of *P. infestans* in sample tubers was confirmed by ELISA (described above) and by isolating pure cultures of *P. infestans* from the infected tuber tissue and successful re-inoculation of potato tubers and leaves. The severity of tuber tissue infection was expressed relative to the ARI (described above) of the control tubers for each cultivar/ABL. The relative ARI (RARI) was calculated as:

$$RARI(\%) = \left(1 - \frac{mean \quad ARI \quad treatment}{mean \quad ARI \quad control}\right) \times 100$$

RARI (%) has minimum value of zero (no symptoms) and maximum value of hundred (completely dark tuber surface).

Data for all experiments were analyzed by analysis of variance (least squares method) using the JMP program version 7.0 (SAS Institute Inc., SAS Campus Drive, Cary, North Carolina 27513, USA). Treatment effects were determined by three-way factorial ANOVA, where the main effects corresponded to: Cultivar/ABL, *P. infestans* genotype and temperature and multiple interactions among the main effects, including the three factor interaction. Data were not combined across years as different genotypes of *P. infestans* and different cultivars/ABL were used in each year.

Funding: USDA/ARS, MPIC and MSU GREEEN

Results

A high degree of tuber late blight developed in the trial with the average RARI (%) in the least susceptible cultivar reaching a value of 23.6%. Factorial ANOVA analyses resulted in significant differences by variety and *P. infestans* genotype and the interactions between them (Table 1).

The effect of genotype of *P. infestans* on the different varieties of potatoes showed a broad range of responses. There were significant interactions in tuber late blight development [RARI (%)] among varieties genotypes (Table 2). US-8 was the most aggressive genotype of *P. infestans* followed by US-14 and Blue 13. The US-10, and US-22 genotypes were significantly less aggressive but still caused substantial tuber blight (Tables 1 and 2).

Table 1. Main effects analyses on tuber tissue darkening of different varieties and Advanced Breeding Lines in response to inoculation with various genotypes of *Phytophthora infestans* measured as RARI (%) at MSU 2011.

Main effects ANOVA			Tuber tissue darkening					
Source	DF	Prob > F	Variety	RARI (%)[a]		Genotype	RARI (%)	
Variety	15	<0.0001	MSP459-5	41.5	a[b]	US 8: Pi 06-02	40.9	a
Genotype	5	<0.0001	MSQ440-2	40.6	a	US 14: Pi 99-2	33.2	b
Variety*Genotype	75	<0.0001	Russet Norkotah	40.5	a	Blue13	32.7	b
			MSR061-1	40.0	a	US 10: SR83-84	29.1	c
			MSR159-02	38.4	a	US 22: Pi 1B 2010	28.9	c
			MSR157-1Y	37.5	a	US 22: Pi LT5 2009	27.1	c
			MSL268-D	32.3	b			
			MSM182-1	30.4	bc			
			Missaukee	29.6	b-d			
			Stirling	28.4	b-e			
			MSQ070-1	27.1	c-f			
			MSQ176-5	26.8	c-f			
			Jacqueline Lee	26.1	d-f			
			MSQ130-4	25.5	ef			
			MSL211-3	23.7	f			
			Monticello	23.6	f			

[a] Normalized tuber tissue darkening score expressed % RARI = [1- Mean ARI $_{treatment}$ / Mean ARI $_{control}$] *100; % RARI has a minimum value of zero (no darkening) and maximum value of 100 (cut tuber surface is completely blackened). The numbers are derived from the mean average reflective intensity of three surfaces cut latitudinally 25, 50 and 75% from the cut inoculated surface of n = 32 tubers

[b] Values followed by the same letter are not significantly different at $P = 0.05$ for comparisons of mean RARI values of cultivars/ABLs within different *P. infestans* genotypes (Tukey Multiple Comparison)

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Table 2. Tuber tissue darkening of different varieties and Advanced Breeding Lines in response to inoculation with various genotypes of *Phytophthora infestans* measured as RARI (%) at MSU 2011; varieties/ABL responses to the genotypes of *P. infestans* are sorted relative to US-8 data.

	Tuber tissue darkening RARI (%)[a] Genotype of *Phytophthora infestans*											
Variety	US 8 Pi 06-02		Blue13		US 10 SR83-84		US 14 Pi 99-2		US 22 Pi 1B 2010		US 22 Pi LT5 2009	
MSQ130-4	27.5	f[b]	26.1	e-g	31.0	abc	24.0	e	22.5	d	21.8	bc
MSQ176-5	27.7	f	28.8	d-g	23.7	bcd	29.2	de	30.0	a-d	21.4	bc
Monticello	31.8	ef	26.2	e-g	19.4	d	26.3	e	21.3	d	16.6	c
MSL211-3	31.9	ef	22.5	g	19.2	d	25.1	e	23.5	cd	20.0	bc
MSM182-1	35.8	def	33.2	b-f	31.7	ab	28.7	de	27.5	bcd	25.5	bc
Stirling	36.9	cde	30.1	c-g	23.1	bcd	28.5	de	27.8	bcd	23.8	bc
Missaukee	37.3	cde	23.8	fg	31.5	ab	38.0	bcd	25.3	cd	21.6	bc
MSL268-D	39.1	b-e	35.7	a-e	24.1	bcd	30.1	cde	36.9	ab	27.7	b
MSQ070-1	42.8	bcd	24.2	fg	31.8	ab	22.5	e	21.6	d	19.6	bc
MSR157-1Y	43.1	bcd	41.1	ab	38.3	a	39.8	bc	24.2	cd	38.3	a
MSR159-02	43.6	bcd	40.8	ab	37.1	a	39.3	bc	30.6	a-d	38.8	a
Jacqueline Lee	44.2	bcd	26.6	efg	21.4	cd	20.4	e	24.6	cd	19.2	bc
MSQ440-2	44.9	bc	39.4	abc	36.8	a	44.5	ab	39.0	a	38.8	a
MSR061-1	46.7	b	37.2	a-d	36.2	a	44.2	ab	36.9	ab	38.6	a
Russet Norkotah	57.0	a	44.9	a	32.6	ab	53.0	a	33.7	abc	21.8	bc
MSP459-5	63.6	a	42.0	ab	28.5	a-d	37.4	bcd	36.8	bd	40.5	a

[a] Normalized tuber tissue darkening score expressed % RARI = [1- Mean ARI $_{treatment}$ / Mean ARI $_{control}$] *100; % RARI has a minimum value of zero (no darkening) and maximum value of 100 (cut tuber surface is completely blackened). The numbers are derived from the mean average reflective intensity of three surfaces cut latitudinally 25, 50 and 75% from the cut inoculated surface of n = 32 tubers

[b] Values followed by the same letter are not significantly different at P = 0.05 for comparisons of mean RARI values of cultivars/ABLs within different *P. infestans* genotypes (Tukey Multiple Comparison)

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2011 COLORADO POTATO BEETLE RESEARCH UPDATE

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Objective 1. Monitor Michigan field populations for changes in resistance levels to neonicotinoids

Imidacloprid (i.e.: Admire Pro) and thiamethoxam (i.e.: Platinum, Actara) continue to be the most common means of Colorado potato beetle control. Today, greater than 75% of the acres in the northeastern and midwestern United States are protected by these compounds (NASS 2006). Such consistent and heavy dependency on any compound sets the stage for resistance development. Further complicating the issue is the availability of generic imidacloprid formulations; these formulations drive down product cost, which will likely lead to even greater field exposure to these compounds. All of these reasons strongly support the need to continue monitoring resistance development and to encourage growers to adopt resistance management strategies.

Our objective was to continue gathering data on susceptibility to imidacloprid and thiamethoxam in Colorado potato beetle populations collected from commercial potato fields in Michigan and other regions of the United States. To accomplish this objective, 15 Colorado potato beetle populations (six Michigan populations and nine populations collected in other states) were bioassayed with imidacloprid and/or thiamethoxam.

METHODS. During 2011, six Colorado potato beetle populations were collected from two Michigan counties (Mecosta and Montcalm). One susceptible laboratory strain was also tested (Table 1).

Adult Colorado potato beetles were treated with 1 μl of acetone/insecticide solution of known concentration applied to the ventral surface of the abdomen using a 50 μl Hamilton® microsyringe. A range of five to six concentrations was selected for each population, depending on the number of available beetles and known resistance history for each population. In each bioassay, 15-30 adults were treated with each concentration (seven to 10 beetles per dish and two to three dishes per concentration). Following treatment, beetles were placed in 100 mm diam. petri dishes lined with Whatman® No. 1 filter paper and provided with fresh potato foliage. They were kept at 25±1°C and the foliage and filter paper were checked daily and changed as needed.

Beetle response was assessed 7 days post treatment. A beetle was classified as dead if its abdomen was shrunken, it did not move when its legs or tarsi were pinched, and its elytra were darkened. A beetle was classified as walking and healthy if it was able to grasp a pencil and walk forward normally. A beetle was classified as poisoned if its legs were extended and shaking, it was unable to right itself or grasp a pencil, and it was unable to walk forward normally at least one body length. Beetles that had died due to *Beauvaria* spp. infection were excluded from analysis; these beetles were easily recognized by their pale, petrified appearance and/or presence of white filamentous fungi. Dead and poisoned beetle numbers were pooled for analysis. Data were analyzed using standard log-probit analysis (SAS Institute, 2009).

RESULTS. The imidacloprid LD_{50} value (dose lethal to 50% of the beetles) for the susceptible laboratory strain was 0.115 μg/beetle (Table 2). The LD_{50} values from the field for imidacloprid ranged from 0.476 μg/beetle (Sackett Potatoes Fields 1-2) to 8.480 μg/beetle (Main Farms Field R2) for Michigan populations (Figure 1). The imidacloprid LD_{50} values from the out-of-state populations ranged from 0.046 μg/beetle (Eden, ID) to 8.508 (Fryeburg, ME).

LD_{50} values for all but one population (Eden, ID) were significantly higher than the susceptible laboratory strain. Consistent with the past two years, all Michigan imidacloprid LD_{50} values were significantly higher than the susceptible comparison. In 2011, 57% of the Michigan samples were greater than 10-fold resistant to imidacloprid, compared to 60% in 2010 and 85% in 2009.

The thiamethoxam LD_{50} value for the susceptible laboratory strain was 0.112 μg/beetle (Table 1). LD_{50} values for thiamethoxam in Michigan ranged from 0.231 μg/beetle (Sackett Potatoes Fields 1-2) to 1.471 μg/beetle (Paul Main Field R2), and from 0.102 μg/beetle (Becker, MN) to 0.836 μg/beetle (Jamesport, NY) for out-of-state populations (Figure 1). One Michigan population (Main Farms Field R2) was more than 10-fold resistant to thiamethoxam.

Thiamethoxam resistance remains uncommon and has probably been delayed by the more prevalent use of imidacloprid in the field. However, now that some Michigan sites are showing greater than 10-fold resistance to thiamethoxam, it will be important to monitor the progress of thiamethoxam resistance, and even more important to avoid multiple applications of neonicotinoids in a single growing season.

Objective 2. Evaluate alternative insecticides to neonicotinoids in field and laboratory tests for Colorado potato beetle control

A. Conduct field experiments to evaluate the efficacy of currently registered products

<u>METHODS</u>. Seventeen insecticide treatments and an untreated check (Table 3) were tested at the MSU Montcalm Research Farm, Entrican, MI for control of Colorado potato beetle. 'Atlantic' potato seed pieces were planted 12 in. apart, with 34 in. row spacing on 12 May 2011. Treatments were replicated four times in a randomized complete block design. Plots were 40 ft. long and three rows wide with untreated guard rows bordering each plot.

A16901, Admire Pro, Brigadier 2SC, and Platinum 75 SG treatments were applied as in-furrow sprays at planting. One Brigadier treatment also required a second application at hilling, which was made by applying a narrow band to the soil on 14 June. Foliar treatments were first applied at greater than 50% Colorado potato beetle egg hatch on 16 June. Based on the economic threshold of more than one large larva per plant, additional first generation sprays were needed for Blackhawk (6 July), Endigo ZC (6 July), the two low rates of HGW86 10 OD (29 June), Leverage 360 (6 July), and Provado (29 June & 6 July). All applications were made using a single-nozzle hand-held boom (30 gallons/acre and 30 psi).

Post-spray counts of first generation Colorado potato beetle adults, small larvae (1st and 2nd instars), and large larvae (3rd and 4th instars) of five randomly selected plants from the middle row of each plot were made weekly, starting on 21 June. Plots were visually rated for defoliation weekly by estimating total defoliation per plot.

The numbers of small larvae, large larvae, and adults, as well as the defoliation ratings, were transformed (log + 1) prior to analysis. Analysis of variance was used for data analysis and ad-hoc Tukey means separation was used to compare treatment means ($P < 0.05$).

<u>RESULTS</u>. All treatments significantly reduced the number of large larvae per plant, compared to the untreated (Table 3). There were also significant differences in numbers of large larvae among the insecticide treatments. Admire Pro and Provado 1.6F were some of the poorer performing products. Brigadier 2SC (a product containing bifenthrin and imidacloprid), performed as well as most other treatments when applied in-furrow, but when low rates were applied in-furrow and then at hilling, eight other insecticide treatments had significantly fewer large larvae per plant. Except for Admire Pro, all treatments resulted in significantly fewer small larvae than the untreated control. The untreated plots had significantly greater defoliation compared to all other treatments. The

seasonal defoliation average was 51.9% in the untreated plots, compared to less than 6% for all other treatments. Differences in defoliation among insecticide treated plots ranged from 0.6 to 5.4%. Neonicotinoid insecticides are still providing sufficient Colorado potato beetle control for Michigan farmers, but new chemical classes such as HGW86 10 OD and Tolfenpyrad 15 EC are also proving to be effective.

B. Conduct laboratory insecticide feeding bioassays with summer field adults and highly resistant laboratory Colorado potato beetle adults to evaluate the performance of currently registered products

METHODS. Six treatments, plus an untreated control, were tested at the MSU Muck Soils Research Farm, Bath, MI. 'Atlantic' potato seed pieces were planted 12 in. apart, with 34 in. row spacing on 13 June and 11 July 2011; potatoes planted on 13 June were used for an assay with Michigan-collected field beetles and those planted on 11 July for an assay with lab-reared, imidacloprid-selected beetles. Plots were 25 ft. long and one row wide with untreated rows separating all treatments. Treatments were replicated four times in a randomized complete block design.

The following six treatments were applied: Agri-Mek SC (3 fl oz/acre), Blackhawk (3.2 oz/acre), Coragen (5.0 fl oz/acre), Provado 1.6 F (3.8 fl oz/acre), Radiant SC (8.0 fl oz/acre), and Voliam Xpress (9.0 fl oz/acre). All applications were made using a single-nozzle hand-held boom (30 gallons/acre and 30 psi). Applications were made to the first planting on 26 July and the second planting on 7 September.

One hour post-application, foliage was collected from three different plants per plot and transported back to the lab. Two leaves from each plot were put into water picks and each placed in a separate small deli container with three adult Colorado potato beetles. Foliage was changed 2 and 4 days later, by collecting new leaves in the same manner and using them to replace the old leaves in the water picks. Each day, beetle response (alive, poisoned, or dead) and defoliation on a 0-5 scale (0: <5%, 1: 6-20%, 2:21-40%, 3: 41-60%, 4: 61-80%, 5: >85%) were recorded.

Two different strains of Colorado potato beetles were used in this experiment. The first was a Michigan field population collected by Mark Otto, Agri-Business Consultants, Inc., in June. The second was a laboratory strain initially collected from Montcalm County, Michigan in 1997 and, since, intensely selected in the laboratory with imidacloprid to increase its resistance levels. The Michigan field population is only four times more resistant to imidacloprid compared to a susceptible laboratory colony, while the lab colony is more than 130 times more resistant than the susceptible colony, providing strains with different levels of imidacloprid resistance for testing against a variety of foliar insecticide options.

RESULTS**.** For the field beetles, Blackhawk SC and Radiant SC had the best knockdown activity and the longest residual effect among the tested beetles; both significantly better than the untreated control (Figure 2). Results for the resistant lab strain were similar, except that Agri-Mek SC also provided knockdown and residual effects. Response to Coragen and Voliam Xpress did not differ significantly from the untreated control, but these treatments resulted in less defoliation after one day, when compared Agri-Mek SC, Blackhawk SC, and Radiant SC. Surprisingly, the imidacloprid-resistant lab strain was sensitive to Provado 1.6F, with good short-term activity against both strains, but no residual effect after 3 days of field aging.

The lab strain's greater initial knockdown, especially for Agri-Mek SC, Blackhawk SC, and Radiant SC could be due to the fact that this strain has been in colony since 1997, and thus had no previous exposure to these compounds. In contrast, the field beetles have been

exposed to all these compounds at some point in recent years, as they were collected from a commercial potato field with a history of reduced neonicotinoid sensitivity.
These results show that several foliar options are available for use as a second generation foliar insecticide to control summer adult Colorado potato beetles. However, growers should not expect lengthy residual control, requiring frequent scouting to assess potential needs for additional applications.

Objective 3. Investigate mechanism of insecticide resistance in the Colorado potato beetle

In 2011, we completed the sequencing of the transcriptomes of adult Colorado potato beetle (CPB) guts. We compared gene expression from the guts of three groups of beetle: (1) susceptible, (2) imidacloprid resistant pre-selection, and (3) imidacloprid resistant post-selection. Pre- and post selection resistant beetles were from the same laboratory strain, but pre-selection insects were sampled from the generation before selecting with imidacloprid and the post-selection insects were the offspring of the selected generation. Colorado potato beetle colonies were maintained under Adam Byrne's (Research Associate, MSU Vegetable Entomology) supervision, and he conducted the selection of insects with the insecticide. All insect dissections and RNA isolation from the guts were conducted by Dr. Diana Londono (Postdoctoral Associate, MSU Vegetable Entomology) and sequencing was done at the MSU Research Technology Support Facility. Dr. Alessandro Grapputo (Collaborator, Professor at University of Padua, Italy) analyzed the sequence data.

After sequencing, we evaluated the sequence similarity between our three groups of beetles and found that the susceptible beetles' guts are 90% similar to the pre-selection resistant, but only 50% similar to the post-selection insects' guts. Therefore, it is clear that selection with imidacloprid changes gene regulation in the insect, but that this effect wanes as time elapses from the selection event. This may mean that certain genes are up regulated to cope with the effect of the selection (as a reminder, the post-selection insects were not in direct contact with the insecticide, these were the offspring of the generation that was selected), therefore the impact we noticed is not due to the direct effect of the insecticide, but is inherited to the next generation. Those sequences that were found to be different between the susceptible and the post-selection resistant insects were then compared to sequences stored in a large, international database where sequences from many different organisms are stored. We found that about 22% of CPB sequences were the same as the red flour beetle's and 65% were novel hits, meaning that these are unique to CPB, furthermore they are relevant to insecticide resistance. In terms of the biological role of these genes, we found that about 45% take part in metabolic, cellular, and developmental processes, and about 30% have a role in biological regulation, reproduction, and cell proliferation.

