2010 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 Farm, Lake City Experiment Station, Muck Soils Research Farm, 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). 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 solids, insect resistance, disease resistance and nutritional enhancement. 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 addition of the SolCAP translational genomics project, funded through the USDA, will enhance our abilities to identify important traits 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 and we can use for linking to traits of interest such as dry matter content, low reducing sugars, bright skin, disease resistance, etc. The USPB is supporting national early generation trials called the National Coordinated Breeder Trial (NCBT) which will feed lines into the SFA trial.

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 Muck Soils Research Farm for late blight testing (now moving to Clarksville), 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 Farm, new land at the Lake City Experiment Station along with a well for irrigation and expanded land at the Montcalm Research Farm 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.

PROCEDURE

I. Varietal Development

The MSU breeding program has been operating for over 20 years and we feel that we have reached a point of "clarity and focus". We have the genetic variation to combine tuber shape, skin type, scab resistance and low sugars, yield and storability as well as late blight resistance. We have increased our standards for what we consider a commercial selection because of this clarity and focus. In addition, 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 2010 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. Five of these are in commercial seed production (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.

Each year the MSU breeding program will cross elite germplasm to generate and evaluate 50,000 new seedlings for adaptation to Michigan. In the subsequent years these selections are then advanced to 12-hill, 30-hill, 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 Farm. 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 Farm 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 or PVY expressing 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 Farm, 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*), drought resistance (*CBF1*), PVY, late blight resistance from *S. microdontum*, and lower reducing sugars with acid invertase gene silencing.

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 2010 field season, progeny from over 500 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 2010 harvest, over 1,200 selections were made from the 50,000 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 300 and 60 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.

Chip-Processing

Over 80% of the single hill selections have a chip-processing parent in their pedigree. Our promising chip-processing lines are MSJ147-1, MSH228-6 (moderate scab resistance), 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).

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 are planning to release four lines for the specialty market (MSN215-2P, MSR226-1RR, MSQ425-4PY and Midnight). 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 2010, while others were tested under replicated conditions at the Montcalm Research Farm. Promising tablestock lines include MSL211-3, MSQ440-2, MSM182-1 and MSL268-D and MSQ176-5. We have a number of tablestock selections with late blight resistance (MSQ176-5, MSM182-1, and MSL268-D). MSL211-3 has late blight and moderate scab resistance with 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), MSQ440-2 (scab resistant) and MSN230-6RY (scab and late blight 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 pigmented lines are MSS576-05SPL (red splash) and Michigan Red and Purple Splash. MSQ558-2RR and MSR226-1RR are red fleshed chippers and Midnight is a purple-fleshed chipper.

Early harvest breeding material screen

In 2010, we had a second 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 191 lines, we were able to identify some promising early breeding lines for the out-of-the-field chipping and tablestock use. **Table 1** (*next page*) 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 2011. Some of these lines are MSQ035-3, MSQ086-3 and MSR127-2. We also identified some desirable early tablestock lines among this material tested. These lines are MSL211-3, MSM182-1, MSM288-3Y, MSQ440-2 and MSS576-05SPL.

Table 1 Early Observation Trial: Most promising lines.

Line	1=Good; 4=Bad Merit	Total Weight (kg)	Specific Gravity	OTF Chip	8/16/10 MAT	Female	Male
Atlantic	**2**	**9.88**	**1.088**	**2.0**	**2.0**		
FL1879	**2**	**6.26**	**1.068**	**1.0**	**2.5**		
Kalkaska (J036-A)	**2.5**	**7.62**	**1.073**	**2.0**	**2.5**		
Snowden	**2**	**8.46**	**1.079**	**1.5**	**2.5**		
Michigan Purple	1.5	9.10	1.066	-	1.0	-	-
MSL211-3	1	11.14	1.070	-	2.0	MSG301-9	J. Lee
MSM182-1	2	6.78	1.059	-	2.5	Stirling	NY121
MSM288-2Y	2	9.94	1.067	1.5	2.5	MSG145-1	MSA097-1Y
MSN215-2P	1.5	6.97	1.064	-	2.0	MI Purple	Norland
MSNDU045-1	2	7.39	1.057	1.5	2.0	-	-
MSQ035-3	2	9.44	1.075	1.0	3.0	MSG227-2	Missaukee
MSQ086-3	2	9.09	1.076	1.0	3.0	Onaway	Missaukee
MSQ341-BY	2	7.11	1.071	1.0	2.5	MSJ126-9Y	NY120
MSQ425-4Y	2	9.66	1.069	-	2.5	MSG147-3P	MSJ319-1
MSQ440-2	1.5	8.78	1.060	-	2.5	MSK214-1R	Missaukee
MSQ461-2PP	2	9.26	1.074	1.5	3.0	NY120	POROOPG2-16
MSR089-9Y	2	7.79	1.080	1.0	3.0	MSJ319-1	OP
MSR127-2	2	8.04	1.077	1.5	3.0	MSJ167-1	MSG227-2
MSR214-2P	2	5.59	1.083	-	3.0	ND5084-3R	MSJ317-1
MSR219-2R	2	5.68	1.055	-	2.5	NDTX4271-5R	Stirling
MSR241-4RY	2	5.93	1.073	-	2.5	PoorpG9-3	MN96013-RY
MSS258-1	2	6.28	1.061	1.5	2.5	MSH098-2	MSH228-6
MSS576-05SPL	1	9.74	1.066	-	2.5	MSI005-20Y	MSL211-3
MSU161-1	2	7.09	1.068	2.5	3.0	MSM182-1	MSL211-3
MSU200-5PP	2	4.16	1.057	1.5	3.0	MSN111-4PP	NDTX4271-5R
MSU278-1Y	1.5	8.01	1.060	2.5	3.0	Torridon	MSL211-3
Reba	2	8.15	1.067	-	2.5	-	-

Disease and Insect Resistance Breeding

Scab: Disease screening for scab has been an on-going process since 1988. In 2010 we added an on-farm trial and a new site at the Montcalm Research Farm for scab evaluation. Some of results are summarized in **Table 2**. The susceptible checks of Snowden and Atlantic were highly infected with pitted scab. Interestingly, Onaway had pitted lesion in the on-farm field. Promising resistant selections were CO95051-7W, MSJ126-7Y, MSH228-6, MSL007-B, MSR061-1, MSR169-8Y, MSP270-1, MSQ279-1 and MSQ440-2. The high level of scab infection at the on-farm site with a history of scab infection and MRF helped with our assessment of resistance and susceptibility. Results from the 2010 MSU scab nursery were not used because the level infection was too low. We also had to drop our scab inoculation study to examine factors to increase scab in the field because of low infection on the tubers! The MRF scab site was used for assessing scab susceptibility in our advanced breeding lines and early generation material. Of the advanced breeding lines 60 of 160 lines evaluated had a scab rating of 1.0 or less (better than Pike). The single observation early generation assessment for scab resistance among our breeding material was very good. In 2010, 97 of 227 early generation selections showed strong scab resistance (rating of 1.0 or better). 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.

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. Previous trials were conducted at the MSU Crops Barn and resulted in poor tuberization and thrip infestations. For the spring, 2010 trial the NFT system was moved to our greenhouse in order to better control the intensity of light, the day-length and insect pressure and thereby improve tuberization. In general, each plant produced 1 mini-tuber with some plants producing two to three mini-tubers. We also tried using plastic cups for this trial rather than peat pots. This was done so that we could monitor stolon development and be better able to time the application of the inoculum. The plastic cups did allow us to see the stolons developing but may have contributed to the poor vigor of the plants and an unexpected number of rotten tubers.

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). In Liberator, 22% of the control tubers were infected (small patches of raised lesions), 92% of the tubers in inoculated vermiculite were infected and 72% of the tubers that were drenched were infected. Based on scab index ratings, there was no difference between tubers in inoculated vermiculite (1.6 scab index rating) and those that were drenched (2.4 scab index rating).

Based on the results of this study we will continue to conduct NFT trials in the greenhouse under the same growing conditions. However, we will revert to using peat pots rather than plastic cups. Not only were the plastic cups difficult to prepare, they

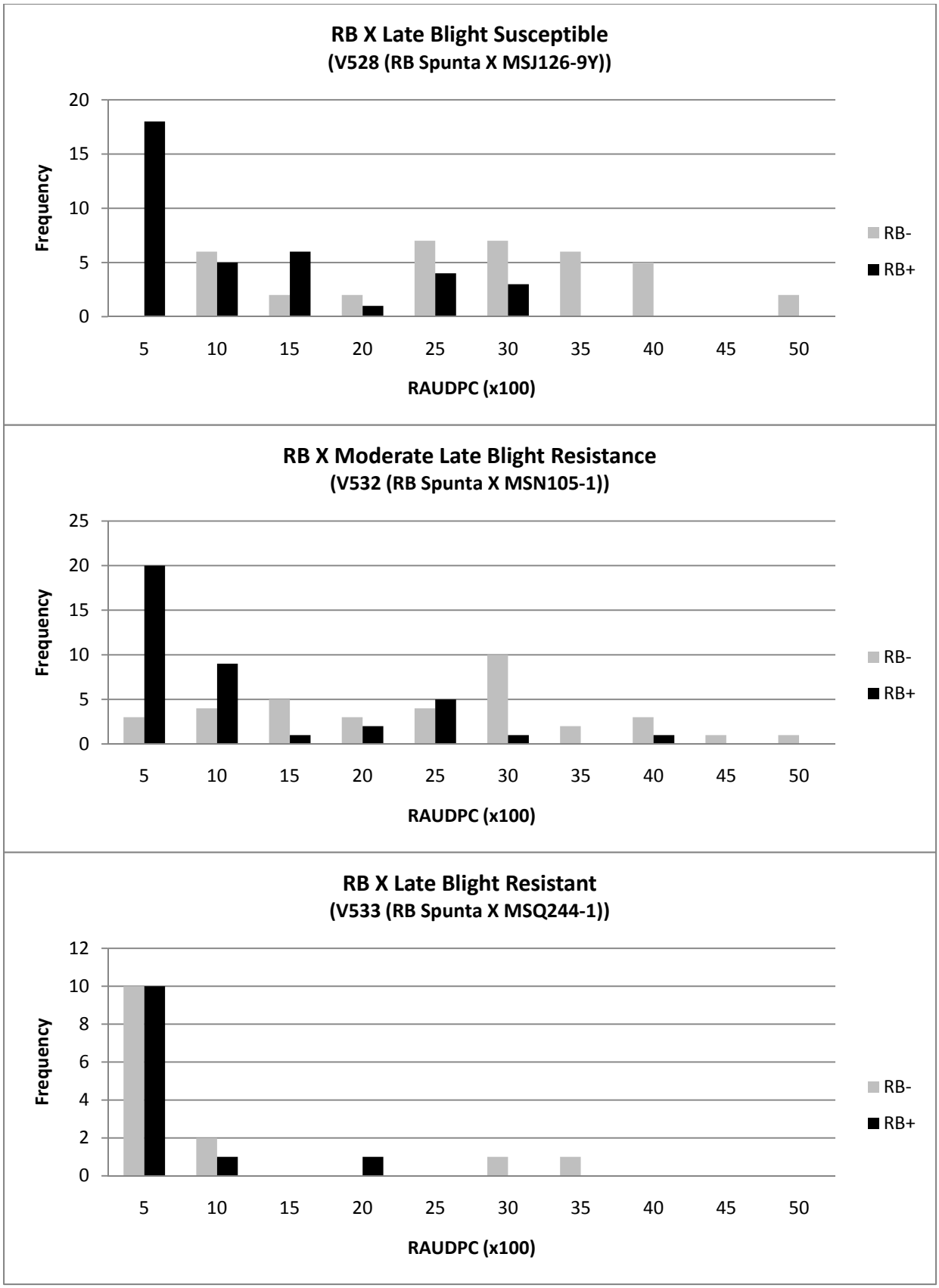
retained more water and impeded the solution flow through the troughs allowing nutrient solution to stand in the troughs. This likely contributed to poor plant vigor and tuber rot. As there was no difference in the amount of disease between the 2 inoculation methods, we will use inoculated vermiculite 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. We feel as though we have optimized the system and are ready to conduct replicated trials on multiple breeding lines. The NFT study is supported through Project GREEEN.

Table 2. *Streptomyces* Scab Trial Results from three trial locations.

	Location		
Line	**On Farm**	**Montcalm**	**Campus**
Chip-processing Lines			
Atlantic	**3.8**	**2.9**	**2.0**
Snowden	**3.0**	**2.9**	**1.5**
Beacon Chipper	**3.0**	**2.0**	**1.0**
Kalkaska	**1.8**	**1.5**	**0.5**
Pike	**1.5**	**1.1**	**0.9**
CO95051-7W	1.0	1.5	1.0
MSJ126-9Y	1.0	1.0	1.0
MSH228-6	2.0	1.0	1.0
MSL007-B	2.0	1.0	1.0
MSJ147-1	1.3	1.3	1.0
MSL292-A	3.5	2.5	1.5
MSR061-1	1.6	1.3	1.0
MSQ070-1	1.5	1.3	0.5
MSP270-1	1.0	1.0	0.5
MSQ035-3	1.8	1.0	1.0
MSR169-8Y	2.0	1.0	0.5
MSQ279-1	1.3	1.3	1.0
Mean	*1.9*	*1.5*	*1.0*
Tablestock Lines			
Onaway	2.3	2.1	0.8
MSL211-3	2.3	2.2	1.7
MSQ176-5	3.5	3.0	1.5
MSN215-2P	1.0	1.0	0.0
MSQ440-2	1.3	1.8	0.5
Mean	*2.1*	*2.0*	*0.9*

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. In 2010 we conducted late blight trials at the Muck Soils Research Farm. We inoculated with the US8 genotype, but the foliar reaction to the *Phytophthora infestans* was different from all previous years. 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 2010. This difference in late blight reaction could be attributed to the US22 genotype that was found in fields in Michigan. In the 2010 trials, 39 of 139 early generation lines were resistant to late blight comprised of 15 sources of late blight resistance. Of the 157 advanced breeding lines and varieties tested, 37 were resistant. 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. 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*. 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*. 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. *Agrobacterium*-mediated transformation has been used to introgress the RB gene, cloned from *Solanum bulbocastanum*, into susceptible cultivars. We have crossed these lines with the conventionally-bred resistant lines and applied the same marker-assisted selection strategies to characterize the lines that may be combining late blight resistance R-genes. Twelve of 20 4x selections express the RB gene for resistance to late blight in the 2010 trials. In addition, we compared three crosses for their late blight reaction when segregating for the RB gene. Spunta-RB (a late blight resistant transgenic line) was crossed to susceptible (MSJ126-9Y), moderately resistant (MSN105-1) and resistant (M244-1) line. Progeny were determined to be carrying the RB gene (RB+) or not (RB-). Foliar late blight reaction was measured on each individual in the cross over three replications. The crosses segregating for late blight resistance genes gave us valuable information. The data is summarized in the three figures. In all three crosses the majority of the RB progeny were resistant to late blight. The frequency of progeny with late blight resistance increased in relation to the late blight resistance of the parent crossed to Spunta-RB. The cross with only one resistant gene had a few progeny with late blight resistance. The lines with at least two resistant genes segregating had a much higher frequency of progeny with a high level of resistance to late blight. For example, only 6 of the 26 progeny in the Spunta-RB x MSQ244-1 cross were classified as susceptible. This study supports our breeding efforts to combine resistance genes to late blight to achieve more durable resistance. This is a GREEN-funded project.


