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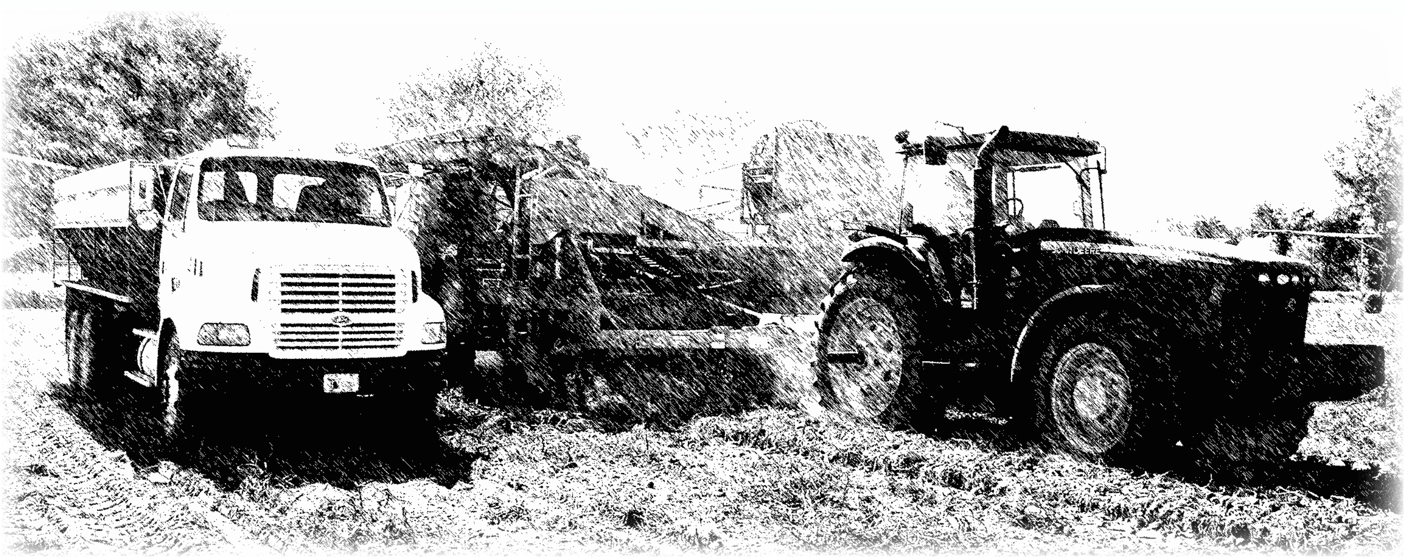
In Cooperation with the

Michigan Potato Industry Commission



2007

Michigan Potato Research Report

Volume 39

MICHIGAN POTATOES
MICHIGAN POTATO INDUSTRY COMMISSION

Michigan Potato Industry Commission

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March 1, 2008

To All Michigan Potato Growers & Shippers:

The Michigan Potato Industry Commission, Michigan State University's Agricultural Experiment Station and Cooperative Extension Service are pleased to provide you with a copy of the results from the 2007 potato research projects.

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

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

Best wishes for a prosperous 2008 season.

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2007 MICHIGAN POTATO RESEARCH REPORT

C. M. Long, Coordinator

INTRODUCTION AND ACKNOWLEDGMENTS

The 2007 Potato Research Report contains reports of the many potato research projects conducted by MSU potato researchers at several locations. The 2007 report is the 39th volume, which has been prepared annually since 1969. This volume includes research projects funded by the Potato Special Federal Grant, the Michigan Potato Industry Commission (MPIC), GREEEN and numerous other sources. The principal source of funding for each project has been noted at the beginning of each report.

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

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

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

Special thanks go to Dick Crawford for the management of the MSU Montcalm Research Farm (MRF) and the many details which are a part of its operation. We also want to recognize Barb Smith and Esther Haviland at MPIC and Greg Steere for helping with the details of this final draft.

WEATHER

The overall 6-month average maximum temperature during the 2007 growing season was higher than the 6-month average maximum temperature for the 2006 season and was higher than the 15-year average (Table 1). There were eight recorded temperature readings of 90 °F or above in 2007. Two of these days occurred in late July during potato bulking. There were no recorded daytime temperatures above 90 °F or night time temperatures above 70 °F in the month of August. There were no days during the growing season that the air temperature was below 32 °F. There was only one daytime low, below 50 °F, during harvest in mid October. There were three night time lows below 32 °F in October; they occurred on October 13th, 14th and 25th. The average maximum temperatures for June, July and August of 2007 were at or above the 15-year average (Table 1).

Rainfall for April through September was 11.77 inches, which was far below the 15-year average. (Table 2). Rainfall recorded during the month of June was the lowest recorded for that month in 15 years. Irrigation at MRF was applied 16 times from June 13th to August 17th , averaging 0.73 inches for each application. The total amount of irrigation water applied during this time period was 11.7 inches.

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

Year	April		May		June		July		August		September		6-Month Average	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1993	54	33	68	45	74	55	81	61	79	60	64	46	70	50
1994	57	34	66	43	78	55	79	60	75	55	73	51	71	50
1995	51	31	66	45	81	57	82	60	82	65	70	45	72	51
1996	50	31	64	44	75	57	76	55	80	59	70	51	69	50
1997	54	31	59	39	79	56	80	57	73	55	69	50	69	48
1998	60	37	75	51	77	56	82	58	81	60	76	52	75	52
1999	59	37	71	48	77	55	84	62	76	56	73	48	73	51
2000	56	34	70	49	75	57	77	56	79	57	70	49	71	50
2001	61	37	70	49	78	57	83	58	72	70	69	48	72	53
2002	56	36	63	42	79	58	85	62	81	58	77	52	73	51
2003	56	33	64	44	77	52	81	58	82	58	72	48	72	49
2004	62	37	67	46	74	54	79	57	76	53	78	49	73	49
2005	62	36	65	41	82	60	82	58	81	58	77	51	75	51
2006	62	36	61	46	78	54	83	61	80	58	68	48	72	51
2007	**53**	**33**	**73**	**47**	**82**	**54**	**81**	**56**	**80**	**58**	**76**	**50**	**74**	**50**
15-Year Average	57	34	67	45	78	56	81	59	78	59	72	49	72	50

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

Year	April	May	June	July	August	September	Total
1993	3.47	3.27	4.32	2.58	6.40	3.56	23.60
1994	3.84	2.63	6.04	5.16	8.05	1.18	26.90
1995	3.65	1.87	2.30	5.25	4.59	1.38	19.04
1996	2.46	3.99	6.28	3.39	3.69	2.96	22.77
1997	2.02	3.13	3.54	2.80	2.71	1.46	15.66
1998	2.40	2.21	1.82	0.40	2.22	3.05	12.10
1999	5.49	5.07	5.82	4.29	5.46	4.03	30.16
2000	3.18	6.46	4.50	3.79	5.28	5.25	28.46
2001	3.28	6.74	2.90	2.49	5.71	4.43	25.55
2002	2.88	4.16	3.28	3.62	7.12	1.59	22.65
2003	0.70	3.44	1.85	2.60	2.60	2.06	13.25
2004	1.79	8.18	3.13	1.72	1.99	0.32	17.13
2005	0.69	1.39	3.57	3.65	1.85	3.90	15.05
2006	2.73	4.45	2.18	5.55	2.25	3.15	20.31
2007	**2.64**	**1.60**	**1.58**	**2.43**	**2.34**	**1.18**	**11.77**
15-Year Average	2.75	3.91	3.54	3.31	4.15	2.63	21.44

GROWING DEGREE DAYS

Tables 3 and 4 summarize the cumulative growing degree days (GDD) for 2007. Growing degree days base 50 for May through September, 2007 are in (Table 3) and growing degree days base 40 for May through October, 2007 are in (Table 4). The total GDD base 50 for 2007 was 2495 (Table 3), which is higher than the 10-year average. The total GDD base 40 for 2007 was 4443 (Table 4).

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

Cumulative Monthly Totals					
Year	May	June	July	August	September
1998	427	932	1545	2180	2616
1999	317	865	1573	2070	2401
2000	313	780	1301	1851	2256
2001	317	808	1441	2079	2379
2002	319	903	1646	2214	2613
2003	330	762	1302	1922	2256
2004	245	662	1200	1639	2060
2005	195	826	1449	2035	2458
2006	283	765	1444	2016	2271
2007	**358**	**926**	**1494**	**2084**	**2495**
10-Year Average	310	823	1440	2009	2381

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

Cumulative Monthly Totals						
Year	May	June	July	August	September	October
2006	532	1310	2298	3180	3707	3923
2007	**639**	**1503**	**2379**	**3277**	**3966**	**4443**
2008						
2009						
2010						
2011						
2012						
2013						
2014						
2015						
10-Year Average	586	1407	2339	3229	3837	4183

*1998-2007 data from the weather station at MSU Montcalm Research Farm (Michigan Automated Weather Network System Entrican, MI.)

PREVIOUS CROPS, SOIL TESTS AND FERTILIZERS

The general potato research area utilized in 2007 was rented from Steve Comden, directly to the West of the Montcalm Research Farm. This acreage was planted to an alfalfa cover crop in the Spring of 2004 and was harvested for hay for two consecutive seasons. The alfalfa was killed off in the fall of 2006 and the ground was chisel plowed. In the spring of 2007, the recommended rate of potash was applied and disked into the remaining alfalfa residue. The ground was moldboard plowed for direct potato planting. The area was not fumigated prior to potato planting. Potato early die was not an issue in 2007.

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

	lbs/A			
pH	P_2O_5	K_2O	Ca	Mg
5.4	312 (156 ppm)	130 (65 ppm)	650 (325 ppm)	128 (64 ppm)

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

Application	Analysis	Rate	Nutrients ($N-P_20_5-K_20$)
Broadcast at plow down	0-0-60	250 lbs/A	0-0-150
At planting	19-17-0	20 gpa	42-37-0
At emergence	46-0-0	100 lbs/A	46-0-0
1st Early side dress	46-0-0	100 lbs/A	46-0-0
2nd Late side dress (late varieties)	46-0-0	100 lbs/A	46-0-0

HERBICIDES AND PEST CONTROL

Hilling was done in late May, followed by a pre-emergence application of Lorox at 1.5 lb/A and Cinch at 1.33 pints/A. A post-emergence application of Sencor at ¼ lb/A and Matrix at 1 oz/A was made in early July.

Platinum was applied at planting at a rate of 8 Fl oz/A. Asanna XL was applied once in late July at 9.6 Fl oz/A. Fungicides used were Bravo, Equus 720 over 12 applications. Potato vines were desiccated with Reglone in early September at a rate of 1 pint/A.

2007 POTATO BREEDING AND GENETICS RESEARCH REPORT

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INTRODUCTION

At Michigan State University we are breeding potatoes for the chip-processing and tablestock markets. The program is one of four integrated breeding program in the North Central region. 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. 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 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, 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.

PROCEDURE

I. Varietal Development

Each year, during the winter months, 500-1000 crosses are made using about 150 of the most promising cultivars and advanced breeding lines. The parents are chosen on the basis of yield potential, tuber shape and appearance, chip quality, specific gravity, disease resistance, adaptation, lack of internal and external defects, etc. These seeds are then used as the breeding base for the program. We also obtain seedling tubers or crosses from other breeding programs in the US. The seedlings are grown annually for visual evaluation (size, shape, set, internal defects) at the Montcalm and Lake City Research Farms as part of the first year selection process of this germplasm each fall. Each selection is then evaluated post harvest for specific gravity and chip processing. These selections each represent a potential variety. This system of generating new seedlings is the initial step in an 8-12 year process to develop new varieties. This step is followed by evaluation and selection at the 8-hill, 20-hill and 30-hill stages. The best selections out of the four-year process are then advanced for testing in replicated trials (Preliminary, Adaptation, Dates-of-Harvest, Grower-cooperator trials, North Central Regional Trials, Snack Food Association Trials, and other out-of-state trials) over time and locations. The agronomic evaluation of the advanced breeding lines in the replicated trials is in the annual Potato Variety Evaluation Report.

There is a need to find a russet table potato that will be profitable and produce quality russets for the eastern market. Currently the two most desirable potatoes for production and type in Michigan are Russet Norkotah and Silverton Russet. These 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 will be making more russet crosses in 2008 to support this new russet market.

II. 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-bred lines.

III. 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 4x 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). In general, diploid breeding utilizes haploids (half the chromosomes) from potato varieties, and diploid wild and cultivated tuber-bearing relatives of the potato. 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.

IV. 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 15 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, Bt-cry1Ia1* and avidin), potato tuber moth, late blight resistance via the *RB* gene, drought resistance (*CBF1*) and vitamin E. Furthermore, we are investing our efforts in developing new vector constructs that use alternative selectable markers and give us the freedom to operate from an intellectual property rights perspective. In addition, we are exploring transformation techniques that eliminate the need for a selectable marker (antibiotic resistance) from the production of transgenic plants.

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 2007 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. In addition to crosses from the MSU breeding program, crosses were planted and evaluated from collaborative germplasm exchange from other breeding programs including North Dakota State University, University of Minnesota, and the USDA/ARS program at the University of Wisconsin as part of the Quad state cooperative effort. During the 2007 harvest, over 1200 selections were made from the 40,000 seedlings produced. All potential chip-processing selections will be tested in January or March 2008 directly out of 40°F and 45°F 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 process that have desirable agronomic characteristics and chip-processing potential. At the 8-hill and 20-hill evaluation state, about 350 and 150 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. Based upon the pedigrees of the parents we have identified for breeding cold-chipping potato varieties, there is a diverse genetic base. We have at least eight cultivated sources of cold-chipping. Examination of pedigrees shows up to three different cold-chipping germplasm sources have been combined in these selections. Our promising chip-processing lines are MSJ147-1, MSJ036-A (scab resistant), MSH228-6 (moderate scab resistance), MSJ126-9Y (moderate scab resistance), MSJ316-A (moderate scab resistance), MSK061-4 (moderate scab resistance), MSK409-1 (scab resistant), MSN238-A (scab resistance), MSL007-B (scab resistance), MSM246-B, MSN191-2Y, MSL292-A, MSR061-1 (scab and PVY resistant) and MSQ070-1 (scab and late blight resistant). Other promising lines include MSQ089-1 (scab resistant), MSQ492-2 (scab and late blight resistant), MSP516-A (scab and late blight resistant), MSR036-5 (scab and late blight resistant), MSR102-3 (scab and late blight resistant), MSR127-2 (scab resistant), MSR041-5 (scab and late blight resistant) and MSR160-2Y (PVY, scab and late blight 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 and late blight. 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. Potato lines with We have also been spinning off some pigmented skin and tuber flesh lines that may fit some specialty markets. 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 long, russet type and 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 2007, while others were tested under replicated conditions at the Montcalm Research Farm. Promising tablestock lines include MSI005-20Y, MSN105-1 and MSM171-A. We have a number of tablestock selections with late blight resistance. These are MSL072-C and MSM171-A. MSL211-3 and MSN105-1 has late blight and scab resistance. MSA8254-2BRUS is a russet table selection that has scab resistance, while MSL794-BRUS has late blight resistance. Some newer lines with promise include MSQ176-5 (late blight resistant), MSN230-6RY (scab and late blight resistant), MSM182-1 (PVY and late blight resistant), MSQ440-2 (scab and late blight resistant and MSL268-D (late blight resistant). MSM288-2Y is a yellow flesh selection with scab resistance. Some new pigmented lines are MSS582-1 (purple splash) and Michigan Red and Purple Splash. MSQ558-2RR is a red fleshed chipper and MSQ432-2PP is a purple-fleshed chipper. MSL228-1 (purple splash) is being considered by Gurney's Seed for their home garden catalog (Garden's Alive).

Disease and Insect Resistance Breeding

Scab: Disease screening for scab has been an on-going process since 1988. Results from the 2007 MSU scab nursery indicate that 62 of 166 lines evaluated had a scab rating of 1.4 or less (better or equivalent to Pike). The limitation of breeding for scab resistance is the reliance on the scab nursery. We found a moderate correlation between the field screening and greenhouse screening for scab. We expanded the scab nursery with an additional acre of land nearby. This expansion has allowed us to conduct early generation selection for scab resistance among our breeding material. In 2007, 90 of 279 early generation selections showed strong scab resistance. These data were incorporated into the early generation evaluation process at Lake City. We are seeing that this expanded effort is leading to more scab resistant lines advancing through the breeding program.

Late Blight: With support from GREEEN, the Muck Soils Research Farm, Bath, Michigan has become an excellent North American site for late blight testing because of the humid microclimate and isolation from major commercial potato production. As a result, late blight infection has been consistently achieved each year making breeding efforts to select late blight resistant germplasm very efficient. In 2007 41 of 160 advanced breeding lines were classified as late blight resistant. Of the early generation material tested 49 of 190 lines were late blight resistant.

Colorado potato beetle: With support from GREEEN, we also introduced an early generation Colorado potato beetle screen at the Montcalm Research Farm. In 2007, 10 of 69 breeding lines were at least moderately resistant to Colorado potato beetle at the Montcalm Research Farm Beetle Nursery. The beetle pressure was extremely high leading to complete defoliation in all susceptible check lines. Percent defoliation was visually estimated during the beetle infestation in June and July. This resistant material was selected for further advancement in the breeding program and also for use in the next round of crossing to develop beetle resistant cultivars. Some of these lines are beginning to enter the preliminary trials in the breeding program. Concurrently, a field cage (no-choice) experiment was conducted to evaluate 3 avidin transgenic lines. In 2007 beetle behavior and defoliation was evaluated in lines that expressed differing levels of avidin. The data from this experiment has not been analyzed yet.