Interestingly, we found that a group of genes (associated with P450 enzymes which regulate detoxification after exposure to insecticides) are up regulated post-selection with imidacloprid. This has been suspected, but this is the first direct evidence of this effect. Next, we will further study the role of this large and diverse group of genes in the CPB.

In addition to the sequencing work, Dr. Diana Londono has been conducting enzyme bioassays with inhibitors. The goal of these experiments was to find enzymes in CPB that are involved in the insecticide detoxification process, by de-activating specific enzymes with an inhibitor. If the inhibited enzyme has a role in insecticide detoxification, then we can measure an increase in CPB mortality after insecticide treatment. In fact we found that inhibiting the same group of enzymes (P450) that were up regulated in our post-selection insect guts were responsible in large part for the ability to overcome the lethal effect of imidacloprid.

In the future, we are investigating avenues to use this information in the development of novel pest management technologies for CPB.

Note:
Sequencing refers to the mapping of the order of nucleotides (molecules) that make up DNA and RNA (the genetic information carried in all living cells).
Sequence is the order of nucleotides in a long strand of DNA or RNA.

Table 1. Colorado potato beetle populations tested for susceptibility to imidacloprid and thiamethoxam in 2011.

Michigan populations

Montcalm Farm Summer adults were collected on 20 July 2011 from untreated potatoes at the Michigan State University Montcalm Potato Research Farm, Entrican, MI.

Main Farms Summer adults were collected by Mark Otto, Argi-Business Consultants, Inc. from commercial potato fields in Mecosta and Montcalm Counties.

Field D2-3 Adults were collected in Montcalm County in July 2011.

Field R2 Adults were collected in Mecosta County in August 2011.

Sackett Potatoes Field 1-2 Overwintered and summer adults were collected by Mark Otto, Argi-Business Consultants, Inc. from a commercial potato fields in Mecosta County. Overwintered adults were collected in June and summer adults in July.

Sackett Ranch Summer adults were collected by Mark Otto, Agri-Business Consultants, Inc. from commercial potato fields in Montcalm County.

Field LJ7 Adults were collected in July 2011.

Fields 93-94 Adults were collected in August 2011.

Out-of-state populations

Becker, Minnesota Overwintered adults were collected in late June 2011 by Ian MacRae, University of Minnesota, from the University of Minnesota Sand Plain Research Farm in Becker, MN.

Bridgewater, Maine Overwintered adults were collected on 17 August 2011 by Gary Sewell, University of Maine, from an organic seed farm near Bridgewater, ME.

Fryeburg, Maine Overwintered adults were collected in early June 2011 and summer adults in early August 2011 by Andrei Alyokhin, University of Maine, from a commercial potato field near Fryeburg, ME.

Eden, Idaho Summer adults were collected on 15 August 2011 by Erik Wenninger, University of Idaho, from a commercial field in Eden, Idaho.

Jamesport, New York Overwintered adults were collected on 25 May 2011 by Sandra Menasha, Cornell Cooperative Extension, from a commercial potato field in Suffolk County, NY.

New Church, Virginia Summer adults were collected on 21 June 2011 by Adam Wimer, Virginia Polytechnic Institute and State Universiy, from a commercial potato field near New Church, VA.

Painter, Virginia Summer adults were collected on 7 June 2011 by Jim Jenrette, Virginia Polytechnic Institute and State Universiy, from a commercial potato field in Painter, VA

Perham, Minnesota Summer adults were collected on 1 August 2011 by Chad Ingemann from a commercial potato field.

Prairie, Minnesota Summer adults were collected on 1 August 2011 by Chuck Schiemann from a commercial potato field.

Laboratory strain

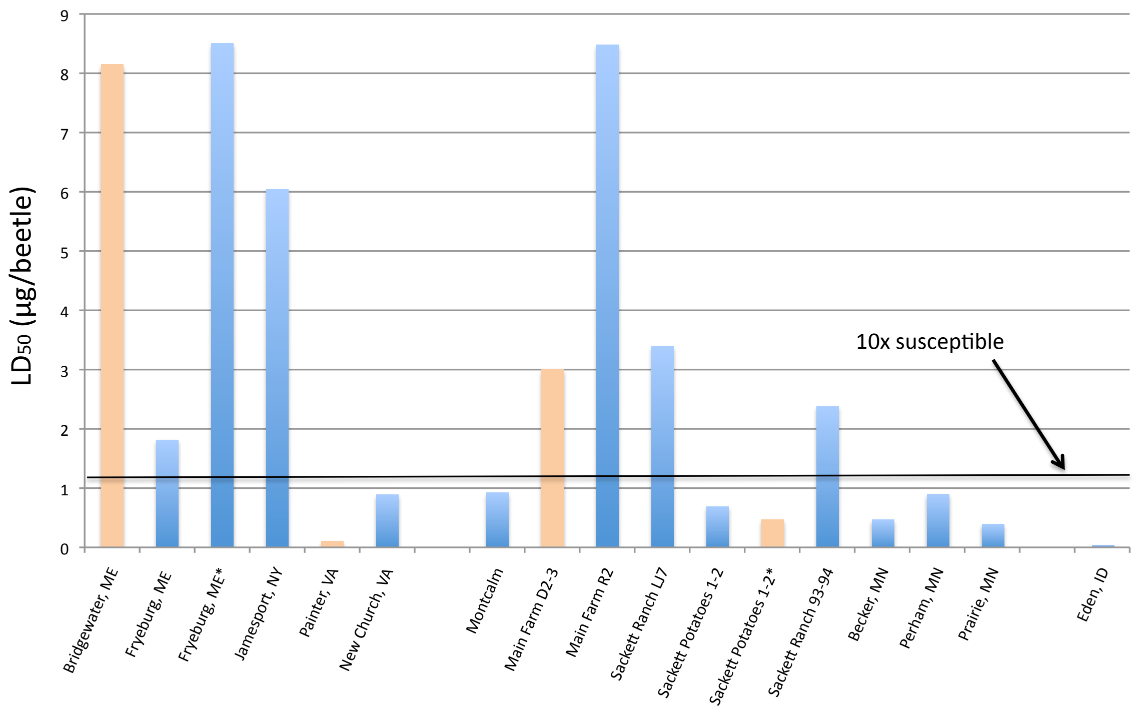
New Jersey Adults obtained in 2008 from the Phillip Alampi Beneficial Insects Rearing Laboratory, New Jersey Department of Agriculture and since reared at Michigan State University without contact to insecticides.

Table 2. LD_{50} values (µg/beetle) and 95% fiducial limits for Colorado potato beetle populations treated with imidacloprid and thiamethoxam at 7 days post treatment.

IMIDACLOPRID	**LD_{50} (µg/beetle)**	**95% Confidence Intervals**
Michigan populations		
Montcalm	0.931	0.683 – 1.128
Main Farms D2-3	3.006	*
Main Farms R2	8.480	6.110 – 20.944
Sackett Potatoes 1-2 (overwinter) (summer)	0.697 0.476	0.603 – 0.802 *
Sackett Ranch LJ7	3.395	1.281 – 420.200
Sackett Ranch 93-94	2.386	1.812 – 3.005
Out-of-state populations		
Becker, Minnesota	0.473	*
Bridgewater, Maine	8.152	*
Freyburg, Maine (overwinter) (summer)	1.816 8.508	1.416 – 2.197 5.265 – 35.642
Eden, Idaho	0.046	0.041 – 0.053
Jamesport, New York	6.046	2.827 – 8.612
Painter, Virginia	0.113	*
Perham, Minnesota	0.904	0.630 – 1.228
Prairie, Minnesota	0.399	0.189 – 0.585
Virginia	0.897	0.620 – 2.466
Laboratory strain		
New Jersey	0.115	0.068 – 0.156
THIAMETHOXAM		
Michigan populations		
Montcalm	0.532	*
Main Farms R2	1.471	0.813 – 217.151
Sackett Potatoes 1-2 (overwinter)	0.231	0.201 – 0.265
Sackett Ranch 93-94	0.412	0.364 – 0.468
Out-of-state populations		
Becker, Minnesota	0.102	0.087 – 0.122
Bridgewater, Maine	0.445	*
Fryeburg, Maine (overwinter) (summer)	0.516 0.596	0.299 – 0.707 0.516 – 0.675
Jamesport, New York	0.836	0.685 – 0.978
Painter, Virginia	0.112	0.091 – 0.149
Perham, Minnesota	0.198	*
Prairie, Minnesota	0.193	0.164 – 0.224
Virginia	0.401	0.333 – 0.473
Laboratory strain		
New Jersey	0.112	0.098 – 0.130

* no confidence limits calculated due to insufficient fit to the model

A.



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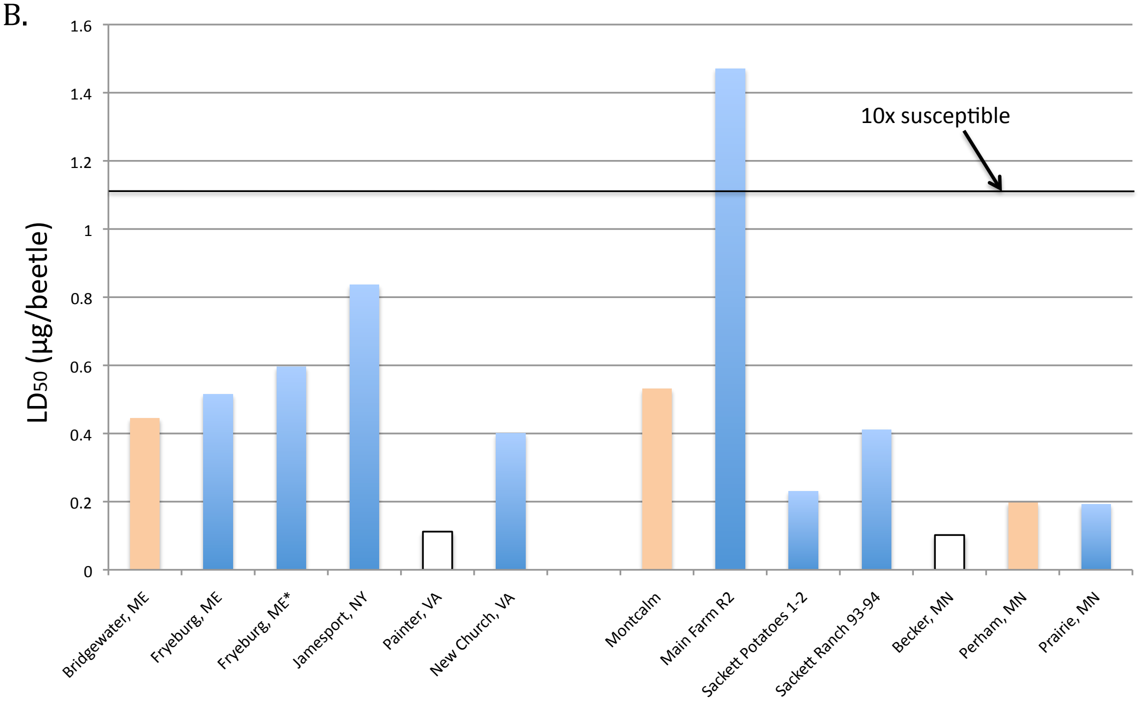


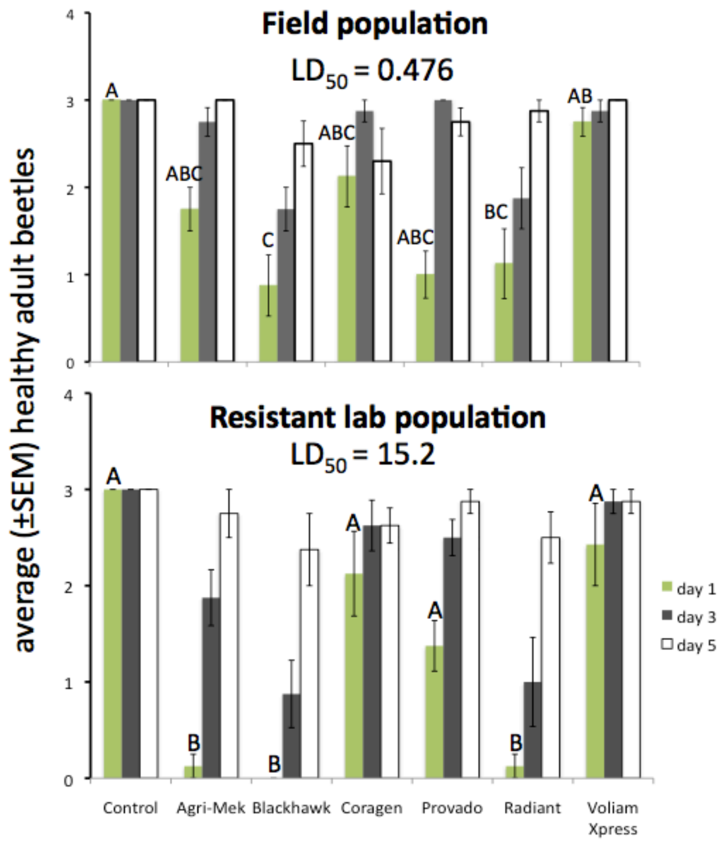
* indicates 2nd generation adults where two populations were collected from same site

Figure 1. Susceptibility of field populations of Colorado potato beetle to imidacloprid (A) and thiamethoxam (B). Blue bars represent populations that had significantly greater LD_{50} values compared to the susceptible strain, orange bars indicate that confidence limits were not calculated, and white bars represent populations that were not significantly different from the susceptible strain.

Table 3. Seasonal mean number of different Colorado potato beetle life stages and defoliation in an insecticide field-trial conducted by the MSU vegetable entomology laboratory.

Treatment	Insecticide class	Application mode	Rate	Adult[1]	Small Larva[1]	Large Larva[1]	% defoliation
Untreated				0.6 abc	6.1 e	5.5 e	51.9 f
HGW86 10 OD	Ryanodine receptor modulators	foliar	3.37 fl oz/A	0.2 ab	1.5 abc	1.5 ab	1.1 abc
HGW86 10 OD	Ryanodine receptor modulators	foliar	6.75 fl oz/A	0.4 abc	1.4 abcd	0.0 a	0.9 abc
HGW86 10 OD	Ryanodine receptor modulators	foliar	10.1 fl oz/A	0.3 abc	1.6 bcd	0.3 abc	1.6 abcde
Provado 1.6 F	neonicotinoid	foliar	3.8 fl oz/A	0.3 abc	2.9 de	1.1 d	2.6 bcde
Blackhawk	spinosyn	foliar	3.2 oz/A	0.3 abc	2.4 bcd	0.8 bcd	4.8 de
Endigo ZC	pyrethroid + neonicotinoid	foliar	3 oz/A	0.2 ab	3.0 cd	0.8 abcd	2.1 abcde
Leverage 360	pyrethroid + neonicotinoid	foliar	2.8 oz/A	0.3 abc	3.0 cd	0.6 abcd	2.6 bcde
Tolfenpyrad 15 EC	mitochondrial complex I electron transport inhibitor	foliar	14 fl oz/A	0.3 abc	1.1 abcd	0.6 abcd	3.0 bcde
Tolfenpyrad 15 EC	mitochondrial complex I electron transport inhibitor	foliar	21 fl oz/A	0.1 a	3.1 cd	1.2 d	2.1 bcde
Admire Pro	neonicotinoid	infurrow	8.7 fl oz/A	0.4 abc	0.9 ab	0.8 cd	2.0 bcd
Platinum 75 SG	neonicotinoid	infurrow	1.68 oz/A	0.6 bc	0.2 ab	0.1 abc	0.9 ab
Platinum 75 SG	neonicotinoid	infurrow	2.66 oz/A	0.2 ab	0.3 a	0.1 ab	0.6 a
A16901		infurrow	6.5 oz/A	0.6 c	0.4 ab	0.1 ab	5.4 cde
A16901		infurrow	10 oz/A	0.3 abc	0.3 a	0.1 ab	0.9 ab
Brigadier 2SC	pyrethroid + neonicotinoid	infurrow	25.6 oz/A	0.3 abc	0.8 abc	0.6 abcd	1.9 abcde
Brigadier 2SC	pyrethroid + neonicotinoid	infurrow	38.4 oz/A	0.4 abc	0.7 abc	0.2 abc	1.3 abcd
Brigadier 2SC	pyrethroid + neonicotinoid	infurrow+ at hilling	12.8 oz/A 12.8 oz/A	0.3 ab	1.5 abcd	1.2 d	4.5 e

[1] Different letters within a column denote statistically significant differences among treatments.



Different numbers above bars represent significant differences within a population for 24 hr old residue.

Figure 2. Colorado potato beetle response to foliar insecticides.

Potato Nitrogen Response to Slow-Release and Soluble Fertilizer Source, Rate, and Application Timing

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Location: Montcalm Research Farm	**Tillage**: Conventional
Planting Date: May 31, 2011 (Vinekill 9/9/11)	**N Rates**: See below
Soil Type: Loamy sand; 2.2 OM; 5.1 pH	**Population**: 34 in. rows, 12 in. spacing
Variety: Snowden	**Replicated**: 4 replications

There continues to be a critical need to develop nutrient management strategies that maximize nutrient use efficiency yet simultaneously remain productive long term through incremental improvements in soil quality and disease suppression. *Slow-release nitrogen fertilizers* are a technology intended to improve N use efficiency by improving potato yields or reducing nitrogen rates. These products are often comprised of plastic, resin, or wax coatings surrounding pellets of urea and function as urease inhibitors by delaying the dissolution of N and slowing the conversion of urea to ammonium and nitrate-N. Environmentally Sensitive Nitrogen or ESN® is one example of a polymer-coated slow-release urea fertilizer. The benefits of utilizing a slow-release product could result in a decreased total number of N applications, reduced N rates, or grower reassurance that N remains available during adverse or inconsistent rainfall patterns. Data on the use of ESN in Michigan potato production systems are limited.

Objectives:

1) Identify the effects of ESN and urea at two nitrogen rates and multiple application timings on potato yield.
2) Determine the effects of slow release nitrogen on potato vine kill.
3) Determine the influence of nitrogen rate, source, and timing on in-season plant tissue nutrient levels.

Materials and Methods.

The experiment was conducted in a randomized complete block design with four replications. Individual plots were 11.3 feet wide and 25 feet long, consisting of four potato rows spaced at 34 inches. 'Snowden' variety tubers were planted on May 31, 2011. Admire (imidacloprid) at 8 oz was applied at planting. Fungicides were applied throughout the season to maintain potato health. Bravo (chlorothanlonil) was applied on June 25 and June 30, 2011; July 9, 15 and 21, 2011 at 2 pts/A. Bravo was applied on August 6, 2011 at 2 qts/A. A tank –mix of Bravo and Tanos (fomoxadone + cymoxanil) at 2 pts and 8 fl oz /A respectively was applied on July 15, and 21, 2011. Tanos was also applied on August 19, 2011 at 6 fl oz/A. Manzate (mancozeb) was applied on August 12, 19 and 26, 2011 and September 1, 2011 at 2 lbs/A. Plots were maintained weed free using herbicides which consisted of Dual (metolachlor) and Linex (linuron) at 1.3 pts + 1.5 qts applied on June 13, 2011. Additional herbicide treatments consisted of Volunteer (clethodim + Matrix (rimsulfuron) + NIS (non-ionic surfactant), at 8 fl oz + 1.3 oz + ¼%v/v/A on July 30, 2011. Matrix was also applied on Aug 6, 2011 at the previous rate. Reglone (diquat) + NIS were applied as a potato desiccant and was applied on September 9, 2011 at 2 pts + ¼ % .