RB X Late Blight Susceptible
(V528 (RB Spunta X MSJ126-9Y))
Frequency
20
15
10
5
0
5 10 15 20 25 30 35 40 45 50
RAUDPC (x100)
RB-
RB+
RB X Moderate Late Blight Resistance
(V532 (RB Spunta X MSN105-1))
Frequency
25
20
15
10
5
0
5 10 15 20 25 30 35 40 45 50
RAUDPC (x100)
RB-
RB+
RB X Late Blight Resistant
(V533 (RB Spunta X MSQ244-1))
Frequency
12
10
8
6
4
2
0
5 10 15 20 25 30 35 40 45 50
RAUDPC (x100)
RB-
RB+

Colorado potato beetle: With support from GREEEN, we conducted our Colorado potato beetle resistance screening. In 2010 we focused on screening our selections with detached leaf bioassays (no-choice) and screening new genetic material for resistance. The new species were screened through detached leaf bioassays and screened field cages. Some breeding lines were at least moderately resistant or showed reduced susceptibility to Colorado potato beetle in the detached leaf bioassays. In the field cages, the adults that were added to the cages clipped the leaves on some of the lines. We have seen this behavior previously when we have strong resistance but the beetles have no choice. We need to repeat the testing of some of these lines in 2011 and study larval behavior. Some of these lines are beginning to enter the preliminary trials in the breeding program and are being used as parents for further breeding. We have been using the moderately resistant breeding lines for crossing and we have been selecting seedling with improved tuber appearance. Combining host plant resistance to insects in a commercially acceptable line is a great challenge.

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 two 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 2009 and 2010. These early generation selections will be further evaluated in 2011 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 2009 - June 2010)

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 11 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 2009, tuber samples from 19 MSU lines from the Montcalm Research Farm and Lake City Experiment Station trials were placed in the bins along with four check varieties. The first samples were chip-processed in October and then 8 more times until June 2010. Samples were evaluated for chip-processing color and defects. **Table 3** summarizes the chip-processing color and scab rating of 19 lines and four check varieties (Atlantic, FL1879, Pike and Snowden) over the 7-month storage season. From November a number of lines had poor chip color that was attributed to the cold harvest conditions of some of the lines (Kalkaska, MSQ035-3, MSR102-3, MSR159-02,

MSR058-1 and MSQ131-A). Other lines chip processed well from the storage until April. The lines that chip processed well until May were MSP459-5, MSP270-1 and MSR061-1.The lines that chip processed exceptionally well until June were MSH228-6, MSJ126-9Y, MSL292-A, and Pike. These lines are highlighted in the table. We are that some of the lines with good chip quality also have scab resistance and/or late blight resistance.

Table 3: 2009-2010 Demonstration Storage Chip Results of Elite MSU Breeding Lines

			11/10/09	12/9/09	1/5/10	2/1/10	3/1/10	4/7/10	5/10/10	6/2/10
		2010	SFA Chip Score Rating Scale 1-5							
Line	**Resistance**	Scab	56 F	55 F	55 F	55 F	55 F	55 F	54 F	54 F
Atlantic		**2.9**	**2.0**	**1.5**	**1.5**	**1.5**	**1.0**	**1.5**	**ND**	**ND**
Beacon Chipper	ScabMR	2.0	1.0	1.5	1.0	1.0	1.5	2.5	2.5	2.5
FL1879		**3.5**	**1.5**	**1.0**	**1.0**	**1.0**	**1.5**	**1.0**	**1.5**	**2**
Kalkaska	ScabR	1.5	2.5	2.0	2.0	2.0	1.5	2.0	2.5	2.5
MSH228-6	ScabR	1.0	1.0	1.0	1.5	1.5	1.5	1.5	1.0	1.5
MSJ126-9Y	ScabR	1.0	1.0	1.0	1.5	1.0	1.5	1.0	1.0	1.5
MSJ147-1	ScabMR	1.3	1.0	1.0	1.5	1.0	1.0	1.5	2.0	2
MSK061-4	ScabR	-	1.0	1.0	1.5	1.0	1.0	1.5	2.5	3
MSL292-A		2.5	1.0	1.0	ND	1.0	2.0	ND	1.0	1.5
MSN148-A	ScabMR	1.5	1.0	1.0	1.0	1.0	1.5	2	2.5	3.5
MSP459-5		3.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	ND
MSP270-1	ScabR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5	2
MSQ035-3	ScabR, LBR	1.0	3.0	2.0	2.0	1.5	2.5	2.0	1.5	2
MSQ070-1	ScabR, LBR	1.3	1.0	1.0	1.0	1.0	1.0	1.5	2.0	2.0
MSQ131-A	LBR	-	3.0	2.0	2.0	2.0	2.0	ND	ND	ND
MSQ461-2PP		2.0	1.0	1.0	1.5	1.5	1.5	1.5	1.5	2
MSR036-5	ScabR, LBR	1.0	3.5	2.5	2.5	2.5	2.5	2.5	3.0	3
MSR058-1	ScabMR, MRLB	1.5	3.0	2.0	2.0	2.0	2.0	2.0	1.5	2.5
MSR061-1	ScabR, LBR, PVYR	1.3	1.0	1.5	ND	1.0	1.0	1.5	1.5	ND
MSR102-3	LBR ScabR	1.0	2.5	1.0	1.5	1.5	1.0	1.5	ND	2
MSR159-02	MRScab	2.0	3.0	ND	2.0	ND	2.5	2.0	2.0	2.5
Pike	**ScabR**	**1.1**	**1.0**	**ND**	**1.0**	**1.0**	**1.5**	**1.0**	**2.0**	**1.5**
Snowden		**2.9**	**2.5**	**1.5**	**1.5**	**1.0**	**1.0**	**2.5**	**3.0**	**3**

Early generation sugar profiling was also conducted on a series of MSU advanced breeding lines. These glucose and sucrose sugar profiles are presented in Figures 1 and 2. The results confirm the good storage potential of MSJ126-9Y, MSH228-6 and MSL292-A. MSJ147-1 has stored longer in 2010 than 2009. The long storability advantage has been compromised by the average or below average yield in commercial fields. Of the newer advanced breeding lines tested MSQ070-1 and MSR061-1 showed promising sugar profiles. Both lines exhibit scab resistance.

During the 2009-10 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. 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. 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. 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. A second study 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.

Table 4. Overall Analysis of Variance of main effects means for acrylamide for variety, process-type, and processor effects.

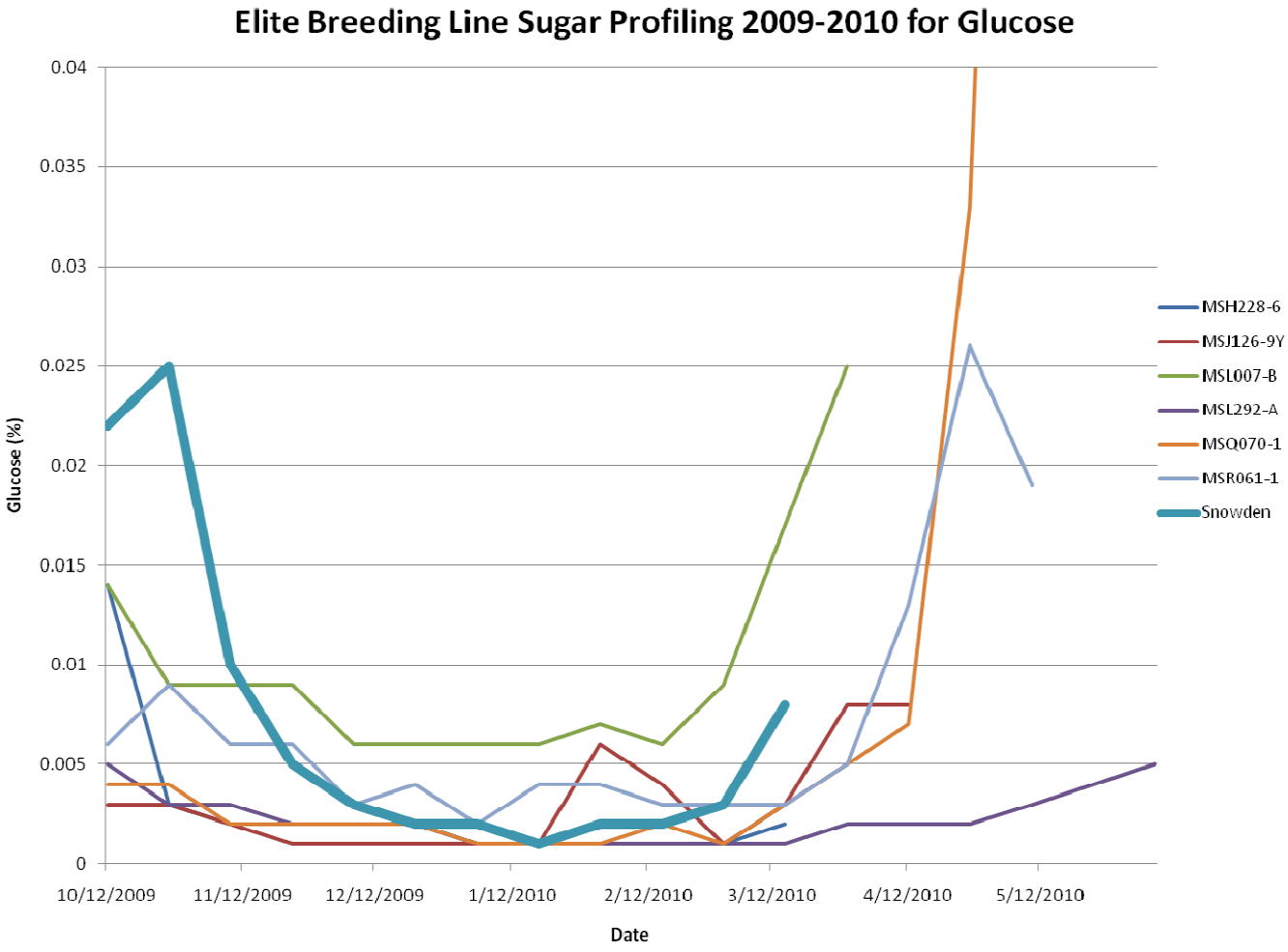
Overall ANOVA of Main Effects for Acrylamide

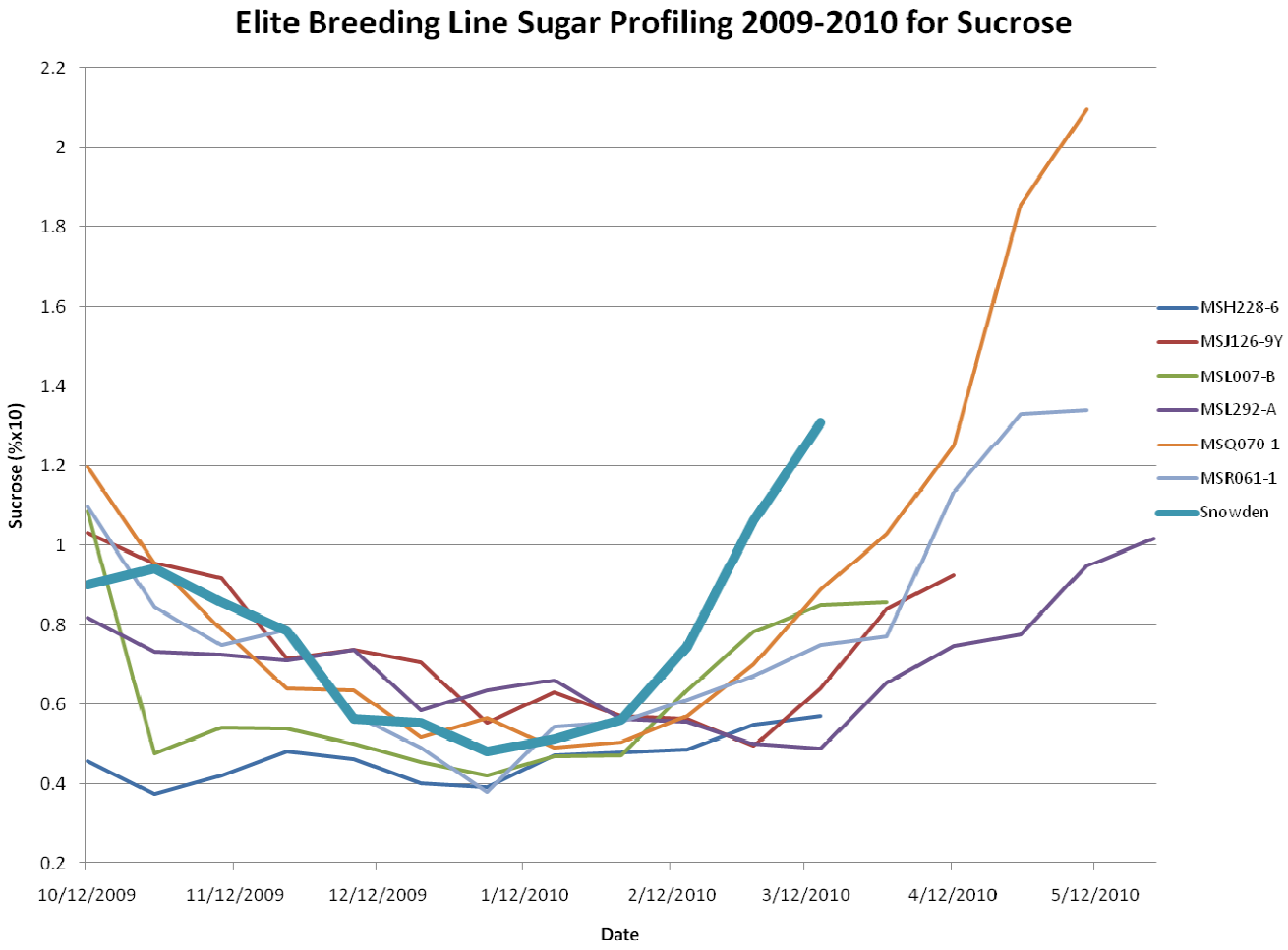
				Acrylamide (ppb)
Variety Effect				
Variety 2	A			708
Variety 1	A	B		644
Variety 4		B		552
Variety 3			C	401
Process-type Effect				
Continuous	A			733
Test Batch	A			635
Kettle		B		395
Processor Effect				
Processor 2	A			780
Processor 5	A			679
Processor 6	A	B		594
Processor 1		B		489
Processor 4		B		469
Processor 3		B		463

*Effects were analyzed separately. Effects with the same letter are not significantly different at α=0.05.