It is a great challenge to achieve host plant resistance to insects in a commercially acceptable line. We have some promising advanced selections with partial resistance to Colorado potato beetle. In addition, we have *Bt-cry3A* transgenic lines that could be commercialized if the processors renewed their acceptance and regulatory environment was modified to reduce costs. I am on a national committee to help build infrastructure to so that transgenic specialty crops like potato can be deregulated in a more efficient and less costly manner. However, the national potato industry needs to be supportive of this technology before we can move forward.

II. Sugar Profile Analysis of Early Generation Selections for Extended Storage: Chip-processing Results From the MPIC Demonstration Commercial Storage (October 2006 - June 2007)

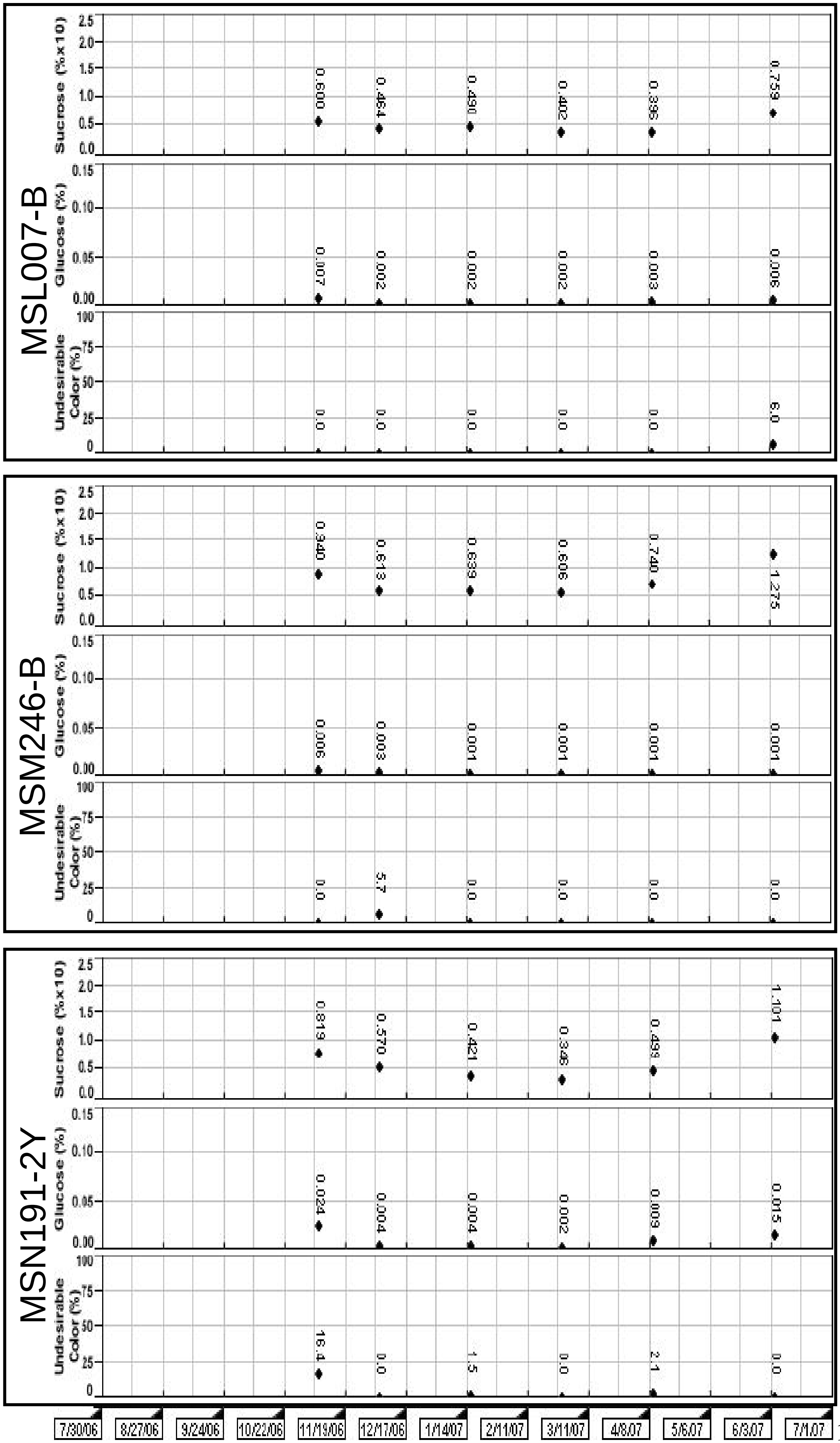
The MSU Potato Breeding Program has been conducting chip-processing evaluations each year on potato lines from the MSU breeding program and from other states. For 8 years we have been conducting a long-term storage study to evaluate advanced breeding lines with chip-processing potential in the Dr. B. 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, Wisconsin and North Dakota breeding programs 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 6 times to determine their ability to chip-process from storage. In October 2006, tuber samples from 12 MSU lines, 1 North Dakota line, and four Wisconsin lines from the Montcalm Research Farm and Lake City Experiment Station trials were placed in the bins. The first samples were sugar-profiled and chip-processed at TechMark in November and then five more times until June 4, 2007. Samples were evaluated for chip-processing color, defects and glucose and sucrose were measured. Because of the extremely high sugar levels of some samples in November and December, 5 lines were dropped from the sugar profiling study. These high sugar levels were attributed to the poor fall harvest conditions and will be retested in 2007-8.

Table 1 summarizes the chip-processing color and scab rating of 12 lines over the 7-month storage season. From November to April all lines chip-processed acceptably with a 1.0 color score. This is not surprising since the best chip-processing lines were selected for this study. In some cases, SED or hollow heart was observed in a few chips, but no patterns emerged. In June the color darkened for 9 of the 12 lines and the storage test was terminated. Based upon the data, many of these lines have potential to be further tested in storage tests. Six lines had a good combination of color, low defects and desirable sugar profiles. **Figure 1** shows the TechMark sugar profiles of sucrose, glucose and undesirable color for three MSU lines (MSL007-B, MSM246-B and MSN191-2Y) that performed well in the study. MSL007-B has scab resistance. These and other lines will be tested further in 2007-8.

Table 1. 2006-2007 Early Generation Sugar Profiling Study
SFA Chip Scores for seven months storage at the MPIC Demonstration Storage

			Date						2006
Line	Female	Male	11/6/06	12/4/06	1/15/07	2/26/07	4/11/07	6/4/07	Scab
MSJ461-1[LBR]	Tollocan	NY88	1.0	1.0	1.0	1.0	1.0	1.5	1.8
MSL007-B	MSA105-1	MSG227-2	1.0	1.0	1.0	1.0	1.0	1.5	0.8
MSM102-A	MSI111-A	MSG227-2	1.5	1.0	1.0	1.0	1.0	2.5	1.5
MSM246-B	MSE274-A	NY115	1.0	1.0	1.0	1.0	1.0	1.5	2.5
MSN099-B	MSG015-C	MSI111-A	1.0	1.0	1.0	1.0	1.0	2.5	1.3
MSN191-2Y	MSI234-6Y	MSH098-2	1.5	1.5	1.0	1.0	1.0	1.5	2.5
MSP292-7	MSF015-1	MSJ212-2	1.0	1.0	1.0	1.0	1.0	2.0	1.8
ND5775-3	unknown	unknown	1.0	1.0	1.0	1.0	1.5	1.5	2.0
W2133-1	Snowden	RHL167	1.0	1.0	1.0	1.0	1.0	1.0	2.0
W2310-3	unknown	unknown	1.0	1.0	1.0	1.0	1.0	1.0	1.8
W2324-1	Snowden	RHL166	1.0	1.0	1.0	1.0	1.0	1.5	2.6
W2717-5	unknown	unknown	1.0	1.0	1.0	1.0	1.0	1.0	2.5
Average			1.1	1.0	1.0	1.0	1.0	1.6	1.9

*Note: These five lines were chipped at MSU beginning 1/15/07
SFA Chip Score 1-5 scale: 1=excellent; 5=poor (>= 2.5 is considered unacceptable).
Scab Rating: 0: No Infection; 1: Low Infection <5%; 3: Intermediate; 5: Highly Susceptible.



MSL007-B
MSM246-B
MSN191-2Y
Sucrose (%x10)
Glucose (%)
Undesirable Color (%)
7/30/06
8/27/06
9/24/06
10/22/06
11/19/06
12/17/06
1/14/07
2/11/07
3/11/07
4/8/07
5/6/07
6/3/07
7/1/07

III. Germplasm Enhancement

In 2007, only a few diploid populations were evaluated as single hills. From this breeding cycle, we plan to screen the selections chip-processing from storage. In addition, selections were made from over progeny that was obtained from the USDA/ARS at the University of Wisconsin. These families 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. Through GREEEN funding, we were able to initiate a breeding effort to introgress leptine-based insect resistance. From previous research we determined that the leptine-based resistance is effective against Colorado potato beetle. 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 in 2008. In 2004 we made crosses with late blight resistant diploid lines derived from *Solanum microdontum* to our tetraploid lines. This *S. microdontum*-based resistance is unique and very effective against the US-8 strains. These progeny are being grown in the greenhouse and now we have used DNA marker analysis to identify which lines have the late blight resistance. We have conducted lab-based detached leaf bioassays and have identified resistant lines. We will field test these in 2008.

IV. Integration of Genetic Engineering with Potato Breeding

Segregation of Transgenes and Selectable Markers in Tetraploid Potato Crosses

The insertion of transgenes into cultivated potato offers the opportunity to introduce novel genes/traits into the cultivated germplasm. If a transgenic event is commercialized in the US, the progeny generated from the transgenic lines are also approved for growing. Thus, transgenic lines can be valuable parents in a breeding program. We have generated transgenic lines and made crosses to examine segregation of transgenes and the *nptII* selectable marker. In one set of crosses we examined the segregation of the Bt-cry1Ia1 gene and the *nptII* gene. We also tested a subset of the progeny for potato tuber moth resistance. We learned that the Bt gene is inherited in a simple genetic manner and all the progeny that carried the Bt gene were resistant.

In another set of crosses we examined the segregation of the *RB* gene and the *nptII* genes. In some of these crosses the *RB* gene was co-integrated with the *nptII* gene in the transgenic line. In another transgenic line the *RB* gene was independently integrated from the *nptII* gene so that *RB* and *nptII* would segregate independently in the progeny. Segregation data showed that we were able to select progeny that carried the *RB* gene, but not the *nptII* gene. Hence the progeny do not have the antibiotic resistance gene. Separating out the *nptII* gene makes transgenic potatoes have greater public perception. In addition, we have been able to combine the *RB* gene for late blight resistance with the conventionally bred resistance genes. We will further test these progeny in 2008.

Commercialization of Potato Tuberworm Resistant Potatoes in South Africa

The potato tuberworm (*Phthorimaea operculella* Zeller) is a primary pest problem facing potato farmers in developing countries. Currently, the primary means to control the potato tuberworm and avoid major crop losses is the use of chemical pesticides. Michigan State University (MSU), funded by the U.S. Agency for International Development (USAID), initiated biotechnology research on the development of potato tuberworm resistant varieties in 1992. A *Bacillus thuringiensis* (Bt)-*cry1Ia1* gene, was successfully introduced into several potato varieties and shown to be highly resistant to potato tuberworm in the Spunta-G2 line (both tuber and foliage). This Bt potato will be one of the first public sector developed products to reach farmers in developing countries and will serve as a model for the public sector deployment of insect resistant transgenic crops. The commercialization project includes six components: Product Development, Regulatory File Development, Obtaining Freedom to Operate and Establishing Licensing Relationships, Marketing and Technology Delivery, Documentation of Socio-Economic Benefits, and Public Communication. This technology would also have benefits in controlling PTM in the US and reducing the need for insectcide-based protection. In 2007 we focused on collecting the regulatory data that has to be submitted to the review agency. We also evaluated 15 Bt-progeny in replicated trials at the Montcalm Research Farm. All these lines are potato tuber moth resistant and many are also late blight resistant. Based upon the agronomic data this year, we have reduced the number of progeny to further advance to 7.

V. Variety Release

We are planning to release MSJ036-A as Kalkaska in 2008. We are continuing to promote the seed production and testing of Beacon Chipper, a 2005 release. In addition, we are continuing to promote Michigan Purple, Jacqueline Lee for the tablestock markets. Boulder is being commercially grown in Quebec. Commercial seed production has been initiated for MSN105-1, a round white potato for the tablestock market. Lastly, commercial seed of MSH228-6, MSJ147-1, MSK061-4 and MSJ126-9Y are being produced and we will continue to seek commercial testing of these lines. We have also initiated a focused ribavirin-based virus eradication system to generate virus-free tissue culture lines for the industry. Thirty lines are in ribaviran treatment at this time to remove PVS and PVY from lines. This year 74 new breeding lines are being put into tissue culture.

MSU Variety releases

Michigan Purple

Parentage: W870 x Maris Piper
Developers: Michigan State University and the Michigan Agricultural Experiment Station
Plant Variety Protection: Yes

Strengths: Michigan Purple is a purple-skinned tablestock variety with brilliant white flesh with low incidence of internal defects. The tubers have an attractive round-ovoid shape and a strong iridescent purple skin. Yield is high under irrigated conditions, and also performs well under dryland conditions.

Weaknesses: Susceptibility to common scab.

Incentives for production: The purple-skinned, white-fleshed tubers of Michigan Purple offer a unique type that could lend itself to the specialty variety market, such as gourmet restaurants and food stores, as well as farm and road-side markets.

MSJ036-A

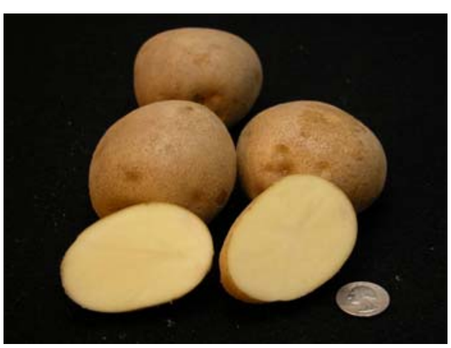
Parentage: B1254-1 X S440
Developers: Michigan State University and the Michigan Agricultural Experiment Station.

Plant Variety Protection: In preparation

Strengths: MSJ036-A is a high yielding, round white potato with an attractive round appearance with shallow eyes.MSJ036-A has a strong vine and a full season maturity. This variety has resistance to *Streptomyces scabies* (common scab) stronger than Pike. MSJ036-A also has chip-processing storage characteristics and better tolerance to blackspot bruise than Snowden.

Weaknesses: Sugar levels have to be watched at harvest during cold temperatures.

Incentives for production: High yield and good tuber type combined with scab resistance.



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 50F 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. Potatoes maintain low reducing sugar content for chip-processing out of the field and from storage.

MSJ461-1

Parentage: Tollocan X NY88
Developers: Michigan State University and the Michigan Agricultural Experiment Station, Michigan Potato Industry Commission
Plant Variety Protection: Plant Variety Protection is being considered for this variety.

Strengths: MSJ461-1 is a round white chip-processing variety with an attractive round shape and bright skin. The primary strength of this variety is its strong foliar resistance to late blight (*Phytophthora infestans*) combined with chip-processing quality. MSJ461-1 can also be marketed as tablestock because of its good culinary quality. The tubers will chip process out-of-the-field and from 10°C (50°F) storage. MSJ461-1 performed well in Michigan on-farm trials and regional testing. Under irrigated conditions, the yield is similar to Snowden. MSJ461-1 is being considered for release, although no name has yet been chosen for this line.

Weaknesses: The specific gravity of MSJ461-1 is lower than Snowden in Michigan.

Incentives for production: High yield with uniform tuber size combined with strong foliar resistance to late blight, GN resistance and tolerance to verticillium wilt. Can be used for both chip-processing and table use.

Jacqueline Lee (MSG274-3)

Parentage: Tollocan x Chaleur
Developers: Michigan State University and the Michigan Agricultural Experiment Station
Plant Variety Protection: Yes

Strengths: Jacqueline Lee has a bright golden skin, yellow flesh, attractive oval shape and excellent cooking qualities that make it suitable for tablestock use. In addition, it has been determined to have a high level of foliar resistance to the US-8 genotype of *Phytophthora infestans* under Michigan field and greenhouse conditions.

Weaknesses: Susceptibility to common scab.

Incentives for production: The tubers have an attractive tuber type, with bright and smooth skin and a yellow flesh, typical of many European varieties. The plants yield a heavy set of medium-sized (3-6 oz.), uniform tubers. The foliage has a high level of resistance to the US-8 genotype of *Phytophthora infestans.* These medium-sized, uniform, oval-shaped tubers of Jacqueline Lee offer a unique type that could lend itself to the specialty variety market, such as farm and road-side markets.

Boulder (MSF373-8)

Parentage: MS702-80 x NY88
Developers: Michigan State University and the Michigan Agricultural Experiment Station
Plant Variety Protection: In application

Strengths: Boulder is a round white selection with medium specific gravity that can be used in both the tablestock and chip-processing markets. The tubers of Boulder are large in size with a low incidence of internal defects. Boulder yields well under both irrigated and dryland conditions.

Weaknesses: Over-size tubers may have deep eyes similar to Red Pontiac.

Incentives for production: High percentage of A-size tubers and excellent culinary quality.