Treatments.

Trt #	N Rate (lb N/A)	Source	Timing
1	CONTROL – No N	CONTROL – No N	CONTROL– No N
2	150	ESN	At planting
3	250	ESN	At planting
4	150	Urea	At planting
5	250	Urea	At planting
6	150	ESN	2/3 at planting 1/3 at emergence
7	250	ESN	2/3 at planting 1/3 at emergence
8	250	Urea	1/3 at planting 2/3 at emergence
9	250	Urea	1/3 at planting ½ at emergence 1/6 at flower
10	250	ESN and Urea	½ (all ESN) at planting 1/3 (all urea) at emergence 1/6 (all urea) at flower
11	250	Urea	¼ at planting ¼ at emergence ¼ at flower ¼ at late bloom

All plots received starter fertilizer in the form of 40 lbs. P2O5 and 150 lbs. K2O per acre; 50 pounds of K2O surface broadcast prior to planting; All of the at planting nitrogen applications, all of the P2O5, and the remaining 100 pounds of K2O was applied in starter bands on **BOTH sides of the seed pieces and 2 inches away from seed pieces;

Fertilizer treatment timings were as follows: At Planting; May31. Emergence; June 15. Flowering; June 28. and Late Bloom; July 12, 2011. Potato tubers were harvested and yields determined.

Results.

Table 1. Effects of slow-release and soluble nitrogen *at planting* applications on total yield, marketable yield, and vine desiccation, Entrican, MI, 2011.

N Trt. (Total lb. N/A)	Total Yield (cwt/A)	Marketable Yield (cwt/A)	Desiccation Prior to Vinekill (%)
0 – Check	187	158	83.8
150 ESN	213	180	53.8
250 ESN	188	160	71.3
150 Urea	206	178	48.8
250 Urea	189	171	26.3[b]
LSD(0.10)[a]	**17.8**	**15.7**	**19.3**

[a] LSD, least significant difference between means within a column at ($\alpha = 0.10$).
[b] 250 lbs. urea at planting severely stunted potato plants causing delays in emergence and development resulting in a delayed rate of natural vine desiccation at end of season due to differences in maturity.

Table 2. Effects of slow-release and soluble nitrogen *at planting* applications on tissue percentage total N at 40 and 80 DAP, Entrican, MI, 2011.

N Trt. (Total lb. N/A)	Tissue % Total N 40 DAP	Tissue % Total N 80 DAP
0 – Check	4.38 b	3.66 c
150 ESN	5.30 a	3.94 bc
250 ESN	5.25 a	4.40 a
150 Urea	5.50 a	3.99 abc
250 Urea	5.56 a	4.15 ab
LSD(0.05)[a]	**0.34**	**0.48**

[a] LSD, least significant difference between means within a column at ($\alpha = 0.05$).

Table 3. Effects of slow-release nitrogen rate and application timing on total yield, marketable yield, and vine desiccation, Entrican, MI, 2011.

N Trt. (Total lb. N/A)	Application Timing	Total Yield (cwt/A)	Marketable Yield (cwt/A)	Desiccation Prior to Vinekill (%)
0 – Check	---	187	158	83.8
150 ESN	At Plant	213	180	53.8
250 ESN	At Plant	188	160	71.3
150 ESN	2/3 Plant 1/3 Emergence	214	178	67.5
250 ESN	2/3 Plant 1/3 Emergence	223	192	41.3
LSD(0.10)[a]	**---**	**28.1**	**26.4**	**26.2**

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

Table 4. Effects of slow-release nitrogen rate and application timing on tissue percentage total N at 40 and 80 DAP, Entrican, MI, 2011.

N Trt. (Total lb. N/A)	Application Timing	Tissue % Total N 40 DAP	Tissue % Total N 80 DAP
0 – Check	---	4.38 b	3.66 b
150 ESN	At Plant	5.30 a	3.94 ab
250 ESN	At Plant	5.25 a	4.40 a
150 Urea	2/3 Plant 1/3 Emergence	5.23 a	4.05 ab
250 Urea	2/3 Plant 1/3 Emergence	5.67 a	4.07 ab
LSD(0.05)[a]	**---**	**0.63**	**0.53**

[a] LSD, least significant difference between means within a column at ($\alpha = 0.05$).

Table 5. Effects of 250 lbs. nitrogen as either a slow-release or soluble source and application timing on total yield, marketable yield, and vine desiccation, Entrican, MI, 2011.

N Trt. (Total lb. N/A)	Application Timing	Total Yield (cwt/A)	Marketable Yield (cwt/A)	Desiccation Prior to Vinekill (%)
0 – Check	---	187	158	83.8
250 ESN	2/3 Plant 1/3 Emergence	223	192	41.3
250 Urea	1/3 Plant 2/3 Emergence	201	175	57.5
250 Urea	1/3 Plant ½ Emergence 1/6 Flower	205	180	70.0
250 ESN/Urea	½ (ESN) Plant 1/3 (Urea) Emergence 1/6 (Urea) Flower	208	168	56.3
250 Urea	¼ Plant ¼ Emergence ¼ Flower ¼ Late Bloom	197	168	75.0
LSD(0.10)[a]	**---**	**24.0**	**21.6**	**20.3**

Table 6. Effects of 250 lbs. nitrogen as either a slow-release or soluble source and application timing on tissue percentage total N at 40 and 80 DAP, Entrican, MI, 2011.

N Trt. (Total lb. N/A)	Application Timing	Tissue % Total N 40 DAP	Tissue % Total N 80 DAP
0 – Check	---	4.38 c	3.66 b
250 ESN	2/3 Plant 1/3 Emergence	5.67 a	4.07 ab
250 Urea	1/3 Plant 2/3 Emergence	5.63 a	4.34 a
250 Urea	1/3 Plant ½ Emergence 1/6 Flower	5.38 ab	4.42 a
250 ESN/Urea	½ (ESN) Plant 1/3 (Urea) Emergence 1/6 (Urea) Flower	5.66 a	4.24 a
250 Urea	¼ Plant ¼ Emergence ¼ Flower ¼ Late Bloom	5.09 b	4.34 a
LSD(0.05)[a]	**---**	**0.50**	**0.42**

All treatments were 100% desiccated within 7 days following desiccant application. Split applications of 250 lbs. N as ESN did appear to reduce natural end of season vine desiccation. Splitting nitrogen applications into at least but not greater than two application timings provided the least desiccation/greatest vigor at the end of the season. Splitting urea applications into more than two application timings increased end of season desiccation. Slow-release nitrogen in the form of ESN did not inhibit vine desiccation when treated chemically. Increased end-of-season vine vigor with split applications of the 250 lb. N rate of ESN may be viewed either in a positive or negative light dependent upon field specific conditions and harvest scenarios.

Concerns have been raised on whether slow-release nitrogen would be able to maintain sufficient tissue N levels over the course of an entire season. In this study, nitrogen applications in the form of slow-release ESN were able to maintain sufficient total N levels at both 40 and 80 days after planting. Total tissue nitrogen levels with ESN did appear to be less than soluble N sources early in the growing season but these levels did meet sufficiency standards. ESN tissue total nitrogen levels did increase as the growing season progressed and in some cases surpassed tissue N levels from soluble N sources later in the season. Split applying slow-release nitrogen did not offer any advantage from s tissue sufficiency perspective.

Due to cool, wet spring soil conditions and later planting dates, potato yields were consistently depressed across the state of Michigan in 2011. In this study, 250 lbs. N as either urea or ESN as a one-time *at planting* application of nitrogen caused significant injury, stunting, and delayed tuber maturation. These effects may have been exacerbated by the later planting date and warmer soil conditions causing N release much sooner than what otherwise would occur with an earlier spring planting date. Split applications of ESN at the 150 lb. N rate offered no benefit from a yield perspective. However, split applying larger rates of ESN, in this case 250 lbs. N, did appear to increase potato yield as compared to a one-time ESN application. This response would most likely occur due to a longer, more uniform period of N release with less N subject to loss at any one time from the split application. At the 250 lb. N rate, split applying ESN with 2/3 at planting and 1/3 at plant emergence yielded greater than all other urea or urea/ESN nitrogen combinations. Fertilizer technologies including ESN need further investigation as these products have the potential to more cost effectively produce potatoes while simultaneously having fewer negative environmental consequences.

Funding: Industry and MPIC

Evaluation of fungicide programs for potato early blight, brown leaf spot and tan spot control: 2011.

W. W. Kirk[1] and R. Schafer[1],
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Potatoes (cut seed, treated with Maxim FS at 0.16 fl oz/cwt) were planted at Michigan State University Horticultural Experimental Station, Clarksville, MI (Capac loam soil); 42.8733, -85.2604 deg; elevation 895 ft. on 25 May into two-row by 20-ft plots (ca. 10-in between plants to give a target population of 50 plants at 34-in row spacing) replicated four times in a randomized complete block design. Plots were irrigated as needed with sprinklers and were hilled immediately before sprays began. All fungicides in this trial were applied on a 7-day interval from 5 Jul Jun to 30 Aug (8 applications) with an ATV rear-mounted R&D spray boom calibrated to deliver 25 gal/A (80 p.s.i.) using three XR11003VS nozzles per row. Potato late blight was prevented from movement into the plots from adjacent plots inoculated with *Phytophthora infestans* with weekly applications of Previcur Flex at 1.2 pt/A from early canopy closure on 5 Jul to 30 Aug. Weeds were controlled by hilling and with Dual 8E (2 pt/A on 3 Jun), Poast (1.5 pt/A on 13 Jul). Insects were controlled with Admire 2F (20 fl oz/A at planting), Sevin 80S (1.25 lb/A on 13 and 27 Jul), Thiodan 3EC (2.33 pt/A on18 Aug) and Pounce 3.2EC (8 oz/A on 13 Jul). Plots were rated visually for combined percentage foliar area affected by early blight and brown leaf spot on 12 Sep [15 days after final application (DAFA)]; and Botrytis tan spot on 12 Sep and green leaf area (%) remaining on 19 Sep. Vines were killed with Reglone 2EC (1 pt/A on 6 Sep). Plots (2 x 25-ft row) were harvested on 22 Oct and tubers from individual treatments were weighed and graded. Meteorological variables were measured with a Campbell weather station located at the farm from 1 May to harvest (5 Oct). Maximum, minimum and average daily air temperature (^{o}F) were 91.2, 45.4 and 66.6 and 2-d with maximum temperature >90^{o}F (Jun); 93.2, 53.3 and 74.1 and 3-d with maximum temperature >90^{o}F (Jul); 85.8, 49.6 and 68.9 (Aug); 87.8, 34.8 and 59.1 (Sep); 81.0, 33.1 and 58.5 (to 22 Oct). Maximum, minimum and average relative humidity (%) was 98.2, 25.6 and 69.5 (Jun); 98.2, 28.2 and 69.3 (Jul); 98.7, 30.7 and 73.5 (Aug); 99.1, 33.8 and 75.3 (Sep); 98.9, 25.7 and 64.8 (to 22 Oct). Maximum, minimum and average daily soil temperature at 4" depth (^{o}F) was 88.5, 58.6 and 71.5 (Jun); 100.1, 67.4 and 81.9 (Jul); 88.8, 63.2 and 75.4 (Aug); 82.6, 55.9 and 67.1 (Sep); 64.8, 51.3 and 58.7 (to 22 Oct). Maximum, minimum and average soil moisture (% of field capacity) was 41.3, 38.1 and 39.0 (Jun); 43.7, 36.6 and 39.6 (Jul); 41.3, 36.9 and 38.9 (Aug); 39.1, 35.3 and 37.1 (Sep); 37.5, 36.0 and 36.5 (to 22 Oct). Precipitation was 2.09 in. (Jun), 6.11 in. (Jul), 3.4 in (Aug), 1.02 in. (Sep) and 0.12 in. (to 22 Oct). Plots were irrigated to supplement precipitation to about 0.1 in./A/4 day period with overhead sprinkle irrigation. Early blight severity values accumulated from emergence on 10 Jun to 12 Sep (evaluation date) were 3592.

Weather conditions were conducive for the development of early blight and brown leaf spot and Botrytis tan spot. Early blight and brown leaf spot developed steadily during Aug and untreated controls reached about 45% foliar infection by 12 Sep. All treatments had significantly less combined early blight and brown leaf spot than the untreated control except CX-10440 treatments. All fungicide programs had significantly less foliar tan spot values than the untreated control (35.0%). All fungicide programs had significantly greater green leaf are remaining 20 days after the final fungicide application on 19 Sep than the untreated control (11.3%) except the low rate of CX-10440. Treatments with greater than US1 yield of 203 cwt/A and total yield of 292 cwt/A were significantly different from the untreated control. Phytotoxicity was not noted in any of the treatments.

Funding: Industry and MPIC

Treatment and rate/A	EB/BLS (%)[z]		Tan spot (%)		Green leaf area (%)		Yield (cwt/A) US1		Yield (cwt/A) Total	
Echo ZN 4.17SC 1.5 pt (A-I[y])…………………………………………	26.3	cd[x]	7.5	efg	52.5	hi	185	ab	277	ab
Echo ZN 4.17SC 1.5 pt (A-I); Luna Tranquility 500SC 8 fl oz (B,D)…	13.8	e-h	6.3	efg	61.3	gh	172	ab	266	ab
Echo ZN 4.17SC 1.5 pt (A-I); Scala 60SC 7 fl oz (E,G)……………….	33.8	bc	7.5	efg	41.3	ij	171	ab	258	ab
Echo ZN 4.17SC 1.5 pt (A-I); Endura 7WG 5.5 oz (B,D)……………..	11.3	e-h	5.0	fg	73.8	b-g	154	b	238	b
Echo ZN 4.17SC 1.5 pt (A-I); Luna Tranquility 500SC 8 fl oz (B,D); Scala 60SC 7 fl oz (E,G)……....	8.8	e-h	6.3	efg	75.0	b-f	178	ab	271	ab
Echo ZN 4.17SC 2 pt (A,C,F,G,H,I); Luna Tranquility 500SC 11 fl oz (B,D); Reason 500SC 5.5 fl oz (C,F); Scala 60SC 7 fl oz (E,G)………………	6.3	gh	5.0	fg	78.8	a-e	163	b	255	ab
Echo ZN 4.17SC 2 pt (A,C,F,G,H,I); Luna Tranquility 500SC 8 fl oz (B,D); Reason 500SC 5.5 fl oz (C,F); Scala 60SC 7 fl oz (E,G)………………	7.5	fgh	6.3	efg	81.3	abc	169	ab	268	ab
Echo ZN 4.17SC 2 pt (A,C,F,G,H,I); Luna Tranquility 500SC 11 fl oz (B,D,E); Reason 500SC 4 fl oz (C,F); Scala 606SC 7 fl oz (G,F)……………….	7.5	fgh	4.0	g	84.3	ab	181	ab	262	ab
Echo ZN 4.17SC 2 pt (A,C,F,G,H,I); Luna Tranquility 500SC 8 fl oz (B,D,E); Reason 500SC 4 fl oz (C,F); Scala 606SC 7 fl oz (G,F)……………….	5.0	h	5.0	fg	89.0	a	159	b	247	ab
Vertisan 1.67EC 16 fl oz + NIC 0.25% (A,C,E,G,I); Tanos 50WG 6 oz + Manzate 75WG 1.5 lb (B,D,F,H,I)…………...…..	10.0	e-h	8.8	def	76.0	a-f	186	ab	266	ab
Tanos 50WG 6 oz + Manzate 75WG 1.5 lb (A,C,E,G,I); Vertisan 1.67EC 16 fl oz + NIC 0.25% (B,D,F,H,I)…………………...	17.5	de	8.8	def	66.3	efg	198	ab	284	ab
Vertisan 1.67EC 24 fl oz + NIC 0.25% (A,C,E,G,I); Tanos 50WG 6 oz + Manzate 75WG 1.5 lb (B,D,F,H,I)…………...…..	12.5	e-h	6.3	efg	73.8	b-g	183	ab	266	ab
Endura 7WG 2.5 oz (A,C,E,G,I); Tanos 50WG 6 oz + Manzate 75WG 1.5 lb (B,D,F,H,)….………….....	16.3	ef	13.8	bc	61.3	gh	182	ab	282	ab
Echo ZN 4.17SC 2.12 pt (A,C,E,I); Headline 2.09SC 2.5 oz + Echo ZN 4.17SC 1.5 pt (B,F); Endura 7WG 2.5 oz (D); Dithane Rainshield 75DF 2 lb + Super Tin 80WP 2.5 oz (G,H)……….	15.0	efg	13.8	bc	67.5	d-g	203	ab	283	ab
Echo ZN 4.17SC 2.12 pt (A,C,E,I); Endura 7WG 2.5 oz (B,F); Headline 2.09SC 2.5 oz + Echo ZN 4.17SC 1.5 pt (D); Dithane Rainshield 75DF 2 lb + Super Tin 80WP 2.5 oz (G,H)……....	10.0	e-h	8.8	def	75.0	b-f	151	b	233	b
Echo ZN 4.17SC 2.12 pt (A,C,E,I); Priaxor 4.17SC 4 fl oz + Echo ZN 4.17SC 2 pt (B,D,F) Dithane Rainshield 75DF 2 lb + Super Tin 80WP 2.5 oz (G,H)……….	8.8	e-h	8.8	def	75.0	b-f	227	a	317	a
Echo ZN 4.17SC 2.12 pt (A,C,E,I); Priaxor 4.17SC 4 fl oz + Echo ZN 4.17SC 2 pt (B,F) Dithane Rainshield 75DF 2 lb + Super Tin 80WP 2.5 oz (G,H)……….	15.0	efg	7.5	efg	70.0	c-g	163	b	242	b
Echo ZN 4.17SC 2.12 pt (A,C,E,I); Cabrio Plus 60WG 4.17SC 2 lb (B,F); Endura 7WG 2.5 oz + Echo ZN 4.17SC 1.5 pt (D) Dithane Rainshield 75DF 2 lb + Super Tin 80WP 2.5 oz (G,H)……....	16.3	ef	12.5	bcd	65.0	fgh	171	ab	255	ab
Echo ZN 4.17SC 2.12 pt (A,C,E,I); Priaxor 4.17SC 4 fl oz (B,F); Endura 7WG 2.5 oz (D); Dithane Rainshield 75DF 2 lb + Zampro 4.38SC 14 fl oz (G,H)……....	12.5	e-h	15.0	b	65.0	fgh	171	ab	253	ab
Echo ZN 4.17SC 2.12 pt (A,C,E,I); Endura 7WG 2.5 oz + Echo ZN 4.17SC 2 pt (B,F); Priaxor 4.17SC 4 fl oz + Cabrio Plus 60WG 4.17SC 2 lb (D) Dithane Rainshield 75DF 2 lb + Zampro 4.38SC 14 fl oz (G,H)………	6.3	gh	7.5	efg	80.0	a-d	172	ab	245	b
Echo ZN 4.17SC 2.12 pt (A,C,E,I); Endura 7WG 2.5 oz + Echo ZN 4.17SC 2 pt (B,F); Echo ZN 4.17SC 2 pt (D); Dithane Rainshield 75DF 2 lb + Zampro 4.38SC 14 fl oz (G,H)……....	12.5	e-h	10.0	cde	72.5	b-g	178	ab	260	ab
CX-10440 11.3SC 3.8 fl oz (A-I)…………………………………..…..	36.3	ab	8.8	def	20.0	k	201	ab	292	ab
CX-10440 11.3SC 7.5 fl oz (A-I)………………………………..……..	35.0	bc	10.0	cde	38.8	j	164	b	247	b
Untreated……………………………………………………………...…...	45.0	a	35.0	a	11.3	k	151	b	231	b

[z] Combination of foliar infection due to a combination of early blight [EB (*Alternaria solani*)] *and* Brown leaf spot [BLS (*A. alternata*)] on 12 Sep, 13 days after final application of fungicide
[y] Application dates: A= 5 Jul; B= 12 Jul; C= 19 Jul; D= 25 Jul; E= 1 Aug; F= 8 Aug; G= 16 Aug; H= 23 Aug; I= 30 Aug
[x] Values followed by the same letter are not significantly different at $p = 0.05$ (Fishers LSD)

Funding: Industry and MPIC

Evaluation of fungicide programs for potato late blight control: 2011.