We propose to conduct a follow up study to the 2009 season so that we can have a better understanding of the season effect on acrylamide formation in the chips. We will examine three potato lines: Snowden, MSJ147-1 and NY139. We will sample the tubers every four weeks during the storage season until the tubers reach physiological maturity. The tuber samples will be processed by TechMark and one commercial processor. The chips will be sent to MSU for processing and the University of Wisconsin will run the acrylamide analysis.

Snowden and MSJ147-1 are chosen because these two lines were the best lines for maintaining low acrylamide levels in the 2009-10 storage season. We need to make direct comparisons to that year. We will also include NY139 because of Michigan's commercial interest in this line.





National Coordinated Breeder Trial (NCBT)

2010 was the first 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, TX, CA) in addition to a scab trial in MN. A total of 220 lines were tested as 15-hill single observation plots. The lines were evaluated for tuber type and appearance, yield, specific gravity, chip color and chip defects. 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 2011 and new early generation lines will be added. **Table 5** summarizes the data of the location merit rating. Three checks (Atlantic, Snowden and Megachip) and 68 lines are included in the table. Lines that received a high merit rating in at least two locations are included in the table. Those lines that had a high rating in at least two southern locations are highlighted in yellow. Those lines that had a high rating in at least two northern locations are highlighted in green. Those lines that had a high rating in at least two northern and southern locations each are highlighted in blue. MSU had 19 of the 68 lines in the table. Moreover, the MSU lines were more scab resistant than the lines from the programs. Some of the promising lines are MSL007-B, MSR169-8Y, MSR058-1, MSR127-2, MSR148-4 andMSS165-2Y. Beacon Chipper also showed merit in the northern sites.

Table 5. National Coordinated Breeder Trial (NCBT) Overall merit ranking summary.

				Merit									Merit					
				Location - South				Location - North				Scab	South	North	Overall	South	North	Overall
Line	Female	Male	Program	CA	FL	NC	TX	MI	NY	ND	WI	MN	Mean	Mean	Mean	Count	Count	Count
MSL007-B	MSA105-1	MSG227-2	MSU-MI	2	2			2	2	1	2	MR	2.0	1.8	1.8	2	4	6
CO02321-4W	A91790-13	S440	CSU-CO			1	3	1	2	1		SUSC	2.0	1.3	1.6	2	3	5
MSR058-1	Megachip	MSJ319-1	MSU-MI		2		3	2	1		2	MR	2.5	1.7	2.0	2	3	5
NYE106-4	NY128	MARCY	Cornell-NY	1			2	1	2	2		R	1.5	1.7	1.6	2	3	5
NYE50-8	V101-9	NY115	Cornell-NY	2		4		1		2	2	SUSC	3.0	1.7	2.2	2	3	5
Atlantic			**Check**	**1**		**4**	**1**	**1**	**1**			**SUSC**	**2.0**	**1.0**	**1.6**	**3**	**2**	**5**
MSR169-8Y	Pike	MSJ126-9Y	MSU-MI	2	2		3	1		2		R	2.3	1.5	2.0	3	2	5
MSS165-2Y	MSM188-1	MSL159-AY	MSU-MI		2	1		2		2		R	1.5	2.0	1.8	2	2	4
MSK409-1	MSC148-A	Liberator	MSU-MI	2	1	4					2	MR	2.3	2.0	2.3	3	1	4
MSR127-2	MSJ167-1	MSG227-2	MSU-MI		2			1	2		2	R	2.0	1.7	1.8	1	3	4
AC01151-5W	A91790-13	NDTX4930-5W	CSU-CO	1				2		2		SUSC	1.0	2.0	1.7	1	2	3
Beacon Chipper	UEC		MSU-MI			4		2			2	SUSC	4.0	2.0	2.7	1	2	3
MSM246-B	MSE274-A	NY115	MSU-MI	1				1		2		SUSC	1.0	1.5	1.3	1	2	3
ND8331Cb-3			NDSU-ND	1				2		2		SUSC	1.0	2.0	1.7	1	2	3
NYG20-58	ANDOVER	NY119	Cornell-NY		1				2	2		SUSC	1.0	2.0	1.7	1	2	3
NYG20-63	ANDOVER	NY120	Cornell-NY	1				2	1			SUSC	1.0	1.5	1.3	1	2	3
NYG86-1	NY138	C956-1	Cornell-NY	2					2	3		SUSC	2.0	2.5	2.3	1	2	3
NYG87-3	NY139	MARCY	Cornell-NY		2				2		2	MR	2.0	2.0	2.0	1	2	3
Snowden			**Check**		**2**			**1**	**1**			**SUSC**	**2.0**	**1.0**	**1.3**	**1**	**2**	**3**
A-32	Superior	Snowden	UoWI-WI			3.5	3		2			SUSC	3.3	2.0	2.8	2	1	3
B2721-78			USDA-MD			4	2			2		SUSC	3.0	2.0	2.7	2	1	3
BNC202-7			USDA-MD		2	1			2			ND	1.5	2.0	1.7	2	1	3
CO02024-9W	BC0894-2W	A91790-13	CSU-CO			2	2		2			SUSC	2.0	2.0	2.0	2	1	3
MSL292-A	Snowden	MSH098-2	MSU-MI		1		3	1				susc	2.0	1.0	1.7	2	1	3
MSR148-4	MSI152-A	Dakota Pearl	MSU-MI	1	2			1				SUSC	1.5	1.0	1.3	2	1	3
NYG20-30	ANDOVER	NY115	Cornell-NY		2		3			2		SUSC	2.5	2.0	2.3	2	1	3
B2721-101			USDA-MD					2	2			SUSC	-	2.0	2.0	0	2	2
B2721-13			USDA-MD							2	2	SUSC	-	2.0	2.0	0	2	2
MSR128-4Y	MSJ167-1	MSJ126-9Y	MSU-MI					2	2			SUSC	-	2.0	2.0	0	2	2
NYF57-3	WHITE PEARL	NY115	Cornell-NY					2		2		SUSC	-	2.0	2.0	0	2	2
NYG20-31	ANDOVER	NY115	Cornell-NY					2		2		SUSC	-	2.0	2.0	0	2	2
NYG20-41	ANDOVER	NY116	Cornell-NY					2	2			SUSC	-	2.0	2.0	0	2	2
NYG20-55	ANDOVER	NY117	Cornell-NY							1	2	MR	-	1.5	1.5	0	2	2
NYG20-56	ANDOVER	NY118	Cornell-NY						2		2	SUSC	-	2.0	2.0	0	2	2
NYG89-2	NY139	C956-1	Cornell-NY						2	2		SUSC	-	2.0	2.0	0	2	2
W5955-1			UoWI-WI						2		2.5	SUSC	-	2.3	2.3	0	2	2
W8539-2			UoWI-WI						2		2	MR	-	2.0	2.0	0	2	2
W8615-5			UoWI-WI						2	3		MR	-	2.5	2.5	0	2	2
B2721-63			USDA-MD			1	1					SUSC	1.0	-	1.0	2	0	2
B2721-64			USDA-MD		1	2						SUSC	1.5	-	1.5	2	0	2
B2721-73			USDA-MD			2	1					SUSC	1.5	-	1.5	2	0	2
MSK061-4	MSC148-A	Dakota Pearl	MSU-MI	2	2							MR	2.0	-	2.0	2	0	2
MSP459-5	Marcy	NY121	MSU-MI		1		2					SUSC	1.5	-	1.5	2	0	2
MSQ130-4	Boulder	MSJ456-4Y	MSU-MI			4	3					SUSC	3.5	-	3.5	2	0	2
NYD40-50	NY121	NY115	Cornell-NY	1		3						ND	2.0	-	2.0	2	0	2
NYG20-11	ANDOVER	NY114	Cornell-NY	2			1					SUSC	1.5	-	1.5	2	0	2
NYG20-13	ANDOVER	NY115	Cornell-NY			3	3					SUSC	3.0	-	3.0	2	0	2
W8603-1			UoWI-WI	1		2						SUSC	1.5	-	1.5	2	0	2
A03471-7C	Dakota Diamond	A98399-1C	USDA-ID	1				2				SUSC	1.0	2.0	1.5	1	1	2
AC03433-1W	A94322-8C	COA96141-4	CSU-CO		1			2				SUSC	1.0	2.0	1.5	1	1	2
AF4240-3	SC9512-4	AF290-5	UoM-ME	2						2		SUSC	2.0	2.0	2.0	1	1	2
AF4254-2	A8469-5	AF290-5	UoM-ME			2		2				SUSC	2.0	2.0	2.0	1	1	2
AF4307-1	A97070-51LB	A95162-1	UoM-ME			1				2		SUSC	1.0	2.0	1.5	1	1	2
AF4363-2	A91790-13	W2309-7	UoM-ME			4				2		SUSC	4.0	2.0	3.0	1	1	2
B1992-106			USDA-MD		1			1				ND	1.0	1.0	1.0	1	1	2
B2721-121			USDA-MD			1		2				SUSC	1.0	2.0	1.5	1	1	2
B2721-18			USDA-MD				2			2		SUSC	2.0	2.0	2.0	1	1	2
B2721-40			USDA-MD				1	2				SUSC	1.0	2.0	1.5	1	1	2
B2721-67			USDA-MD			2			2			MR	2.0	2.0	2.0	1	1	2
B2721-93			USDA-MD			4				2		SUSC	4.0	2.0	3.0	1	1	2
Boulder	MS702-80	NY88	MSU-MI			3		2				SUSC	3.0	2.0	2.5	1	1	2
CO00270-7W	CO95051-7W	A91790-13	CSU-CO	1						2		SUSC	1.0	2.0	1.5	1	1	2
MegaChip			**UoWI-WI**			**2**		**1**				**SUSC**	**2.0**	**1.0**	**1.5**	**1**	**1**	**2**
MSQ035-3	MSG227-2	Missaukee	MSU-MI				3	1				MR	3.0	1.0	2.0	1	1	2
MSQ089-1	A91790-13	Missaukee	MSU-MI	1				2				SUSC	1.0	2.0	1.5	1	1	2
MSR036-5	MSL766-1	Liberator	MSU-MI		2			2				R	2.0	2.0	2.0	1	1	2
MSS026-2Y	SJ-Y7	MSJ126-9Y	MSU-MI				1	2				SUSC	1.0	2.0	1.5	1	1	2
ND7799c-1			NDSU-ND	2				2				SUSC	2.0	2.0	2.0	1	1	2
NDMN07-B322BG1			UoM-MN			4					2	ND	4.0	2.0	3.0	1	1	2
W2324-1			UoWI-WI		1				2			SUSC	1.0	2.0	1.5	1	1	2
W2717-5			UoWI-WI				3	2				R	3.0	2.0	2.5	1	1	2
71				21	20	26	21	36	24	25	13		2.0	1.8	1.9	88	98	186

69 lines with 2 or more merit scores
2 checks: Snowden and Atlantic

select for both	7
select for north	22
select for south	18
one select in N and S	23

Variety Release

We released MSJ461-1 as Missaukee (late blight, golden nematode and verticillium wilt resistant round white) in 2010. 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 MSH228-6 and MSJ126-9Y 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. We also have a focused ribavirin-based virus eradication system to generate virus-free tissue culture lines for the industry. About 30 lines are in ribaviran treatment at this time to remove PVS and PVY. This year, about 80 new MSU breeding lines are being put into tissue culture.

MSU Variety Releases:

MSJ147-1

Parentage: NorValley X S440
Developers: Michigan State University and the Michigan Agricultural Experiment Station
Plant Variety Protection: Will be considered.

Strengths: MSJ147-1 is a round white chip-processing potato that has a bright skin, white flesh and round shape. In addition, it has been determined to store at temperatures below 50°F and maintain low reducing sugar levels into May or June.

Weaknesses: Small vine, slow to emerge.

Incentives for production: MSJ147-1 produces many A-size tubers that are low in defects, however we are seeing some HH in the large tubers this storage season. Potatoes maintain low reducing sugar content for chip-processing out of the field and from storage.

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.

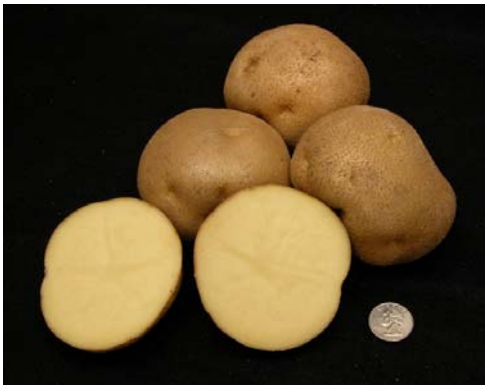
MSH228-6

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.

Incentives for production: **C**hip-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.

MSQ176-5

Parentage: MSI152-A x Missaukee (MSJ461-1)
Developers: Michigan State University and the Michigan Agricultural Experiment Station
Plant Variety Protection: Will be considered.

Strengths: MSQ176-5 is a high-yielding freshmarket potato with bright skin and a uniform smooth, round appearance with an attractive tuber type. This variety has a strong vine and a mid-season maturity. MSQ176-5 has strong foliar resistance to the US8 genotype of late blight. MSQ176-5 also has resistance to *Streptomyces scabies* (common scab) similar to Pike.

Incentives for production: Excellent freshmarket tuber quality and type with foliar late blight resistance and common scab resistance.

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 will start to characterize these populations in 2011 and conduct the linkage analysis studies following 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

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Summary of the Problem

Numerous potato viruses are prevalent worldwide and can cause substantial economic losses. In the US four potato viruses PVY, PVX, PLRV and PVS are most frequently identified, but PVY and its various associated strains is the most common and economically most harmful (Valkonen 2007). These potato viruses are transmitted to the next seed generation through tubers. The use of disease-free tissue culture stocks in combination with state seed certification programs has historically been a source of clean seed to the commercial farmers, but in recent years, the level of PVY in potato certified seed lots has reached problem levels (Whitworth et al. 2005). The extensive spread of various strains of PVY have become very common in seed production due to the amount of PVY symptom-less expression varieties being grown combined with the high numbers of non-persistent PVY vectoring aphids present in potato growing regions. It is difficult to produce seed clean of PVY when the inoculum is so widely distributed throughout seed production regions.

The variety, Russet Norkotah and its line selections, make it the second most common variety in the US (NASS 2007). This variety along with Shepody and Silverton Russet are described as being symptom-less carriers of PVY. One solution to this problem is to replace these varieties with new and improved ones. Ideally these varieties would have extreme resistance to all PVY strains, but some advanced breeding lines such as A95109-1 that show great promise still have the weakness of PVY susceptibility. Resistance to PVY common and necrotic (NTN, N:O) strains is critical as the necrotic strains are present in the industry and can cause tuber defects. Michigan State University and other breeding programs are currently using the *Ry* gene to introduce extreme resistance to PVY into advanced breeding germplasm through conventional breeding combined with marker-assisted selection techniques (Gebhardt et al. 2006). It will take a significant number of years to identify, release and commercialize a new variety that will compete with the market impact of Russet Norkotah.