Map-based cloning of a Major Late Blight Resistant QTL in *Solanum microdontum* (GREEEN Project)

Problem Statement: Potato (*Solanum tuberosum* L.) is the fourth most important food crop in the world and the top vegetable crop is the United States. In Michigan the potato is approximately $120 million value crop of which the majority is processed as chips, making Michigan the premier state for supplying this market. Late blight caused by *Phytophthora infestans* (Mont.) de Bary is a significant constraint to potato production in the US and worldwide. One of the major goals of our potato breeding program is to introduce new market-quality cultivars with late blight resistance. Quantitative trait loci analysis (QTL) of a diploid mapping population identified closely linked markers associated with foliar resistance to late blight that explained about 70% of the disease reaction (Bisognin et al. 2004) and is resistant to all Michigan *P. infestans* isolates. Based upon the pedigree and resistance reaction of the *S. microdontum* germplasm, the resistance in this material is a unique and it needs to be utilized and combined with other late blight resistance genes. Recently other late blight resistance genes have been mapped and cloned from S. *bulbocastanum* (Song et al. 2003; van der Vossen et al. 2003), *S. mochiquense* (Smilde et al. 2004), and a complex genomic hybrid (Park et al. 2005). The resistance genes from these Solanum species offers race non-specific resistance unlike those previously utilized from *S. demissum*. Access to specific resistance genes combined with the ability to pyramid transgenes is a powerful strategy to study the interaction of *P. infestans* and host plant resistance and breed cultivars with durable host plant resistance. The purpose of this research is to initiate the map-based cloning of a major late blight QTL from *S. microdontum*.

The ability to transform major late blight resistance genes into potato provides a unique opportunity to pyramid late blight resistance genes in an analytic manner. In this way we could study the interaction of *P. infestans* and single and combined gene-based host plant resistance. Moreover, the pyramided resistance genes in a single genotype should be a better strategy to deploy late blight resistant potato varieties (Dangl and Jones 2001).

Objectives:

1. Construct a high resolution map of the late blight QTL region in *S. microdontum* to identify tightly linked flanking markers.

2. Conduct late blight assessment of mapping population.

3. Create a BAC library from *S. microdontum.*

Accomplishments:

1. Construct a high resolution map of the late blight QTL region in *S. microdontum* to identify tightly linked flanking markers.

A mapping population, based upon SSRs and AFLPs, was established between a late blight resistant *S. microdontum* selection (TF75-5) and a susceptible diploid clone (MSA133-57). SSR marker, STM0020, was identified to be tightly linked to a major

QTL affecting late blight resistance (Bisognin et al. 2004). We currently have 5 markers (including STM0020) linked to the late blight resistance QTL.
The genetic marker STM0020 was placed on Chr. 4. A second marker, STM1002 (aka. S9101 and X67511), had earlier been placed in the same linkage group as STM0020 and it too has since been mapped to Chr.4, thus confirming the placement of our QTL on Chr. 4. Since that time, over 40 Chr. 4 specific markers (Table 1) have been screened using a subset of a mapping population to identify polymorphisms between late blight resistant and sensitive individuals. To date, none of these markers has resulted in a difference that allowed distinct identification of the resistance phenotype. Additional markers will need to be tested in order to develop a high resolution map of the region surrounding the late blight QTL. With this QTL being located on Chr. 4, it may be associated with the R-gene hotspot that already includes R2, R2-like and Rpi-blb3 genes for late blight resistance.

An alternative PCR based approach for isolating resistance genes analogs (RGAs) has also begun. This approach uses conserved regions found in most of the cloned R genes to design primers which are then used to amplify RGAs from genomic DNA. This approach has been used by others to map resistance genes in a number of different plants. In our situation, if any RGAs are found that map to Chr. 4, they will be considered candidates genes from which additional markers can be generated. To date, this protocol has yielded a few classes of amplification products (Fig. 1) which will be sequenced and subsequently compared to databases to confirm they contain putative RGA DNA.

2. Conduct late blight assessment of mapping population.
The greenhouse grown mapping population was subjected to detached leaf assays with three replications. Fully expanded and healthy leaflets were collected and placed in Petri dishes in which high moisture is maintained. Each leaflet was sprayed with a suspension of *P. infestans* US-8 isolate (Pi02-007, the most aggressive isolate). The leaflets will be evaluated for percent infection at 6, 9 and 12 days according to Kuhl et al. (2001). Based upon the 12 day percent infection the population had a continuous distribution for reaction to late blight. Some progeny were more resistant than the original *S. microdontum* source of resistance (TF75-5). This mapping population will be useful for fine-mapping studies

3. Create a BAC library from *S. microdontum*
Clemson University Genomics Institute (CUGI) was chosen to produce a BAC library because of their extensive experience in creating custom large insert BAC libraries with an average insert size generally ranging between 120 and 160kb. CUGI has produced numerous plant, animal and microbial BAC libraries encompassing many different taxa in the tree of life. The *S. microdontum* BAC library was constructed using *HindIII* digested genomic DNA. Greater than 36,000 colonies/clones were picked, each containing inserts of at least 120kb of sequence which in total represents about 5 times coverage of the entire genome. The library was completed in June 2007 and we have plates containing each individual clone as well as arrayed filters for screening.

Impacts:

We are making forward progress in cloning a putative R-gene from *S. microdontum* for late blight resistance. The ability to transform major late blight resistance genes into potato provides a unique opportunity to pyramid late blight resistance genes in an analytic manner. In this way we will be able to study the interaction of *P. infestans* and single and combined gene-based host plant resistance and extend our knowledge of fundamental host-pathogen interactions. Moreover, the pyramided resistance genes in a single genotype should be a more durable strategy to deploy late blight resistant potato varieties (i.e., should be more difficult to overcome multiple new R genes than one R gene at a time). The use of late blight resistant varieties will lessen the need for weekly protectant fungicides programs. As a result, production costs can be lowered and environmental impact of the fungicides will be lessened.

Photos, charts, graphs:

Table 1. Screened Markers

SSR Markers	SCAR Markers	CAPS Markers	Others
STM0020	Th21	TG506R	E35M54.G
STM1002	TG339	TGH2	E32M48.b
STM3016	CT229	cLPT5B19	E35R50.a
STM5112	At4g09010	AF411807L	E32M61.b
STM5140	At3g16150	RGH3	GP511
STM5156	At1g42990	TG370F	GP180-a
STG008	At1g76080	B57R	
STG018	Blb22T	54I8L	
STG020	rpiblb3-1	139K15L	
STI001	rpiblb3-2	B10L	
STI012	rpiblb3-3	Blb22S	
STI020		Blb25S	
STI026		Blb25T	
STI055			

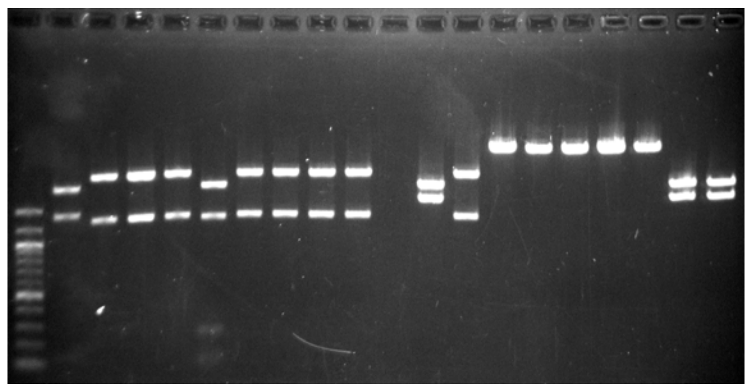


Figure 1. Restriction Digest of Putative RGA DNA. PCR amplified DNA using degenerate primers was cloned into pGEM T-Easy (Promega), transformed into *E.coli*, cultures grown and plasmid isolated. The plasmid was digested with *RsaI* and run on a 1% agarose gel. Lane M is a 100bp DNA marker. Lanes 1-1 through 1-9 and 2-1 through 2-9 represent individual clones originating from different sets of primer pairs respectively. X is an empty lane. This image shows at least four distinct classes of insert DNA based on banding pattern. Lanes 2-3 through 2-7 insert DNA was not cut by *RsaI*.

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What has that Potato Breeding Program been doing?

This year marks a time of 20 years at Michigan State University and I have been continuously involved in potato breeding and genetics research for 25 years. This spring will begin the 20th year of the breeding program since I made my first crosses in Michigan and it seemed like a time for reflection. I fondly remember meeting with Dick Chase, Ben Kudwa and a few growers during the interview process and learning what the industry needs. There was a need for a better storage chipper than Atlantic and varieties with improved internal quality, scab resistance, bruise resistance and with high specific gravity. Potato early die was also a concern. In the table market there was a need for a better Yukon Gold and Onaway market type. With an emphasis on round white potatoes, I set off to work towards these objectives. Ray Hammerschmidt and I teamed up on the scab resistance efforts and with George Bird on the potato early die research.

I learned that the genetics of scab resistance is not well understood and characterizing scab resistance has a strong environmental interaction. There were also few lines that had scab resistance that were not russets. I these first four years we were trying to learn what parents could transfer the desired traits we needed. During that time we made and evaluated a few thousand crosses and this helped focus further crossing schemes to improve our chances of finding desirable varieties. Early on there was a common pattern: if the scab resistance was in a line, the chip quality was usually poor. The reverse was also common. Combining scab resistance with chip-processing quality was a challenge.

We also had to establish a tissue culture lab so for line maintenance and for providing the industry with plantlets in seed increase. Today we are now using ribaviran to remove virus from the advanced breeding lines that are brought into tissue culture. In 1992 we moved the breeding program to Lake City where we had better disease and insect isolation. This helped reduce the leaf roll and PVY infection. Also Colorado potato beetle was developing resistance and we began looking into Bt genes and natural resistance from the wild species as a long-term effort to breed beetle resistant potatoes. We established research collaborations with Ed Grafius and Walter Pett. Through USAID we were able obtain funding to use genetic engineering techniques to introduce genes for insect resistance. This line of funding continues through 2008.

In the second four years, Dr. Kaz Jastrzebski joined us from Poland and we identified many lines with excellent chip quality from storage. During this period we created the foundation for the chip processing quality in our breeding material. Scab resistance was elusive. We learned that the scab evaluation trials in the scab nursery required multiple years to confidently identify resistant lines, whereas other traits were more quickly characterized.

Then in the mid-1990s came the re-emergence of late blight, but it was a more aggressive strain than what was observed in the past. All breeding programs across North America began to add late blight resistance to the breeding objectives. There was a lucky convergence in Michigan. Willie Kirk joined MSU and the Muck Soils Research Farm was the best site in the US for testing for late blight resistance. Adding late blight resistance to our breeding objectives created new challenges. Identifying resistance and learning the breeding value of the resistance sources required extra effort and also led to another set of observations. The late blight resistant sources were very late maturing, scab susceptible and poor chippers. It was a challenge to combine chip-processing quality, scab resistance and late blight resistance. With the Muck Soils Farm Research farm being such a reliable late blight testing site. We proposed that that we could use early generation selection for late blight resistance. This effort increased our breeding efficiency. We were able to select numerous late blight resistant lines and began to find lines that combined chip-processing or scab resistance with late blight resistance.

Comparing our breeding progress in late blight resistance to our progress in scab resistance, scab resistance breeding was not as efficient. We attributed this to the difficulty of accurately identifying resistant lines. We made the decision to expand the scab nursery, create higher levels of scab infection in the soil and attempt early generation selection. It took us five years to create a new scab nursery with high infection levels on the MSU campus and we then began to expand our scab evaluation to early generation selections in the breeding program.

We now screen all our early generation selections (8, 20, 30 and 50-hill selections) for late blight resistance, scab resistance, specific gravity and chip processing each year and incorporate this data into the selection process in the field. We also have established a Colorado potato beetle nursery at the Montcalm Research Farm for screening the breeding material that has been bred for insect resistance. In the lab we use DNA analysis to identify the Golden Nematode and PVY resistant lines. Advanced breeding lines are evaluated for all these traits above along with vine maturity, blackspot bruise resistance, yield, internal defects and chip-processing from storage. Select lines are screened in the potato early die trial at Montcalm and advanced chip-processing lines are evaluated in the Demonstration Storage. Chris Long takes the promising lines from the program and moves them through on-farm trials that complement the data from the Montcalm Research Farm. The most promising chip-processing lines for commercialization are tested in the 10 and 500 cwt bins and also sugar profiled.

Along side the development of the breeding program in the past two decades, there has been the concurrent development of the commercial seed production of MSU lines, commercial testing, construction of the Demonstration storage building, variety release mechanisms, plant variety protection, licensing of the varieties and determination of royalty structure. These steps, despite not being research oriented are critical to the successful commercialization and release of an MSU variety.

In 2007 we have two MSU lines in the Demonstration storage bins. We see MSJ036-A (Kalkaska), a cross from 1997, being released by MSU and commercialized. It is a scab resistant chipper. We have a series of other scab resistant chipping lines that will be evaluated on commercial scale in the future (MSH228-6, MSK061-4, MSJ126-9Y and MSK409-1). Interestingly, the scab resistance in these chippers comes from different sources. This gives us the opportunity to make improvements in scab resistance.

Moreover, the pedigrees also indicate that chip-processing (low sugars) in these lines are from different sources. So we also have the ability to make further genetic improvements in chipping.

Also in the storage is MSJ147-1. This line is an excellent long term storage chipper that can process from colder storage temperatures. If you study the pedigree you will see that multiple sources of chip-processing quality including two wild species from South America. On the female side ND860-2 (cold chipper derived from *S. phureja*) is crossed to Norchip. On the male side the cold chipping is introduced from S440 which has *S. tarijense* as a unique cold chipping source.

A line that has been very important in our breeding program is MSJ461-1. This round white potato has high yield, uniform round white potatoes with low incidence of internal defects, strong late blight resistance, Golden nematode resistance along with Verticillium wilt resistance. It has become an important parent to combine with our scab resistant chipping potatoes. We are now a number of 'next generation' advanced breeding lines that combine late blight and scab resistance with chip -processing. One clone, MSQ070-1, is being sugar profiled this storage season. With a desirable sugar profile, we will consider fast tracking this line. Three of the 'next generation' lines also are PVY resistant and many are Golden nematode resistant. We are very excited about the future!

When I look at the breeding material and varieties in our program up to this time, we have an excellent genetic base. We have incorporated 15 different sources of scab resistance into our advanced lines and varieties, 9 sources of late blight resistance and 20 sources of chip-processing. We have also broadened the genetic base by using 6 different wild potato species to bring in traits such as scab resistance, late blight resistance, chip-processing from cold storage, PVY resistance, Verticillium wilt resistance, high specific gravity and Colorado potato beetle resistance. With this material we will be able to continue to make genetic improvements. When we combine this with our genetic engineering efforts, we are in for an exciting next 20 years!

Lastly, for all this to work, the human capital is very important. The MSU breeding and genetics program will not work without the great work of Joe Coombs, Kelly Zarka, Jay Estelle, Devan Berry, Donna Kells, Dick Crawford (at Montcalm Research Farm) and many of the past technical staff over the years. In the industry, having great cooperators in the seed industry (Jeff Axford, Kruegers, Sklarzycks, Iotts), commercial growers (Sandyland, Lennards, Walthers, Sackett Potatoes, Sackett Acres, Crooks, Leep) have been valuable in moving the MSU advanced selections through the breeding program and along the commercialization path.

I feel much honored to be hired by Michigan State University to run the potato breeding and genetics program. The opportunity to run my own potato breeding program and release varieties important to the industry is an ideal career and I am still working hard to achieve my goal of breeding improved varieties.

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2007 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 2007, we trialed 193 varieties and breeding lines. The variety evaluation also includes disease testing in the scab nursery (MSU Soils Farm, E. Lansing) and foliar and tuber late blight evaluation (Muck Soils Research Farm, Bath). The objectives of the evaluations are to identify superior varieties for fresh market or for processing, and to develop recommendations for the growing of those varieties. 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 field, 45°F and 50°F storage), as well as susceptibilities to common scab, late blight (foliar and tuber), and blackspot bruising are determined.

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 long and spacing between plants was 12 inches. Inter-row spacing was 34 inches. Supplemental irrigation was applied as needed. The field experiments were conducted on new potato ground that was in corn the previous year.

The most advanced selections in the breeding program were harvested at two dates to evaluate early and late harvest potential (Date-of-Harvest trial: Early and Late). The other field trials were the Round White, Russet and Long-Types, Red-Skinned, Adaptation (chip-processors and tablestock), and Preliminary (chip-processors and tablestock) and Transgenic. In each of these trials, the yield was graded into four size classes, incidence of external and internal defects in > 3.25 in. diameter (or 10 oz. for Russet types) potatoes were recorded, and samples for specific gravity, chipping, disease tests, bruising, and cooking tests were taken. Chip quality was assessed on 25-tuber samples, taking two slices from each tuber. Chips were fried at 365°F. The chip color was measured visually with the SFA 1-5 color chart. Tuber samples were also stored at 45°F and 50°F for chip-processing out of storage in January and March. Advanced selections are also placed in the Commercial Demonstration Storage for monthly sampling. The scab nursery at the MSU Soils Farm and the late blight trial at the Muck Soils Research Farm are used for scab and foliar late blight assessment of lines in the agronomic trials.