W. W. Kirk[1] and R. Schafer[1],
[1]Department of Plant Pathology, Michigan State University, East Lansing, MI 48824

Potatoes ('Monticello', cut seed, treated with Maxim FS at 0.16 fl oz/cwt) were planted at Michigan State University Horticultural Experimental Station, Clarksville, MI (Capac loam soil); 42.8733, -85.2604 deg; elevation 895 ft. on 25 May into two-row by 20-ft plots (ca. 10-in between plants to give a target population of 50 plants at 34-in row spacing) replicated four times in a randomized complete block design. Plots were irrigated as needed with sprinklers and were hilled immediately before sprays began. All rows were inoculated (3.4 fl oz/25-ft row) with a zoospore suspension of *Phytophthora infestans* [US-22 biotype (sensitive to mefenoxam, A2 mating type)] at 10^4 spores/fl oz on 1 Aug. Plots were irrigated as needed with sprinklers and were hilled immediately before sprays began. All fungicides in this trial were applied on a 7-day interval from 5 Jul Jun to 30 Aug (8 applications) with an ATV rear-mounted R&D spray boom calibrated to deliver 25 gal/A (80 p.s.i.) using three XR11003VS nozzles per row. Weeds were controlled by hilling and with Dual 8E (2 pt/A on 3 Jun), Poast (1.5 pt/A on 13 Jul). Insects were controlled with Admire 2F (20 fl oz/A at planting), Sevin 80S (1.25 lb/A on 13 and 27 Jul), Thiodan 3EC (2.33 pt/A on18 Aug) and Pounce 3.2EC (8 oz/A on 13 Jul). Plots were rated visually for percentage foliar area affected by late blight on 23, 30 Aug, 6 and 14 Sep [22, 29, 36 and 44 days after inoculation (DAI)] when there was about 100% foliar infection in the untreated plots. The relative area under the late blight disease progress curve was calculated for each treatment from the date of inoculation to 14 Sep, a period of 45 days. Vines were killed with Reglone 2EC (1 pt/A on 18 Sep). Plots (2 x 25-ft row) were harvested on 22 Oct and tubers from individual treatments were weighed and graded. A sample of 50 tubers was collected from each plot at harvest and stored at 50°F and 95% RH in the dark for 14 days. The incidence of late blight affected tubers was evaluated 14 days after harvest. Meteorological variables were measured with a Campbell weather station located at the farm from 1 May to harvest (5 Oct). Maximum, minimum and average daily air temperature (°F) were 91.2, 45.4 and 66.6 and 2-d with maximum temperature >90°F (Jun); 93.2, 53.3 and 74.1 and 3-d with maximum temperature >90°F (Jul); 85.8, 49.6 and 68.9 (Aug); 87.8, 34.8 and 59.1 (Sep); 81.0, 33.1 and 58.5 (to 12 Oct). Maximum, minimum and average relative humidity (%) was 98.2, 25.6 and 69.5 (Jun); 98.2, 28.2 and 69.3 (Jul); 98.7, 30.7 and 73.5 (Aug); 99.1, 33.8 and 75.3 (Sep); 98.9, 25.7 and 64.8 (to 12 Oct). Maximum, minimum and average daily soil temperature at 4" depth (°F) was 88.5, 58.6 and 71.5 (Jun); 100.1, 67.4 and 81.9 (Jul); 88.8, 63.2 and 75.4 (Aug); 82.6, 55.9 and 67.1 (Sep); 64.8, 51.3 and 58.7 (to 12 Oct). Maximum, minimum and average soil moisture (% of field capacity) was 41.3, 38.1 and 39.0 (Jun); 43.7, 36.6 and 39.6 (Jul); 41.3, 36.9 and 38.9 (Aug); 39.1, 35.3 and 37.1 (Sep); 37.5, 36.0 and 36.5 (to 12 Oct). Precipitation was 2.09 in. (Jun), 6.11 in. (Jul), 3.4 in (Aug), 1.02 in. (Sep) and 0.12 in. (to 12 Oct). Plots were irrigated to supplement precipitation to about 0.1 in./A/4 day period with overhead sprinkle irrigation. The total number of late blight disease severity values (DSV) over the disease development period from 28 Jul to 1 Sep was 61 using 90% ambient %RH as bases for DSV accumulation.

Late blight developed steadily after inoculation and untreated controls reached on average 100% foliar infection by 14 Sep. Up to 30 Aug, all fungicide programs had significantly less foliar late blight than the untreated control. By 14 Sep, all programs had significantly better foliar late blight than the untreated control. All fungicide programs had significantly lower RAUDPC values in comparison to the untreated control (29.5). On the 7 Nov (14 days after harvest) the percent incidence of infected tubers from untreated plots was 9.8%. Several treatments had very low incidence of tuber blight and ranged from 2.3 to 5.5% in the most effective treatments. Treatments with greater than 5.8% incidence were not significantly different from the untreated check. Treatments with greater than US1 yield of 321 cwt/A and total yield of 411 cwt/A were significantly different from the untreated control. Phytotoxicity was not noted in any of the treatments.

Funding: Industry and MPIC

Treatment and rate/A or rate per 1000 ft row	Foliar potato late blight 6 Sep 37 DAI[z]		14 Sep 45DAI		RAUDPC[y] 45 DAI		Tuber blight (%)[x] 7 Nov 156 DAP[w]		Yield (cwt/A) US1		Total	
Bravo WS 6SC 2 pt + NIS[v] (A-H[u])……….	3.3	b[t]	8.8	bc	1.5	b	2.3	e	314	d-h	388	d-g
Gavel 75DF 2 lb + NIS (A-H)…………….	2.0	b	6.5	bcd	1.0	b	2.3	e	298	gh	375	efg
GWN-4700 80WP 3.4 oz + GWN-9941 6SC 21.3 fl oz + NIS (A-H)…	5.0	b	7.5	bcd	2.1	b	3.8	de	288	h	349	g
GWN-4700 80WP 3.4 oz + GWN-9938 4.28SC 41 fl oz + NIS (A-H)..	0.4	b	4.0	de	0.5	b	4.8	b-e	293	gh	365	fg
GWN-4700 80WP 3.4 oz + GWN-10043 90DF 17.8 oz + NIS (A-H)...	5.1	b	8.8	bc	2.0	b	4.5	cde	304	e-h	363	fg
GWN-9938 4.28SC 41 fl oz + NIS (A,C,E,G); Gavel 75DF 2 lb + NIS (B,D,F,H)………..	1.5	b	8.8	bc	1.2	b	5.8	bcd	356	abc	411	c-f
Bravo WS 4.17SC 1.5 pt (A,C,E,G,H); Zampro 4.38SC 14 fl oz (B,D,F)…………	3.5	b	6.5	bcd	1.5	b	4.5	cde	350	bcd	408	c-f
Bravo WS 4.17SC 1.5 pt (A,C,E,G,H); Revus Top 4.17SC 5.5 fl oz (B,D,F)……....	1.6	b	3.8	de	0.7	b	7.8	abc	338	b-f	402	c-f
SA-0011401 100SL 2.3 pt (A-H)…………	2.1	b	5.5	cde	1.0	b	5.3	b-e	347	bcd	425	bcd
SA-0011401 100SL 3 pt (A-H)…………..	1.8	b	5.8	b-e	0.9	b	8.0	ab	321	c-h	401	c-f
Actinogrow 0.0371WP 0.275 oz (A̲[s]); SA-0011401 100SL 2.3 pt (A-H)…………	3.0	b	6.3	b-e	1.2	b	3.5	de	299	fgh	379	d-g
Actinogrow 0.0371WP 0.275 oz (A̲); SA-0011401 100SL 3 pt (A-H)…………....	2.0	b	6.3	b-e	1.0	b	5.3	b-e	372	ab	475	a
Previcur N 6SC 1.2 pt + Bravo WS 6SC 1.5 pt (A-H)……………...	3.3	b	8.8	bc	1.5	b	5.8	bcd	318	c-h	386	d-g
Previcur N 6SC 1.2 pt + Bravo WS 6SC 1.5 pt (A,C,E,G); Reason 500SC 7 fl oz (B,D,F,H)…………	2.5	b	7.5	bcd	1.2	b	4.5	cde	356	abc	420	cde
BravoWS 6SC 1.0 pt (A,C,E); Ranman 3.33SC 2.08 fl oz + Penncozeb 4F 2 fl oz + NIS (B,D,F)..........	1.9	b	5.5	cde	0.9	b	9.3	a	372	ab	441	abc
BravoWS 6SC 1.5 pt (A,C,E); Ranman 3.33SC 2.73 fl oz + Penncozeb 4F 2.88 fl oz + NIS (B,D,F)…..	0.8	b	2.0	e	0.4	b	3.8	de	341	b-e	420	cde
BravoWS 6SC 1.5 pt (A,B,C); Ranman 3.33SC 2.73 fl oz + NIS (D,E,F)..	3.0	b	5.0	cde	1.1	b	7.8	abc	392	a	470	ab
BravoWS 6SC 1.5 pt + Ranman 3.33SC 2.08 fl oz (A,B,C); Gavel 75DF 2 lb (D); Ranman 3.33SC 2.73 fl oz + Penncozeb 4F 2.88 fl oz + NIS (E,F)……..	2.0	b	7.0	bcd	1.3	b	5.5	b-e	367	ab	444	abc
BravoWS 6SC 1.5 pt + Ranman 3.33SC 2.08 fl oz (A,B); Gavel 75DF 2 lb (C); Ranman 3.33SC 2.73 fl oz + Penncozeb 4F 2.88 fl oz + NIS (D,E,F)…..	3.0	b	10.0	b	1.6	b	5.3	b-e	333	b-g	420	cde
Untreated Check………………………..	72.5	a	100	a	29.5	a	9.8	a	292	h	367	fg

[z] Days after inoculation of *Phytophthora infestans* (US-22, A2 mating type, mefenoxam sensitive) on 1 Aug
[y] RAUDPC, relative area under the disease progress curve calculated from day of appearance of initial symptoms
[x] Incidence of tuber late blight at harvest and after storage for 20 days at 50^{o}F
[w] Days after planting
[v] NIS = Non Ionic Surfactant applied at 0.25% v/v
[u] Application dates: A̲= 25 May; A= 5 Jul; B= 12 Jul; C= 19 Jul; D= 25 Jul; E= 1 Aug; F= 8 Aug; G= 16 Aug; H= 23 Aug
[t] Values followed by the same letter are not significantly different at $p = 0.05$ (Fishers LSD)
[s] In-furrow at-planting applications were delivered at 8 pt water/A in a 7 in. band using a single XR11003VS nozzle at 30 p.s.i. on 25 May

Funding: Industry and MPIC

Evaluation of fungicide programs for white mold control in potatoes, 2011.

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Potatoes ('FL1833', cut seed, treated with Maxim FS at 0.16 fl oz/cwt; "FL1833") were planted at the Michigan State University Potato Research Farm, Entrican, MI (sandy soil); 42.3526, -85.1761 deg; elevation 950 ft. on 2 Jun 2011 into four-row by 25-ft plots (ca. 9-in between plants at 34-in row spacing) replicated four times in a randomized complete block design. The four-row beds were separated by a 34-in unplanted row. Fertilizer was drilled into plots before planting, formulated according to results of soil tests. Additional nitrogen (final N 28 lb/A) was applied to the growing crop with irrigation 45 DAP (days after planting). Weeds were controlled by hilling and with Dual 8E at 2 pt/A 10 DAP and Poast at 1.5 pt/A 58 DAP. Insects were controlled with Admire Pro 2F at 1.25 pt/A at planting, Sevin 80S at 1.25 lb/A 31 and 55 DAP, Thiodan 3 EC at 2.33 pt/A 65 and 87 DAP and Pounce 3.2EC at 8 oz/A 48 DAP. Vines were killed with Reglone 2EC (1 pt/A on 15 Sep). Potato late blight and general foliar diseases were prevented with with weekly applications of Bravo WS at 1.5 pt/A from early canopy closure on 29 Jun to 24 Aug except on the days when white mold treatments were applied. Plots were rated visually for combined percentage foliar area affected by early blight and brown leaf spot on 13 Sep [20 days after final application (DAFA)]; and Botrytis tan spot on 13 Sep. Plots were rated visually for percentage foliar area affected by white mold and bacterial stem blight on 20 Sep. Vines were killed with Reglone 2EC (1 pt/A on 30 Sep). Plots (2 x 25-ft row) were harvested on 28 Oct and individual treatments were weighed and graded. Meteorological variables were measured with a Campbell weather station located at the farm from 1 Jun to the end of Sep. Maximum, minimum and average daily air temperature (^oF) were 92.8, 45.8 and 66.2 and 3-d with maximum temperature >90^oF (Jun); 94.2, 51.7 and 73.4 and 3-d with maximum temperature >90^oF (Jul); 87.1, 46.6 and 68.5 (Aug); 88.5, 33.9 and 61.1 (Sep). Maximum, minimum and average relative humidity (%) was 98.2, 21.6 and 69.6 (Jun); 98.9, 29.7 and 71.7 (Jul); 98.8, 29.8 and 73.9 (Aug); 98.7, 32.5 and 71.8 (Sep). Maximum, minimum and average daily soil temperature at 4" depth (^oF) was 85.1, 58.0 and 69.7 (Jun); 90.7, 63.5 and 76.0 (Jul); 90.8, 58.9 and 73.1 (Aug); 85.8, 53.0 and 67.1 (Sep). Maximum, minimum and average soil moisture (% of field capacity) was 26.4, 16.4 and 17.8 (Jun); 30.0, 17.2 and 18.4 (Jul); 25.6, 17.6 and 18.6 (Aug); 25.1, 16.9 and 18.1 (Sep). Precipitation was 2.38 in. (Jun), 1.63 in. (Jul), 2.57 in (Aug), 0.84 in. (Sep). Plots were irrigated to supplement precipitation to about 0.1 in./A/4 day period with overhead gun irrigation.

Weather conditions were conducive for the development of early blight and brown leaf spot and Botrytis tan spot. Early blight and brown leaf spot developed steadily during Aug and untreated controls reached about 18.8% foliar infection by 13 Sep. All treatments had significantly less combined early blight and brown leaf spot than the untreated control. All fungicide programs had significantly less foliar tan spot values than the untreated control (16.3%). All fungicide programs had significantly less white mold and bacterial vine rot values than the untreated control (26.3 and 32.5%, respectively). Treatments with greater than US1 yield of 210 cwt/A were significantly different from the untreated control but no treatments were significantly different from the untreated control in terms of total yield. Phytotoxicity was not noted in any of the treatments.

Funding: Industry and MPIC

Treatment and rate and rate/A	Early blight/BLS severity (%) 13 Sep 104 DAP[z]		Botrytis gray mold severity (%) 13 Sep 104 DAP		White mold severity (%) 20 Sep 111 DAP		Bacterial vine rot severity (%) 20 Sep 111 DAP		Yield (cwt/A) US1		Yield (cwt/A) Total	
Endura 70WG 5.5 oz (A,B[y])…………..	4.5	bc[x]	4.5	c	4.5	b	4.5	b	202	a-d	230	ab
Omega 500F 1.5 pt + Top 2.08 EC MP 6.95 fl. oz (A,B)……..	3.5	c	2.5	c	7.0	b	5.0	b	176	d	205	b
Omega 500F 1.5 pt + Top 2.08 EC MP 6.95 fl. oz + Actigard 4SS 0.33 fl. oz (A,B)…………	3.5	c	3.5	c	5.0	b	5.3	b	188	bcd	219	ab
Omega 500F 8.0 fl. oz (A,B)…………..	4.5	bc	12.5	b	6.3	b	5.0	b	197	a-d	235	ab
Omega 500F 5.5 fl. oz + Inspire 2.08SC 5.5 fl. oz (A,B)………....	3.5	c	4.5	c	5.3	b	6.3	b	210	abc	239	a
Omega 500F 8.0 fl. oz + Inspire 2.08SC 8.0 fl. oz (A,B)…………	3.5	c	4.0	c	7.5	b	6.3	b	202	a-d	231	ab
Untreated check………………………..	18.8	a	16.3	a	26.3	a	32.5	a	182	cd	218	ab

[z] DAP = days after planting

[y] Application dates (white mold target treatments only): A= 13 Jul; B= 27 Jul

[x] Values followed by the same letter are not significantly different at P = 0.05 (Tukey Multiple Comparison)

POTATO (*Solanum tuberosum*) 'Snowden'
RADISH (*Raphanus sativus*) 'Cherry Belle'
Common Scab; *Streptomyces scabies*

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Evaluation of biologically based materials and organic amendments for the control of common scab of potato – Crop and Soil Science and Montcalm Research Farms, 2011

Potatoes were planted 6 and 27 June to establish field trials at the Crop and Soil Science (CSS), and Montcalm Research Center (MRC) Farms in Mid-MI respectively to evaluate organic amendments and biological control materials efficacy for control of potato soil diseases. Treatments were included for common scab. Approximately 2 oz. seedpieces were cut by hand from Snowden tubers and the seedpieces were allowed to heal before planting. Treatment plots consisted of four 25-ft-long rows spaced 36 in. apart with 14 in. spacing in the row. A randomized complete block design with four replications was used for the trial. Drive rows for pesticide application equipment were placed adjacent to plots in order to minimize soil compaction and damage to plants in rows used for tuber scab and yield evaluation. The soil type was Metea loamy sand at CSS, and Montclam and McBride loamy sand and sandy loam at MCS. The soil treatments included two-week pre planting application in furrow of horseradish mixture (1 ton/A), chestnut shell-pellicle mixtures (15 ton/A) or oregano essential oil (13.5 quart/A), and four applications post planting of *Bacillus amyloliquefaciens* BAC03 (13.5 quart/A, at two week intervals during the season). Non-treated soil and soil treated with non-inoculated growth media for BAC03 (TSB; 13.5 quart/A, at two week intervals during the season) were used as negative controls. The soil used for pre-planting treatments was covered with plastic film for a week to prevent treatment evaporation. Experiential field plots were harvested on 22 Sep (MRC) and Oct 10 (CSS), and tubers from individual treatments were weighed for total tuber yield. Tuber samples of 50 per plot were harvested 30 days post vine-kill. Harvested tubers were washed and assessed for common scab (*S. scabies*) incidence (%) and severity. Severity of common scab was measured as an index calculated by counting the number of tubers (n = 50) falling in class 0 = 0%; 1 = 1 - 10%; 2 = 11 -25%; 3 = 25 - 50; 4 >50% surface area covered with by scab lesions on sample tubers (surface and pitted).