The conventional breeding strategy must be employed; however current technology exists to introduce PVY resistance directly into Russet Norkotah and other PVY susceptible varieties using pathogen-derived resistance (e.g. viral coat protein). NatureMark had released in the late 1990s transgenic lines of Russet Burbank that were resistant to PVY (Kaniewski and Thomas, 2003). It is well known that these and other transgenic potato lines were removed from the market in 2001 when the quick serve restaurant industry was attacked by the anti-biotech activists through media tactics to create concern among the public regarding the food and environmental safety of these potatoes (Simon 2003).

Transgenic technology has continued to advance since the 1990s and Simplot scientists have recently developed a new method to introduce native genes into potato without any additional genes or DNA sequences (Rommens *et al.*, 2004). With this

technology they can create transgenic potato lines that contain only potato genes rather than genes obtained from other organisms. The public perception of this technology is much more accepting of this transformation technique that employs only the crop's genes rather than genes from other organisms such are viruses, bacteria, etc. (K. Swords pers. comm.).

Research Objectives and Research Plan

The new transgenic approach can be applied to the PVY problem in the potato industry. ***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 lycoperisicum*) 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. A previously cloned potato gene with over 96% sequence identity to the *S. hirsutum pot-1* gene but lacking the signature amino acid changes in key regions known to be associated with PVY resistance in pepper and tomato was sub-cloned into a pSPUD4 binary vector as well and will be used in transformations as a control.

Transformation experiments to introduce the *S. hirsutum* eIF4E gene or the potato gene into the PVY susceptible line E149-5Y were completed resulting in at least 20 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. In addition to the first round of transformation experiments, we now have 10 lines with the *S. hirsutum pot-1* gene derived from Russet Norkotah, 25 lines from Classic Russet and over 50 lines from Silverton Russet. Select lines from each of these varieties 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 18 putative PVY resistant potato lines are being sent to JW for greenhouse PVY evaluation this fall.

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 are being increased for minituber production so that field studies can be conducted in 2011.

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2010 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 Farm (Entrican). In 2010, we tested 182 varieties and breeding lines in the replicated variety trials, plus single observational plots of 186 lines for the Early Observational Trial and 219 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.

Improving agronomic performance of plots at the Montcalm Research Farm has been an on-going process. In 2010, we saw a significant increase in plot yields as a result of improved trial management. We would like to acknowledge the collaborative effort of Bruce Sackett, Mark Otto (AgriBusiness Consultants), Darryl Warncke, Chris Long, and the Potato Breeding Team.

PROCEDURE

Ten field experiments were conducted at the Montcalm Research Farm 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 that was in corn the previous year and in potatoes 4 years previously.

The most advanced selections in the breeding program were harvested at two dates to evaluate early and late harvest potential (Early Harvest Trial). These same

clones also harvested at a later standard harvest date, included in the various other variety trials. The Date of Harvest Early and Late Trials were replaced by the Early Trial entries being included in other trials for the second (Late) harvest. 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), and Preliminary (chip-processors and tablestock). *Note: We also conducted an early harvest observation trial (90 days), to screen newer lines from the breeding program for early performance potential as out of the field chip-processing and tablestock varieties. The early observational trial is discussed in the breeding report.*

2010 was the first 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, TX, CA) in addition to a scab trial in MN. A total of 220 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 MSU Soils Farm, and at *a new scab site at the Montcalm Research Farm*. There was very strong scab disease pressure at the new Montcalm Scab Disease Nursery. The 2010 late blight trial was conducted at the Muck Soils Research Farm. 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. Early Trial:

Chip-processors and Tablestock (Table 1: Early Harvest)

There were 12 entries that were evaluated at the early harvest trial. The results are summarized in **Table 1**. Atlantic, Snowden, Pike and Onaway were used as check varieties. The plot yields were above average in the early harvest (97 days), and specific gravity values were average to slightly below average. Hollow heart was the most prevalent internal defect in the early harvest this year, although only to a limited degree. Atlantic showed the highest incidence of hollow heart in the late harvest (18%). In the

early harvest trial, the best yielding lines were Onaway, MSL211-3, Michigan Purple Sport III, and Michigan Purple. MSL211-3 is an attractive, smooth-skinned, round to oval tablestock line with foliar late blight resistance. Michigan Purple Sport III is a unique selection with splashes of purple from a sport of Michigan Purple. Michigan Purple continues to demonstrate early bulking potential for the farm market.

B. Advanced Trial (Table 2)

A summary of the 18 entries evaluated in the Advanced trial results is given in **Table 2**. Overall, the yields for the Advanced trial (140 days) were above average. The check varieties for this trial were Snowden, Atlantic, and FL1879. The highest yielding lines were Snowden (439 cwt/a), MSL292-A, Kalkaska, MSH228-6, MSQ279-1, and MSQ086-3 (372 cwt/a), followed by Atlantic, MSP515-2, and Beacon Chipper. Hollow heart and vascular discoloration were the predominant internal defects, with FL1879 and Atlantic having the highest levels of hollow heart (33 and 20%, respectively). There was a higher incidence of internal brown spot than typical, with 13% in MSP515-2 and 8% for Atlantic, MSQ070-1, and Kalkaska. Specific gravity was average with five lines having specific gravities equal to or higher than Snowden (1.079): MSQ070-1 (1.088), Atlantic (1.085), MSJ147-1 (1.083), Kalkaska (1.081), and MSL292-A (1.079). 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. Beacon Chipper continues to be consistently high yielding line with good specific gravity, chip quality, and scab resistance. MSH228-6 also continues to be a top agronomically performing clone with scab resistance. Two newer promising chip-processing lines are MSL292-A (chip quality, high yield, good specific gravity, and shows potential as a long-term storage chipper) and MSQ279-1 (good yield and chip quality and scab résistance). Other lines that continue to show promise are MSL007-B, MSJ126-9Y, MSR061-1, MSP270-1, and MSJ147-1.

Variety and Advanced Breeding Line Characteristics

Beacon Chipper – a chip processing line that has high yield potential and moderate scab tolerance along with excellent chip-processing quality. Yield performance in the USPB/SFA trials was also high.

MSH228-6 – a chip-processing line with moderate scab resistance. It has a good type and has performed well in on-farm trials.

Kalkaska (MSJ036-A) – an MSU chip-processing selection with high yield potential. It also has a high specific gravity and scab resistance. The tuber type of MSJ036-A is round and attractive. We are conducting transformations to lower the reducing sugar in the tubers.

MSJ126-9Y – an earlier season chip-processing line with excellent chip quality and long-term storage potential. This line also has scab resistance and an attractive type.

MSL007-B – an MSU chip-processing selection with strong scab resistance, uniform round type, and a unique netted skin. This newer line produces excellent chips with a good specific gravity and average yield.

MSL211-3 – an attractive round-white tablestock line with strong foliar late blight resistance, moderate scab resistance, and an early maturity.

MSL268-D – is also a round-to-slightly oval white tablestock line with moderate scab resistance, strong foliar late resistance, and PVY resistance. This line has an average yield with mid-early maturity.

MSL292-A – a round-white chip-processing line with high yield, good specific gravity, and excellent chip quality that has demonstrated potential for good long-term chip quality.

MSP270-1 – a new round-white chip-processing line with good scab resistance, average specific gravity, and good type. This line produces clean chips with good specific gravity and an early maturity, and has storage potential.

MSQ279-1 – a round-white chip-processing line with good agronomic performance and excellent chip quality that has good scab tolerance.

MSR061-1 – is also a round-white chip-processing line with good scab resistance, moderate foliar late resistance, and PVY resistance. This line has an average yield with mid-early maturity.

In the past the MPIC has sponsored a booth at the Great Lakes Fruit, Vegetable, and Farm Market Expo in December to market Liberator, Michigan Purple, Jacqueline Lee, and new specialty potato varieties to the farm market/roadside stand market segment. The breeding program sponsored the booth in 2009 and 2010 to continue to promote varieties and promising advanced selections that may be of interest to this market segment. There continues to be a strong interest in specialty potato varieties and a growing demand for new, unique potato varieties. We also showcased some of the newer up-and-coming selections from the breeding program to get a sense of the interest from growers who stopped by the booth.

C. North Central Regional Trial Entries (Tables 3 and 4)

The North Central Trial is conducted in a wide range of environments (11 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 2010. The clones were from three market classes: Red (5 entries), Russet (5 entries), or Round White (12 entries). The results are presented in **Tables 3**

and 4. The MSU lines MSL211-3, MSL268-D, MSM182-1, and MSQ176-5 were the Michigan representatives included in the 2010 North Central Trial. MSL211-3 is an attractive, bright-skinned round to oval white tablestock with 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, and round type. MSQ176-5 is a late blight resistant tablestock with very uniform, large, round-white tubers and smooth, bright skin.

D. Russet Trial (Table 4)

We continue to increase our russet breeding efforts to reflect the growing interest in russet types in Michigan. In 2010, 13 lines evaluated after 128 days. The results are summarized in **Table 4**. Russet Burbank, Russet Norkotah, Silverton Russet were the reference varieties used in the trial. The highest yielding lines were Silverton Russet (337 cwt/a), A98134-2RUS, W6234-4RUS, and AC00395-2RUS (289 cwt/a). Overall, the internal quality in the russet trial was above average; however, hollow heart and vascular discoloration continue to be the most prevalent internal defects. The highest hollow heart level was observed in AC00395-2Rus (60%) and A01124-3Rus (60%). Specific gravity measurements were average to below average with Russet Norkotah at 1.064. Off type and cull tubers were found in nearly all lines tested, with the highest being Russet Burbank (33%).

E. Adaptation Trials (Tables 5 and 6)

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 18 advanced breeding lines are reported in the chip-processing trial. The trial was harvested after 139 days and the results are summarized in **Table 5**. All entries had good out-of-the-field chip scores. Specific gravity values were average for the Montcalm Research Farm (Atlantic was 1.086 and Snowden was 1.080). The highest specific gravity was Atlantic (1.086), followed by MSK409-1 (1084). The greatest hollow heart was noted in MSR159-02 (40%), followed by Atlantic and MSR036-5 (25%). The overall plot yields for this trial were above average in 2010. MSQ035-3 was the highest yielding line in 2010 (514 cwt/a), followed closely by MSS206-2 (504 cwt/a), Missaukee (491 cwt/a), and then Snowden (476 cwt/a). Multiple new breeding lines combine scab resistance and chip-processing: MSQ035-3, MSR036-5, MSR169-8Y and MSR131-2.

In the tablestock trial, 15 advanced breeding lines were evaluated with Onaway and check variety. The trial was harvested after 126 days and the results are summarized in **Table 6**. In general, the yield was above average in this trial and internal defects were low. The greatest amount of hollow heart was seen in Reba (18%). There were a significant number of oversize potatoes in MSS582-1SPL and Reba. The highest yielding line was MSS582-1SPL (round-white with red splashes) at 510 cwt/a, followed

by Reba, MSQ461-2PP, MSQ341-BY, and Onaway (379 cwt/a). Five of the lines have moderate to strong scab resistance. Eight of the 15 lines also had early maturity, similar to Onaway. Promising lines with an attractive type for the tablestock market are MSS582-1SPL, MSQ461-2PP, MSQ341-BY, and MSM288-2Y. Four specialty lines are being considered for release for 2011: MSQ425-4Y (purple splash skin with yellow flesh), MSN215-2P (purple skin with white flesh), MSR226-1R (red skin and red flesh), and Midnight (purple skin with deep purple flesh).

F. Preliminary Trials (Tables 7 and 8)

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 7**) had 33 advanced selections and two check varieties (Atlantic and Snowden). The chip-processing trial was harvested after 134 days. Most lines chip-processed well from the field (SFA chip score 1.0 – 1.5). Specific gravity values were average to below average for the trial (Atlantic: 1.090). The MSU lines with the highest specific gravities were MSR127-2, MSU383-1, MSU245-1, and MSU246-1. The yields were above average with Snowden at 423 cwt/a and Atlantic at 417 cwt/a. The highest yielding lines were MSU379-1 (547 cwt/a), MR148-A, MSR127-2, MSU383-1, and MST220-8 (434 cwt/a). Sixteen of the lines (46%) were classified to be resistant or moderately resistant to scab ($\leq$ 1.5 scab disease rating). The greatest internal defects were hollow heart (Atlantic, MSU245-1, and MSQ029-1 at 45%), and 55% internal brown spots in Atlantic. Many of the lines in the Preliminary Trial combine good agronomic performance with chip quality, specific gravity, and scab resistance.

Table 8 summarizes the 35 tablestock lines evaluated in the Preliminary Trial (Onaway was the check variety). This tablestock trial was harvested and evaluated after 126 days. Eight of the selections were scab resistant or moderately resistant ($\leq$ 1.5 scab disease rating). MSU161-1 (490 cwt/a), MSR214-2P, MST386-1P, MST285-2, and Onway (417 cwt/a) were the highest yielding lines. In general, there was 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. Zongshu 3 and Jingshu 2 were two lines from the Chinese breeding program that were also evaluated.

G. Potato Scab Evaluation (Table 9)

Each year, a replicated field trial at the MSU Soils Farm (E. Lansing, MI) is conducted to assess resistance to common scab. In 2010, we added two new scab testing locations. A site at the Montcalm Research Farm with high common scab disease pressure was chosen as a second testing location for the early generation observational trial (240 lines), and two replications of the scab variety trial (158 lines). *Additionally, we added a replicated On-Farm scab trial (32 lines), which is summarized in the 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 2010 scab ratings are based upon the Montcalm Research Farm site. **Table 9** categorizes many of the varieties and advanced selections tested in 2010 along with three-year averages where applicable. 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 9**). The table is sorted in ascending order by 2010 rating. This year's results continue indicate that we have been able to breed numerous lines for the chip-processing and tablestock markets with resistance to scab. A total of 60 lines, of the 158 tested, had a scab rating of 1.5 (better than or equivalent to Pike) or lower in 2010. Most notable scab resistant MSU lines are MSH228-6, Kalkaska, MSJ126-9Y, MSL007-B, MSM037-3, MSN215-2P, MSP270-1, MSR036-5, MSR102-3 and MSR169-8Y; as well as some earlier generation lines MSS297-3, MSS544-1R, MSU383-1, and MSU384-1. 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 one year. Of the 240 early generation selections that were evaluated, 98 were resistant (scab rating of ≤ 1.0). Scab results from the disease nursery are also found in the Trial Summaries (**Tables 2-8**).