RESULTS

A. Date of Harvest Trial Varieties:

Chip-processors and Tablestock (Tables 1 and 2)

There were 17 entries that were compared at two harvest dates (98 and 141 days). Atlantic, Snowden, Pike and three Frito-Lay clones were used as checks. The two new Frito-Lay clones evaluated this year were FL2053 and FL2101. The plot yields were average to above average in the early harvest (98 days), and specific gravity values were more typical to an average year. On average, there was only a 35 cwt/a increase in yield for the second harvest date (141 days). The results are summarized in **Tables 1 and 2**. Hollow heart and vascular discoloration were the most prevalent internal defects this year. FL1879, Atlantic, and FL2101 showed the highest incidence of hollow heart in the early harvest. There was a high incidence of above-average hollow heart in the late harvest ranging from FL1879 (43%), Beacon Chipper, Atlantic, Snowden, FL2101, to FL2053 (23%). In the early harvest trial, the best yielding lines were FL1879, MSN105-1, and MSM171-A. MSN105-1 is a round-white tablestock line with bright skin, excellent type, moderate scab resistance, moderate foliar late resistance, and an early maturity. MSM171-A is also a round-to-oblong white tablestock line with scab resistance, strong foliar late resistance, and an early maturity. The highest yielder for the late harvest was FL1879, followed by MSJ036-A, Snowden, MSN105-1, MSJ316-A, and MSM171-A. MSJ036-A has high yield potential and shows scab resistance and chip-processing potential. MSJ316-A continues to be a consistent yielding line with scab resistance. MSJ147-1 is showing promise as a chipper out of colder and long term storage, and we were surprised by the low yield seen in 2007. In addition, MSJ036-A, MSJ126-9Y, MSJ316-A, MSH228-6, MSK061-4, and MSK409-1 offer scab resistance.

The out-of-the-field chip scores for 2007 were more typical than we have seen in past years. All chip-processing lines made excellent chips out of the field, with many having above average chip quality (i.e. chip scores marked as 1.0! for Beacon Chipper, MSH228-6, MSJ147-1, MSK061-4, MSK409-1, and FL2101).

Variety Characteristics

Beacon Chipper – a chip processing line that has high yield potential and moderate scab tolerance along with excellent chip-processing quality. Beacon Chipper was named and released in 2005.

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

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.

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

MSJ147-1 – a full season storage chipper that also has some early sizing. It has excellent chip-processing quality and a large percentage of A-size tubers. It has performed well in on-farm trials and has demonstrated an excellent long-term storage chipping profile.

MSJ316-A – an MSU chip-processing selection. Has high yield potential and scab resistance and bright skin appearance. Currently in on-farm trials. There are concerns of Pike-type necrosis occurring sporadically.

MSK061-4 – an attractive round-white chip-processing line with good scab resistance. This line produces clean chips with good specific gravity and average yield, with low blackspot bruising.

MSK409-1 – a round-white chip-processing line with good scab resistance. This earlier maturing line has average yield and slightly lower specific gravity.

MSM171-A – a round-white tablestock line in moderate scab resistance and strong foliar late blight resistance. This line also has an early maturity with an attractive set of tubers.

MSN105-1 – an attractive round-white tablestock line with moderate foliar late blight resistance, moderate scab resistance, and an early maturity.

MSN191-2Y – an MSU chip-processing selection with a very uniform round type. This newer line produces excellent chips with a high specific gravity and low incidence of internal defects.

In December 2004, 2005 and 2007, MPIC sponsored a booth at the Great Lakes Expo to market Liberator, Michigan Purple and Jacqueline to the farm market/roadside stand market segment. The booth was not at the Great Lakes Expo in 2006 due to a scheduling conflict. There is an increasing interest in specialty potato varieties and a growing demand for new, unique potato varieties. We also show-cased 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. The description of two of these varieties that fit the specialty potato market are below.

MICHIGAN PURPLE - a tablestock selection with an attractive purple skin. This selection has high yield potential and the tubers have a low incidence of internal defects. The vine maturity is mid-season to mid-early. Do not let the tubers oversize. A thin skin makes this variety a challenge market on a large scale without making adjustments in harvest, washing and grading process. We regard this as a variety that can compete in the red market. It has great potential in the roadside stand and farm markets.

JACQUELINE LEE – an MSU oval/oblong tablestock selection with a high tuber set. The tubers have the bright skinned, smooth and attractive appearance that is typical of many European cultivars. The tubers have very low incidence of internal defects and good baking quality. It is our best tasting potato! The strength of this selection is also its strong foliar resistance to the US8 genotype of late blight. Vine maturity is similar to Snowden. There is interest in California to market this variety. It has great potential in the roadside stand and farm markets.

B. North Central Regional Trial Entries (Tables 3, 4, 5)

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 North Dakota, Minnesota, Wisconsin, Michigan and Canada. The funding situation in 2007 negatively affected the number of entries for these trials. Eleven breeding lines from 3 universities and 6 varieties were tested in Michigan in 2007 (compared to 18 breeding lines from 5 universities in 2006). The clones were incorporated in the Round White (4 entries), Russet (5 entries), or Red-Skinned (2 entries) trials according to market class, and the results are presented in **Tables 3, 4, and 5**. These lines are designated with the superscript$^{\mathbf{NCR}}$ in the tables. The MSU lines MSJ316-A, MSI005-20Y and MSA8254-2BRUS were the Michigan representatives included in the 2007 North Central Trial. MSJ316-A has a uniform type with scab resistance and good chip quality. MSI005-20Y is a yellow-fleshed line with high yield potential and an attractive round appearance. The russet line MSA8254-2BRUS has good agronomic characteristics including high yield potential and strong scab resistance. The most promising Wisconsin selections were W2324-1 (the highest yielder in the Round White Trial) and W2133-1.

C. Round White Varieties (Table 3)

The 17 lines in the Round White Trial consisted mainly of the round-white chip-processing entries from the North Central Regional Trial, as well as other breeding lines from New York, Wisconsin, and Colorado. The trial was harvested 134 days after planting. The top yielding lines were W2324-1, CO96141-4W, and MSJ316-A. The specific gravities were low comparable to a typical year in Michigan (1.078 for Atlantic, 1.074 for Snowden). Hollow heart and vascular discoloration were the predominant internal defects. The greatest hollow heart was seen in W2564-2 (43%), Atlantic (30%) and AC97097-14W (28%). Vascular discoloration was above average as noted in Snowden (58%).

D. Russet Varieties (Table 4)

The russet trial had 18 lines evaluated in 2007 after 127 days. Russet Burbank and Russet Norkotah were the reference varieties used in the trial and the results are summarized in **Table 4**. Scab resistance was prevalent among the lines tested. Hollow heart and vascular discoloration were the most prevalent internal defects. The most hollow heart was observed in CORN-3 (53%), A93157-6LS (48%), and AND98324-1RUS (43%). Specific gravity measurements were below average with Russet Burbank and Russet Norkotah having 1.071 and 1.065 readings, respectively. The yield of the overall trial was below average for 2007, which has been typical for the Russet trials at the Montcalm Research Farm. Off type and cull tubers were found in nearly all lines tested, with the greatest pickouts from Russet Burbank (17%). Vine maturity varied among lines but it did not correlate with yield. The highest yielding entry was W5716-1RUS, a new breeding line from Wisconsin. MSA8254-2BRUS is a high yielding MSU selection with excellent scab resistance that has also performed well in on-farm trials. Two of the Colorado Russet Norkotah Line Selections were also evaluated (CORN-3 and CORN-8). Two of the russets evaluated are being considered for release from Idaho (A93157-6LS) and Wisconsin (W2683-2RUS).

E. Red-Skinned Varieties (Table 5)

Eleven lines were harvested in the red trial in 2007 after 127 days. The highest yielding line was Red Pontiac, followed by ATND98459-1RY and Michigan Purple. In general, internal quality was good, with only Red Pontiac having 20% hollow heart. Among the reds in this trial, scab tolerance was noted in ND5002-3R, ND4659-5R, W2609-1R, and W3882-1R. MSL228-1 has unique splashes of color around the eyes that may make it attractive to the specialty market. This line is being considered for license to Garden's Alive for catalog sales to home gardeners.

F. Adaptation Trial (Tables 6 and 7)

The Adaptation Trial was divided into 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 16 advanced breeding lines are reported in the chip-processing trial. The trial was harvested after 141 days and the results are summarized in **Table 6**. The line MSJ461-1, which has chip quality and strong foliar late blight resistance, was the highest yielding line (145 cwt/a greater than Snowden). Multiple new breeding lines combine scab resistance and chip-processing: MSN190-2, MSN238-A, MSP516-A, MSQ029-1, MSQ070-1, MSQ089-1, and MSQ492-2. Of these lines, some also combine late blight resistance, scab resistance, and chip-processing: MSP516-A, MSQ029-1, MSQ070-1, and MSQ492-2. MSQ029-1 also has resistance to PVY. MSL268-D has foliar late blight resistance. MS246-B is a good chip-processing line that has yield potential and a specific gravity comparable to Atlantic.

In the tablestock trial, Yukon Gold was the check variety and 13 advanced breeding lines are summarized in the table. The trial was harvested after 134 days and the results are summarized in **Table 7**. In general, the yield was good in this trial and internal defects were low. Seven of the 13 lines have late blight resistance (including Jacqueline Lee) and 3 lines have moderate to strong scab resistance. Seven of the 13 lines also had early maturity, often combined with scab and/or late blight resistance. Boulder and MSK498-1 were the highest yielding lines and also have moderate scab resistance. Promising lines with attractive type for the tablestock market and strong foliar late blight resistance include MSL106-AY, MSL183-AY, MSM182-1, MSM137-2, MSQ176-5, and MSQ440-2. MSQ440-2 has excellent type and combines scab and late blight resistance with early maturity. MSM182-1 also has PVY resistance. Another line that has a very attractive, smooth type and bright skin is MSN084-3. It is exciting to see lines with combined traits for type, scab, late blight, and PVY resistance, and earlier maturity classes in more advanced selections in the breeding program.

G. Preliminary Trial (Tables 8 and 9)

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 had 37 advanced selections and two check varieties (Atlantic and Snowden). The chip-processing trial that is summarized in **Table 8** was harvested after 135 days. Most lines chip-processed well from the field. Specific gravity values and yields were average for the trial. Twenty-two of the lines (60%) were also classified to be resistant or moderately resistant to scab ($\leq$ 1.5 in 2007). Eight lines have demonstrated late blight resistance and 3 are moderately late blight resistant. Many of these lines combine chip quality with scab and late blight resistance/moderate resistance (MSQ035-3, MSQ130-4, MSQ134-5, MSR036-5, MSR041-5, MSR061-1, MSR102-3, and MSR160-2Y). The two highest yielding lines were MSQ341-BY and MSR127-2. The two lines MSR061-1 and MSR160-2Y also have PVY resistance.

Table 9 summarizes the 36 tablestock lines evaluated in the Preliminary Trial, including material from South Africa (Reba was used as the check variety). This tablestock trial was harvested and evaluated after 127 days. Five of the 35 lines were late blight resistant, and 11 were scab resistant or moderately resistant. One line, MSP084-3 has good yield potential and moderate resistance to Colorado potato beetle. MSS582-1, MSM224-1, and Michigan Purple Red Sport were the highest yielding lines. MSM183-1 and MSQ086-3 have good type and late blight resistance. MSM288-2Y has an excellent type, strong yellow flesh, and good scab tolerance. A few of the lines in this trial were considered for their unique color attributes for the specialty potato market: Michigan Purple Red Sport, MSQ461-2PP, MSR186-3P, MSQ558-2RR, MSR217-1R, MSQ443-1RR. The purple and red flesh-pigmented lines MSQ461-2PP and MSQ558-2RR have also chipped out of the field. Interestingly, the South African lines were among the lowest yielding lines: Eden, Mnandi (late blight resistant), Darius, Calibra, Van der Plank, Caren, BP-1, Devlin, Esco, and Ronn.

H. Transgenic Trial (Table 10)

A field trial was conducted to continue to evaluate transgenic potato lines for agronomic performance. The results are summarized in **Table 10.** The trial this year (113 days) was used to evaluate a variety of different transgenic material. The Spunta RB line has the *RB* gene cloned from *S. bulbocastanum* which confers resistance to late blight. Three other lines express the *Bt-cry3A* gene which controls Colorado potato beetle (NO8.8, NO8.28 from Norwis, and YG8.8 from Yukon Gold). The majority of the lines were selections from two crosses to combine late blight resistance with the *Bt-cry1Ia1* gene (from SpuntaG2) for resistance to potato tuberworm (*Phthorimaea operculella*). There were 10 selections from the MSR605 family (SpuntaG2 x MSJ461-1) and 7 from the MSR606 family (SpuntaG2 x Jacqueline Lee). These selections had a range of performance for yield, specific gravity, and maturity.

I. Potato Scab Evaluation (Table 11)

Each year, a replicated field trial at the MSU Soils Farm (E. Lansing, MI) is conducted to assess resistance to common scab. We are using a modified scale of a 0-5 ranking 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. **Table 11** categorizes many of the varieties and advanced selections tested in 2007 at the MSU Soils Farm Scab Nursery over a three-year period. The varieties and breeding lines are placed into six arbitrary categories based upon scab infection level and lesion severity. A rating of 0 indicates zero 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, Red Norland, NorValley, Yukon Gold, Red Pontiac, Pike, Atlantic and Snowden can be used as references (bolded in **Table 11**). In general, most russet lines were scab resistant. 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 84 lines, of the 167 tested, had a scab rating of 1.5 or lower in 2007. Most notable scab resistant MSU lines are MSA8254-2BRUS, MSH228-6, MSJ036-A, MSJ126-9Y, MSK061-4, MSK409-1, MSM171-A, MSM288-2Y, MSN073-2, MSN238-A, and MSP516-A; as well as some earlier generation lines MSQ070-1, MSQ089-1, MSQ289-5, MSQ440-2, MSR036-5, and MSR061-1. 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. Scab results from the disease nursery are also found in the Trial Summaries (**Tables 2-10**).

J. Late Blight Trial (Table 12)

In 2007, the late blight trial was conducted at the Muck Soils Research Farm, Bath, MI. This year 147 entries were planted for evaluation in replicated plots. The field was planted on June 11 and inoculated July 27 with a combination of isolates (see **Table 12**). The late blight differential lines LBR8 and LBR9 were resistant in 2007 as in previous years (not shown in table). Twenty-eight MSU lines were highly resistant to late blight. The late blight resistance of the MSU lines is derived from Tollocan (a Mexican variety), B0718-3 (USDA clone), AWN96518-2 (USDA clone), Stirling (Scottish variety), Torridon (Scottish variety), NY121 (Cornell University clone) Jacqueline Lee (MSU variety), and the wild potato species *S. microdontum* and *S. berthaultii*. The line RB Spunta has resistance derived from a gene cloned from *S. bulbocastanum*. These resistant progeny indicate that we can continue to breed for resistance using this group of resistant clones. We find these late blight resistant lines valuable because many of them also have marketable maturity and some are more tolerant to scab as compared to the first generation of late blight resistant lines. Also, some of these lines have chip-processing quality. The MSU Muck Soils Research Farm continues to be an excellent site for evaluating foliar late blight resistance in inoculated field trials. Tuber late blight resistance is currently being evaluated on many of the selections with foliar late blight resistance.

K. Potato Early Die Trial (Table 13)

Since 1998, selected potato varieties and lines have been evaluated annually at the Montcalm Potato Research Farm for tolerance to the Early-Die Disease Complex. This trial has traditionally been conducted by Dr. George Bird and his team. For 2007, the breeding program worked with Dr. Bird for planting, harvesting, and data collection. Sixteen breeding lines and control varieties were evaluated in 2007. The results of the trial were somewhat surprising in that multiple lines did not demonstrate a yield advantage for fumigated versus non-fumigated conditions (Table 13). The control variety Russet Norkotah exhibited high levels of susceptibility, although Atlantic did not. This may be a result of the unusually low yield performance of Atlantic in this trial. The surprisingly low yields of many of the lines in this trial may also contribute to differentiating yield differences between fumigated and non-fumigated plots.

Over the previous nine years, the variety Boulder has been classified as tolerant to PED, which was not the case this year. The breeding line MSJ461-1 did exhibit some tolerance this year and was one of the most *Verticillium*-resistant clones evaluated by Dr. Shelley Jansky (USDA/ARS, U. of Wisconsin, pers. comm.). Additional years of testing should help in classifying the PED resistance in potato breeding lines. The rootlesion nematode population pressure is not reported in this trial.

L. Blackspot Bruise Susceptibility (Table 14)

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 reps) from each line, collected at the time of grading. The 25 tuber sample was held in 50°F 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 13**. 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 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 2007, the bruise levels were comparable to previous years. The most bruise resistant lines this year from the advanced trials were MSJ126-9Y, MSN105-1, FL2101, MSK061-4, MSM102-A, MSQ089-1, MSQ440-2, MSL106-AY, MSL183-AY, MSN073-2, ND6095-1, MSP292-7, MSQ130-4, MSR159-2, MSM288-2Y, MSP197-1, MSJ316-A, and MSA8254-2BRUS. The most susceptible lines from the advanced trials were Atlantic, Beacon Chipper, Snowden, MSP516-A, MSP115-3, MSR127-2, MSR158-4, AC97097-14W, and Canela. The bruise resistant MSU entries in the US Potato Board/Snack Food Association Trial were MSJ147-1, and MSJ316-A. Beacon Chipper was the most bruise susceptible in this trial.