The 2011 growing season was characterized by cool and wet growing conditions early in the season and then dry warm conditions from mid season to harvest. All of the treatment programs provided useful levels of disease control when compared with the control plots and scab disease severity was rated at less than 1.5 at both CSS and MCS (Figs. 1a and 2a). At CSS, BAC03 was the most effective at reducing common scab (Fig. 1a), and was the only treatment that resulted in a significant increase in harvested tuber yield (Fig. 1b) compared to chestnut, essential oil, and horseradish. At MRC, BAC03 was most the most effective at controlling common scab (Fig. 2a) and resulted in a significant increase in harvested tuber yield (Fig. 2b), horseradish was comparable and had a significant effect in disease control compared to untreated controls, followed by chestnut tissue and essential oil in the reduction of common scab symptoms. Additionally horseradish also resulted in a significant increase in harvested tuber yield (Fig. 2b) compared to the other treatments tested.

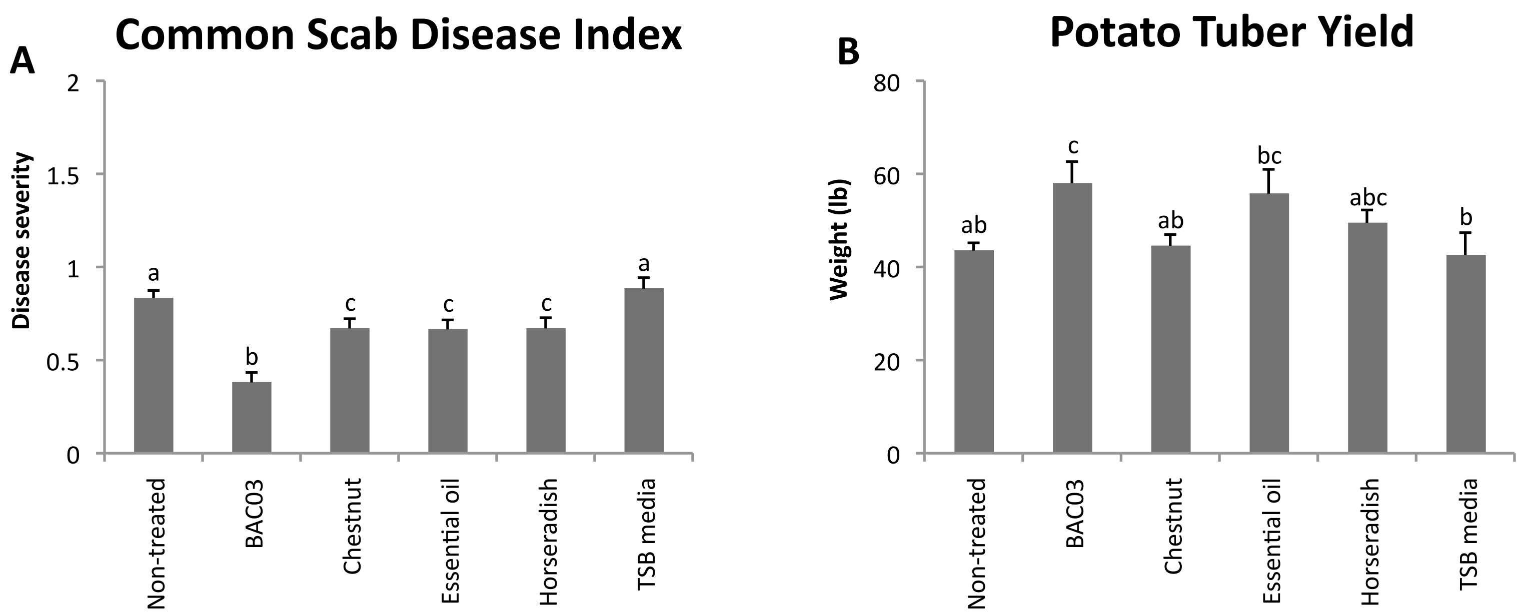

Figure 1. 2011 field evaluations of soil treatments for the control of potato common scab at the Crop and Soil Science Farm, East Lansing, MI. A. Effect of soil treatment on potato common scab severity. B. Effect of soil treatment on tuber yield. Scab severity and tuber yields from different treatments were compared using Fisher's least significance difference (LSD) method at $\alpha = 0.05$. Values followed by the same letter were not significantly different.

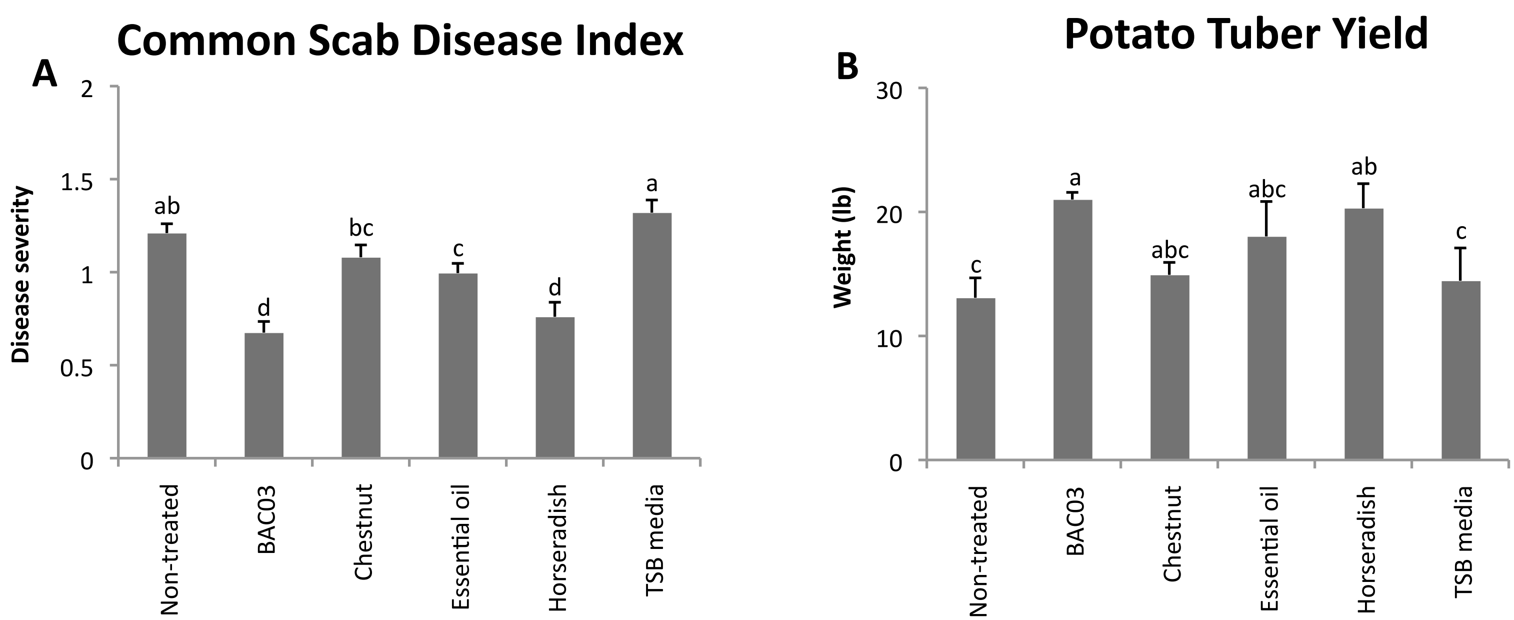

Figure 2. 2011 field evaluations of soil treatments for the control of potato common scab at the Montcalm Research Center, Lakeview, MI. A. Effect of soil treatment on potato common scab severity. B. Effect of soil treatment on tuber yield. Scab severity and tuber yields from different treatments were compared using Fisher's least significance difference (LSD) method at $\alpha = 0.05$. Values followed by the same letter were not significantly different.

Evaluation of BAC03 as a biological control agent for the control of common scab – MSU Plant Pathology Greenhouse, 2011

In the greenhouse, *Bacillus* spp. (BAC03) was evaluated to determine its efficacy for common scab disease control and effect on plant yield in potato and radish under controlled greenhouse conditions. In the first experiment BAC03 was evaluated at two rates to determine its efficacy in controlling common scab and effect on potato yield. The soil treatments included *Streptomyces scabies* 10^6 colony forming unit (CFU) cm-3, BAC03 (10^5 CFU/cm^3), BAC03 (10^6 CFU/cm^3). Non-treated soil and soil treated with non-inoculated growth media for BAC03 were used as negative controls. Seedpieces were cut by hand from Snowden tubers allowed to heal before planting. Seedpieces were allowed to germinate in potting mix in a growth chamber at 25°C until plant emergence. Potato seedlings were transferred to a 3.78 L plastic pot with potting mix. Six weeks after transplanting, the height of the plant from the soil line to the apical meristem of potato was measured with a ruler. Plants were harvested 10 weeks after transplanting. Tubers from individual treatments were weighed for total tuber yield. Severity of common scab was measured as an index calculated by counting the number of tubers falling in class 0 = 0%; 1 = 1 - 10%; 2 = 11 -25%; 3 = 25 - 50; 4 >50% surface area covered with by scab lesions on sample tubers (surface and pitted). In a second experiment Radish seeds were germinated in a Petri dish with moist filter paper overnight at 25 °C. After germination, seedlings were transplanted to a 1 L pot containing autoclaved potting mix infested with *S. scabies* (10^7 CFU/cm^3), in a growth chamber (23°C and 14 h light). BAC03 was applied (10^5 CFU/cm^3). The soil treatments included 1 time after planting (TAP), 2 TAPs, 3 TAPs, and 1 time before planting and 3 TAP. The intervals between BAC03 applications were one week. There were 4 replicates for each treatment. Scab lesions were rated on all scorable radish plants after 5 weeks of growth. Radish hypocotyls were scored on a scale of 0 to 5, where 0 = no lesion, 1 = discrete superficial lesions less than 10 mm in diameter, 2 = coalescing superficial lesions more than 10 mm in diameter, 3 = raised lesions less than 10 mm in diameter, 4 = coalescing raised lesions more than 10 mm in diameter, and 5 = pitted or sunken lesions. Weight of radish leaves and roots were determined at harvest. DNA based approaches (quantitative PCR using primers) to target pathogenic *Streptomyces* was used to quantify pathogen plant toxin (thaxtomin) genes *txtA* and *txtC* production under the various treatments. Pots were arranged in a randomized complete block design. Data was analyzed using the 'R' statistical.

The severity of potato common scab was significantly reduced (Fig. 3 A1), and potato growth (plant height and tuber weight) was significantly increased (Fig. 3 A2) by BAC03 application compared to inoculated control; these effects were enhanced by increasing the concentration of BAC03 application (Fig. 3 A). For radish, high concentrations of *S. scabies* inhibited root expansion, which interfered with the disease evaluation as indicative lesions were not visible (Fig. 3 B1). However, application of BAC03 reduced this inhibition, as a increase in radish root expansion was observed. The greatest response was obtained when BAC03 was applied before radish seeding; this resulted in no disease symptoms. One, two, or three applications after seeding also reduced the disease severity (Fig. 3 B1). The biomass, including weight of leaves and roots, of radish was significantly increased (Fig. 3 B2), when the concentration BAC03 application increased. Quantitative PCR analysis showed that *S. scabies* population in potting mix inoculated with BAC03 before radish seeding was significantly lower compared to other treatments (Fig. 4).

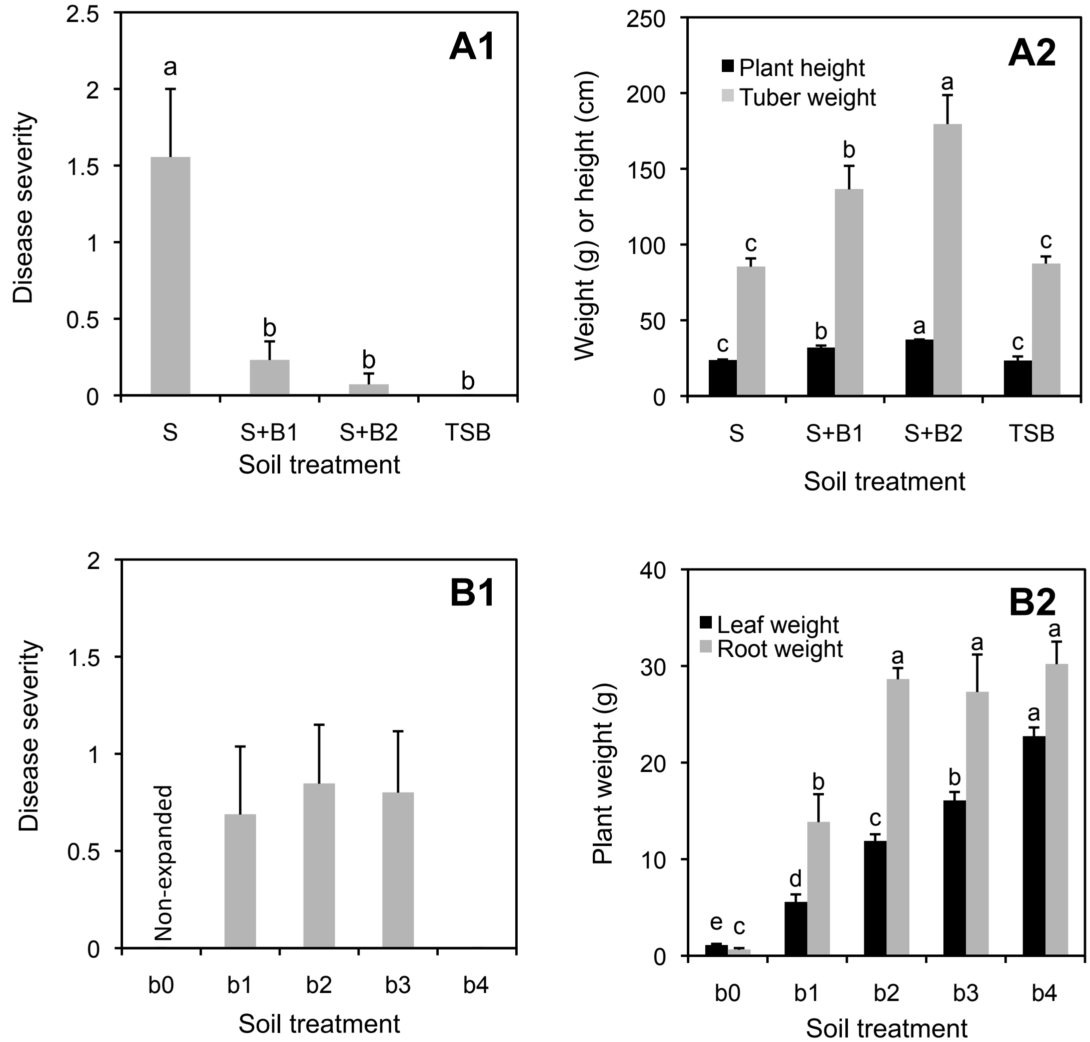

Figure 3. Effect of *Bacillus amyloliquefaciens* BAC03 on disease severity and plant growth in potato and radish. Panels A1 and A2: Potato was planted in potting mix treated with 200 ml of *S. scabies* at final concentrations 10^6 CFU cm-3 (treatment S), BAC03 at 10^5 CFU/cm^3 (treatment B1), BAC03 at 10^6 CFU/cm^3 (treatment B2), and tryptic soy broth (TSB) as a control. Panels B1 and B2: Radish was planted in potting mix treated with 30 ml of BAC03 at final concentration of 10^5 CFU cm-3 each time in the following treatments: b0 (non-treated), b1 [one time of application after planting (TAP)], b2 (2 TAPs), b3 (3 TAPs), and b4 (1 time before and 3 TAPs), with weekly intervals between applications. All pots were infested with Streptomyces scabies at 10^7 CFU/cm^3 potting mix. Fresh plant weight was measured in the end of experiment. Treatments were compared using Fisher's least significance difference (LSD) method at α = 0.05. Values followed by the same letter were not significantly different.

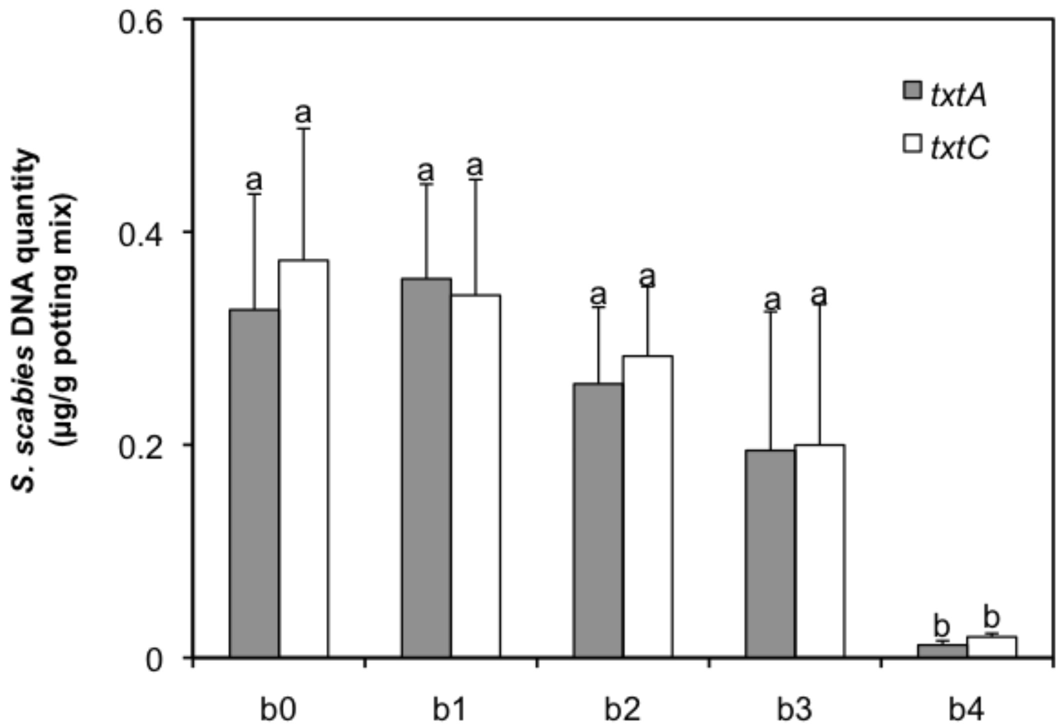

Figure 4. Detection of *S. scabies* plant toxin (thaxtomin) genes *txtA* and *txtC* production in potting mix using quantitative real-time polymerase chain reaction assay. Radish was planted in potting mix treated with BAC03 at final concentrations of 10^5 CFU/cm^3 in the following treatments: b0 (non-treated), b1 [one time after planting (TAP)], b2 (2 TAPs), b3 (3 TAPs), and b4 (1 time before and 3 TAPs). All pots were infested with Streptomyces scabies at 10^7 CFU/cm^3 of potting mix. Soilless potting mix (0.1 g) was collected from each treatment for DNA extraction and quantitative PCR analyses. The quantity of *S. scabies* DNA was estimated based on external standards. Treatments were compared using Fisher's least significance difference (LSD) method at $\alpha = 0.05$. Values followed by the same letter were not significantly different.