H. Late Blight Trial (Table 10)

In 2010, the late blight trial was planted at the Muck Soils Research Farm. As in previous years, 196 entries were planted in replication for evaluation in replicated plots. These include lines tested in the agronomic variety trial (157 lines) and entries in the National Late Blight Variety Trial (39 lines). Block planting full rows of advanced selections provide a better assessment of the late blight resistance of these lines. We also planted 132 early generation breeding lines that have a late blight resistant pedigree. The field was planted on June 7. The trials were inoculated on August 3 with a US-8 genotype of *P. infestans*. Late blight infection was identified in the plots 10 days after inoculation. The plots were evaluated more than seven times over a 45 day period following inoculation. We need to note that the disease reaction in the plots was not typical to the previous years' ratings. 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

2010, twenty-nine lines had moderate to strong late blight resistance to US-22. These were from various late blight resistance sources (Torridon, Stirling, NY121, B0718-3, etc.). **Table 10** lists select lines in the foliar resistance and susceptibility categories.

I. Blackspot Bruise Susceptibility (Table 11)

Evaluations of advanced seedlings and new varieties for their susceptibility to blackspot bruising are also important in the variety evaluation program. Based upon the results collected over the past years, the non-bruised check sample has been removed from our bruise assessment. A composite bruise sample of each line in the trials consisted of 25 tubers (a composite of 4 replications) from each line, collected at the time of grading. The 25 tuber sample was held in 50°F (10°C) storage overnight and then was placed in a hexagon plywood drum and tumbled 10 times to provide a simulated bruise. The samples were peeled in an abrasive peeler in October and individual tubers were assessed for the number of blackspot bruises on each potato. These data are shown in **Table 11**. The bruise data are represented in two ways: percentage of bruise free potatoes and average number of bruises per tuber. A high percentage of bruise-free potatoes is the desired goal; however, the numbers of blackspot bruises per potato is also important. Cultivars which show blackspot incidence greater than Atlantic are approaching the bruise-susceptible rating. In addition, the data is grouped by trial, since the bruise levels can vary between trials. Conducting the simulated bruise on 50°F (10°C) tubers has helped to standardize the bruise testing. We are observing less variation between trials since we standardized the handling of the bruise sample.

In 2010, the bruise levels were comparable to previous years. The most bruise resistant MSU breeding lines this year from the Advanced trial were MSP270-1, MSQ440-2, MSH228-6, MSQ086-3, MSJ126-9Y, MSR061-1, and MSJ147-1. The most susceptible lines from the Advanced trial were MSP515-2, Snowden, MSP459-5, and Atlantic. The Adaptation Trial lines with the best bruise resistance were MSS108-1, MSQ432-2PP, MSR102-3, MSR159-02, MSM288-2Y, MSS544-1R, MSN105-1, MSR157-1Y, and MSS576-05SPL. Of the earlier generation breeding lines (Preliminary Trial), the most bruise resistant were MSR160-2Y, MST202-5, A00188-3C, MSU384-1, CO00188-4W, MSU379-1, MST437-1, MSQ130-4, MSU202-1P, MSR297-A, 1991-563-18, MSQ405-1PP, MST406-2RR, and MSU613-1. The most bruise resistant russet entries were A01124-3RUS, Silverton Russet, W6234-4RUS, CO99053-3RUS, and A98134-2RUS; the most susceptible were W8946-1RUS-NCR and W2683-2RUS. The most bruise resistant entries in the US Potato Board/Snack Food Association Trial were MSJ126-9Y, NY138, and W2978. While W2310-3, Atlantic, Snowden, and W5015-12 were the most bruise susceptible in this trial.

Table 1

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

EARLY HARVEST TRIAL
MONTCALM RESEARCH FARM
May 4 to August 9, 2010 (97 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	MAT[4]	CWT/A
Onaway	**369**	**433**	**85**	**12**	**81**	**4**	**3**	**1.062**	**-**	**0**	**8**	**0**	**0**	**2.2**	**342***
MSL211-3	338	387	87	11	81	6	1	1.066	-	0	0	0	0	3.0	295*
MI Purple Sport III	325	364	89	10	80	9	0	1.068	-	5	5	0	0	3.0	-
MI Purple	321	354	91	9	84	7	1	1.070	-	5	3	3	0	3.0	-
Snowden	**315**	**367**	**86**	**14**	**83**	**3**	**0**	**1.081**	**1.0**	**3**	**8**	**0**	**0**	**3.5**	**-**
Atlantic	**302**	**361**	**84**	**16**	**81**	**3**	**0**	**1.085**	**1.0**	**18**	**5**	**0**	**0**	**3.5**	**257**
MSM037-3	293	340	86	13	84	2	1	1.065	1.0	0	0	0	0	3.0	259*
MSM171-A	287	315	91	8	75	16	1	1.055	-	8	5	0	0	2.9	288
MSQ425-4Y	221	326	68	32	68	0	0	1.065	1.0	3	0	0	0	2.7	-
Pike	**203**	**266**	**76**	**23**	**75**	**1**	**1**	**1.075**	**1.0**	**5**	**0**	**0**	**0**	**3.8**	**207**
MSQ086-3	160	283	56	44	56	0	0	1.066	1.0	0	0	0	0	4.3	219*
MSN215-2P	154	236	65	32	64	1	3	1.069	-	0	0	0	0	2.9	-
MEAN	274	336						1.069							
$HSD_{0.05}$	101	102	11					0.006							

* Two-Year Average

[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]MATURITY RATING: August 3, 2010; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

Table 2

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

ADVANCED TRIAL
MONTCALM RESEARCH FARM
May 4 to September 21, 2010 (140 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	**439**	**490**	**90**	**10**	**80**	**10**	**1**	**1.079**	**1.0**	**8**	**50**	**0**	**0**	**2.9**	**2.1**	**1.5**	**322**
MSL292-A	403	468	86	14	83	3	0	1.079	1.0	3	0	0	0	2.5	1.2	1.3	276*
Kalkaska (MSJ036-A)	400	504	79	21	78	1	0	1.081	1.0	3	8	8	0	1.5	3.3	1.2	371
MSH228-6	383	427	90	9	84	5	2	1.073	1.0	8	25	0	0	1.0	2.4	0.4	287
MSQ279-1	373	411	91	9	77	14	1	1.072	1.0	3	0	0	0	1.3	3.6	0.2	282*
MSQ086-3	372	514	72	27	72	0	0	1.074	1.0	0	5	0	0	2.3	2.9	0.4	-
Atlantic	**356**	**410**	**87**	**13**	**81**	**6**	**0**	**1.085**	**1.0**	**20**	**8**	**8**	**0**	**2.9**	**1.9**	**2.2**	**-**
MSP515-2	349	418	84	16	71	12	0	1.077	1.0	5	10	13	0	2.3	3.0	1.4	333*
Beacon Chipper	349	370	94	5	71	24	1	1.075	1.0	5	35	0	0	2.0	2.8	1.3	347
FL1879	**339**	**373**	**91**	**8**	**77**	**14**	**1**	**1.072**	**1.0**	**33**	**13**	**5**	**0**	**3.5**	**2.0**	**0.7**	**347**
MSQ070-1	338	422	80	20	79	1	0	1.088	1.0	3	8	8	0	1.3	3.6	1.0	304
MSQ440-2	314	353	89	11	82	6	0	1.055	1.0	0	38	0	0	1.8	2.0	0.2	-
MSL007-B	310	382	81	19	79	2	0	1.074	1.0	3	10	0	0	1.0	2.7	0.8	214*
MSJ126-9Y	259	306	85	15	82	3	0	1.070	1.0	0	20	0	0	1.0	2.1	0.6	240
MSR061-1	259	339	76	23	75	1	0	1.077	1.0	8	5	0	0	1.3	2.0	0.6	244
MSP270-1	240	318	75	25	75	1	0	1.070	1.0	0	3	0	0	1.0	3.0	0.2	-
MSP459-5	217	344	63	37	62	1	0	1.070	1.0	0	3	0	0	3.0	2.5	1.6	208
MSJ147-1	158	265	59	33	59	0	8	1.083	1.0	0	0	0	0	1.3	2.9	0.6	197
MEAN	325	395						1.075						1.9	2.5	0.9	
$HSD_{0.05}$	149	153						0.007						2.3	1.4	* Two-Year Average	

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

[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, 2010; 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

NORTH CENTRAL REGIONAL TRIAL
MONTCALM RESEARCH FARM
May 4 to September 7, 2010 (126 days)

	CWT/A		PERCENT OF TOTAL[1]						PERCENT (%)							3-YR AVG
									CHIP	TUBER QUALITY[3]						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
MSL211-3	406	458	89	10	81	8	2	1.068	2.5	0	3	0	0	2.2	1.3	1.0	-
ND8555-8R	391	509	77	23	75	2	0	1.067	1.5	3	0	3	0	2.0	1.0	1.1	-
Snowden	**382**	**433**	**88**	**11**	**82**	**7**	**1**	**1.081**	**1.0**	**18**	**10**	**0**	**0**	**2.9**	**1.6**	**1.4**	**330**
Atlantic	**375**	**420**	**89**	**9**	**75**	**14**	**2**	**1.086**	**1.5**	**53**	**13**	**13**	**0**	**2.9**	**1.8**	**1.4**	**332**
W5015-12	372	451	83	17	77	6	1	1.085	1.0	28	0	10	0	3.0	2.3	2.4	316*
MSQ176-5	367	411	89	10	66	23	1	1.066	1.0	23	3	5	0	3.0	2.0	0.6	292*
Red Pontiac	**365**	**421**	**87**	**10**	**72**	**15**	**3**	**1.061**	**3.5**	**10**	**0**	**0**	**0**	**4.5**	**2.1**	**0.7**	**-**
NorValley	**352**	**416**	**85**	**15**	**77**	**8**	**0**	**1.072**	**1.0**	**0**	**0**	**0**	**0**	**2.3**	**1.4**	**1.2**	**-**
MSL268-D	343	419	82	16	81	1	2	1.081	1.0	0	10	0	0	3.0	1.8	1.5	307
MSM182-1	321	382	84	15	78	6	1	1.068	2.5	5	3	13	0	3.0	2.0	1.2	-
ND8307C-3	289	370	78	21	77	1	1	1.087	1.0 !	5	3	0	0	1.5	1.6	0.8	-
ND8229-3RUS	274	331	83	16	75	8	1	1.076	1.0	3	0	0	0	1.0	2.3	2.0	-
W2609-1R	270	328	82	17	79	3	1	1.058	2.5	0	0	3	0	1.0	1.3	0.4	-
Red Norland	**251**	**287**	**87**	**13**	**84**	**4**	**0**	**1.055**	**2.0**	**3**	**3**	**0**	**0**	**2.0**	**1.5**	**0.2**	**260***
W2978-3	248	322	77	23	74	3	0	1.072	1.0	0	0	0	0	3.5	1.1	0.5	244*
W2717-5	232	282	82	16	82	0	1	1.088	1.5	5	10	3	3	3.0	1.1	1.2	-
W2310-3	227	295	77	21	76	1	2	1.086	1.0	5	0	0	0	2.0	2.1	1.9	-
ND8314-1R	201	365	55	44	53	2	1	1.063	3.0	5	5	0	0	3.0	1.0	1.0	-
MEAN	315	383						1.073						2.5	1.6	1.1	
$HSD_{0.05}$	155	158						0.006						2.3	0.8	* Two-Year Average	

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

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, 2010; 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 4

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

RUSSET TRIAL
MONTCALM RESEARCH FARM
May 4 to September 9, 2010 (128 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
Silverton Russet	**337**	**385**	**88**	**10**	**65**	**23**	**2**	**1.070**	**3**	**5**	**0**	**0**	**1.0**	**2.9**	**0.3**	**322**
A98134-2RUS	302	411	74	24	65	8	3	1.071	0	15	0	0	1.3	2.6	0.4	-
W6234-4RUS	300	390	77	17	62	15	6	1.079	8	5	0	0	3.5	1.8	0.4	-
AC00395-2RUS	289	408	71	26	65	6	3	1.091	60	15	0	0	1.0	2.6	0.6	-
MSN170-A**	278	331	84	13	79	5	3	1.078	5	0	0	0	1.8	1.7	0.5	289
W2683-2RUS	252	330	76	20	65	11	4	1.071	8	3	3	0	1.0	2.9	2.6	-
A01124-3RUS	231	291	79	13	67	12	8	1.075	60	5	3	0	1.5	3.1	0.0	-
W8946-1RUS	228	391	58	36	57	1	5	1.091	0	8	3	0	1.3	3.8	1.5	-
Goldrush	**215**	**323**	**67**	**27**	**58**	**8**	**6**	**1.065**	**0**	**15**	**0**	**0**	**1.0**	**1.5**	**0.6**	**235***
CO99053-3RUS	191	241	79	18	67	12	3	1.074	8	18	0	0	2.0	3.3	0.4	271
Russet Norkotah	**156**	**252**	**62**	**37**	**60**	**2**	**1**	**1.064**	**0**	**5**	**0**	**0**	**2.3**	**1.4**	**0.1**	**155**
Russet Burbank	**124**	**293**	**42**	**25**	**39**	**3**	**33**	**1.073**	**5**	**10**	**0**	**0**	**2.0**	**2.0**	**0.8**	**-**
A98289-1RUS	84	170	50	50	50	0	0	1.066	0	20	5	0	0.5	2.0	0.6	-
MEAN	230	324						1.074					1.5	2.4	0.7	
$HSD_{0.05}$	147	139						0.005					2.3	1.3	* Two-Year Average	

**Not Russet lines

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

[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, 2010; 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 5

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

ADAPTATION TRIAL, CHIP-PROCESSING LINES
MONTCALM RESEARCH FARM
May 4 to September 20, 2010 (139 days)