Table 1

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

DATE OF HARVEST TRIAL: EARLY HARVEST
MONTCALM RESEARCH FARM
May 8 to August 13, 2007 (98 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	CWT/A
FL1879	378	399	95	4	70	25	2	1.072	1.0	48	0	0	0	287
MSN105-1[LBMR]	363	395	92	8	88	4	0	1.081	1.5	3	0	0	0	239*
MSM171-A[LBR]	349	363	96	3	66	30	1	1.061	3.0	5	0	0	0	296*
Atlantic	**327**	**341**	**96**	**3**	**86**	**10**	**1**	**1.084**	**1.0**	**28**	**3**	**0**	**0**	**259**
Snowden	**307**	**336**	**91**	**9**	**86**	**5**	**0**	**1.078**	**1.5**	**13**	**8**	**0**	**0**	**240**
FL2053	293	324	90	6	85	5	4	1.090	1.5	8	0	0	0	277*
MSJ316-A	269	292	92	8	85	7	0	1.073	2.0	0	0	0	0	153
FL2101	267	295	91	9	88	3	0	1.089	1.5	23	0	3	0	-
MSK409-1	244	286	85	13	85	1	2	1.081	1.0	0	3	0	0	207*
MSK061-4	240	272	88	11	86	2	1	1.081	1.5	0	0	0	0	161
Pike	**238**	**258**	**92**	**8**	**89**	**3**	**0**	**1.079**	**1.0**	**5**	**0**	**0**	**0**	**171**
Beacon Chipper	236	243	97	3	82	16	0	1.079	1.0	5	0	0	0	217
MSN191-2Y	233	260	90	10	88	2	0	1.087	1.0	5	0	0	0	-
MSJ126-9Y	224	239	93	5	87	7	1	1.074	2.0	3	0	0	0	206*
MSH228-6	215	243	89	11	88	0	0	1.081	1.0	0	0	0	0	167
MSJ147-1	136	204	67	33	67	0	0	1.081	2.0	0	0	0	0	186
MEAN	270	297						1.079						
$LSD_{0.05}$	68	72						0.004						

* 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.

Table 2

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

DATE OF HARVEST TRIAL: LATE HARVEST
MONTCALM RESEARCH FARM
May 8 to September 25, 2007 (141 days)

LINE	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	PERCENT OF TOTAL[1] Bs	PERCENT OF TOTAL[1] As	PERCENT OF TOTAL[1] OV	PERCENT OF TOTAL[1] PO	SP GR	CHIP SCORE[2]	PERCENT (%) TUBER QUALITY[3] HH	VD	IBS	BC	SCAB[4]	MAT[5]	3-YR AVG US#1 CWT/A
FL1879	394	406	97	3	74	23	0	1.071	1.0	43	13	0	0	2.0	1.3	348
MSJ036-A[†]	383	422	91	9	86	5	0	1.075	ND	5	8	3	3	0.8	2.8	-
Snowden	**359**	**392**	**91**	**9**	**79**	**12**	**0**	**1.072**	**1.0**	**30**	**27**	**0**	**0**	**2.6**	**2.0**	**318**
MSN105-1[LBMR]	354	396	90	10	81	8	0	1.077	ND	0	0	0	0	2.0	1.3	266*
MSJ316-A	345	384	90	10	77	13	0	1.077	1.0	8	5	3	0	1.9	4.8	306
MSM171-A[LBR]	344	376	92	5	66	26	3	1.058	ND	10	0	0	0	1.3	1.0	295*
FL2053	327	377	87	7	73	14	6	1.087	1.0	23	3	0	0	1.8	1.0	290*
Atlantic	**322**	**340**	**95**	**4**	**76**	**19**	**1**	**1.081**	**1.0**	**38**	**8**	**0**	**0**	**2.4**	**1.5**	**315**
Beacon Chipper	315	326	97	3	71	25	0	1.076	1.0!	40	10	0	0	1.8	3.0	343
FL2101	310	355	87	12	82	6	1	1.083	1.0!	25	5	0	0	1.5	1.8	-
MSH228-6	309	349	89	11	86	3	0	1.077	1.0!	0	5	0	0	1.5	3.5	247
MSJ126-9Y	282	300	94	6	76	18	0	1.070	1.0	5	5	0	0	1.3	1.3	252*
MSK061-4	269	323	83	15	78	5	2	1.076	1.0!	0	33	0	0	1.0	2.0	221
Pike	**261**	**296**	**88**	**12**	**87**	**2**	**0**	**1.076**	**1.0**	**0**	**10**	**0**	**0**	**1.4**	**2.0**	**215**
MSN191-2Y	241	273	88	12	80	8	0	1.084	1.0	3	0	0	3	1.5	1.3	-
MSK409-1	215	258	83	16	76	7	1	1.081	1.0!	3	13	3	0	0.8	1.0	202*
MSJ147-1	155	288	54	46	54	0	0	1.082	1.0!	7	7	0	0	1.0	2.5	216
MEAN	305	345						1.077								
$LSD_{0.05}$	69	72						0.003								* 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 23, 2007; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

[†]MSJ036-A had a poor stand count in DOH, data from the Transgenic Trial.

Table 3

ROUND WHITE TRIAL
MONTCALM RESEARCH FARM
May 8 to September 18, 2007 (134 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]	CWT/A
W2324-1[NCR]	455	556	82	5	79	3	13	1.079	1.5	20	28	0	0	2.5	3.5	494*
CO96141-4W	386	417	92	7	84	8	1	1.069	1.0	3	10	3	0	2.3	1.0	-
MSJ316-A[NCR]	379	423	90	10	80	10	1	1.079	1.5	25	10	0	0	2.0	4.5	-
Snowden[NCR]	**368**	**433**	**85**	**11**	**82**	**3**	**4**	**1.074**	**2.0**	**13**	**58**	**0**	**3**	**2.6**	**2.5**	**378**
NY139	363	394	92	7	88	4	1	1.076	2.5	0	20	0	0	1.5	2.8	-
W2564-2	350	402	87	5	63	24	8	1.067	2.5	43	0	0	0	1.0	4.5	-
W2133-1[NCR]	336	383	88	11	85	2	1	1.075	1.0	0	8	3	0	1.8	3.5	308
MSI005-20Y[NCR]	329	393	84	8	70	13	8	1.064	ND	0	8	0	0	2.0	1.8	355
CO97043-14W	303	341	89	11	80	9	0	1.073	1.0	0	15	0	3	3.0	1.5	-
AC97097-14W	299	365	82	14	75	7	4	1.077	1.0	28	10	0	0	3.3	2.0	-
NorValley[NCR]	**281**	**350**	**80**	**17**	**76**	**5**	**2**	**1.068**	**1.5**	**3**	**13**	**0**	**0**	**2.0**	**1.3**	**304***
Atlantic[NCR]	**273**	**322**	**85**	**9**	**74**	**11**	**6**	**1.078**	**1.0**	**30**	**18**	**3**	**5**	**2.5**	**1.8**	**331**
W2978-3	255	319	80	19	78	2	1	1.067	1.0	0	5	0	0	1.5	1.0	-
CO97065-7W	249	293	85	14	84	1	1	1.075	1.0	0	0	0	0	2.0	1.3	-
W2310-3	247	326	76	23	76	0	1	1.082	1.0	0	0	0	0	2.0	2.0	231
CO95051-7W	215	264	81	17	78	3	2	1.077	1.0	0	23	0	0	1.5	3.0	212
W4016-4	214	270	80	20	79	1	1	1.072	1.5	5	10	0	0	2.7	3.5	-
MEAN	312	368						1.074								
$LSD_{0.05}$	71	68						0.003								

* 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.
[NCR] North Central Regional Entry

[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 23, 2007; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

Table 4

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

RUSSET and LONG TYPES TRIAL
MONTCALM RESEARCH FARM
May 8 to September 11, 2007 (127 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]	CWT/A
W5716-1RUS	316	388	82	15	71	10	3	1.073	10	8	3	0	1.0	3.8	-
W3328-1RUS	306	396	77	16	66	11	7	1.065	8	8	0	0	1.0	3.3	318*
CORN-3	287	376	76	16	64	13	7	1.070	53	3	3	0	1.5	3.5	-
MSA8254-2BRUS[NCR]	285	368	77	14	62	16	8	1.064	28	5	3	0	0.5	3.2	303
AND98324-1RUS[NCR]	276	340	81	15	71	10	4	1.077	43	28	0	0	3.0	3.0	310*
MSL794-BRUS[LBR]	265	353	75	20	62	13	5	1.073	0	5	8	0	1.8	3.3	328
W2683-2RUS[NCR]	263	359	73	22	65	9	5	1.067	3	13	3	0	0.5	3.8	275
CO95086-8RUS	261	322	81	15	69	12	4	1.066	5	18	0	0	0.0	2.3	266*
A95109-1	255	320	80	14	64	15	7	1.067	3	15	0	0	0.8	2.5	259*
CO97087-2RUS	251	381	66	23	58	7	11	1.074	3	10	0	0	0.5	2.0	-
Canela	239	294	81	15	74	8	3	1.077	3	20	0	0	0.3	2.8	-
A93157-6LS	237	305	78	17	69	9	6	1.075	48	8	3	0	1.0	3.8	235*
ND7882B-7RUS	219	325	67	28	63	5	5	1.070	0	8	3	0	0.7	2.3	233*
Russet Burbank[NCR]	**195**	**334**	**58**	**24**	**57**	**2**	**17**	**1.071**	**13**	**10**	**0**	**0**	**1.0**	**3.0**	**219***
W1879-1RUS[NCR]	185	287	64	34	57	7	2	1.070	5	8	0	0	0.8	1.3	153
CORN-8	179	280	64	31	59	5	5	1.066	0	10	0	0	2.3	1.5	-
Russet Norkotah[NCR]	**156**	**250**	**62**	**35**	**59**	**3**	**2**	**1.065**	**3**	**0**	**0**	**0**	**2.0**	**1.0**	**151**
AOA95154-1	144	231	62	37	59	3	1	1.077	0	23	0	0	0.5	3.7	-
MEAN	240	328						1.070							
$LSD_{0.05}$	83	82						0.003							

* 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.

[NCR] North Central Regional Entry

[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 23, 2007; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

Table 5

MICHIGAN STATE UNIVERSITY

POTATO BREEDING and GENETICS

RED-SKINNED TABLESTOCK TRIAL
MONTCALM RESEARCH FARM
May 8 to September 11, 2007 (127 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]
Red Pontiac	**456**	**535**	**85**	**9**	**69**	**16**	**6**	**1.056**	**20**	**5**	**0**	**0**	**3.0**	**2.0**
ATND98459-1RY	326	398	82	16	80	2	2	1.068	0	0	0	0	2.0	2.0
Michigan Purple	312	363	86	8	73	13	6	1.061	3	3	0	0	2.3	1.3
Rio Colorado	310	366	85	13	77	7	2	1.063	13	3	0	0	1.5	1.0
ND5002-3R[NCR]	251	317	79	20	76	3	1	1.059	0	8	0	0	0.3	3.5
MSQ441-6R	246	276	89	10	85	4	0	1.053	0	0	0	0	2.0	1.3
W2609-1R	213	251	85	14	84	1	1	1.055	0	3	0	0	0.8	1.0
Red Norland[NCR]	**213**	**241**	**88**	**9**	**88**	**0**	**3**	**1.053**	**0**	**0**	**0**	**0**	**1.5**	**1.5**
W3882-1R	206	249	83	16	83	0	1	1.055	5	8	0	0	1.0	1.0
ND4659-5R[NCR]	202	244	83	16	78	5	1	1.060	0	0	0	0	0.5	1.0
MSL228-1	180	217	83	8	80	3	9	1.072	0	10	0	0	ND	1.3
MEAN	265	314						1.060						
$LSD_{0.05}$	58	61						0.003						

[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 23, 2007; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

Table 6

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

ADAPTATION TRIAL, CHIP-PROCESSING LINES
MONTCALM RESEARCH FARM
May 8 to September 25, 2007 (141 days)

	CWT/A		PERCENT OF TOTAL[1]						CHIP	PERCENT (%) TUBER QUALITY[3]					
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	SCORE[2]	HH	VD	IBS	BC	SCAB[4]	MAT[5]
MSJ461-1[LBR]	425	472	90	9	79	11	1	1.075	1.0	0	5	10	0	1.8	3.7
Snowden	**380**	**422**	**90**	**9**	**83**	**7**	**1**	**1.080**	**1.0**	**18**	**63**	**3**	**3**	**2.6**	**2.3**
MSQ070-1[LBR]	369	433	85	14	80	5	1	1.089	1.0	8	8	10	0	0.8	4.8
MSQ089-1	326	370	88	10	76	12	2	1.073	1.5	0	8	0	0	1.0	3.3
MSQ029-1[LBR,PVYR]	322	348	93	7	73	19	0	1.081	1.0	20	13	0	0	1.3	4.0
MSQ108-1	314	343	91	7	83	9	1	1.079	1.5	5	10	0	0	2.0	1.5
MSL292-A	279	316	88	9	71	17	3	1.073	1.0!	8	5	0	0	2.3	1.5
MSN238-A	278	300	93	7	85	8	0	1.080	1.5	13	10	0	0	1.3	2.0
Atlantic	**276**	**303**	**91**	**5**	**79**	**12**	**4**	**1.081**	**1.5**	**30**	**13**	**3**	**0**	**2.4**	**1.5**
MSL268-D[LBR]	270	336	80	15	75	5	5	1.072	1.0	0	20	0	0	1.5	2.5
MSQ492-2[LBR]	262	321	82	17	78	4	1	1.069	1.5	0	13	18	0	1.3	3.3
MSM246-B	258	292	88	10	80	8	1	1.081	1.0!	3	13	0	0	2.3	2.0
MSM060-3	255	305	84	16	80	3	0	1.088	1.0	5	23	3	0	1.8	1.4
Pike	**252**	**285**	**88**	**11**	**85**	**3**	**1**	**1.082**	**1.0**	**3**	**10**	**0**	**0**	**1.4**	**2.5**
MSN099-B	247	281	88	8	71	17	4	1.069	1.0	10	8	0	3	1.8	1.5
MSP516-A[LBR]	235	276	85	12	81	4	3	1.071	1.0!	0	25	0	0	1.0	3.0
MSN313-A	230	330	70	20	68	2	10	1.078	1.5	5	3	0	0	1.8	3.5
MSN190-2	162	240	68	30	64	4	2	1.082	1.5	5	3	0	0	1.3	1.0
MSM102-A	147	173	84	14	79	5	2	1.078	1.0	0	0	0	0	2.0	1.7
MEAN	278	323						1.078							
$LSD_{0.05}$	71	72						0.005							

[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 23, 2007; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

Table 7

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

ADAPTATION TRIAL, TABLESTOCK LINES
MONTCALM RESEARCH FARM
May 8 to September 18, 2007 (134 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]
Boulder	440	460	96	2	50	46	2	1.076	3	0	0	0	1.8	3.3
MSK498-1Y	426	466	92	7	81	10	1	1.064	0	28	0	0	2.0	3.3
MSM070-1	389	439	89	7	80	9	4	1.072	8	13	0	0	1.5	1.0
MSN170-A	378	408	93	5	84	9	2	1.076	0	13	0	0	1.3	1.5
MSL183-AY[LBR]	317	358	88	10	85	4	2	1.061	0	10	0	0	2.8	1.0
MSN084-3	315	332	95	5	82	13	0	1.056	0	23	0	0	3.0	1.0
MSM182-1[LBR,PVYR]	306	355	86	13	85	1	1	1.067	0	5	0	0	2.0	2.5
MSQ425-4Y	282	349	81	19	80	0	0	1.064	0	15	0	0	3.0	1.3
MSM137-2[LBR]	264	323	82	13	79	3	5	1.064	0	3	0	0	2.3	2.3
Yukon Gold	**245**	**272**	**90**	**6**	**77**	**13**	**4**	**1.070**	**15**	**8**	**3**	**0**	**2.8**	**1.0**
MSQ176-5[LBR]	239	263	91	8	69	22	1	1.060	13	10	3	0	2.0	3.8
Jacqueline Lee[LBR]	234	425	55	42	55	0	3	1.075	0	3	0	0	2.3	3.0
MSL106-AY[LBR]	225	264	85	13	83	3	2	1.060	0	3	0	0	2.8	1.0
MSQ440-2[LBR]	192	212	91	9	83	8	1	1.053	0	23	0	0	1.0	1.3
MEAN	304	352						1.066						
$LSD_{0.05}$	69	66						0.004						

[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]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 23, 2007; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

Table 8

PRELIMINARY TRIAL, CHIP-PROCESSING LINES
MONTCALM RESEARCH FARM
May 8 to September 19, 2007 (135 days)