Modern Soil Fumigation Research and Education for Michigan Potato Production

About half of Michigan's potato acreage is treated with soil fumigants through modern subsurface shank injections to control the penetrans root-lesion nematode and dahliae Verticillium fungus. No reliable data have been developed in Michigan on efficacy for this technology. This Specialty Crop Block Grant, funded at $49,000 from the Michigan Department of Agriculture to the Michigan Potato Research Commission for research conducted by Michigan State University compared various treatment rates and injection depths against non-treated control plots. The 2010-2011 research results should lead to recommendations for fumigators and an information set for non-fumigators to use for deciding whether or not to adopt fumigation. Educational materials, including a "Soil Fumigation Field Guide" and a "Potato Nematode Farm Guide" were also produced as part of the project. The project design and associated EPA fumigant re-registration process were presented to the Michigan potato industry at their 2011 annual meeting. The research results and copies of the educational materials will be presented and distributed at the 2012 meeting in February. This process is essential in light of the Environmental Protection Agency's new required inclusion of detailed Good Agricultural Practices (GAP) as part of labels on re-registered fumigants.

Background

Approximately half of Michigan's 40,000 acres in potato production is fumigated. Growers make rough fumigation cost-benefit calculations. Some are willing to sacrifice fumigation and live with lower yields; whereas, others would not operate without fumigant protection. Fumigation that controls the penetrans root-lesion nematodes and dahliae Verticillium fungus has been a significant contributing factor in the doubling of Michigan potato yields in the last half-century to approximately 320 hundredweight per acre.

The fumigant most commonly used is metam sodium. The typical fumigation technique in Michigan is subsurface injection whereby a moving shank digs into the soil and the fumigant is injected through an attached nozzle. The nozzle can be placed at a 12-inch depth for reaching the nematode zone or a six-inch depth that is believed to be effective against dahliae Verticillium. The mechanism can be adapted for injections at both 12-inch and six-inch depths. Shank-injection technology includes backflow control to prevent accidental fumigant discharges.

The rates used in Michigan potato fields are still largely guesswork. No controlled studies have been done with modern injection equipment to determine optimal rates for optimal pest control at the respective depths. Growers face the quandary of wasting money by over-applying the costly fumigants or losing the degree of pest control they need by applying too low a fumigant rate.

While the research results and educational materials will assist Michigan potato growers in evaluation the economics of fumigation, a second year of data will be necessary. Funding for this has been obtained from industry and the work initiated in the fall of 2011. Both of the educational products from this project stress Good Agricultural Practices (GAP). This is an issue having an impact on the entire Michigan potato industry. Fumigants have been re-registered by EPA. The new labels mandate a Fumigation Management Plan and Post-

Application Report. under the Phase I labels that took effect in 2011. It is believed that various GAP will be available for reducing the size of Buffer Zones when the Phase II labels are finalized in the spring of 2012.

Objectives

1. Develop sound research data that will yield recommendations growers can follow to achieve maximum productivity at the least cost in their nematode and *Verticillium* control. The data will also be available for non-fumigators to evaluate in their own decision-making concerning the advisability of fumigation. The purpose is to enhance the competitiveness of Michigan potato growers through reliance on rigorously designed replicated research.

2. Develop educational materials for soil fumigation and nematode management in potato production. Make these materials available and discuss them at Michigan potato industry at grower meetings.

Research Design

Two sites on Michigan commercial potato farms (Farm I. and Farm II.) were selected for the study based on grower fumigation experience and site availability. Both sites were selected in part, based on moderate potato early-die risk information provided by the farm. Four treatments, each replicated four times in a randomized block design were established in the fall of 1010. Each plot was four-rows in width and 250 feet in length. The sites were sampled for the penetrans root-lesion nematode and dahliae Verticillium fungus at 0-6 and 6-12 inch soil depths in both the fall of 2010 and spring of 2011. The plots were sampled again in the fall of 2012 at a 0-12 inch soil depth. Both sites were fumigated in the fall of 2010 using grower equipment. At Farm I, the fumigant was shank injected at a 12-inch soil depth. On Farm II, the fumigant was injected at both a 5 and 10-inch soil depth, with 60% of the material being applied at the 5-inch depth and 40% at the 10-inch depth. The variety Snowden was planted in the spring of 2011 at Farm I. and F-2137 at Farm II. The following four treatments were used:

Farm I.

Non-treated control
Metam (18.75 gallons per acre)
Met am (37.5 gallons per acre)
Metam (75 gallons per acre)

Farm II.

Non-treated control
Metam (50 gallons per acre) + Water (20 gallons/acre)
Metam (50 gallons per acre)
Metam(70 gallons per acre)

A subsample of each plot was harvested in the fall of 2011 and the tubers graded.

Research Results

2011 potato tuber yields were general low throughout Michigan. This was reflected in the research yields on both of the farms included in the study. At Farm I., total tuber yields were significantly increased (P = 0.049) through the use of metam (Table 1). The highest yield was 276 cwt/acre, 34 cwt/acre more than yield associated with the non-treated control. The A tuber yield exhibited a positive linear increase from the non-treated control through the highest rate of metam. While there were no statistically significant differences in the J yields associated with the treatments, the highest were from the 18.75 gal/acre and 37.5 gal/acre rates. B tuber yield was significantly (P = 0.030) enhance through application of metam, with the greatest yield being associated with the 37.5 gal/acre rate. The treatments did not appear to have any impact on culls or specific gravities.

Table 1. Specialty Crop Block Grant Metam Research, Farm I. 2011 potato tuber yields (cwt/A).

Treatment	Total	A's[1]	J's	B's	Culls	S. G.
Control	242	183	0.7	57	0.7	1.070
18.75 gpa	269	193	3.5	71	1.2	1.069
37.5 gpa	276	197	3.4	93	0.0	1.071
75 gpa	267	204	1.9	62	0.0	1.070
P	0.049	0.224	0.500	0.030	0.293	0.581

[1]A, B and J refer to tuber size: 1 7/8 in. to 3 ¼ inch in. diameter, < 1 7/8 in. and > 3 ¼ in, respectively.

At Farm II., tuber yields ranged from 389 to 424 cwt/acre, with the highest yield associated with the 50 gal/acre metam rate diluted with 20 gal. of water (Table 2). While the yields were higher on Farm II., compared to Farm I., there were no statistically significant differences in the total, A, J, B or cull tubers associated with the four treatments. Likewise, there were not statistically significant differences in the specific gravities associated with the four treatments.

Table 2. Specialty Crop Block Grant Metam Research, Farm II. 2011 potato tuber yields (cwt/A).

Treatment	Total	A's	J's	B's	Culls	S. G.
Control	389	334	31	29	3.5	1.085
50/20 gpa[2]	424	364	47	19	6.5	1.083
50 gpa	403	343	38	21	3.3	1.083
70 gpa	388	321	46	18	2.0	1.084
P	0.428	0.280	0.693	0.593	0.127	0.161

[1]A, B and J refer to tuber size: 1 7/8 in. to 3 ¼ inch in. diameter, < 1 7/8 in. and > 3 ¼ in, respectively.
[2]50 gal of metam diluted with 20 gal of water an applied at a rate of 70 gal/acre.

The initial population density of penetrans root-lesion nematode at Farm I. was uniformly distributed throughout the research site (P = 0.905 and P = 0.903, Table 3.). The population density at the 6-12 inch soil depth was significantly (P = 0.05) greater than at the 0-6 inch soil depth at the beginning of the experiment.   The population density of this nematode remained low at this site throughout the research period and no differences were detected among the four treatments.

Table 3. Specialty Crop Block Grant Metam Research, Farm I. 2010-2011 penetrans root-lesion nematodes per 100 cm^3 soil.

Treatment	Fall, 0-6 in.	Fall, 6-12 in.	Spr., 0-6 in.	Spr., 6-12 in.	Final 0-12 in.
Control	5	12	1	0.0	2.3
18.75 gpa	5	17	1	0.3	8.0
37.5 gpa	4	13	0	1.0	1.5
75 gpa	5	15	0	0.3	3.0
P	0.905	0.903	0.574	0.352	0.430

Population densities of the penetrans root-lesion nematode were higher at Farm II. than those encountered at Farm I. (Table 4). At the beginning of the research, the population density of this nematode was uniformly distributed throughout the research site (P = 0.970 and P = 0.971). At this time, the population density was significantly (P = 0.05) greater at the 6-12 inch soil depth than at a soil depth of 0.6 inches. In the spring of 2011, the highest population density of the penetrans root-lesion nematode as associated with the non-treated control at a soil depth of 6-12 inches (P = <0.001). At a soil depth of 0-6 inches the highest nematode population density was associated with the 50 gal/acre metam treatment without water. By harvest population densities had increased where the fumigant had been used,

Table 4. Specialty Crop Block Grant Metam Research, Farm II. 2010-2011 penetrans root-lesion nematodes per 100 cm^3 soil.

Treatment	Fall, 0-6 in.	Fall, 6-12 in.	Spr., 0-6 in.	Spr., 6-12 in.	Final 0-12 in.
Control	22	50	0.5	32.5	42
50/20 gpa[1]	18	41	0.0	0.5	18
50 gpa	21	49	10.5	0.0	15
70 gpa	19	40	3.0	1.0	17
P	0.970	0.971	0.070	<0.001	0.693

[1]50 gal of metam diluted with 20 gal of water an applied at a rate of 70 gal/acre.

Population densities of the dahliae Verticillium fungus were higher in the soil on Farm I., compared to Farm II. (Table 5. and Table 6.). the poopulatiopn density appears to be slightly higher at a soil depth of 6-12 inches, compared to a 0-6 inch soil depth. There were no detectable differences in the population densities of this fungus among the treatments at any of the sampling dates or soil depths at Farm I.

Table 5. Specialty Crop Block Grant Metam Research, Farm I. 2010-2011 dahliae Verticullium fungal colonies per 10 grams of soil by wet sieving.

Treatment	Fall, 0-6 in.	Fall, 6-12 in.	Spr., 0-6 in.	Spr., 6-12 in.	Final 0-12 in.
Control	6.8	3.5	9.3	13	3.8
18.75 gpa	1.8	8.3	5.8	5	1.8
37.5 gpa	4.5	5.3	9.3	8.3	2.5
75 gpa	5.5	3.8	8	9	5.0
P	0.627	0.686	8.063	0.343	0.468

Population densities of the dahliae Verticillium fungus at Farm II. Were low at all sampling dates (Table 6). At the beginning of the experiment, the distribution of this fungus throughout the experimental site was more uniform at a soil depth of 6-12 inches than at a 0-6 inch soil depth. There were no detectable significant differences in the population densities among the four treatments.

Table 6 Specialty Crop Block Grant Metam Research, Farm II. 2010-2011 dahliae Verticullium fungal colonies per 10 grams of soil by wet sieving.

Treatment	Fall, 0-6 in.	Fall, 6-12 in.	Spr., 0-6 in.	Spr., 6-12 in.	Final 0-12 in.
Control	1.3	2.5	0.3	0.3	3.8
50/20 gpa	0.8	2.3	2.0	2.0	1.8
50 gpa	2.8	2.0	0.5	0.5	2.5
70 gpa	1.8	2.0	1.0	1.0	5.0
P	0.426	0.983	0.608	0.938	0.468

Grower meetings and development of two field guides were used to fulfill the educational component of the project. The first educational session was held at the 2010 Michigan Winter Potato Meeting in Mt. Pleasant. The soil fumigation component consisted of three presentations. The first described this project, the second reviewed the Michigan atmospheric admissions research that resulted in significant changes in the EPA proposed buffer zones, and the third was a review of the Good Agricultural Practices (GAP) that will be part of Phase II fumigant labels The field guides were to be published in time for the 2011, Great Lakes Expo, but this was not possible since EPA did not meet the fall 2011 deadline in regards to Phase II labels. A soil fumigation session was held at 2011 Great Lakes Expo. It was extremely well attended! There were presenters from EPA, private business and Michigan State University. The general consensus was that the first year of implementation of the Fumigant Management Plans went very well. It is very likely that this was the case because of the leadership by the Michigan Potato Industry Commission in regards to pre-implementation educational programs. The most significant new items discussion at the session related to the fact that two separate postings for each fumigated site are required under the new labels. One is for the treated area and the other for the buffer zone. They have separate requirements in regards to entry periods and posting take-down. The second related to Good Agricultural Practices (GPA). There are three separate types of GAP associated with potato production: 1) those used for formal farm GAP certification, 2) those will be used in Phase II labels for buffer zone size reductions, 3) and those recommended by Michigan State University for superior fumigation results.

Immediately before the December 31, 2011, end of this project, the two field guides were published. The first is entitled*, Potato Soil Fumigation: A Field Guide to Fumigant Management plans, With Special Reference to Potato Early-Die in Michigan (2011 Review Edition)*. Because of the project completion deadline an the fact that EPA will not have Phase II labels available. A limited number of review copies were produced and a second edition will be published as soon as Phase II labels are available. It was originally intended for this publication to have co-authors from Oregon and Florida. After discussion with these individuals, it was determined that there were enough differences in the fumigation practices in these regions to focus solely on Michigan. A copy is included as part of this report as Appendix A.

The second educational publication is entitled, *Potato Nematodes: A Farm Guide to Nematode Diagnostics and Management*. Both educational documents will be introduced to the Research Committee of the Michigan Potato Industry Commission at their meeting on January 12, 2012. As described in the original project proposal, they will be used as part of the soil fumigant educational session at the Michigan Winter Potato Meeting in Mt. Pleasant on February, 16, 2011. It was originally intended for the nematode document to have co-authorship with an individual from Wisconsin. Because of the constraints in regards to the delay in Phase II labels, this was not possible. It is hoped that Dr. Ann MacGuidwin, of the University of Wisconsin will be a co-author of the second edition of this publication. A copy of this document is attached to this report as Appendix B.

Discussion

Potato-Dearly Die is a key limiting factor in Michigan potato production. Soil fumigation is frequently used for managing this infectious disease. During two decades of research at the Montcalm Potato Research Farm with metam, increases in tuber yields from application of this chemical were always in the 100-200 cwt/acre range. The equipment used in these studies, however was different than the modern soil fumigation equipment used on today's potato production systems. In one case, it was demonstrated that while the 35 gal/acre rate was adequate for control of the penetrans root-lesion nematode and early-die, the 75 gal/acre rate was necessary for reducing population densities of the dahliae Verticilium fungus. In recent years, however, there have been a number of cases where Michigan potato growers failed to obtain major tuber yield responses. In general, potato yields in Michigan in 2011 were lower than usual. This was the case for both Farm I. and Farm II. used in the current research project. The reason for this is unknown. At both sites, early-die symptoms were relatively mild and did not appear until later in the growing season than normal. Yield response to what would be considered optima fumigation was only 34 cwt/acre at Farm I. and 35 cwt/acre at Farm II. This mandates that the research be repeated under a different set of environmental conditions. Funding from private industry has been obtained to do this and the research was initiated in the fall of 2011 at three commercial potato production enterprises in Michigan.

Key findings/discussion associated with the research are:

1. The rates of fumigant used must be specific for the type of equipment used and other associated management practices used on each farm. Excellent penetrans root-lesion nematode control was obtained at Farm II. This could not be adequately accessed at Farm I. because of low initial, growing season and final population densities of this nematode.

2. When the fumigant was injected at a 12-inch soil depth at Farm I., there was a linear increase in tuber yield with increasing fumigant rates from 18.75 to 75 gallons per acre. At this site, however, the greatest yield increase was with B size tubers, indicating that the crop may not have completely matured properly.

3. When the fumigant amount is split and is injected at two soil depths, 5 and 10 inches (60% at the 5 inch depth and 40% at the 10-inch depth) dilution with water appears to the necessary. This was reflected in both tuber yield and nematode control. The width of the blade at the base of the shank may have a bearing on this. The blade used for the 12-inch injection was wide and that used for the split injection was significantly narrower.

4. In Michigan, the dahliae Verticillium fungus is uniformly distributed through the 0-12 inch soil depth profile. The population density was not greater at the 0-6 inch soil depth, compared to a soil depth of 6-12 inches. This is logical because of the types of tillage, crop rotation systems used in addition to various environmental stresses.

The Michigan potato soil fumigation education program appears to have been successful and on a good future trajectory. Growers seem to be very interested in the GAP approach to both their overall farm and soil fumigation technology. It is believed that the 2012 Michigan soil fumigation research will provide significant additional practical information in regards to this topic.

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2010-2011 DR. B. F. (BURT) CARGILL POTATO DEMONSTRATION STORAGE ANNUAL REPORT MICHIGAN POTATO INDUSTRY COMMISSION

Chris Long, Coordinator and Luke Steere

Introduction and Acknowledgements

Round white potato production leads the potato market in the state of Michigan. Michigan growers continue to look for promising, new, round white varieties that will meet necessary production and processing criteria. There are many variety trials underway in Michigan that are evaluating chipping varieties for yield, solids, disease resistance and chipping quality with the hope of exhibiting to growers and processors the positive attributes of these lines. Extended storage chip quality and storability are areas of extreme importance in round white potato production. Due to the importance of these factors, any new chip processing varieties that have commercial potential will have storage profiles developed of them. Being able to examine new varieties for long-term storage and processing ability is a way to keep the Michigan chip industry at the leading edge of the snack food industry. This information can position the industry to make informed decisions about the value of adopting these varieties into commercial production.

The Michigan Potato Industry Commission (MPIC) Burt Cargill Potato Demonstration Storage facility currently consists of two structures. The first building, constructed in 1999, provides the Michigan potato industry with the opportunity to generate storage and chip quality information on newly identified chip processing clones. This information helps to establish the commercial potential of these new varieties. This demonstration storage facility utilizes six, 550 cwt. bulk bins (Bins 1-6) that have independent ventilation systems. The second structure, built in 2008, has three, 600 cwt. bulk bins that are independently ventilated. The first of these bulk bins, Bin seven, has been converted into 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 level point in storage profiling that allows the industry to learn about a varieties' storability before advancing to the bulk bin level. We would typically have 4-6 years' worth of agronomic data on a variety before entering box bin testing. In the variety development process, little information has been collected about a varieties' storability or storage profile prior to being included in the box bin trial. A storage profile consists of bi-weekly sampling of potatoes to obtain; sucrose and glucose levels, chip color and defect values. In addition, each variety is evaluated for weight loss or shrinkage and pressure bruise. With this information, the storage history of a variety can be created, 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 designed to be used to evaluate the post-harvest physiology of the potato. The facility can be used to evaluate storage pathology or sprout inhibitor products. The Michigan industry recognizes the importance of being able to control disease and sprout development in storage and is committed to doing research in these areas.