	CWT/A		PERCENT OF TOTAL[1]							PERCENT (%) TUBER QUALITY[3]						
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	CHIP SCORE[2]	HH	VD	IBS	BC	SCAB[4]	MAT[5]	BRUISE[6]
MSQ035-3	514	561	92	8	84	8	0	1.075	1.0	0	5	0	0	1.0	2.3	2.2
MSS206-2	504	531	95	4	76	19	1	1.065	1.5	0	15	0	0	2.5	2.3	0.9
Missaukee	491	576	85	14	79	6	0	1.075	1.0	0	3	5	0	2.5	2.4	1.5
Snowden	**476**	**528**	**90**	**10**	**83**	**7**	**0**	**1.080**	**1.0**	**10**	**23**	**0**	**0**	**2.9**	**2.6**	**1.6**
MSQ432-2PP	407	468	87	9	77	10	4	1.070	2.0	3	0	0	0	2.0	2.5	0.4
Atlantic	**378**	**434**	**87**	**12**	**81**	**6**	**1**	**1.086**	**1.0**	**25**	**3**	**8**	**0**	**2.9**	**1.9**	**1.9**
MSR036-5	365	428	85	9	64	21	6	1.078	1.5	25	10	0	0	1.0	2.5	1.2
MSR058-1	360	486	74	20	70	4	6	1.076	1.0	8	20	0	0	1.5	2.5	1.5
MSR169-8Y	359	450	80	20	77	3	0	1.081	1.0!	3	5	0	0	1.0	2.6	1.0
MSK409-1	333	395	84	14	78	6	2	1.084	1.0	13	18	3	0	1.3	2.0	2.6
MSS026-2Y	286	343	83	17	76	7	0	1.080	1.0	5	8	0	0	3.0	2.8	1.5
MSS108-1	276	354	78	22	75	3	1	1.072	2.0	0	10	0	0	1.5	2.5	0.3
MSR159-02	269	330	82	14	67	14	4	1.080	1.0	40	5	5	0	2.0	2.9	0.6
CO95051-7W	262	338	77	22	76	1	0	1.079	1.0	0	13	0	0	1.5	2.9	2.0
MSR131-2	256	383	67	33	66	1	0	1.072	1.0	0	15	5	0	1.0	3.1	1.0
MSN148-A	249	350	71	28	69	2	1	1.083	1.0	3	3	0	0	1.5	2.8	1.9
Pike	**243**	**298**	**82**	**17**	**78**	**4**	**1**	**1.078**	**1.0**	**3**	**8**	**0**	**0**	**1.1**	**2.1**	**0.8**
MSQ558-2RR	230	380	60	39	60	1	1	1.066	1.0	0	0	0	0	2.3	1.3	1.8
MSR102-3	207	256	81	12	69	12	7	1.078	1.0	8	10	0	0	1.0	3.4	0.5
MSS258-1	187	225	83	17	78	5	0	1.059	1.0	0	0	0	0	2.0	1.3	0.8
MSR226-1RR	169	294	57	39	55	2	4	1.060	1.0!	0	0	0	0	3.0	1.6	0.6
MEAN	325	400						1.075						1.8	2.4	1.3
$HSD_{0.05}$	193	199						0.009						2.3	1.0	

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

[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, 2010; 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 6

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

ADAPTATION TRIAL, TABLESTOCK LINES
MONTCALM RESEARCH FARM
May 4 to September 7, 2010 (126 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]
MSS582-1SPL	510	541	94	5	78	17	1	1.074	0	3	0	0	2.0	2.3	0.5
Reba	469	494	95	5	81	14	0	1.072	18	23	0	0	2.5	2.8	1.4
MSQ461-2PP	412	465	89	10	85	3	1	1.079	0	0	0	0	2.0	1.9	0.4
MSQ341-BY	399	458	87	13	84	3	0	1.078	0	18	0	0	1.5	2.5	0.5
Onaway	**379**	**432**	**88**	**11**	**82**	**6**	**1**	**1.060**	**0**	**30**	**0**	**0**	**2.1**	**1.7**	**1.1**
MSN230-1RY	364	447	82	17	81	1	1	1.087	3	13	0	0	2.0	2.6	1.9
MSM288-2Y	358	483	74	25	74	0	0	1.071	3	13	0	0	3.0	1.5	0.1
MSS576-05SPL	347	422	82	18	81	1	0	1.071	0	3	0	0	2.0	1.9	0.4
MSL228-1SPL	318	361	88	10	82	6	2	1.077	3	10	0	0	1.8	1.8	0.5
MSQ134-5	302	413	73	26	72	1	1	1.074	0	5	0	0	2.5	3.0	0.6
MSR157-1Y	266	307	87	13	83	4	1	1.075	0	10	0	0	1.3	2.4	0.3
MSQ425-4Y	259	359	72	28	72	0	0	1.067	0	15	0	0	2.5	1.9	1.5
MSS514-1PP	251	340	74	23	74	0	3	1.061	0	0	0	0	2.0	2.0	0.5
MSN215-2P	240	338	71	22	71	0	7	1.072	0	10	0	0	1.0	1.6	0.6
Jacqueline Lee	155	309	50	37	50	0	12	1.079	0	8	0	0	3.3	2.6	0.9
MSS544-1R	140	219	64	36	64	0	0	1.059	0	3	0	0	1.0	1.6	0.1
MEAN	323	399						1.072					2.0	2.1	0.7
$HSD_{0.05}$	134	149						0.006					2.3	1.0	

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

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, 2010; 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 7

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

PRELIMINARY TRIAL, CHIP-PROCESSING LINES
MONTCALM RESEARCH FARM
May 4 to September 15, 2010 (134 days)

	CWT/A		PERCENT OF TOTAL[1]							PERCENT (%) TUBER QUALITY[3]						
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	CHIP SCORE[2]	HH	VD	IBS	BC	SCAB[4]	MAT[5]	BRUISE[6]
MSU379-1	547	604	91	8	80	11	1	1.071	1.0	0	0	0	0	1.5	2.8	0.2
MSR148-4	534	638	84	16	84	0	0	1.073	1.0	0	20	10	0	2.5	2.0	1.0
MSR127-2	486	575	84	16	84	0	0	1.091	1.0	0	0	0	0	1.0	3.8	2.3
MSU383-1	446	488	91	7	78	13	1	1.088	1.0	10	5	0	0	1.0	1.5	1.4
MST220-8	434	522	83	15	78	6	1	1.071	1.5	20	0	0	0	1.5	3.3	0.8
Snowden	**423**	**478**	**88**	**10**	**76**	**12**	**1**	**1.079**	**1.0**	**25**	**10**	**0**	**0**	**3.0**	**2.8**	**1.2**
CO02033-1W	422	512	82	12	78	4	5	1.089	1.0	20	25	10	0	3.5	2.8	1.1
Atlantic	**417**	**483**	**86**	**11**	**75**	**11**	**2**	**1.090**	**1.0**	**45**	**5**	**55**	**0**	**3.0**	**2.3**	**1.5**
NY139	416	466	89	10	86	3	1	1.085	1.0	0	20	0	0	2.0	3.0	0.9
AF2291-10	403	455	89	11	83	5	1	1.086	1.0	10	25	5	0	2.0	2.5	1.4
MSU384-1	393	444	88	10	84	4	1	1.083	1.0	0	10	10	0	1.0	2.8	0.2
MSQ130-4	379	452	84	16	76	7	0	1.074	1.5	25	0	10	0	2.0	2.3	0.4
CO02024-9W	377	492	77	22	75	1	1	1.078	1.0	0	0	0	0	3.0	3.0	0.7
MSU389-1	370	425	87	11	84	3	2	1.074	-	0	0	0	0	-	1.8	-
MST191-2Y	367	471	78	21	75	3	1	1.084	1.0!	0	0	0	0	3.0	2.8	1.5
MSNDU030-1	364	437	83	16	77	7	1	1.080	1.0	10	5	0	0	1.5	2.3	1.0
CO02321-4W	363	425	85	14	76	10	1	1.082	1.0	10	0	10	0	3.0	2.0	1.3
CO00197-3W	361	482	75	21	75	0	4	1.080	1.0	0	15	0	0	3.5	1.8	0.7
MSU088-1	356	421	85	15	83	2	0	1.084	1.0	0	0	0	0	3.0	2.8	1.2
MST306-1	351	481	73	26	73	0	1	1.078	1.5	0	0	5	0	1.5	2.0	0.4
MSU245-1	325	416	78	20	78	0	2	1.088	1.0	45	0	0	0	-	2.3	0.6
MST424-3	308	345	89	9	84	5	2	1.069	1.0	0	15	0	0	1.5	2.0	1.1
MST437-1	304	364	84	13	72	11	3	1.084	1.0	10	5	0	0	2.5	2.5	0.4
MSU246-1	301	381	79	21	77	2	0	1.088	1.0	5	20	5	0	-	2.5	1.6
CO00188-4W	294	395	75	25	73	2	1	1.074	1.0	0	10	0	0	1.5	1.3	0.2
MSS297-3	290	391	74	26	74	0	0	1.074	1.0	0	0	0	0	1.0	2.3	1.2
MSQ029-1	288	338	85	13	74	11	2	1.076	1.5	45	0	0	0	1.5	4.5	0.5
MSU245-2	270	332	81	18	77	4	1	1.081	1.0	20	15	5	0	-	3.3	0.6

Table 7

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

PRELIMINARY TRIAL, CHIP-PROCESSING LINES
MONTCALM RESEARCH FARM
May 4 to September 15, 2010 (134 days)

	CWT/A		PERCENT OF TOTAL[1]							PERCENT (%) TUBER QUALITY[3]						
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	CHIP SCORE[2]	HH	VD	IBS	BC	SCAB[4]	MAT[5]	BRUISE[6]
Pike	**269**	**338**	**80**	**18**	**74**	**6**	**2**	**1.076**	**1.0**	**10**	**5**	**0**	**0**	**1.0**	**2.0**	**0.6**
MST441-1	253	341	74	25	69	5	1	1.072	1.5	0	0	0	0	1.0	1.3	0.8
MSU358-2	251	291	87	12	74	13	1	1.079	1.0	0	0	0	0	-	1.8	1.2
A01143-3C	247	326	76	15	76	0	10	1.078	1.5	5	0	25	0	1.5	3.5	0.6
A00188-3C	230	342	67	29	67	0	4	1.082	1.0	0	10	0	0	1.5	2.5	0.1
AC01151-5W	206	310	66	31	66	0	3	1.076	1.0	0	0	15	0	3.5	2.8	0.7
MST202-5	147	239	61	36	61	0	2	1.064	1.0	0	30	0	0	1.5	1.0	0.0
MSR160-2Y	126	320	39	61	39	0	0	1.083	1.5	0	0	0	0	2.0	2.0	0.0
MEAN	342	423						1.080						2.0	2.4	0.8
$HSD_{0.05}$	233	225						0.012						2.3	1.8	

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

[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, 2010; 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 8

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

PRELIMINARY TRIAL, TABLESTOCK LINES
MONTCALM RESEARCH FARM
May 4 to September 7, 2010 (126 days)

	CWT/A		PERCENT OF TOTAL[1]							PERCENT (%) TUBER QUALITY[3]						
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	CHIP SCORE[2]	HH	VD	IBS	BC	SCAB[4]	MAT[5]	BRUISE[6]
MSU161-1	490	529	93	7	80	12	1	1.074	2.5	0	1	0	0	2.0	2.5	0.8
MSR214-2P	457	543	84	16	84	0	0	1.069	2.5	0	0	0	0	2.5	3.0	0.8
MST386-1P	454	509	89	7	78	11	4	1.079	2.5	1	4	0	0	1.0	1.8	1.6
MST285-2	419	481	87	10	77	10	3	1.079	2.5	3	0	0	0	1.3	2.8	1.0
Onaway	**417**	**469**	**89**	**11**	**81**	**8**	**0**	**1.063**	**3.5**	**0**	**3**	**0**	**0**	**2.1**	**1.5**	**1.7**
CO99256-2R	398	510	78	22	77	1	0	1.069	2.5	0	4	0	0	2.8	3.0	0.8
MSU320-2Y	393	462	85	14	83	2	1	1.074	2.5	0	1	0	0	1.0	3.0	0.8
MSU613-1	350	385	91	9	83	8	0	1.070	1.0!	0	0	0	0	2.5	1.8	0.5
Colorado Rose	330	390	85	13	75	9	2	1.065	2.5	0	3	0	0	3.5	1.3	0.6
MSU202-1P	322	376	86	13	68	18	1	1.062	2.5	0	0	0	0	-	2.3	0.2
MSU279-1	307	412	75	24	72	2	1	1.079	3.5	0	1	0	0	1.8	2.8	0.8
Midnight	286	415	69	30	67	2	1	1.048	1.5	0	0	0	0	3.5	1.0	0.8
W5767-1R	284	334	85	14	73	12	1	1.070	2.5	1	0	0	0	2.0	1.8	2.0
MSU500-2SPL	280	466	60	40	60	0	0	1.071	1.5	0	0	0	0	2.0	1.5	0.8
MSU200-5PP	242	278	87	13	78	9	0	1.064	1.5	0	0	0	0	1.0	2.5	0.8
Zongshu 3	242	302	80	16	80	0	3	1.070	3.0	1	0	0	0	3.5	2.3	0.9
MSNDU022-1	238	282	85	14	80	5	1	1.079	1.0	2	0	0	0	3.0	1.0	1.0
MSNDU045-1	225	315	71	28	71	0	1	1.063	1.0	0	1	0	0	-	1.0	0.8
CO00291-5R	222	268	83	17	83	0	0	1.063	2.5	1	1	0	0	2.5	4.0	0.7
MSU616-3P	197	282	70	28	70	0	2	1.066	1.5	0	0	0	0	2.0	2.0	-
MSR217-1R	194	238	81	16	73	9	3	1.059	2.0	0	0	0	0	2.0	1.0	0.7
MSR297-A	173	211	82	18	79	3	0	1.065	1.0!	0	0	0	0	1.0	1.8	0.3
MSU616-1PP	168	276	61	38	61	0	1	1.065	1.5	0	0	0	0	2.0	1.0	0.8
Jingshu 2	154	291	53	46	52	1	1	1.089	2.0	1	4	0	0	3.0	3.5	2.4
MST406-2RR	146	213	69	16	63	5	16	1.048	1.5	0	0	0	0	1.5	1.8	0.5
MSR241-4RY	120	204	59	41	58	1	0	1.067	1.5	0	0	0	0	3.5	1.8	0.8
Sieglinde	75	217	34	61	34	0	4	1.071	-	0	0	0	0	0.5	2.8	-
MSQ405-1PP	72	159	45	55	45	0	0	1.064	1.5	0	0	0	0	2.0	3.3	0.5

Table 8

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

PRELIMINARY TRIAL, TABLESTOCK LINES
MONTCALM RESEARCH FARM
May 4 to September 7, 2010 (126 days)

	CWT/A		PERCENT OF TOTAL[1]							PERCENT (%) TUBER QUALITY[3]						
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	CHIP SCORE[2]	HH	VD	IBS	BC	SCAB[4]	MAT[5]	BRUISE[6]
1991-563-18	58	144	40	60	40	0	0	1.082	1.5	0	0	0	0	1.0	3.3	0.4
MSU616-2PP	17	104	16	84	16	0	0	1.071	1.0	0	0	0	0	2.0	1.8	0.6
MEAN	258	336						1.069						2.1	2.1	0.9
$HSD_{0.05}$	268	276						0.010						2.3	2.1	

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

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

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[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, 2010; 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 9

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

2008-2010 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, MONTCALM CO., MI