	CWT/A		PERCENT OF TOTAL[1]						CHIP	PERCENT (%) TUBER QUALITY[3]					
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	SCORE[2]	HH	VD	IBS	BC	SCAB[4]	MAT[5]
MSQ341-BY	401	439	91	8	81	10	1	1.074	1.5	0	15	5	5	1.5	2.0
MSR127-2	373	408	92	8	84	8	0	1.079	1.0	0	0	0	0	1.0	4.0
Snowden	**360**	**411**	**88**	**12**	**85**	**3**	**1**	**1.074**	**1.0**	**20**	**45**	**10**	**0**	**2.6**	**3.0**
MSM205-A	352	428	82	11	81	2	7	1.080	1.5	0	20	0	0	1.3	2.0
Atlantic	**346**	**364**	**95**	**3**	**86**	**9**	**1**	**1.083**	**1.5**	**20**	**20**	**0**	**0**	**2.5**	**2.0**
MSR159-19[LBMR]	341	381	90	8	71	19	2	1.070	1.0	30	10	0	0	1.5	2.0
MSR160-2Y[LBR PVYR]	335	430	78	22	78	0	1	1.082	1.5	5	0	0	0	1.3	2.5
MSR036-5[LBR]	326	359	91	7	80	11	2	1.081	1.5	0	10	0	0	1.0	4.5
MSR156-7	322	348	93	7	89	4	1	1.082	1.0	0	10	0	0	1.8	3.0
MSR061-1[LBMR PVYR]	321	370	87	13	86	1	0	1.073	1.0	0	5	0	0	1.0	3.0
MSP459-5	312	375	83	13	81	3	3	1.072	1.0	25	10	0	0	1.0	1.0
MSQ035-3[LBMR]	312	358	87	10	79	8	3	1.068	ND	5	5	0	0	1.5	4.0
MSP497-1	311	351	89	9	73	15	3	1.064	1.0	25	0	0	0	1.8	3.0
MSR159-10	311	345	90	8	79	11	1	1.078	1.5	5	0	15	0	1.8	4.5
MSN148-A	302	370	82	17	80	2	1	1.083	1.0!	0	20	0	0	-	2.0
MSR131-5	302	348	87	13	87	0	0	1.083	1.0	0	15	0	0	1.0	3.0
MSQ134-5[LBR]	298	343	87	13	87	0	0	1.065	1.5	0	5	0	0	1.5	2.5
MSR159-06	282	322	88	12	79	9	0	1.070	1.0	0	0	0	0	1.7	1.0
MSR090-1Y	272	292	93	4	63	30	3	1.067	1.5	0	0	5	0	3.0	3.0
MSP102-5	272	406	67	28	67	0	5	1.087	2.0	0	0	0	0	1.5	2.5
ND7519-1	271	313	87	11	86	1	3	1.079	1.0	0	30	5	10	2.0	1.0
MSR159-07Y	266	317	84	15	81	3	2	1.086	1.0	5	0	0	0	1.7	1.0
MSR167-3Y	246	303	81	16	80	2	3	1.072	1.5	30	0	0	0	1.0	2.5
MSR128-4Y	243	298	81	15	77	4	4	1.078	1.5	5	5	0	0	1.0	3.5
MSR102-3[LBR]	225	263	86	11	68	17	3	1.076	1.5	5	10	0	0	0.5	5.0

continued on next page:

PRELIMINARY TRIAL, CHIP-PROCESSING LINES
MONTCALM RESEARCH FARM
May 8 to September 19, 2007 (135 days)

	CWT/A		PERCENT OF TOTAL[1]						CHIP	PERCENT (%) TUBER QUALITY[3]					
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	SCORE[2]	HH	VD	IBS	BC	SCAB[4]	MAT[5]
continued:															
MSQ130-4[LBR]	220	246	89	11	74	16	0	1.070	1.0	40	0	15	0	1.5	1.0
MSR041-5[LBR]	218	254	86	14	81	5	0	1.076	1.5	0	10	0	0	1.0	3.0
MSR125-1	216	237	91	8	89	2	1	1.082	1.0	0	5	0	0	1.3	1.0
MSR130-1	209	253	83	14	83	0	3	1.075	1.0	0	10	0	0	1.0	3.0
MSR049-4	205	246	83	15	83	0	1	1.067	1.0	0	0	0	0	2.0	3.5
MSP408-10Y[LBR]	201	268	75	23	75	0	2	1.070	2.0	0	5	0	0	0.8	3.5
MSN073-2	188	232	81	15	79	2	4	1.069	1.5	5	0	0	0	1.0	1.5
MSP115-3	168	207	81	15	80	1	4	1.084	1.5	65	15	0	0	2.0	5.0
ND8305-1	164	236	69	29	69	0	1	1.083	1.0	10	5	0	0	2.0	1.0
MSP292-7	161	202	80	13	77	3	7	1.073	1.5	5	0	0	0	1.0	1.0
ND6095-1	160	273	59	39	59	0	2	1.070	1.0	0	25	0	0	2.7	1.0
MSR089-14Y	145	218	66	32	65	1	2	1.076	1.5	0	30	0	0	2.3	1.0
MSR089-9[LBR]	124	178	70	23	63	6	8	1.077	1.0	0	10	0	0	2.0	2.3
ND8304-2	115	179	64	34	64	0	1	1.067	ND	0	25	0	0	2.5	1.0
MEAN	261	312						1.076							
$LSD_{0.05}$	90	96						0.005							

[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 23, 2007; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

Table 9

PRELIMINARY TRIAL, TABLESTOCK LINES
MONTCALM RESEARCH FARM
May 8 to Septmeber 11, 2007 (127 days)

	CWT/A		PERCENT OF TOTAL[1]						PERCENT (%) TUBER QUALITY[3]					
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	HH	VD	IBS	BC	SCAB[4]	MAT[5]
MSS582-1	517	577	90	4	72	17	6	1.064	0	15	0	0	2.0	2.0
MSM224-1	422	487	87	10	78	9	3	1.063	10	0	0	0	1.8	3.5
MI Purple Red Sport	398	451	88	7	72	16	4	1.056	5	0	0	0	ND	1.0
Reba	**383**	**401**	**95**	**5**	**68**	**28**	**0**	**1.059**	**40**	**5**	**0**	**0**	**1.8**	**3.0**
MSR081-14	369	439	84	15	79	6	1	1.054	5	10	0	0	2.0	4.5
MSR051-1	358	406	88	11	85	3	1	1.059	0	5	0	0	2.0	4.5
MSR158-4	356	415	86	14	75	11	0	1.071	0	20	0	0	2.3	4.0
MSQ461-2PP	345	387	89	9	80	10	2	1.067	0	0	0	0	1.3	2.0
MSR605-15	341	426	80	18	71	9	2	1.057	10	0	0	0	2.0	3.5
MSP084-3[CPBMR]	340	395	86	9	86	0	5	1.084	10	10	5	10	2.3	2.0
MSR214-2P	323	372	87	9	87	0	4	1.057	0	5	0	0	2.0	4.5
MSM183-1[LBR]	301	393	76	20	73	3	3	1.073	0	5	0	0	2.5	4.5
MSR159-2[LBR]	299	360	83	15	78	5	2	1.076	15	10	0	0	1.3	5.0
MSR161-2	297	350	85	10	80	5	6	1.073	10	5	0	0	1.0	4.5
MSP197-1	296	350	85	8	72	13	7	1.063	30	10	5	0	2.3	1.0
MSQ505-4	286	334	86	9	56	30	5	1.058	5	0	0	0	2.0	4.0
MSM288-2Y	286	356	80	18	77	3	1	1.066	0	0	0	0	1.3	1.0
MSQ086-3[LBR]	284	321	88	11	85	3	0	1.068	30	10	0	0	2.0	3.0
NY121[LBR]	280	399	70	28	67	4	2	1.070	15	0	0	0	2.0	1.0
Eden	280	374	75	18	75	0	7	1.066	10	0	0	0	3.0	1.5
Mnandi[LBR]	275	359	77	21	74	2	2	1.061	0	5	0	0	2.0	2.5
MSQ279-1	273	296	92	3	71	21	5	1.065	5	0	0	0	1.8	3.5
Darius	253	324	78	19	74	4	4	1.071	25	20	5	5	2.0	3.5
Calibra	224	259	87	13	76	11	0	1.073	35	20	0	0	1.0	4.0
Van der Plank	219	278	79	14	68	11	7	1.055	5	35	0	0	2.5	2.5

continued on next page:

PRELIMINARY TRIAL, TABLESTOCK LINES
MONTCALM RESEARCH FARM
May 8 to Septmeber 11, 2007 (127 days)

	CWT/A		PERCENT OF TOTAL[1]						PERCENT (%) TUBER QUALITY[3]					
LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	HH	VD	IBS	BC	SCAB[4]	MAT[5]
continued:														
Caren	216	282	77	12	77	0	12	1.073	0	5	20	0	1.5	4.0
MSR157-1Y	212	248	85	15	80	6	0	1.063	10	5	0	0	1.3	2.5
BP-1	211	294	72	28	70	2	0	1.061	50	0	0	0	2.8	4.5
MSR186-3P	208	270	77	14	71	6	9	1.054	0	10	5	0	1.3	2.3
Devlin	207	243	85	13	80	5	1	1.076	25	20	0	0	2.3	2.5
MSQ558-2RR	181	311	58	42	58	0	0	1.064	0	0	5	0	2.0	1.0
MSR217-1R	174	227	77	17	72	5	6	1.056	0	15	0	0	1.5	1.0
MSQ443-1RR	114	149	77	22	77	0	1	1.075	10	0	0	0	1.0	5.0
Esco	108	172	63	26	63	0	11	1.055	0	5	0	0	2.3	5.0
Ronn	89	161	55	37	55	0	7	1.061	5	20	0	0	1.7	5.0
MSQ437-2PP	81	169	48	24	48	0	28	1.059	5	0	0	0	1.3	4.0
MEAN	272	334						1.065						
$LSD_{0.05}$	145	161						0.009						

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 23, 2007; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

Table 10

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

TRANSGENIC TRIAL
MONTCALM RESEARCH FARM
May 17 to September 6, 2007 (113 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	MAT[3]
MSJ036-A	383	422	91	9	86	5	0	1.075	5	8	3	3	2.8
Spunta RB	321	374	86	8	62	23	6	1.057	0	78	8	3	2.8
NO8.28	306	321	95	4	87	9	0	1.061	0	15	0	0	2.3
NO8.8	296	308	96	4	83	13	0	1.063	0	10	0	3	2.0
MSR605-15	267	329	81	17	75	6	2	1.062	0	10	0	0	3.3
MSR605-08	255	290	88	8	79	9	4	1.058	0	20	3	3	1.0
MSR606-10	251	321	78	16	74	4	6	1.069	13	20	0	0	3.0
MSR606-08	246	381	65	34	64	0	2	1.072	0	18	55	0	1.5
MSR606-09	221	288	77	20	73	4	3	1.066	0	20	0	0	2.3
MSR605-17	197	253	78	15	73	5	7	1.070	0	25	0	3	3.0
MSR605-01	187	225	83	11	80	3	6	1.062	3	3	0	0	2.3
MSR605-14	185	217	86	10	85	1	4	1.063	0	3	0	0	1.5
MSR606-05	178	219	81	13	72	10	5	1.059	0	8	0	0	1.0
MSR605-07	177	210	84	12	78	7	3	1.058	0	0	17	13	2.7
MSR605-04	171	221	77	17	73	5	5	1.063	0	20	10	0	2.7
YG8.8	170	189	90	9	87	3	1	1.071	3	13	0	0	1.0
MSR605-05	144	204	70	29	70	0	1	1.065	0	5	5	0	1.0
MSR605-10	141	177	79	21	78	1	0	1.066	0	0	0	0	2.3
MSR606-02	138	182	76	23	71	4	1	1.059	0	15	0	0	1.5
MSR605-02	137	194	71	25	71	0	4	1.056	0	13	0	3	1.3
MSR606-03	130	194	67	30	65	2	3	1.059	0	13	0	0	1.0
MSR606-06	99	177	56	40	56	0	3	1.056	0	3	0	3	1.0
MEAN	209	259						1.063					
$LSD_{0.05}$	73	79						0.003					

[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]MATURITY RATING: August 23, 2007; Ratings 1-5; 1: Early (vines completely dead); 5: Late (vigorous vine, some flowering).

Table 11

MICHIGAN STATE UNIVERSITY

POTATO BREEDING and GENETICS

2005-2007 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, EAST LANSING, MI

LINE	*3-YR* AVG.*	2007 RATING	2007 WORST	2007 N	2006 RATING	2006 WORST	2006 N	2005 RATING	2005 WORST	2005 N
Sorted by ascending 2007 Rating;										
CO95086-8RUS	*0.4*	0.0	0	4	0.3	1	4	1.0	1	3
Canela	-	0.3	1	4	-	-	-	-	-	-
ND5002-3R[NCR]	*0.6**	0.3	1	4	1.0	1	4	-	-	-
AOA95154-1	-	0.5	1	4	-	-	-	-	-	-
CO97087-2RUS	-	0.5	1	4	-	-	-	-	-	-
MSA8254-2BRUS	*0.2*	0.5	1	4	0.0	0	4	0.0	0	5
MSR102-3	-	0.5	1	2	-	-	-	-	-	-
ND4659-5R	-	0.5	1	4	-	-	-	-	-	-
W2683-2RUS[NCR]	*0.4*	0.5	1	8	0.3	1	4	0.3	1	6
A95109-1	*0.8*	0.7	1	3	1.7	3	3	0.0	0	4
ND7882B-7RUS[NCR]	*0.7**	0.7	1	3	0.8	1	4	-	-	-
MSJ036-A	*0.9*	0.8	1	4	1.2	2	3	0.8	1	4
MSK409-1	*0.8*	0.8	1	4	1.0	1	4	0.7	1	3
MSP408-10Y	*1.2*	0.8	1	4	1.8	2	3	1.0	2	4
MSQ070-1[LBR]	-	0.8	1	4	-	-	-	-	-	-
W1879-1RUS[NCR]	*0.4*	0.8	1	4	0.3	3	4	0.3	1	3
W2609-1R	-	0.8	1	4	-	-	-	-	-	-
A93157-6LS	*1.0*	1.0	2	4	1.4	3	4	0.8	2	4
Calibra	-	1.0	1	1	-	-	-	-	-	-
MSJ147-1	*1.6*	1.0	1	4	1.8	2	4	2.0	2	4
MSK061-4	*1.0*	1.0	1	4	1.3	2	3	0.8	1	4
MSN073-2	*1.3*	1.0	1	4	1.3	2	4	1.5	2	2
MSP292-7	*1.2*	1.0	1	4	1.7	2	3	1.0	1	4
MSP459-5	*1.4*	1.0	1	4	2.0	2	4	1.3	2	3
MSP516-A[LBR]	*1.0**	1.0	1	4	1.0	1	1	-	-	-
MSQ089-1	-	1.0	1	3	-	-	-	-	-	-
MSQ289-5	*0.8**	1.0	1	4	0.5	1	4	-	-	-
MSQ440-2	*1.4**	1.0	1	4	1.8	2	4	-	-	-
MSQ443-1RR	-	1.0	3	4	-	-	-	-	-	-
MSR036-5	-	1.0	1	3	-	-	-	-	-	-
MSR041-5	-	1.0	1	2	-	-	-	-	-	-
MSR061-1	-	1.0	1	4	-	-	-	-	-	-
MSR127-2	-	1.0	1	3	-	-	-	-	-	-
MSR128-4Y	-	1.0	1	3	-	-	-	-	-	-
MSR130-1	-	1.0	1	2	-	-	-	-	-	-
MSR131-5	-	1.0	1	1	-	-	-	-	-	-
MSR161-2	-	1.0	1	3	-	-	-	-	-	-
MSR167-3Y	-	1.0	1	1	-	-	-	-	-	-
Russet Burbank[NCR]	***1.6****	**1.0**	**1**	**4**	**2.3**	**2**	**4**	-	-	-
W2564-2	-	1.0	1	4	-	-	-	-	-	-
W3328-1RUS	*1.3**	1.0	2	4	1.5	2	4	-	-	-
W3882-1R	-	1.0	1	4	-	-	-	-	-	-
W5716-1RUS	-	1.0	2	4	-	-	-	-	-	-

2005-2007 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, EAST LANSING, MI

	*3-YR**	2007	2007	2007	2006	2006	2006	2005	2005	2005
LINE	*AVG.*	RATING	WORST	N	RATING	WORST	N	RATING	WORST	N
Sorted by ascending 2007 Rating;										
MSJ126-9Y	*1.3*	1.3	2	4	1.5	2	4	1.0	1	3
MSM046-4	-	1.3	2	4	-	-	-	-	-	-
MSM058-A	*1.0*	1.3	2	4	1.0	1	4	0.8	1	4
MSM171-A[LBR]	*1.2*	1.3	2	4	1.3	2	4	1.0	1	3
MSM205-A	-	1.3	2	4	-	-	-	-	-	-
MSM288-2Y	-	1.3	2	4	-	-	-	-	-	-
MSN170-A	-	1.3	2	4	-	-	-	-	-	-
MSN190-2	*1.4*	1.3	2	4	1.6	2	4	1.3	2	4
MSN238-A	*1.3*	1.3	2	4	1.5	2	4	1.0	1	4
MSQ461-2PP	-	1.3	2	4	-	-	-	-	-	-
MSQ492-2[LBR]	*1.5**	1.3	2	4	1.8	2	3	-	-	-
MSR066-1	-	1.3	2	4	-	-	-	-	-	-
MSR157-1Y	-	1.3	2	4	-	-	-	-	-	-
MSR159-2	-	1.3	2	4	-	-	-	-	-	-
MSR160-2Y	-	1.3	2	4	-	-	-	-	-	-
MSQ029-1[LBR]	*1.7**	1.3	2	3	2.0	2	1	-	-	-
MSQ437-2PP	-	1.3	2	3	-	-	-	-	-	-
MSR125-1	-	1.3	2	3	-	-	-	-	-	-
MSR186-3P	-	1.3	2	3	-	-	-	-	-	-
Pike	***1.2***	**1.4**	**2**	**8**	**1.4**	**2**	**7**	**1.0**	**1**	**8**
Caren	*1.8**	1.5	2	4	2.0	2	4	-	-	-
CO95051-7W	*1.1*	1.5	2	4	1.4	2	4	0.5	1	2
CORN-3	-	1.5	2	4	-	-	-	-	-	-
FL2101	-	1.5	3	4	-	-	-	-	-	-
MSH228-6	*1.3*	1.5	2	4	1.4	2	4	1.0	1	4
MSL183-AY[LBR]	*2.2*	1.5	2	2	3.0	3	3	2.0	2	4
MSL268-D[LBR]	*1.6*	1.5	2	4	2.3	3	4	1.0	2	4
MSM070-1	-	1.5	2	4	-	-	-	-	-	-
MSN191-2Y	*1.8*	1.5	2	4	2.5	3	4	1.5	2	2
MSP102-5	-	1.5	2	4	-	-	-	-	-	-
MSQ035-2[LBR]	*2.3**	1.5	2	2	3.0	3	2	-	-	-
MSQ130-4	-	1.5	2	4	-	-	-	-	-	-
MSQ134-5	-	1.5	2	4	-	-	-	-	-	-
MSQ341-BY	-	1.5	3	2	-	-	-	-	-	-
MSR090-1Y	-	1.5	3	4	-	-	-	-	-	-
MSR159-19	-	1.5	2	4	-	-	-	-	-	-
MSR217-1R	-	1.5	2	2	-	-	-	-	-	-
NY139	-	1.5	2	4	-	-	-	-	-	-
Red Norland[NCR]	***1.3****	**1.5**	**3**	**4**	**1.0**	**2**	**4**	-	-	-
Rio Colorado	-	1.5	2	4	-	-	-	-	-	-
W2978-3	-	1.5	2	4	-	-	-	-	-	-
MSM183-1	-	1.7	3	3	-	-	-	-	-	-
MSR159-06	-	1.7	2	3	-	-	-	-	-	-
MSR159-07Y	-	1.7	2	3	-	-	-	-	-	-
Ronn	-	1.7	3	3	-	-	-	-	-	-