This tenth annual Demonstration Storage Report contains the results of the storage work conducted in the facility during the 2010-2011 storage season. Section I, "2010-2011 New Chip Processing Variety Box Bin Report", contains the results and highlights from our 10 cwt. box bin study. Section II, "2010-2011 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 Chair of the committee is Brian Sackett of Sackett Potatoes. Other members of the committee include: Bruce Sackett, Steve Crooks, Todd Forbush, Chris Long, Troy Sackett, Dennis Iott, Randy Styma, Keith Tinsey, Ben Kudwa, Duane Anderson, Tim Wilkes, Larry Jensen, Chase Young and Tim Young. The funding and financial support for this facility, and the research that is 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. These are the growers that provided the material to fill the bulk bins this year and without their willingness to be involved, we could not have accomplished our objectives: Steve, Norm and John Crooks, Crooks Farms, Inc.; Jason Walther, Karl Ritchie and Keith Tinsey, Walther Farms; Jeff Thorlund, Thorlund Brothers Farm and Kim and Kyle Lennard and Fernando Montealegre, Lennard Ag Co. Equal in importance are the processors who invested in this research. They are; Gene Herr, Herr Foods Inc., Nottingham, PA; Mitch Keeny of UTZ Quality Foods, Inc., Hanover, PA; 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. Dick Chase (MSU Professor Emeritus), Dr. Dave Douches and the MSU potato breeding program, Todd Forbush (Techmark, Inc), Larry Jensen (Chief Wabasis Potato Growers), and Tim Wilkes (Potato Services of Michigan). All played a role in making this facility useful to the Michigan potato industry.

Overview of the production season *

The overall 6-month average maximum temperature during the 2010 growing season was three degrees higher than the 6-month average maximum temperature for the 2009 season and was two degrees higher than the 15-year average. The 6-month average minimum temperature for 2010 was three degrees higher than the 15-year average. There were no recorded temperature readings of 90 °F or above in 2010. There were 220 hours of 70 °F temperatures between the hours of 10 PM and 8 AM which occurred over 43 different days, April to September. There were two days in May that the air temperature was below 32 °F. These occurred on May 9th and 10th. The average maximum temperatures for July and August, 2010, were two and three degrees higher than the 15-year average, respectively. In October 2010, there were 8 days with measureable rainfall and two daytime highs below 50 °F.

Rainfall for April through September was 15.13 inches, which was 3.81 inches below the 15-year average. In October 2010, 1.45 inches of rain was recorded. Overall, the 2010 growing season resulted in average specific gravity with average overall yield. The early part of the season was warm and dry. The harvest season was generally wet and warm.

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

I. 2010-2011 New Chip Processing Variety Box Bin Report

(Chris Long, Luke Steere and Brian Sackett)

Introduction

The purpose of this project was to evaluate new chip processing varieties from national and private breeding programs for their ability to process after being subjected to storage conditions. A variety's response to pile temperature, as reflected in sucrose and glucose levels, was evaluated. Weight loss and pressure bruise susceptibility of each variety was also evaluated. Bin 7 contained 36, 10 cwt. boxes. Thirty-six boxes were placed in six stacks of six. The boxes were designed for air to travel in from a header or plenum wall through the forklift holes of each box, up through the potatoes within it and onto the next box above until the air reaches the top and is drawn off the top of the chamber, 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 tubers can be removed to conduct bi-weekly quality evaluations.

Procedure

Twenty new varieties were evaluated and compared to the check variety Snowden. The 20 varieties were chosen by the MPIC Storage and Handling Committee. Once the varieties were chosen, 1 cwt. of each variety was planted on May 10th at the MSU, Montcalm Research Center, Entrican, MI. The varieties were all planted at a 10" in-row seed spacing. All varieties received a rate of fertilizer recommended to achieve a 375 to 425 cwt./A yield (270 lb. N/A). The varieties were vine killed after 120 days and allowed to set skins for 24 days before harvest on September 28, 2010; 144 days after planting. Variety maturity is not taken into account in the harvest timing due to storage and handling restrictions.

Approximately ten cwt. of each variety was placed in each box bin, labeled and stacked in Bin 7. The average storage temperature for all the box bins (Bulk Bin 7) was 54.6 ºF for the 2010-2011 season. At harvest, nine, 20 lb. samples from each variety were collected for weight loss and pressure bruise evaluation. Some additional tuber samples were taken and shipped to regional chip plants for evaluation throughout the storage season. A description of the varieties tested, their pedigree and scab ratings are listed in Table 1. Yield, size distribution, chip quality, and specific gravity were recorded at harvest (Table 2). All 21 varieties were graded to remove all "B" size tubers and pick-outs and entered the storage in good physical condition.

The storage season began September 28, 2010, and ended June 6, 2011. Bin 7 was gassed with CIPC and Clove Oil on October 21, 2010. Variety evaluation began September 28, 2010, followed by a bi-weekly sampling schedule until June. Thirty tubers were removed from each box every two weeks and sent to Techmark, Inc. for sucrose, glucose, chip color and defect evaluation. Nine pressure bruise sample bags were taken for each variety, weighed and placed in one of the bulk bins at the storage facility. Three bags were placed at each of 5', 10' and 15' from the pile floor. When that bin was unloaded, the sample bags were weighed and percent weight loss was calculated. A 25 tuber sample was taken from each of the nine bags and was evaluated for the presence or absence of pressure bruise. The number of tubers and severity of bruise was recorded. All pressure bruises were evaluated for discoloration.

This report is not intended to be an archive of all of the data that was generated for the box bin trial, but a summary of the data from the most promising lines. The purpose of this report is to present a summary of information from 2-5 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 Crop and Soil Sciences Department for assistance (517) 355-0271 ext. 1193.

Table 1. 2010 MPIC Demonstration Box Bin Variety Descriptions

Entry	Pedigree	2010 Scab Rating*	Characteristics
Snowden (W855)	B5141-6 X Wischip	2.3	High yield, late maturity, late season storage check variety, reconditions well in storage, medium to high specific gravity
A00188-3C	A91790-13 X Dakota Pearl	1.3	High U.S. No. 1 yield, scaly buff skin, high specific gravity
A01143-3C	COA95070-8 X Chipeta	1.3	High yielding, scaly buff chipper; smaller tuber size
AF2291-10	SA8211-6 X EB8109-1	2.0	Early blight resistant clone with good chipping quality, medium-late vine maturity, round to oblong, white netted tubers, specific gravity similar to Atlantic
CO00188-4W	A90490-1W X BC0894-2W	2.0	Medium-high yield potential, small tuber size, minimal grade defects, medium-early maturity, high specific gravity, some ability to recondition out of 40º F
CO00197-3W	A91790-13W X NDTX4930-5W	3.5	Medium yield potential, small size profile, minimal grade defects, early maturity, medium-high specific gravity, some ability to recondition out of 40º F
MSH228-6	MSC127-3 X OP	1.3	Average yield, mid-season maturity, blocky flat tuber type, shallow eyes, medium specific gravity
MSL007-B	MSA105-1 X MSG227-2	1.0	Average yield, early to mid-season maturity, uniform tuber type, medium specific gravity, scab resistant
MSL292-A	Snowden X MSH098-2	2.3	Above average yield, scab susceptible, late blight susceptible, medium-high specific gravity, long storage potential
MSP270-1	MSNT-1 X MSG227-2	1.0	Below average yield, uniform round type, netted skin, good chip quality from early to mid-season storage, average specific gravity
MSP459-5	Marcy X NY121	1.8	Bright chips, low incidence of defects, medium specific gravity
MSP515-2	Marcy X Missaukee	2.3	Above average yield, large tuber size, medium-late maturity, below average specific gravity
MSQ070-1	MSK061-4 X Missaukee	1.3	Round tuber type, late maturity, scab and late blight resistant, high specific gravity, strong vine and roots
MSQ279-1	Boulder X Pike	1.4	High yield, large round tubers, good internal qualities
MSR061-1	W1201 X NY121	1.1	Average yield, round tuber type with netted skin, low sugars, PVY resistant, moderate late blight resistance

*Scab rating based on 0-5 scale; 0 = most resistant and 5 = most susceptible

Entry	Pedigree	2010 Scab Rating*	Characteristics
MSR102-3	W1773-7 X Missaukee	1.0	Below average yield, very late maturity, uniform tuber type, foliar late blight resistance to US-8
NY 139 (Lamoka)	NY120 X NY115	2.0	High yield, mid-late season maturity, medium specific gravity, oval to oblong tuber type
W2310-3 (Tundra)	Pike X S440	2.0	Average yield potential, high specific gravity, smaller size profile, good chip quality from storage
W2717-5	S440 X ND2828-15	3.0	Round tuber type, medium yield, medium maturity, medium specific gravity, moderate scab susceptibility
W2978-3	Monticello X Dakota Pearl	3.5	Above average yield potential, early bulking, medium-early vine maturity, scab susceptible
W5015-12	Brodick X W1355-1	-	Relative high tuber set and yield, medium-late vine maturity, uniform size tubers, tubers tend toward flat shape, very flat in some environments

*Scab rating based on 0-5 scale; 0 = most resistant and 5 = most susceptible

Table 2. 2010 Michigan Potato Industry Commission Box Bin Processing Potato Variety Trial

2010 MPIC Box Bin Processing Potato Variety Trial
Montcalm Research Farm, Montcalm County, MI

Harvest 28-Sep-10 141 Days

DD, Base 40[6] 3816

LINE	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR	CHIP SCORE[3]	TUBER QUALITY[2] HH	VD	IBS	BC	TOTAL CUT	VINE VIGOR[4]	VINE MATURITY[5]	COMMENTS	CHIP COMMENTS
MSP515-2	519	554	94	6	72	22	0	1.077	1.5	1	1	0	0	10	2.0	4.0	large tuber size	sl SED
A01143-3C	442	613	72	12	72	0	16	1.077	1.0	0	0	3	0	10	2.5	4.5	severe heat sprouts, knobs	tr SED
MSQ279-1	384	417	92	6	83	9	2	1.073	1.5	1	0	1	0	10	1.5	4.0		SED
NY139	382	422	90	10	81	9	0	1.085	1.0	0	0	0	0	10	2.5	3.0	smooth oval flattened tubers	tr SED
AF2291-10	381	449	85	13	77	8	2	1.085	1.5	2	6	0	0	10	1.5	2.5	not uniform type, tr points	sl SED, some HH
Snowden	**346**	**401**	**86**	**13**	**77**	**9**	**1**	**1.083**	**1.0**	**0**	**3**	**0**	**0**	**10**	**2.0**	**3.0**		**tr SED**
MSH228-6	346	377	91	7	70	21	2	1.074	1.5	0	5	0	0	10	1.0	3.0	large tuber size	SED
A00188-3C	339	445	76	24	75	1	0	1.082	1.0	0	7	0	0	10	2.5	2.5	small uniform tuber type	sl SED
W5015-12	331	419	79	14	63	16	7	1.077	1.0	6	4	0	0	10	1.0	4.0	surface and pitted scab, large tuber size	VD
MSL007-B	319	381	84	16	80	4	0	1.078	1.0	1	1	0	0	10	1.5	2.5	heavy netted skin, uniform tuber type	
MSR102-3	297	345	86	13	80	6	1	1.079	1.5	0	4	0	0	10	1.5	5.0	sticky stolons	SED
W2978-3	295	369	80	18	77	3	2	1.072	1.5	0	3	0	0	10	2.5	1.5	bright tuber appearance	tr SED
MSP459-5	291	386	75	25	75	0	0	1.070	1.0	0	2	0	0	10	2.0	2.5	netted skin, uniform tuber type	tr SED
W2310-3	268	353	76	17	76	0	7	1.087	1.0	0	1	0	0	10	1.5	3.0	misshappen tubers in pickouts, surface and pitted scab	tr SED
MSP270-1	252	304	83	17	80	3	0	1.074	1.0	0	1	1	0	10	1.0	3.5	netted skin, uniform type	
MSL292-A	244	344	71	29	71	0	0	1.074	1.0	0	2	0	0	10	2.0	2.5	uniform type	tr SED
W2717-5	212	263	81	17	79	2	2	1.087	1.0	1	2	0	2	10	2.0	1.5		sl SED
MSQ070-1	211	255	83	17	77	6	0	1.085	1.5	2	2	3	0	10	1.0	4.5	sticky stolons	tr SED
MSR061-1	195	255	76	24	76	0	0	1.076	1.0	0	0	0	0	10	1.0	3.0	netted skin, uniform type	tr SED
CO00188-4W	185	313	59	41	59	0	0	1.069	1.0	0	2	0	0	10	3.0	2.5	small uniform tuber type	
CO00197-3W	87	144	61	37	61	0	2	1.066	1.0	1	3	0	0	10	2.0	4.0	small tuber yield	tr SED
MEAN	**301**	**372**	**80**					**1.078**										

tr = trace, sl = slight, N/A = not applicable

SED = stem end defect, gc = growth crack

[1]SIZE
Bs: < 1 7/8"
As: 1 7/8" - 3.25"
OV: > 3.25"
PO: Pickouts

[2]TUBER QUALITY (number of tubers per total cut)
HH: Hollow Heart
VD: Vascular Discoloration
IBS: Internal Brown Spot
BC: Brown Center

[3]CHIP COLOR SCORE - Snack Food Association
(Out of the field)
Ratings: 1 - 5
1: Excellent
5: Poor

[4]VINE VIGOR RATING
Date Taken: 8-Jun-10
Ratings: 1 - 5
1: Slow Emergence
5: Early Emergence (vigorous vine, some flowering)

[5]VINE MATURITY RATING
Date Taken: 24-Aug-10
Ratings: 1 - 5
1: Early (vines completely dead)
5: Late (vigorous vine, some flowering)

Planted: 10-May-10
Vines Killed: 7-Sep-10
Days from Planting to Vine Kill: 120
Seed Spacing: 10"
No Fumigation

[6]MAWN STATION: Entrican
Planting to Vine Kil

Results: 2010-2011 New Chip Processing Box Bin Report

MSH228-6

MSH228-6 is a Michigan State University (MSU) chip processing variety with common scab tolerance. This variety has a tuber set of six to eight tubers that are round to oval in shape with a good netted skin. The specific gravity for this variety was below average and the recorded yield was 45 cwt. above the trial average in the 2010 Box Bin Trial at 346 cwt./A US#1 (Table 2). The variety appeared to have a medium maturity and a small set of large tubers, suggesting that this variety should be planted at an eight inch in-row seed spacing and managed for a 120 to 130 growing day maturity. This variety has a Snowden-like storage profile, exhibiting the ability to store well into March in most years. During the 2010-2011 storage season, MSH228-6 was placed into storage on September 28th 2010, having a sucrose value of 0.679 mg/g (X10) and a glucose value of 0.002 mg/g. These values decreased quickly until the middle of April 2011 when the sucrose levels began to increase. A chip picture is included from May 9th 2011 to show the chip quality during this period. Overall, this variety performed well enough to warrant further large scale commercial testing in hopes of replacing some Snowden acreage with a variety that has common scab resistance. The storability of MSH228-6 is similar to Snowden but the common scab tolerance of this variety is its big advantage.

MSL007-B

This Michigan State University (MSU) chip processing variety has common scab tolerance and a uniform round tuber type with a heavy netted skin. The specific gravity for this variety was above average and the recorded yield was 18 cwt. above the trial average in the 2010 Box Bin Trial at 319 cwt./A US#1 (Table 2). The variety appears to have an early to medium maturity with a good set of medium sized tubers (Table 1). During the 2010-2011 storage season, MSL007-B was placed into storage on September 28th 2010, having a sucrose value of 0.748 mg/g (X10) and a glucose value of 0.002 mg/g. These values decreased quickly and remained low until the end of the storage season in late May. A chip picture is included from May 9th 2011 to show the chip quality during this period. The sucrose and glucose values on this day were 0.643 mg/g (X10) and 0.004 mg/g, respectively. A trace of internal black spot and hollow heart was observed on this same date. The percent weight loss recorded for this variety at the time of bin unloading was 3.56, with 8.4 percent of the tubers evaluated expressing bruise with discoloration under the surface of the skin. These numbers are higher than the majority of the varieties evaluated this season. Overall, this variety performed well. Further testing will continue in hopes of replacing Snowden acreage with a variety that has common scab resistance.

MSL292-A

This MSU variety exhibited a below average yield and specific gravity in the 2010 Box Bin Trial. The recorded yield was 244 cwt. /A US#1 (Table 2). The tuber type and size of MSL292-A was uniform and round. This variety experienced stronger than normal vine competition from adjacent plots of late maturing varieties, resulting in poor agronomic performance for MSL292-A. The long term chip quality of MSL292-A continues to be excellent. The vine maturity for MSL292-A is medium-late (110 Days). A ten inch in-row seed spacing would be recommended for this variety. On September 28th 2010, this variety was put into storage with a 0.649 mg/g (X10) sucrose rating and a 0.002 mg/g glucose value. Sucrose and glucose levels came down to their lowest points in early March at 0.469 and 0.002, respectively. At this point in storage, the sucrose values began to rise to 0.789 in late May 2011. From late March 2011 until mid-May 2011, the glucose level remained at or below 0.004 mg/g. Total defects recorded for this variety on May 9th 2011 were 2.2 percent, resulting largely from a trace of stem end defect present in the tubers which can be observed in the picture above. The percent weight loss recorded at the time of bin unloading for this variety was 5.32, with 6.2 percent of the tubers evaluated expressing bruise with discoloration under the surface of the skin. The only negative aspect to this clone is the lack of strong common scab tolerance. Overall, this variety has great yield potential and excellent long term storability for chip processing. This variety has the potential to store and chip process into early June most seasons.

Lamoka (NY139)

In the 2010 Box Bin Trial, Lamoka yielded above the trial average at 382 cwt. /A US#1 (Table 2). This Cornell University developed clone can have a slightly elongated and pear shaped tuber type in the larger oversized tubers, but has great yield potential, excellent chip quality and some moderate common scab tolerance. NY139 expresses better common scab tolerance and longer term chip quality than the check variety Snowden. The vine maturity for NY139 is medium-late. A ten inch in-row seed spacing would be recommended for this variety because it can oversize. NY139 was placed into storage on September 28th 2010, with a 0.636 mg/g (X10) sucrose rating and a 0.002 mg/g glucose value. The sucrose and glucose levels were at their lowest in mid-January at 0.335 and 0.001, respectively. The picture above shows NY139 in mid-May with a 1.251 sucrose value and a 0.004 glucose value. Even when the sucrose had increased significantly, the glucose accumulated at a rather slow rate. The tuber percent weight loss was reported at 3.51 percent, with 0.4 percent of the tubers having bruise and discoloration under the skin. Overall, this variety has great commercial potential. Its yield and chip quality provide the industry with some potential improvements in duration of storability and common scab tolerance.