LINE	*3-YR* AVG.*	2010 RATING	2010 WORST	2010 N	2009 RATING	2009 WORST	2009 N	2008 RATING	2008 WORST	2008 N
Sorted by ascending 2010 Rating;										
A98289-1RUS	-	0.5	1	2	-	-	-	-	-	-
Sieglinde	-	0.5	1	2	-	-	-	-	-	-
MSS297-3	***1.1***	0.9	1	4	1.0	1	4	1.5	2	1
1991-563-18	-	1.0	1	2	-	-	-	-	-	-
AC00395-2RUS	-	1.0	1	2	-	-	-	-	-	-
Goldrush Russet	***1.0****	**1.0**	**1**	**2**	**1.0**	**1**	**4**	**-**	**-**	**-**
MSH228-6	***1.1***	1.0	1	2	1.3	2	4	1.0	1	3
MSJ126-9Y	***1.1***	1.0	1	2	1.3	2	4	1.1	2	4
MSL007-B	***1.0****	1.0	1	2	1.0	1	3	-	-	-
MSM037-3	***1.3***	1.0	1	2	1.3	2	4	1.8	2	4
MSN215-2P	***0.9***	1.0	1	2	0.8	1	4	1.0	1	4
MSP270-1	***1.3****	1.0	1	2	1.5	2	4	-	-	-
MSQ035-3[LBR]	***1.5***	1.0	1	2	2.0	2	4	1.5	2	3
MSR036-5[LBR]	***1.3***	1.0	1	2	1.3	2	4	1.5	2	3
MSR102-3[LBR]	***1.0***	1.0	1	2	0.8	1	4	1.1	2	4
MSR127-2	***1.1***	1.0	1	2	1.0	1	4	1.3	2	4
MSR131-2	-	1.0	1	2	-	-	-	-	-	-
MSR169-8Y	***1.0***	1.0	1	2	1.0	1	4	1.0	1	2
MSR297-A	***1.5***	1.0	1	2	1.7	2	3	1.8	2	3
MSS544-1R	***0.9***	1.0	1	2	0.8	1	4	1.0	1	4
MST386-1P	-	1.0	1	2	-	-	-	-	-	-
MSU320-2Y	-	1.0	1	1	-	-	-	-	-	-
MSU383-1	-	1.0	1	2	-	-	-	-	-	-
MSU384-1	-	1.0	1	2	-	-	-	-	-	-
ND8229-3	-	1.0	1	2	-	-	-	-	-	-
Silverton Russet	***1.0***	1.0	1	2	1.3	2	4	0.8	1	4
W2609-1R	-	1.0	1	2	-	-	-	-	-	-
W2683-2RUS	-	1.0	1	2	-	-	-	-	-	-
MSU200-5PP	-	1.0	2	2	-	-	-	-	-	-
Pike	***1.3***	**1.1**	**2**	**8**	**1.5**	**2**	**8**	**1.4**	**2**	**15**
A98134-2RUS	-	1.3	2	2	-	-	-	-	-	-
MSJ147-1	***1.4***	1.3	2	2	1.7	2	3	1.4	2	4
MSK409-1	***1.6***	1.3	2	2	1.6	2	4	2.0	4	3
MSQ279-1	-	1.3	2	2	-	-	-	-	-	-
MST441-1	-	1.3	2	2	-	-	-	-	-	-
W8946-1RUS	-	1.3	2	2	-	-	-	-	-	-
MSQ070-1[LBR]	***1.2***	1.3	2	2	1.3	2	3	1.0	1	4
MSR061-1[LBMR,PVYR]	***1.2***	1.3	2	2	1.1	2	4	1.3	2	4
MSR157-1Y	***1.4***	1.3	2	2	1.5	2	4	1.5	2	4
MST285-2	***1.4****	1.3	2	2	1.5	2	4	-	-	-
MSU230-2Y	-	1.5	2	1	-	-	-	-	-	-
A00188-3C	***1.4****	1.5	2	2	1.3	2	3	-	-	-
A01124-3RUS	-	1.5	2	2	-	-	-	-	-	-

Table 9

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

2008-2010 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, MONTCALM CO., MI

LINE	*3-YR* AVG.*	2010 RATING	2010 WORST	2010 N	2009 RATING	2009 WORST	2009 N	2008 RATING	2008 WORST	2008 N
Sorted by ascending 2010 Rating;										
CO00188-4W	***1.8****	1.5	2	2	2.0	2	4	-	-	-
CO95051-7W	-	1.5	2	2	-	-	-	-	-	-
Kalkaska (MSJ036-A)	***1.3***	**1.5**	**2**	**2**	**1.3**	**2**	**4**	**1.1**	**2**	**4**
MSM171-A[LBR]	***1.8***	1.5	2	2	2.3	3	4	1.7	3	8
MSN148-A	***1.6***	1.5	2	2	2.0	3	4	1.4	2	4
MSNDU030-1	-	1.5	2	2	-	-	-	-	-	-
MSQ341-BY	-	1.5	2	2	-	-	-	-	-	-
MSR058-1	***1.3***	1.5	2	2	1.3	2	4	1.3	2	4
MSR605-11	-	1.5	2	2	-	-	-	-	-	-
MSS108-1	-	1.5	2	2	-	-	-	-	-	-
MSS737-1Y[LBR]	***1.5***	1.5	2	2	1.3	2	4	1.7	2	3
MST202-5	***1.6****	1.5	2	2	1.8	3	4	-	-	-
MST220-8	***1.8****	1.5	2	2	2.1	3	4	-	-	-
MST306-1	***1.3****	1.5	2	2	1.0	2	4	-	-	-
MST406-2RR	-	1.5	2	2	-	-	-	-	-	-
MSU379-1	-	1.5	2	2	-	-	-	-	-	-
ND8307c-3	-	1.5	2	2	-	-	-	-	-	-
A01143-3C	***1.5****	1.8	2	2	1.3	2	4	-	-	-
MSL228-1SPL	***2.0***	1.8	2	2	2.5	4	3	1.6	2	4
MSN170-A	-	1.8	2	2	-	-	-	-	-	-
MSQ440-2	***1.3***	1.8	2	2	1.0	2	4	1.3	2	4
MST424-3	***1.5****	1.8	2	2	1.3	2	4	-	-	-
MSU279-1	-	1.8	2	2	-	-	-	-	-	-
AF2291-10	-	2.0	2	2	-	-	-	-	-	-
Beacon Chipper	***1.4***	2.0	2	2	1.3	2	4	1.0	1	1
CO99053-3RUS	***1.7***	2.0	2	2	1.5	3	4	1.5	3	4
MSN230-1RY	***1.1****	2.0	2	2	0.3	1	4	-	-	-
MSN251-1Y	-	2.0	2	2	-	-	-	-	-	-
MSQ029-1[LBR]	***2.0***	2.0	2	1	2.0	2	4	2.0	2	4
MSQ405-1PP	***1.4****	2.0	2	2	0.8	1	4	-	-	-
MSQ432-2PP	***1.8***	2.0	2	2	1.8	3	4	1.5	2	2
MSQ461-2PP	***1.4***	2.0	2	2	0.8	1	4	1.5	2	4
MSR041-3	-	2.0	2	2	-	-	-	-	-	-
MSR159-02[LBR]	***1.7***	2.0	2	2	1.5	2	4	1.5	2	3
MSR160-2Y	-	2.0	2	2	-	-	-	-	-	-
MSR217-1R	***1.9****	2.0	2	1	1.8	3	4	-	-	-
MSR605-5	-	2.0	2	2	-	-	-	-	-	-
MSS258-1	***2.0***	2.0	2	2	2.0	3	4	2.0	2	1
MSS514-1PP	***1.4***	2.0	2	2	1.5	3	4	0.8	1	4
MSS576-05SPL	***2.0***	2.0	2	2	2.0	3	4	-	-	-
MSS582-1SPL	***2.0***	2.0	2	2	1.6	3	4	2.4	3	4
MSU161-1	-	2.0	2	2	-	-	-	-	-	-
MSU372-1Y	-	2.0	2	2	-	-	-	-	-	-

Table 9

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

2008-2010 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, MONTCALM CO., MI

LINE	*3-YR* AVG.*	2010 RATING	2010 WORST	2010 N	2009 RATING	2009 WORST	2009 N	2008 RATING	2008 WORST	2008 N
Sorted by ascending 2010 Rating;										
MSU500-2SPL	-	2.0	2	2	-	-	-	-	-	-
MSU616-1PP	-	2.0	2	2	-	-	-	-	-	-
MSU616-2PP	-	2.0	2	1	-	-	-	-	-	-
MSU616-3P	-	2.0	2	2	-	-	-	-	-	-
ND8555-8R	-	2.0	2	2	-	-	-	-	-	-
NY139	-	2.0	2	2	-	-	-	-	-	-
Red Norland	-	**2.0**	**2**	**2**	-	-	-	-	-	-
Russet Burbank	-	**2.0**	**2**	**2**	-	-	-	-	-	-
W2310-3	-	2.0	2	2	-	-	-	-	-	-
W5767-1R	-	2.0	2	2	-	-	-	-	-	-
MSQ130-4[LBR]	***1.8***	2.0	3	2	1.8	3	4	1.5	2	4
MST437-1	-	2.0	3	2	-	-	-	-	-	-
Onaway	***1.8***	**2.1**	**3**	**6**	**1.6**	**2**	**8**	**1.8**	**2**	**7**
MSL211-3	***2.3****	2.2	3	6	2.4	3	4	-	-	-
MSP515-2	***2.0****	2.3	3	2	1.8	2	4	-	-	-
Spunta	-	2.3	3	2	-	-	-	-	-	-
MI Purple Sport III	-	2.3	3	2	-	-	-	-	-	-
MSQ086-3[LBR]	***2.1***	2.3	3	4	2.5	4	4	1.5	2	4
MSQ558-2RR	***1.7***	2.3	3	2	1.3	2	4	1.6	2	4
NorValley	-	2.3	3	2	-	-	-	-	-	-
Russet Norkotah	***2.1****	**2.3**	**3**	**4**	**2.0**	**3**	**4**	**-**	**-**	**-**
CO00291-5R	-	2.5	3	2	-	-	-	-	-	-
Missaukee	-	2.5	3	2	-	-	-	-	-	-
MSL292-A	***2.5***	2.5	3	2	2.3	3	4	2.8	3	4
MSN105-1[LBMR]	***2.1***	2.5	3	2	2.0	2	4	1.9	3	4
MSQ134-5[LBR]	***2.1***	2.5	3	2	1.9	2	4	1.9	3	4
MSQ425-4Y SPL	***2.2***	2.5	3	4	2.3	4	4	1.9	2	4
MSR148-4	-	2.5	3	2	-	-	-	-	-	-
MSR214-2P	-	2.5	3	2	-	-	-	-	-	-
MSR219-2R	***2.4***	2.5	3	2	2.5	3	2	2.3	3	4
MSR605-02	-	2.5	3	2	-	-	-	-	-	-
MSR606-02	-	2.5	3	2	-	-	-	-	-	-
MSS206-2[LBR]	***2.1***	2.5	3	2	2.1	3	4	1.8	2	4
MSU278-1	-	2.5	3	2	-	-	-	-	-	-
MSU613-1	-	2.5	3	2	-	-	-	-	-	-
Reba	***2.2***	2.5	3	2	2.0	3	8	2.0	3	8
Spunta G2	-	2.5	3	2	-	-	-	-	-	-
CO99256-2R	***2.3****	2.8	4	2	1.8	3	4	-	-	-
Snowden	***2.6***	**2.9**	**4**	**10**	**2.3**	**3**	**12**	**2.6**	**3**	**16**
Atlantic	***2.7***	**2.9**	**3**	**10**	**2.7**	**3**	**8**	**2.4**	**3**	**12**
CO02024-9W	-	3.0	3	2	-	-	-	-	-	-
CO02321-4W	-	3.0	3	2	-	-	-	-	-	-
MSL268-D[LBR,PVYR]	***2.2***	3.0	3	2	2.5	4	4	1.1	2	4

Table 9

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

2008-2010 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, MONTCALM CO., MI

LINE	*3-YR* AVG.*	2010 RATING	2010 WORST	2010 N	2009 RATING	2009 WORST	2009 N	2008 RATING	2008 WORST	2008 N
Sorted by ascending 2010 Rating;										
MSM182-1[LBR,PVYR]	***2.7***	3.0	3	2	2.9	4	4	2.1	3	4
MSM288-2Y	-	3.0	3	2	-	-	-	-	-	-
MSNDU022-1	-	3.0	3	2	-	-	-	-	-	-
MSP459-5	-	3.0	3	2	-	-	-	-	-	-
MSQ176-5[LBR]	***2.3***	3.0	3	2	1.8	3	4	2.0	2	3
MSR089-9Y	-	3.0	3	2	-	-	-	-	-	-
MSR226-1RR	***2.0***	3.0	3	2	1.0	2	4	2.0	2	3
MSS026-2Y	***2.6***	3.0	3	2	2.5	3	4	2.2	3	3
MST191-2Y	-	3.0	3	2	-	-	-	-	-	-
MSU088-1	-	3.0	3	2	-	-	-	-	-	-
ND8314-1R	-	3.0	3	2	-	-	-	-	-	-
W2717-5	-	3.0	3	2	-	-	-	-	-	-
Jingshu 2	-	3.0	4	2	-	-	-	-	-	-
MSS070-B	***2.5****	3.0	4	2	2.0	3	4	-	-	-
W5015-12	-	3.0	4	2	-	-	-	-	-	-
Jacqueline Lee[LBR]	***3.0***	3.3	4	2	2.5	3	4	3.3	4	4
CO00197-3W	***3.3****	3.5	4	2	3.1	4	4	-	-	-
Colorado Rose	-	3.5	4	2	-	-	-	-	-	-
FL1879	***2.7***	3.5	4	2	2.0	3	7	2.5	3	11
Midnight	***2.9****	3.5	4	2	2.3	4	3	-	-	-
MSR241-4RY	***2.5***	3.5	4	2	1.8	3	4	2.3	3	4
MSR606-10	-	3.5	4	2	-	-	-	-	-	-
W2978-3	-	3.5	4	2	-	-	-	-	-	-
W6234-4RUS	-	3.5	4	2	-	-	-	-	-	-
Zongshu 3	-	3.5	4	2	-	-	-	-	-	-
CO02033-W	-	3.8	4	2	-	-	-	-	-	-
AC01151-5W	-	3.8	5	2	-	-	-	-	-	-
MSM183-1	-	4.0	4	2	-	-	-	-	-	-
Red Pontiac	-	**4.5**	**5**	**2**	-	-	-	-	-	-
H/LSD$_{0.05}$ =		**2.3**			**1.1**			**0.9**		

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.