2005-2007 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, EAST LANSING, MI

LINE	*3-YR** *AVG.*	2007 RATING	2007 WORST	2007 N	2006 RATING	2006 WORST	2006 N	2005 RATING	2005 WORST	2005 N
Sorted by ascending 2007 Rating;										
A96517-2	-	1.8	3	4	-	-	-	-	-	-
Beacon Chipper	*1.5*	1.8	2	4	1.8	2	4	1.0	1	4
Boulder	*1.7**	1.8	2	4	1.6	2	4	-	-	-
FL2053	*2.1**	1.8	2	4	2.5	3	4	-	-	-
MSJ143-4	-	1.8	2	4	-	-	-	-	-	-
MSJ461-1 LBR	*1.6*	1.8	3	4	1.8	2	4	1.3	2	7
MSL794-BRUS LBR	*1.8*	1.8	3	4	2.5	3	4	1.3	2	4
MSM060-3	*1.5*	1.8	2	4	1.8	2	3	1.0	1	4
MSM224-1	-	1.8	3	4	-	-	-	-	-	-
MSN099-B	*1.4*	1.8	2	4	1.3	2	4	1.3	2	4
MSN313-A	*1.9*	1.8	2	4	3.0	3	4	1.0	2	4
MSP497-1	-	1.8	2	4	-	-	-	-	-	-
MSQ279-1	-	1.8	3	4	-	-	-	-	-	-
MSR089-9	-	1.8	3	4	-	-	-	-	-	-
MSR156-7	-	1.8	2	4	-	-	-	-	-	-
MSR159-10	-	1.8	3	4	-	-	-	-	-	-
Reba	-	1.8	2	4	-	-	-	-	-	-
W2133-1 NCR	*1.6*	1.8	2	4	2.0	2	4	1.0	1	4
MSJ316-A	*1.5*	1.9	3	8	1.6	2	4	1.0	1	4
ATND98459-1RY	-	2.0	2	4	-	-	-	-	-	-
CO97065-7W	-	2.0	2	4	-	-	-	-	-	-
Darius	*2.3**	2.0	3	4	2.5	3	2	-	-	-
FL1879	*2.3*	2.0	2	4	2.6	3	4	2.3	3	3
Mnandi	-	2.0	2	1	-	-	-	-	-	-
MSI005-20Y NCR	*1.9*	2.0	2	4	2.5	3	4	1.3	2	4
MSK498-1Y	*1.9*	2.0	3	4	2.0	2	4	1.8	2	4
MSM102-A	*1.5*	2.0	2	4	1.6	2	4	1.0	1	4
MSM182-1 LBR	*2.1*	2.0	3	4	2.7	3	3	1.8	2	4
MSN105-1 LBMR	*1.5*	2.0	3	4	1.5	2	2	1.0	1	3
MSP115-3	-	2.0	3	4	-	-	-	-	-	-
MSQ086-3 LBR	*1.5**	2.0	2	4	1.0	1	4	-	-	-
MSQ108-1 LBR	*2.2**	2.0	2	4	2.3	3	3	-	-	-
MSQ176-5 LBR	*2.3**	2.0	2	4	2.5	3	2	-	-	-
MSQ441-6R	*2.5**	2.0	2	3	3.0	3	2	-	-	-
MSQ505-4	-	2.0	3	4	-	-	-	-	-	-
MSQ558-2RR	-	2.0	3	4	-	-	-	-	-	-
MSR049-4	-	2.0	3	4	-	-	-	-	-	-
MSR051-1	-	2.0	3	4	-	-	-	-	-	-
MSR081-14	-	2.0	3	4	-	-	-	-	-	-
MSR089-14Y	-	2.0	3	4	-	-	-	-	-	-
MSR214-2P	-	2.0	2	4	-	-	-	-	-	-
MSR605-15	-	2.0	3	4	-	-	-	-	-	-
MSS582-1	-	2.0	3	5	-	-	-	-	-	-
ND7519-1	-	2.0	2	4	-	-	-	-	-	-

2005-2007 SCAB DISEASE TRIAL SUMMARY
SCAB NURSERY, EAST LANSING, MI

	*3-YR**	2007	2007	2007	2006	2006	2006	2005	2005	2005
LINE	*AVG.*	RATING	WORST	N	RATING	WORST	N	RATING	WORST	N
Sorted by ascending 2007 Rating;										
ND8305-1	-	2.0	3	3	-	-	-	-	-	-
NorValley[NCR]	***2.5****	2.0	3	4	3.0	3	4	-	-	-
NY121	-	2.0	2	1	-	-	-	-	-	-
Russet Norkotah[NCR]	***1.8***	**2.0**	**3**	**4**	**2.2**	**3**	**3**	**1.3**	**2**	**4**
W2310-3	*1.8*	2.0	3	4	1.8	3	4	1.5	2	4
CO96141-4W	-	2.3	3	4	-	-	-	-	-	-
CORN-8	-	2.3	3	4	-	-	-	-	-	-
Devlin	*2.2**	2.3	3	4	2.2	3	3	-	-	-
Esco	*2.1**	2.3	3	4	2.0	2	1	-	-	-
Jacqueline Lee[LBR]	*2.3**	2.3	3	4	-	-	-	2.3	3	4
Michigan Purple	*2.2*	2.3	3	4	2.8	3	4	1.5	2	6
MSL292-A	*1.9*	2.3	3	4	2.5	3	4	1.0	1	3
MSM137-2	-	2.3	3	4	-	-	-	-	-	-
MSM246-B	*1.9*	2.3	3	4	2.4	4	4	1.0	2	4
MSP084-3	-	2.3	3	4	-	-	-	-	-	-
MSP197-1	*2.3*	2.3	3	4	3.0	3	4	1.5	2	4
MSR158-4	-	2.3	3	4	-	-	-	-	-	-
Saginaw Gold	*2.3**	2.3	3	4	2.3	3	4	-	-	-
Atlantic	***2.3***	**2.4**	**3**	**16**	**2.8**	**3**	**16**	**1.6**	**2**	**11**
ND8304-2	-	2.5	3	4	-	-	-	-	-	-
Van der Plank	-	2.5	3	2	-	-	-	-	-	-
W2324-1[NCR]	*2.6**	2.5	3	4	2.6	3	4	-	-	-
Snowden[NCR]	***2.5***	**2.6**	**3**	**18**	**2.8**	**3**	**16**	**2.0**	**3**	**12**
W4016-4	-	2.7	3	3	-	-	-	-	-	-
BP-1	*2.5**	2.8	3	4	2.3	3	4	-	-	-
MSL106-AY	-	2.8	3	4	-	-	-	-	-	-
ND6095-1	-	2.8	3	4	-	-	-	-	-	-
Yukon Gold	**-**	**2.8**	**3**	**4**	**-**	**-**	**-**	**-**	**-**	**-**
AND98324-1RUS	*3.0**	3.0	3	1	3.0	4	4	-	-	-
CO97043-14W	-	3.0	4	4	-	-	-	-	-	-
Eden	*2.8**	3.0	4	4	2.5	3	4	-	-	-
MSN084-3	*2.6*	3.0	3	1	2.5	3	4	2.3	3	4
MSQ425-4Y	-	3.0	3	1	-	-	-	-	-	-
Red Pontiac	**-**	**3.0**	**3**	**4**	**-**	**-**	**-**	**-**	**-**	**-**
AC97097-14W	-	3.3	4	3	-	-	-	-	-	-

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.

$LSD_{0.05}$ = **0.9** (2007) **0.9** (2006) **0.9** (2005)

[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

N = Number of replications (observations).

Table 12

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

2007 LATE BLIGHT VARIETY TRIAL
MUCK SOILS RESEARCH FARM

Sorted by ascending RAUDPC value:

Foliar Resistance Category (select lines):

LINE	RAUDPC[1] MEAN	Female	Male
J138K6A22	0.0	*S. bulbocastanum SFH*	
Kufri Jeevan	0.0		
BER 141	0.7	*S. berthaultii*	
MSQ176-5	0.8	MSI152-A	MSJ461-1
MSM183-1	0.9	Torridon	MSG274-3
BER 83	1.0	*S. berthaultii*	
MSQ176-6	1.0	MSI152-A	MSJ461-1
LBR9	1.0		
LBR8	1.2		
MCR 205	1.3	*S. microdontum*	
97A-51	1.6		
MCR 140	1.7	*S. microdontum*	
MSQ070-1	1.8	MSK061-4	MSJ461-1
MSJ461-1	1.9	Tollocan	NY88
MSP516-A	2.2	Pike	MSJ461-1
ND99362B-1RUS	2.3		
MCR 150	2.3	*S. microdontum*	
Malinche	2.3		
MSL268-D	2.4	NY103	J. Lee
MCR 214	2.4		
MSN230-6RY	2.5	J. Lee	Norland
MSM137-2	2.5	Eramosa	MSG274-3
391046.22	2.6		
MSM182-1	2.9	Stirling	NY121
MSL794-BRUS	3.4	A95053-61	A91194-4
B0718-3	3.4		
MSQ492-2	3.7	Pike	MSJ461-1
MSQ134-5	4.1	MSG004-3	MSJ461-1
MSL106-AY	4.2	MSE230-6	MSH098-2
MSQ086-3	4.3	Onaway	MSJ461-1
MSR160-2Y	4.9	NY121	MSJ126-9Y
ND039051B-1R	5.0		
MSL603-319Y	5.0	J. Lee	MSG227-2
Jacqueline Lee	5.0	Tollocan	Chaleur
A96517-2	5.5		
MSR158-4	6.4	MSL757-1	MSJ126-9Y
MSM171-A	6.4	Stirling	MSE221-1
MSQ440-2	7.3	K214-1R	MSJ461-1
MSM224-1	7.5	MSB106-7	J. Lee
RB Spunta/CSPAG.13	8.8		
MSN105-1	10.5	MSG141-3	J. Lee
$LSD_{0.05}$	9.6		

Foliar Susceptibility Category (select lines)[2]:

LINE	RAUDPC[1] MEAN
CORN-3	22.2
MSJ036-A	23.1
MSJ316-A	28.0
MSH228-6	28.2
W2324-1	29.5
W2133-1	29.9
MSJ147-1	30.0
FL2101	30.1
Yukon Gold	**32.3**
Snowden	**33.2**
Beacon Chipper	33.4
Rio Colorado	33.8
W1879-1RUS	33.8
MSI005-20Y	34.5
W3328-1RUS	34.6
A93157-6LS	34.6
W5716-1RUS	35.4
ATND98459-1RY	35.5
W2978-3	35.6
Atlantic	**35.6**
MSA8254-2BRUS	35.7
NY139	36.0
FL1879	36.1
Russet Burbank	**36.3**
Pike	**37.2**
MSK061-4	37.3
NorValley	**37.7**
AC97097-14W	38.1
CORN-8	38.3
CO97065-7W	39.6
MSJ126-9Y	40.1
FL2053	41.0
Russet Norkotah	**41.2**
CO97043-14W	42.4
Red Norland	**42.8**
Reba	43.7
Saginaw Gold	43.8

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

[2] 147 potato varieties and advanced breeding lines were tested in all. For brevity purposes, only selected varieties and breeding lines are listed.

Phytopthora infestans isolates US-1 (Pi 95-3); US-6 (Pi 95-2); US-8 (Pi 02-007); US-10 (SR83-84); US-11 (Pi 96-1); US-14 (Pi 98-1, Pi 99-2) were inoculated on 7/27/07.

Planted as a randomized complete block design consisting of 3 replications of 4 hill plots on 6/11/2007.

Table 13

MICHIGAN STATE UNIVERSITY

POTATO BREEDING and GENETICS

2007 POTATO EARLY DIE TRIAL
MONTCALM RESEARCH FARM
May 18 to September 26, 2007 (132 days)

	USNo1 (cwt/a)			Yld Advantage	Yld Advantage	Total (cwt/a)		
	Fumigated	Non-fumigated		USNo1	USNo1	Fumigated	Non-fumigated	
Entry	lsmean	lsmean	*P<0.05*	(cwt/a)	(%)	lsmean	lsmean	*P<0.05*
Atlantic	**182**	**122**		**60**	**49**	**199**	**133**	
Boulder	362	242	*	120	50	385	256	*
FL1879	**255**	**214**		**41**	**19**	**263**	**228**	
MSH228-6	257	260		-2	-1	278	281	
MSI005-2	275	247		28	11	292	277	
MSJ036-A	317	235	*	83	35	339	248	*
MSJ316-A	218	215		2	1	232	227	
MSJ461-1	301	270		31	12	330	297	
MSK061-4	233	152	*	80	53	248	166	*
MSK409-1	195	150		45	30	219	170	
MSK498-1	344	230	*	115	50	359	249	*
MSM171-A	307	256		51	20	320	273	
MSN105-1	219	177		43	24	238	194	
MSQ176-5	164	147		18	12	170	152	
MSQ441-6	219	162		57	35	229	172	
R.Norkotah	**250**	**139**	*****	**111**	**79**	**332**	**213**	*****

* Yields were significantly different (a = 0.05), demonstrating a significant difference for yield between funigated and non-funigated plots

Table 14

MICHIGAN STATE UNIVERSITY
POTATO BREEDING and GENETICS

2007 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
DATE OF HARVEST: LATE HARVEST								
MSJ126-9Y	21	2	2				84	0.2
MSN105-1	21	3	0	1			84	0.2
FL2101	16	5	4				64	0.5
MSK061-4	16	6	2	1			64	0.5
Pike	**13**	**5**	**7**				**52**	**0.8**
MSH228-6	12	7	5	1			48	0.8
MSJ147-1	16	2	3	4			64	0.8
MSJ316-A	13	7	3	1	1		52	0.8
MSN191-2Y	14	5	4	1	1		56	0.8
MSM171-A	12	7	4	2			48	0.8
FL2053	10	6	8	1			40	1.0
MSJ036-A	13	3	4	4	1		52	1.1
FL1879	8	7	5	4	1		32	1.3
MSK409-1	7	8	5	4	1		28	1.4
Snowden	**9**	**3**	**8**	**3**	**0**	**2**	**36**	**1.5**
Beacon Chipper	5	2	7	6	3	2	20	2.2
Atlantic	**2**	**7**	**4**	**6**	**2**	**4**	**8**	**2.4**
ADAPTATION TRIAL, CHIP-PROCESSING LINES								
MSM102-A	19	4	2				76	0.3
MSQ089-1	18	5	2				72	0.4
MSN099-B	14	8	3				56	0.6
MSN238-A	14	9	1	0	1		56	0.6
MSQ492-2	12	9	3	1			48	0.7
MSN190-2	16	3	2	2	1	1	64	0.9
MSM060-3	12	5	4	2	2		48	1.1
MSL268-D	7	9	8	1			28	1.1
MSM246-B	8	9	5	3			32	1.1
Pike	**6**	**9**	**4**	**4**	**2**		**24**	**1.5**
MSQ029-1	12	1	4	5	2	1	48	1.5
MSL292-A	0	15	6	3	0	1	0	1.6
MSN313-A	6	8	1	9	1		24	1.6
MSQ108-1	6	6	6	5	2		24	1.6
Atlantic	**7**	**5**	**6**	**4**	**2**	**1**	**28**	**1.7**
MSJ461-1	5	10	4	2	0	4	20	1.8