MSQ070-1

This MSU variety exhibited a below average yield in the 2010 Box Bin Trial. The recorded yield was 211 cwt. /A US#1 with a 1.085 specific gravity (Table 2). The tuber type and size of MSQ070-1 was uniform and round, but some sticky stolons were observed. The vine maturity for MSQ070-1 is late. An eleven inch in-row seed spacing would be recommended for this variety based on set and vine maturity. On September 28th 2010, this variety was put into storage with a 0.772 mg/g (X10) sucrose rating and a 0.002 mg/g glucose value. Sucrose and glucose levels came down to their lowest points in mid-January at 0.445 and 0.001, respectively. At this point in storage, the sucrose values began to rise to 1.146 in late April 2011. From mid-January 2011 until mid-April 2011, the glucose level remained at or below 0.005 mg/g. Total defects recorded for this variety on March 28th 2011 were 7.0 percent, resulting largely from a trace of stem end defect present in the tubers which can be observed in the picture above. The percent weight loss recorded at the time of bin unloading for this variety was 8.76, with 0.4 percent of the tubers evaluated expressing bruise with discoloration under the surface. Overall, this variety has good yield potential, but chip quality performance has been variable. Further testing is needed to develop a consistent trend.

Snowden

This variety is included as a reference point for the 2010 Box Bin Trial. The recorded yield for the Snowden variety was 346 cwt. /A US#1 with a 1.083 specific gravity (Table 2). On September 28th 2010, this variety was put into storage with a 0.608 mg/g (X10) sucrose rating and a 0.002 mg/g glucose value. Sucrose and glucose levels came down to their lowest points in early February at 0.342 and 0.001, respectively. At this point in storage, the sucrose values began to rise to 1.099 on April 11th 2011. The glucose level was at 0.013 mg/g, which can be visualized by the brown shading in the chips in the photo above. Total defects recorded for this variety on April 11th 2011 were 22.6 percent. The percent weight loss recorded at the time of bin unloading for this variety was 7.24, with 9.8 percent of the tubers evaluated expressing bruise with discoloration under the surface of the skin.

II. 2010 - 2011 Bulk Bin (500 cwt. Bin) Report

(Brian Sackett, Chris Long and Luke Steere)

Introduction

The goal of the MPIC Storage and Handling Committee for the 2010-2011 bulk bin storage season was to develop storage profiles on three promising advanced seedlings and to evaluate the effectiveness of a three way tank mix of a fungicide development by Syngenta Crop Protection, Inc. This fungicide is reported to control pathogen spread in potato storages. The pathology study began in the 2010-2011 storage season and will be reported on in the 2012 MPIC Research Report.

The first variety tested for storage profiling was Lamoka (NY139), a clone from the potato breeding program at Cornell University, Ithaca, NY. This clone has a strong yield potential, great late season chip quality and good common scab tolerance. MSJ126-9Y, the second variety of interest, is an MSU developed clone with good agronomic quality, common scab resistance and yellow flesh. The third variety, W2133-1, developed at the University of Wisconsin, has good yield, good tuber qualities and good chip quality from mid-season storage.

For each of the varieties listed above a brief description of agronomic and storage performance is provided. In addition, a short description of pressure bruise susceptibility, chip color and color defects, sugar accumulation and overall chip quality are given. With this information, a clearer perspective can be obtained regarding the viability of these varieties in commercial production.

Procedure

Each bin was filled under contract with potato producers in the state of Michigan. MPIC paid field contract price for the potatoes to be delivered to the demonstration storage. Pressure bruise samples were taken 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 a warmer temperature, in most cases, than the corresponding bulk bin of the same variety. Sugar sampling for the box bin was carried out longer into the storage season, in general, than the bulk bin. 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 might physiologically age.

In the 2010-2011 storage season; Bins 1 and 2 were filled with Lamoka (NY139); Bins 3 and 4 were filled with MSJ126-9Y and Bins 5 and 6 were filled with W2133-1. Bulk Bins 8 and 9 were used for the pathology study and were filled with the variety Pike.

Lamoka was grown by Lennard Ag. Co. and was loaded into Bin 1 and Bin 2 on September 8, 2010. They were planted on April 10, 2010, and vine killed on August 16, 2010 (98 DAP, 3519 GDD_{40}). The variety was harvested on September 8, 20010; 121 days after planting. The pulp temperature for Lamoka at bin loading was 62.1 ºF. A blackspot bruise sample was taken on this variety for each of the two bins at the time of bin loading. The results indicated that the tubers in Bin 1 were 82% bruise free and the tubers in Bin 2 were 76% bruise free. Some tuber breakdown was noted at the time of bin loading and was believed to be caused by Soft Rot.

MSJ126-9Y was grown by Thorlund Brothers and was loaded into Bins 3 and 4 on September 29, 2010. This variety was planted on May 24, 2010, and vine killed on September 7, 2010 (109 DAP, 3212 GDD_{40}). The variety was harvested on September 29, 2010; 131 days after planting. The pulp temperature for MSJ126-9Y at bin loading was 62.3 ºF. A blackspot bruise sample was taken on this variety at the time of bin loading. The results indicated that the tubers in Bin 3 were 88% bruise free and the tubers in Bin 4 were 66% bruise free.

W2133-1 was grown by Walther Farms and was loaded into Bins 5 and 6 on October 14, 2010. They were planted on May 29, 2010, vine killed on September 16, 2010 (111 DAP, 3502 GDD_{40}) and harvested on October 14, 2010; 139 days after planting. W2133-1 had a pulp temperature at bin loading of 60.8 ºF. A blackspot bruise sample was taken on this variety at the time of bin loading. The results indicated that the tubers in Bin 5 were 84% bruise free and the tubers in Bin 6 were 84% bruise free.

Bins 3 and 4 were gassed with CIPC and Clove Oil on October 21, 2010. Bins 1, 2, 5 and 6 were gassed with CIPC and Clove Oil on November 4, 2010. On January 17, 2011, Bin 1 was gassed with CIPC and Clove Oil for a second time. Bin monitoring began the day the tubers were placed into storage and were evaluated on a two week sampling 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 is an access door that allows samples to be taken 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 5, 10, and 15 feet from the storage floor.

The pressure bruise samples were evaluated 3 to 5 days after the bin was unloaded. A set of 25 tubers were randomly selected from each bag and visually inspected for pressure bruise. Each bruise was evaluated for discoloration by removing the tuber skin with a knife. A visual rating was given to the bruise for the presence or absence of flesh color (blackening of flesh). Percent weight loss in each tuber sample was calculated as it was removed from the storage.

Objective

The Storage and Handling Committee's objective in testing the varieties in Bins 1-6 was to determine what the optimal storage temperature was for each variety, while maintaining acceptable storage and chip quality. Also of interest was the level of pressure bruise damage that may be incurred by each variety at a given storage temperature. The goal for the Lamoka (NY139) variety was to evaluate longevity at a given storage temperature while maintaining chip quality. Based on initial storage sugar samples and the evidence of elevated sucrose levels, Bins 1 and 2 were held at 55 to 56 degrees F in order to respire off sugar accumulation. Evidence of physical immaturity and the presence of Black Leg in 5 percent of the tubers affected the long term goals for these potatoes. The immediate goals became: 1) get the potatoes to a point of acceptable chip quality, 2) maintain physical storability of the potatoes. The goal for Bins 3 and 4 was to evaluate tuber and chip quality at a given storage temperature. There was a mix of white flesh and yellow flesh tubers in Bin 4, so the bin was sold early for processing, and consequently no valid information was gained from this bin. The goals for the W2133-1 in Bins 5 and 6 were to evaluate chip quality and tuber quality over time at two different storage temperatures.

Bulk Bin 1, Lamoka (NY139)

Lamoka is a common scab tolerant, round to oval shaped chip processing variety from Cornell University. The variety has shown to have good chip quality late from 48 ºF storage with good internal quality. In the 2010 on-farm variety trials, this line yielded 378 cwt. /A US#1. It has a three year yield average from 2008-2010 of 412 cwt. /A US#1. The specific gravity of this variety averages between at 1.078 – 1.085. Potential draw backs of this variety could be Black Leg and Black Heart susceptibility. These defects need to be evaluated more extensively over different environments and years.

For the 2010-2011 storage season, this variety was grown by Lennard Ag. Co., Sturgis, Michigan, which is located in St. Joseph County. The tuber pulp temperature, upon arrival at the storage, was 62.3 ºF. The variety was tested and found to be 82 percent black spot bruise free after bin loading. The tuber quality was of concern based on the presence of some Soft Rot in the tubers, as well as, the high level of sucrose observed in the initial storage samples. This bin was held warm for a longer period than desired to help remove the latent sucrose. Pile humidity was reduced to slow the spread of the Soft Rot pathogen.

This bin was loaded on September 8th 2010, and was held at 56 ºF until early November, at which time the sucrose levels decreased to 0.688 mg/g (X10) rating. The sugar related chip defects began to decrease, as well, in mid-November. The sucrose levels were at their lowest point in mid-December at 0.398 mg/g (X10). From this point, until mid-February, this bin was chip processing acceptably. Bin 1 was chip processed in early March as a result of increasing sucrose levels. From early January 2011 to early March, Bin 1 remained at or around 50 ºF. At the time of bin unloading, tuber weight loss was 7.6 percent, with 8.4 percent of the tubers that expressed pressure bruise having discoloration under the skin. The higher than normal amount of tuber flesh discoloration can be explained by the reduction in humidity levels early in the storage season to help reduce the spread of the Soft Rot. The Lamoka tubers from this bin were processed at Utz Quality Foods on March 1st, 2011, with a 1.079 specific gravity, 3 percent external chip defects and 6 percent internal chip defects. The external defects were reported to be mostly pressure bruise.

Lamoka has exhibited great agronomic qualities; such as high yield potential, common scab tolerance and good chip quality in small plot tests. The field production of this lot of potatoes was not ideal. The first potential problem was the shortened growing season, as a result of early vine desiccation of the main crop variety in this production field, resulting in physiologically immature tubers. This was evident by the high sucrose levels early in storage. Lamoka has shown to be a 130 day potato, slightly later than the standard chipping variety Snowden. All varieties in the field with Lamoka were also reported to have a similar level of Black Leg. Overall, this variety has many great qualities and needs to be evaluated in large acre trials for a number of years to better understand the storability of this variety.

Bulk Bin 2, Lamoka (NY139)

These Lamoka potatoes are identical to those in Bin 1. They were produced by Lennard Ag. Co. and more detail regarding their production can be obtained by reading the report from Bin 1. This bin was filled at the same time as Bin 1 on September 8th, 2010. The pulp temperature was good at 62.3 ºF. On arrival, the tubers exhibited signs of physiological immaturity and Soft Rot. The variety was evaluated to be 76 percent bruise free. The initial sucrose rating was 1.069 on September 8th. The pile temperature was maintained at 56.0 ºF after bin loading until early November, when the pile was cooled to 54.0 ºF by late November 2010. The sucrose rating decreased to 0.486 mg/g (X10) and the glucose level was 0.009 mg/g. Fan time and fresh air were maintained at the highest level possible to slow disease spread and encourage tuber respiration. Pile humidity was also reduced to help dry the potato tubers in the pile. All these efforts did not result in being able to maintain tuber quality. Bin 2 was unloaded in early December due to a large amount of wet tuber breakdown resulting from Soft Rot.

Bulk Bin 3, MSJ126-9Y

MSJ126-9Y is an MSU variety from the Potato Breeding and Genetics program. This variety has moderate tuber size with a generally round appearance. The common scab tolerance is strong. The US#1 yield for this variety is 350 cwt. /A over three years from 2007-2009. The specific gravity is average, ranging from 1.076 to 1.085 in Michigan. MSJ126-9Y was grown by Thorlund Brothers, Inc. in Greenville, MI. The variety has a good set of medium size tubers that average 2.0 to 3.25 inches in diameter. The storage was filled on September 29th 2010 with a pulp temperature of 62.3 ºF. The variety was evaluated to be 88 percent bruise free.

The variety was maintained at or around 56 ºF until early December. In mid-December, Bin 3 had a 0.636 sucrose level and a 0.001 glucose level, which led the Storage and Handling Committee to cool the pile to 52 ºF. The varieties' sucrose values decreased steadily from an early storage high level to its' lowest point of 0.490 in mid-February, 2011. The glucose level in the tubers varied between 0.001 and 0.003 mg/g fresh weight, November to March. Pile temperature was maintained around 52.0 ºF until mid-February. By early April, the sucrose level began to rise and it was decided that the tubers were losing physiological life and the bin was shipped to Better Made Snack Foods for processing. Tuber weight loss numbers at bin unloading were good at 4.62 percent, and 0.0 percent of the tubers expressed pressure bruise and discoloration under the skin.

On April 20th 2011, the bin was sent to Better Made for processing. The picture in the upper right shows a snap-shot of the chip quality from this bin. The total defects are higher than desired at 10.25 percent. These defects appear to be comprised of mostly stem end and internal sugar related defects. The stem end is quite severe. The sugar related defects could have been reduced by processing the bin at an earlier date. Agronomically, the variety performed well, exhibiting strong common scab tolerance.

Bulk Bin 4, MSJ126-9Y

This bin suffered from an extreme amount of tuber mix, occurring in field production. Due to the high volume of variety mix, the bin was shipped early for processing and no data was collected from this storage bin of MSJ126-9Y.

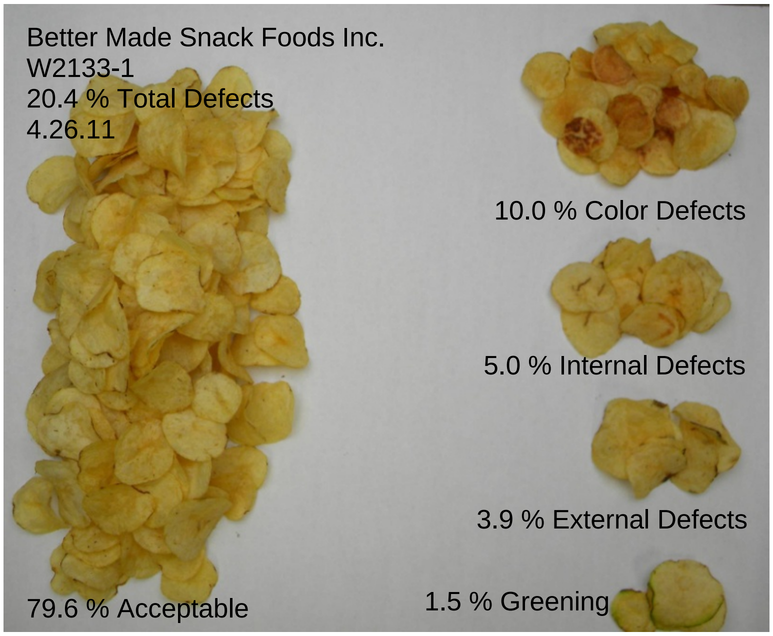
Bulk Bin 5, W2133-1

W2133-1 is a University of Wisconsin developed variety. In the 2010 on farm trials, this variety yielded 496 cwt./A US#1. It has a three year US#1 yield average of 490 cwt./A from 2008-2010. This variety is uniform round in type. It exhibits some moderate common scab tolerance. In-row seed spacing is recommended at 10.5 to 11.5 inches. The tuber set per plant is 10-18 tubers.

The potatoes in Bin 5 were grown by Walther Farms, Three Rivers, MI., and were harvested and loaded into storage on October 14th 2010, with a pulp temperature of 61.0 ºF. The overall size profile of the tubers was small, with 50 percent of the tubers being under 3 inches in diameter. The tubers were determined to be 84% bruise free after bin loading. The tubers were held for two weeks to suberize and then were cooled at 0.2 ºF per day until the potatoes reached a pulp temperature of 52.0 ºF in early December 2010. At this time, the status of the potatoes was reevaluated and then cooled to 49.0 ºF for holding. In mid-February 2011, the tubers reached their most stable sugar levels of the storage season, with a 0.445 sucrose value and a 0.002 glucose value. From this point, the sucrose value rose steadily until the potatoes were shipped in late April. Because the sucrose and glucose levels were increasing steadily, it was determined that the bin was losing dormancy and should be shipped with a 0.686 sucrose rating and a 0.008 glucose value. The pile temperature was 52.0 ºF on the date of shipping.

The picture at the upper right depicts the overall chip quality of this load after processing at Better Made Snack Foods, Inc. on April 26, 2011. Hollow Heart was evident in the internal chip defects, as well as, some pressure bruise in the external defect score. The amount of green was significant and can be attributed to heavy rain during the growing season. The weight loss in this bin was at 5.59 percent, with 5.8 percent of the tubers having pressure bruise and discoloration under the skin, which was evidenced in the external defects. This bin of W2133-1 processed acceptably at Better Made. The specific gravity of the tubers at the time of processing was 1.081. Overall, this variety has good chip quality and processing potential into April. Yield potential can be variable and is potentially negatively affected by this variety having a late vine maturity. The lateness of this variety affects tuber size and yield as well. Managing nitrogen inputs and providing adequate length of growing season are important factors in managing this variety. W2133-1 consistently chips into late March and early April.

Bulk Bin 6, W2133-1



The potatoes in Bin 6 were also grown by Walther Farms, Three Rivers, MI., and were also harvested and loaded into storage on October 14th 2010, with a pulp temperature of 61.0 ºF. Upon arrival, the tubers were held for two weeks to suberize and then were cooled at 0.2 ºF per day until the potatoes reached a pulp temperature of 52.0 ºF in early December 2010. At this time, the status of the potatoes was reevaluated and then cooled to 47.8 ºF for holding. The tubers were determined to be 84% bruise free after bin loading. In mid-January 2011, the tubers reached their most stable sugar levels of the storage season with a 0.484 sucrose value and a 0.002 glucose value. The tubers in Bin 6 reached this point much earlier than those in Bin 5, possibly due to the cooler storage temperature. From this point, the sucrose values remained mostly stable until mid-April. Because the sucrose and glucose levels were increasing slightly, it was determined that the bin was losing dormancy and should be shipped with a 0.634 sucrose rating and a 0.002 glucose value. The pile temperature was 52.0 ºF on the date of shipping. The desire of the Storage and Handling Committee was to hold Bin 6 at 2 degrees cooler than Bin 5 and evaluate the difference in tuber and chip quality. The cooler storage temperature appeared to slightly improve chip quality.

The picture at the upper right depicts the overall chip quality of this load after processing at Better Made Snack Foods, Inc. on April 26, 2011. Some Hollow Heart was evident in the internal chip defects, as well as, some pressure bruise in the external defect score, similar to Bin 5. The amount of greening of the tubers was much less in Bin 6 than in Bin 5; this was difficult to explain. Better Made reported the tubers to be somewhat undersize in this bin as well. Specific gravity was recorded at 1.084. The weight loss in this bin was at 6.29 percent, with 5.3 percent of the tubers having pressure bruise and discoloration under the skin; this was evidenced in the external defects. This bin of W2133-1 processed acceptably at Better Made. W2133-1 appears to be able to store at temperatures as low as 47.8 ºF. The cooler storage temperature does appear to improve chip quality and the overall physical condition of the tubers at the time of tuber processing. It is possible that W2133-1 can be stored cooler and not induce sugar accumulation.