Table 10

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

2010 LATE BLIGHT VARIETY TRIAL
MUCK SOILS RESEARCH FARM

LINE	RAUDPC[1] MEAN	Female	Male	LINE	RAUDPC[1] MEAN
Sorted by ascending RAUDPC value:					
Foliar Resistance Category (select lines):				***Foliar Susceptibility Category (select lines)[2]:***	
Torridon	0.4			Beacon Chipper	43.5
MCR150	0.4			MSR217-1R	43.8
MCR205	0.4			MST306-1	44.3
ND039036-2R	0.4			Silverton Russet	44.3
LBR9	0.6			MSR297-A	44.4
VSB16 (LBR8)	0.7			MSQ134-5	44.7
Montanosa	0.8			A01124-3RUS	44.7
J138K6A22	0.9			A01143-3C	45.1
MSR214-2P	0.9	ND5084-3R	MSJ317-1	ND8229-3RUS	45.5
MSM183-1	0.9	Torridon	J. Lee	Midnight	45.5
Sherriff	0.9			MSQ086-3	45.6
Kenya Baraka	1.0			MSU245-2	46.0
Monserrat	1.0			Austrian Crescent	46.2
MSL268-D	1.0	NY103	J. Lee	MST191-2Y	46.4
Satina	1.0			A98134-2RUS	46.9
MSQ029-1	1.4	B0766-3	NY121	NY139	47.9
Stirling	1.4			MSR041-3	48.6
MSR160-2Y	1.5	NY121	MSJ126-9Y	MSS576-05SPL	48.6
A9520-43	1.7			MSR605-05	49.3
CO00291-5R	2.1			NDU030-1	49.5
Mnandi	2.5			Russian Banana	49.9
MSE149-5Y 82.4	3.9	Saginaw Gold	ND860-2	MSQ035-3	50.4
MSQ405-1PP	4.1	MSG147-3P	MSJ319-1	W2310-3	51.3
NY121	4.9			MSU307-3Y	52.2
MSI152-A	5.0	Mainestay	B0718	**Red Norland**	**52.3**
MSU279-1	6.1	Torridon	NY132	ND8314-1R	53.0
MSR061-1	8.7	MegaChip	NY121	**Russet Norkotah**	**53.0**
MSR036-5	8.8	MSL766-1	Liberator	CO02321-4W	53.5
MSE149-5Y 82.1	9.0	Saginaw Gold	ND860-2	MSR219-2R	54.5
Gala	9.9			MSS026-2Y	55.0
MSR148-4	10.2	MSI152-A	Dakota Pearl	**Onaway**	**56.3**
Sieglinde	10.6			**D Red Norland**	**57.4**
MSM182-1	10.9	Stirling	NY121	W2609-1R	58.1
MSR605-02	10.9	Spunta G2	Missaukee	W2978-3	62.9
MSQ176-5	11.8	MSI152-A	Missaukee	A98289-1RUS	64.7
Tukey $HSD_{0.05}$	20.2				

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

[2] 157 potato varieties and advanced breeding lines were tested in all. For brevity purposes, only selected varieties and breeding lines are listed.

Phytopthora infestans isolate US-8 was inoculated on 8/3/2010. NOTE: US-22 was identified at the Muck Soils Research Farm.

Planted as a randomized complete block design consisting of 3 replications of 4 hill plots on 6/7/2010.

Table 11

MICHIGAN STATE UNIVERSITY

POTATO BREEDING and GENETICS

2010 BLACKSPOT BRUISE SUSCEPTIBILITY TEST
SIMULATED BRUISE SAMPLES*

	NUMBER OF SPOTS PER TUBER						PERCENT (%) BRUISE FREE	AVERAGE SPOTS/TUBER
ENTRY	0	1	2	3	4	5+		
ADVANCED TRIAL								
MSQ279-1	21	4					84	0.2
MSP270-1	20	5					80	0.2
MSQ440-2	20	5					80	0.2
MSH228-6	17	7	1				68	0.4
MSQ086-3	17	7	1				68	0.4
MSJ126-9Y	14	8	2	1			56	0.6
MSR061-1	11	13	1				44	0.6
MSJ147-1	12	10	3				48	0.6
FL1879	12	9	4				48	0.7
MSL007-B	10	11	3	1			40	0.8
MSQ070-1	11	5	6	3			44	1.0
Kalkaska (J036-A)	8	7	6	4			32	1.2
MSL292-A	8	5	9	3			32	1.3
Beacon Chipper	7	8	6	3	1		28	1.3
MSP515-2	7	8	6	2	2		28	1.4
Snowden	**9**	**5**	**5**	**4**		**2**	**36**	**1.5**
MSP459-5	6	6	7	4	2		24	1.6
Atlantic	**4**	**5**	**7**	**2**	**5**	**2**	**16**	**2.2**
RUSSET TRIAL								
A01124-3RUS	25						100	0.0
Russet Norkotah-NCR	**23**	**1**	**1**				**92**	**0.1**
MSS737-1Y	22	2	1				88	0.2
MSR605-11	20	5					80	0.2
MSR605-05	19	6					76	0.2
Silverton Russet	19	5	1				76	0.3
MSR606-10	17	8					68	0.3
W6234-4RUS	17	7	1				68	0.4
MSR606-02	8	5					62	0.4
CO99053-3RUS	16	8	1				64	0.4
A98134-2RUS	16	7	2				64	0.4
MSN170-A	15	8	2				60	0.5
Russet Norkotah-Sandyland	16	6	3				64	0.5
Spunta G2	15	8	2				60	0.5
Goldrush	15	6	4				60	0.6
A98289-1RUS	16	5	2	2			64	0.6
AC00395-2RUS	13	9	2	1			52	0.6

2010 BLACKSPOT BRUISE SUSCEPTIBILITY TEST
SIMULATED BRUISE SAMPLES*

	NUMBER OF SPOTS PER TUBER						PERCENT (%) BRUISE FREE	AVERAGE SPOTS/TUBER
ENTRY	0	1	2	3	4	5+		
Spunta	13	8	4				52	0.6
Russet Burbank-NCR	**12**	**9**	**2**	**2**			**48**	**0.8**
MSR605-02	8	6	6	2	2	1	32	1.5
W8946-1RUS-NCR	8	3	10	3		1	32	1.5
W2683-2RUS	1	2	11	5	3	3	4	2.6
NORTH CENTRAL REGIONAL TRIAL								
Red Norland	19	6					76	0.2
W2609-1R	16	9					64	0.4
W2978-3	14	9	2				56	0.5
MSQ176-5	11	13	1				44	0.6
Pontiac	14	7	3		1		56	0.7
ND8307C-3	11	9	4	1			44	0.8
MSL211-3	8	10	5	2			32	1.0
ND8314-1R	10	5	9	1			40	1.0
ND8555-8R	9	7	7	1	1		36	1.1
NorValley	8	9	5	2	1		32	1.2
MSM182-1	10	7	3	3	1	1	40	1.2
W2717-5	6	12	3	3	1		24	1.2
Atlantic	**8**	**5**	**7**	**4**	**1**		**32**	**1.4**
MSL268-D	5	9	6	3	2		20	1.5
W2310-3	6	3	9	3	3	1	24	1.9
ND8229-3RUS	4	4	10	4	1	2	16	2.0
W5015-12	0	7	7	6	4	1	0	2.4
ADAPTATION TRIAL, CHIP-PROCESSING LINES								
MSS108-1	18	6	1				72	0.3
MSQ432-2PP	16	8	1				64	0.4
MSR102-3	16	6	3				64	0.5
MSR159-02	12	12	1				48	0.6
MSR226-1RR	15	7	2	1			60	0.6
MSS258-1	12	9	2	2			48	0.8
Pike	11	10	3		1		44	0.8
MSS206-2	8	12	4	1			32	0.9
MSR131-2	9	9	5	2			36	1.0
MSR169-8Y	11	7	3	3	1		44	1.0
MSR036-5	9	8	4	3		1	36	1.2
MSS026-2Y	7	8	3	5	2		28	1.5
Missaukee	5	8	7	4	1		20	1.5
MSR058-1	7	7	6	3		2	28	1.5
Snowden	**5**	**10**	**4**	**4**	**1**	**1**	**20**	**1.6**

2010 BLACKSPOT BRUISE SUSCEPTIBILITY TEST
SIMULATED BRUISE SAMPLES*

	NUMBER OF SPOTS PER TUBER						PERCENT (%) BRUISE	AVERAGE
ENTRY	0	1	2	3	4	5+	FREE	SPOTS/TUBER
MSQ558-2RR	7	3	7	6	1	1	28	1.8
Atlantic	**2**	**4**	**15**	**3**	**1**		**8**	**1.9**
MSN148-A	4	6	9	2	2	2	16	1.9
CO95051-7W	3	7	4	10	1		12	2.0
MSQ035-3	2	7	5	6	5		8	2.2
MSK409-1	1	8	4	5	2	5	4	2.6
ADAPTATION TRIAL, TABLESTOCK LINES								
MSM288-2Y	23	2					92	0.1
MSS544-1R	22	3					88	0.1
MSN105-1	6	1					86	0.1
MSR157-1Y	19	4	1				79	0.3
MSS576-05SPL	17	7	1				68	0.4
MSQ461-2PP	16	8	1				64	0.4
MSL228-1SPL	16	5	4				64	0.5
MSQ341-BY	17	4	3	1			68	0.5
MSS514-1PP	14	9	2				56	0.5
MSS582-1SPL	15	7	3				60	0.5
MSN215-2P	14	7	4				56	0.6
MSQ134-5	16	4	4	1			64	0.6
J. Lee	8	12	5				32	0.9
Onaway	**9**	**10**	**3**	**1**	**2**		**36**	**1.1**
Reba	5	7	11	2			20	1.4
MSQ425-4Y	5	8	7	5			20	1.5
MSN230-1RY	3	8	6	4	4		12	1.9
PRELIMINARY TRIAL, CHIP-PROCESSING LINES								
MSR160-2Y	25						100	0.0
MST202-5	13						100	0.0
A00188-3C	12	1					92	0.1
MSU384-1	21	4					84	0.2
CO00188-4W	20	5					80	0.2
MSU379-1	20	4	1				80	0.2
MST437-1	18	5	2				72	0.4
MSQ130-4	17	7		1			68	0.4
MST306-1	15	5	2				68	0.4
MSQ029-1	14	9	2				56	0.5
A01143-3C	16	5	3	1			64	0.6
Pike	**13**	**10**	**1**		**1**		**52**	**0.6**
MSU245-1	16	3	5	1			64	0.6
MSU245-2	13	9	2	1			52	0.6

2010 BLACKSPOT BRUISE SUSCEPTIBILITY TEST
SIMULATED BRUISE SAMPLES*

ENTRY	NUMBER OF SPOTS PER TUBER 0	1	2	3	4	5+	PERCENT (%) BRUISE FREE	AVERAGE SPOTS/TUBER
AC01151-5W	12	10	2	1			48	0.7
CO00197-3W	12	9	4				48	0.7
CO02024-9W	12	10	2	1			48	0.7
MST441-1	12	8	4	1			48	0.8
MST220-8	14	4	5	1	1		56	0.8
NY139	8	12	5				32	0.9
NDU030-1	10	7	5	3			40	1.0
MSR148-4	6	14	4		1		24	1.0
CO02033-1W	8	9	6	2			32	1.1
MST424-3	11	4	6	4			44	1.1
Snowden	**7**	**10**	**5**	**3**			**28**	**1.2**
MSS297-3	9	6	8	1		1	36	1.2
MSU358-2	9	7	5	3	1		36	1.2
MSU088-1	6	9	8	2			24	1.2
CO02321-4W	7	9	5	3	1		28	1.3
AF2291-10	6	7	9	1	2		24	1.4
MSU383-1	12	2	4	3	3	1	48	1.4
Atlantic	**5**	**8**	**8**	**3**	**1**		**20**	**1.5**
MST191-2Y	8	4	8	3	2		32	1.5
MSU246-1	5	7	8	2	3		20	1.6
MSR127-2	4	6	3	5	4	3	16	2.3
PRELIMINARY TRIAL, TABLESTOCK LINES								
MSU202-1P(1REP)	20	5					80	0.2
MSR297-A	19	5	1				76	0.3
1991-563-18	14	7	1				64	0.4
MSQ405-1PP	15	8	2				60	0.5
MST406-2RR	11	5	2				61	0.5
MSU613-1	8	3		1			67	0.5
MSU616-2PP	6	6	1				46	0.6
Colorado Rose	13	8	4				52	0.6
CO00291-5R	13	7	5				52	0.7
MSR217-1R	11	11	2	1			44	0.7
MSR214-2P	12	8	4	1			48	0.8
MSU279-1	12	7	6				48	0.8
MSU500-2SPL	5	6	2				38	0.8
CO99256-2R	11	9	4	1			44	0.8
MSR241-4RY	10	11	3	1			40	0.8
MSU161-1	12	7	5	1			48	0.8
MSU200-5PP	13	5	6	1			52	0.8

2010 BLACKSPOT BRUISE SUSCEPTIBILITY TEST
SIMULATED BRUISE SAMPLES*

	NUMBER OF SPOTS PER TUBER						PERCENT (%) BRUISE FREE	AVERAGE SPOTS/TUBER
ENTRY	0	1	2	3	4	5+		
MSU616-1PP	8	6	3	1			44	0.8
Midnight	7	16	1	1			28	0.8
MSNDU045-1	10	10	4	1			40	0.8
MSU320-2Y	12	9	2	1		1	48	0.8
Zongshu 3	14	4	3	4			56	0.9
MSNDU022-1	9	8	6	2			36	1.0
MST285-2	11	5	6	3			44	1.0
MST386-1P	4	8	8	4	1		16	1.6
Onaway	**5**	**6**	**8**	**4**	**1**	**1**	**20**	**1.7**
W5767-1R	3	8	5	5	3	1	12	2.0
Jingshu 2	3	4	8	4	3	3	12	2.4

2010 BLACKSPOT BRUISE SUSCEPTIBILITY TEST
SIMULATED BRUISE SAMPLES*

	NUMBER OF SPOTS PER TUBER						PERCENT (%) BRUISE FREE	AVERAGE SPOTS/TUBER
ENTRY	0	1	2	3	4	5+		
USPB/SFA TRIAL CHECK SAMPLES (Not bruised)								
NY138	23	1	1				92	0.1
W2978	22	3					88	0.1
MSJ126-9Y	20	5					80	0.2
W2717-5	15	10					60	0.4
CO97043-14W	14	10	1				56	0.5
NY139	14	9	1	1			56	0.6
CO97065-7W	13	9	3				52	0.6
Snowden	**14**	**8**	**2**	**1**			**56**	**0.6**
AF2291-10	10	13	2				40	0.7
MSL292-A	12	6	3	2	2		48	1.0
W2310-3	8	10	5	2			32	1.0
W5015-12	11	5	5	3	1		44	1.1
Atlantic	**2**	**12**	**4**	**5**	**1**	**1**	**8**	**1.8**
USPB/SFA TRIAL BRUISE SAMPLES								
MSJ126-9Y	15	9	1				60	0.4
NY138	17	6	1	1			68	0.4
W2978	12	8	3	2			48	0.8
CO97043-14W	10	9	4	2			40	0.9
NY139	9	10	5		1		36	1.0
MSL292-A	10	9	3	1	1	1	40	1.1
W2717-5	10	5	5	3	2		40	1.3
CO97065-7W	5	5	11	4			20	1.6
AF2291-10	2	10	5	5	2	1	8	1.9
W2310-3	4	9	4	3	2	3	16	2.0
Atlantic	**3**	**7**	**7**	**2**	**3**	**3**	**12**	**2.2**
Snowden	**3**	**2**	**7**	**8**	**1**	**4**	**12**	**2.6**
W5015-12	1	4	5	6	3	6	4	3.0

* 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 10/18/2010.
The table is presented in ascending order of average number of spots per tuber.