2007 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
MSQ070-1	8	4	4	4	3	2	32	1.8
MSP516-A	7	2	6	6	4		28	1.9
Snowden	**2**	**6**	**4**	**6**	**1**	**6**	**8**	**2.6**
ADAPTATION TRIAL, TABLESTOCK LINES								
MSQ440-2	22	2	1				88	0.2
MSL106-AY	21	3	1				84	0.2
MSL183-AY	21	3	1				84	0.2
MSM137-2	21	3	1				84	0.2
Yukon Gold	**21**	**3**	**0**	**1**			**84**	**0.2**
MSQ425-4Y	17	5	3				68	0.4
MSQ176-5	16	6	3				64	0.5
MSM182-1	14	6	3	2			56	0.7
MSK498-1Y	15	5	2	2	1		60	0.8
Boulder	11	7	2	4	1		44	1.1
Jacqueline Lee	6	7	9	2	0	1	24	1.4
MSN170-A	6	6	7	5	1		24	1.6
MSM070-1	6	6	6	6	0	1	24	1.6
PRELIMINARY TRIAL, CHIP-PROCESSING LINES								
MSN073-2	20	5					80	0.2
ND6095-1	21	3	0	0	1		84	0.3
MSP292-7	19	5	1				76	0.3
MSQ130-4	19	4	2				76	0.3
MSR036-5	18	5	2				72	0.4
MSR159-19	18	6	0	1			72	0.4
ND7519-1	17	6	2				68	0.4
MSP497-1	19	4	1	0	1		76	0.4
MSR159-06	18	4	3				72	0.4
MSR128-4Y	17	5	3				68	0.4
MSQ134-5	17	6	0	2			68	0.5
MSR130-1	16	6	2	1			64	0.5
MSR159-07Y	13	10	2				52	0.6
MSQ035-3	14	7	2	2			56	0.7
MSR102-3	12	9	4				48	0.7
MSR131-5	14	6	3	2			56	0.7
MSR061-1	16	3	4	1	0	1	64	0.8
MSR049-4	14	3	4	4			56	0.9
MSR156-7	14	3	5	2	1		56	0.9

2007 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
MSR167-3Y	13	3	7	2			52	0.9
MSP408-10Y	10	1	4	2	1		56	1.1
MSN148-A	11	6	4	3	1		44	1.1
MSP459-5	14	4	2	3	0	2	56	1.1
MSR090-1Y	12	5	5	1	1	1	48	1.1
MSR041-5	6	6	4	4			30	1.3
MSQ341-BY	14	4	1	1	1	4	56	1.3
MSR159-10	9	4	7	4	1		36	1.4
MSR125-1	7	9	3	4	2		28	1.4
ND8305-1	7	4	3	5	1		35	1.5
MSM205-A	8	4	7	5	1		32	1.5
MSR089-14Y	10	2	4	3	3	3	40	1.8
MSR160-2Y	9	3	3	4	3	3	36	1.9
MSR127-2	7	1	6	6	2	3	28	2.2
Snowden	**6**	**3**	**3**	**6**	**4**	**3**	**24**	**2.3**
MSP115-3	6	2	3	3	4	7	24	2.7
PRELIMINARY TRIAL, TABLESTOCK LINES								
MSR159-2	23	2					92	0.1
Esco	22	3					88	0.1
MSM288-2Y	22	3					88	0.1
MSP197-1	22	3					88	0.1
Caren	21	4					84	0.2
MSQ437-2PP	21	4					84	0.2
MSR214-2P	21	4					84	0.2
Eden	21	3	1				84	0.2
MSR186-3P	20	5					80	0.2
Ronn	22	1	2				88	0.2
BP-1	20	4	1				80	0.2
MSQ279-1	21	2	1	1			84	0.3
MSS582-1	20	4	0	1			80	0.3
Mnandi	19	5	0	1			76	0.3
MSR157-1Y	19	3	3				76	0.4
MSR605-15	18	5	2				72	0.4
Van der Plank	20	2	2	1			80	0.4
MI Purple Red Sport	15	10					60	0.4
MSQ443-1RR	17	7	0	1			68	0.4
MSR217-1R	16	8	1				64	0.4
MSQ461-2PP	18	3	4				72	0.4

2007 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
Calibra	18	4	1	2			72	0.5
MSM224-1	15	7	3				60	0.5
Devlin	14	8	3				56	0.6
MSQ505-4	17	5	1	1	0	1	68	0.6
MSR051-1	14	6	4	1			56	0.7
MSR161-2	13	6	6				52	0.7
MSP084-3	16	5	1	1	1	1	64	0.8
Reba	14	7	1	2	0	1	56	0.8
MSQ086-3	14	4	4	3			56	0.8
MSQ558-2RR	7	15	3				28	0.8
Darius	9	9	6	1			36	1.0
MSR081-14	10	5	8	2			40	1.1
MSM183-1	7	8	9	1			28	1.2
NY121	7	8	5	3	1	1	28	1.4
MSR158-4	1	5	2	9	4	4	4	2.9
ROUND-WHITE TRIAL								
W2978-3	21	4					84	0.2
MSJ316-A	19	5	1				76	0.3
CO96141-4W	19	4	2				76	0.3
CO97065-7W	18	4	2	1			72	0.4
W2310-3	16	7	2				64	0.4
MSI005-20Y	17	4	2	1	1		68	0.6
CO97043-14W	13	8	3	1			52	0.7
CO95051-7W	15	5	4	0	0	1	60	0.7
NorValley	**9**	**12**	**4**				**36**	**0.8**
Atlantic	**10**	**7**	**2**	**6**			**40**	**1.2**
W4016-4	10	6	5	3	1		40	1.2
W2324-1	9	6	7	2	1		36	1.2
NY139	6	8	7	3	0	1	24	1.4
W2564-2	9	5	3	6	1	1	36	1.5
W2133-1	7	6	6	4	1	1	28	1.6
Snowden	**4**	**7**	**10**	**3**	**0**	**1**	**16**	**1.6**
AC97097-14W	3	3	7	8	1	3	12	2.4

2007 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
RUSSET TRIAL								
Russet Norkotah	**24**	**1**					**96**	**0.0**
MSA8254-2BRUS	21	3	1				84	0.2
CO95086-8RUS	18	5	2				72	0.4
AND98324-1RUS	19	3	1	2			76	0.4
CO97087-2RUS	14	10	1				56	0.5
W5716-1RUS	14	8	3				56	0.6
CORN-8	17	3	3	1	1		68	0.6
A93157-6LS	15	6	2	1	1		60	0.7
A95109-1	15	4	5	1			60	0.7
W3328-1RUS	14	7	2	2			56	0.7
Russet Burbank	**13**	**6**	**5**	**1**			**52**	**0.8**
AOA95154-1	10	11	3	1			40	0.8
ND7882B-7RUS	15	2	5	3			60	0.8
W1879-1RUS	10	8	5	2			40	1.0
CORN-3	8	10	5	2			32	1.0
MSL794-BRUS	7	11	3	3	1		28	1.2
W2683-2RUS	6	11	5	1	1	1	24	1.3
Canela	5	5	7	6	2		20	1.8
RED TRIAL								
MSQ441-6R	21	4					84	0.2
ND4659-5R	21	4					84	0.2
W2609-1R	21	4					84	0.2
W3882-1R	18	6	1				72	0.3
Red Norland	**17**	**6**	**2**				**68**	**0.4**
Michigan Purple	16	6	3				64	0.5
ND5002-3R	16	5	4				64	0.5
Rio Colorado	13	10	2				52	0.6
MSL228-1	14	7	4				56	0.6
ATND98459-1RY	12	10	3				48	0.6
Red Pontiac	**14**	**7**	**3**	**1**			**56**	**0.6**
TRANSGENIC TRIAL								
MSR606-06	25						100	0.0
MSR605-07	24	1					96	0.0
MSR605-14	24	1					96	0.0
MSR606-05	12	1					92	0.1
MSR606-09	23	2					92	0.1

2007 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
YG8.8	22	2	1				88	0.2
MSR605-05	21	3	1				84	0.2
MSR605-01	23	0	1	0	1		92	0.2
MSR605-10	20	4	1				80	0.2
MSR606-02	19	5	1				76	0.3
MSR606-03	20	4	0	1			80	0.3
NO8.28	20	2	2	1			80	0.4
MSR606-10	8	2	1				73	0.4
MSR605-04	6	1	1				75	0.4
NO8.8	17	6	2				68	0.4
MSR606-08	17	6	2				68	0.4
MSR605-08	18	5	1	0	0	1	72	0.5
MSR605-17	11	7	2	4	1		44	1.1
MSJ036-A	5	11	9				20	1.2
USPB/SFA TRIAL CHECK SAMPLES (Not bruised)								
CO95051-7W	25						100	0.0
MSJ316-A	25						100	0.0
Snowden	**25**						**100**	**0.0**
MSJ147-1	23	2					92	0.1
W2324-1	23	2					92	0.1
CO96141-7W	23	1	1				92	0.1
Atlantic	**22**	**0**	**2**	**1**			**88**	**0.3**
Beacon Chipper	18	7					72	0.3
W2133-1	19	2	2	2			76	0.5
USPB/SFA TRIAL BRUISE SAMPLES								
CO96141-7W	19	4	1	1			76	0.4
MSJ147-1	18	5	2				72	0.4
MSJ316-A	18	5	2				72	0.4
Atlantic	**17**	**6**	**2**				**68**	**0.4**
W2324-1	15	5	5				60	0.6
CO95051-7W	13	9	2	1			52	0.6
Snowden	**12**	**8**	**4**	**1**			**48**	**0.8**
W2133-1	10	11	4				40	0.8
Beacon Chipper	4	10	6	4	1		16	1.5

* Twenty or twenty-five A-size tuber samples were collected at harvest, held at 50 F at least 12 hours, and placed in a six-s plywood drum and rotated ten times to produce simulated bruising. Samples were abrasive-peeled and scored 11/8/07. The table is presented in ascending order of average number of spots per tuber.

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2007 On-Farm Potato Variety Trials

Chris Long, Dr. Dave Douches, Fred Springborn (Montcalm), Dave Glenn (Presque Isle), Dr. Doo-Hong Min and Chris Kapp (Upper Peninsula)

Introduction

On-farm potato variety trials were conducted with 12 growers in 2007 at a total of 18 locations. Ten of the locations evaluated processing entries and eight evaluated fresh market entries. The processing cooperators were Crooks Farms, Inc. (Montcalm), Walther Farms, Inc. (St. Joseph), Lennard Ag. Co. (Monroe), 4-L Farms, Inc. (Allegan), Main Farms (Montcalm) and Sackett Potatoes (Mecosta). The United States Potato Board/Snack Food Association (USPB / SFA) chip trial was at Sandyland Farms, LLC (Montcalm). Fresh market trial cooperators were Crawford Farms, Inc. (Montcalm), DuRussel's Potato Farms, Inc. (Washtenaw), R & E Farms (Presque Isle), Horkey Bros. (Monroe), TJJ VanDamme Farms (Delta), Lennard Ag. Co. (St. Joseph), Sandyland Farms, LLC. (Montcalm) and Walther Farms, Inc. (St. Joseph).

Procedure

There were five types of processing trials conducted this year. The first type contained 20 entries which were compared with the check varieties Snowden, Pike and FL1879. This trial type was conducted at Main Farms, Lennard Ag. Co. and 4-L Farms. Varieties in these trials were planted in 100' strip plots. Seed spacing was grower dependent, but in general ranged from 8 to 11 inches. The second type of processing trial, referred to as a "Select" trial, contained from four to nine lines which were compared to the variety in the field. In these trials each variety was planted in a 15' row plot. Seed spacing and row width was 10" and 34", respectively. These trials were conducted on Crooks Farms, Inc. The third processing trial format was conducted at Sackett Potatoes in Mecosta County. Two varieties were commercially planted in two separate four row blocks. The rows were 500' long by 32" wide. Three 23' yield digs were performed in each block at harvest. These varieties were planted at 10"spacings. The fourth was a four replication processing variety trial conducted at Walther Farms, Inc. in which 22 test varieties were compared to the check varieties FL1867 and FL1879. The plots were 17.5' by 34" and the seed was planted at 10 inches.

The USPB / SFA trial was the 5th chip processing trial type. For procedural details on this trial reference the 2007 annual report published by the United States Potato Board.

Within the fresh market trials, there were 34 entries evaluated. There were 5 to 21 lines planted at each of the following locations: Branch, Delta, Monroe, Montcalm, Presque Isle, St. Joseph, and Washtenaw counties. The varieties in each trial ranged from mostly round white varieties to mostly russet varieties. These varieties were planted in 100' strip plots. Seed spacing varied from 8 to 12 inches depending upon grower production practices and variety. At Walther Farms, Inc (St. Joseph), a four replication trial was evaluated. The plots were 23' long by 34" wide and seed spacing was 12".

Results

A. Processing and "Select" Processing Variety Trial Results

A description of the processing varieties, their pedigree and scab ratings are listed in Table 1. The overall averages of the three locations of Allegan, Montcalm and Monroe counties are shown in Table 2. The overall averages of the "Select" processing trial, which are averaged across five locations, are in Table 3. Table 4 contains the date from the Sackett Potatoes variety trial. The data from Walther Farms, Inc. in St. Joseph County is in Table 5.

Processing Variety Highlights

W2324-1; this clone was developed at the University of Wisconsin and has excellent yield potential. In 2007, W2324-1 was the top yielding variety in 3 of four trials averaging over 470 cwt/A US#1 (Table 2). This variety was susceptible to common scab and had hollow heart in 20% of the oversize tubers (Table 3). In the 2007 USPB/SFA trial, this clone yielded 564 cwt/A US#1 (Table 6). The size profile was good and the specific gravity was above average. The tuber type was marginal and internal defects were higher than desired.

Beacon Chipper; this variety continues to exhibit a strong yield performance and size profile. In 2007, Beacon Chipper was the highest yielding line at 585 cwt/A US#1 in the USPB / SFA Variety Trial (Table 6). Beacon Chipper also performed well in the Walther Farms trial at 375cwt/A yield of US#1 size tubers (Table 5). The specific gravity for this clone was generally average. Tuber type was excellent, with moderate scab tolerance and a small amount of internal defects. This variety again had good storage chip quality in mid-February when stored at 50 ºF. Processor response to this variety has been good, but some negative comments have been made regarding the high percentage of oversize tubers.

Monticello; this variety had a three year average yield of 360 cwt/A US#1 (Table 2). Chip and internal quality was good. Monticello set 10-12 tubers per plant and had a specific gravity below average (Table 5). The general size profile of this variety was small with only a very small percentage of oversize tubers recorded in 2007. Monticello exhibited the ability to store well into May and June.

MSJ036-A (Kalkaska); this Michigan State University developed clone had above average yield of uniform round tubers (Table 3) and excellent resistance to common scab. MSJ036-A has a three year average yield of 387 cwt/A US#1 with an average specific gravity (Table 2). Vine vigor was excellent with some resistance to early die. This variety exhibited a short term storage profile and can be stored until January.

W2133-1; this University of Wisconsin developed variety performed well at 408 cwt/A US#1 (Table 2). W2133-1 has had good chip quality across trial locations. This variety has shown variable agronomic performance and virus susceptibility and is slated to be dropped in 2008.

B. USPB / SFA Chip Trial Results

The Michigan location of the USPB / SFA chip trial was on Sandyland Farms, LLC in Montcalm County in 2007. Table 6 shows the yield, size distribution and specific gravity of the entries when compared with Atlantic and Snowden. Table 7 shows the at harvest raw tuber quality results. Table 8 shows the out of the field chip quality evaluations from samples processed and scored by Herr Foods, Inc., Nottingham, PA and Table 9 provides the blackspot bruise susceptibility of each entry. Tables 10 and 11 provide pre-harvest panels for each of the nine varieties in the trial. They compare tuber specific gravity, percent glucose and sucrose ratings on two different dates.

USPB / SFA Chip Trial Highlights

The varieties in the 2007 trial that displayed the greatest potential for commercialization were Beacon Chipper, W2324-1 and W2133-1. Yield potential and specific gravity were excellent for W2324-1 (Table 6). Beacon Chipper had the top yield but average specific gravity (Table 6). Beacon Chipper had a slight amount of hollow heart recorded (Table 7). W2133-1 had an average yield performance, but tuber and chip quality were very good (Tables 7, 8,9). MSJ147-1 exhibited excellent long-term storage quality. MSJ147-1 displayed the best post harvest chip quality at Herr Foods (Table 8) and was among the top four varieties with the least amount of black spot bruising (Table 9).

C. Fresh Market and Variety Trial Results

A description of the fresh pack varieties, their pedigree and scab ratings are listed in Table 12. Table 13 shows the overall average of eight locations: Branch, Delta, Monroe, Montcalm (2), Presque Isle, St. Joseph and Washtenaw counties.

Fresh Market Variety Highlights

One round white, one red skin and five russet lines are worthy of mention from the 2007 variety trials. They are MSN105-1 (the round white), Rio Colorado (the red variety) and the russets, W3328-1Rus, Freedom Russet, CO95086-8Rus, Corn #8 and Canela.

MSN105-1; this is a new, very promising, selection for the Michigan State University potato breeding program. This variety had an average yield of 334 cwt/A US#1 (Table 13). This clone had foliar late blight resistance, common scab tolerance and an excellent bright appearance.

Rio Colorado; a Colorado State selection had above average yield of 413 cwt/A US#1 with excellent red skin color (Table 13). The variety had a very attractive smooth skin with a round to oval tuber appearance. Internal quality was good and specific gravity averaged 1.069.

W3328-1Rus; this University of Wisconsin variety was the top yielding russet in 2007 at 463 cwt/A US#1 with 30 percent oversize and no hollow heart found in 30 cut tubers (Table 13). The specific gravity was 1.072 with no internal defects noted.

Freedom Russet (W1836-3Rus); this University of Wisconsin selection was at eight locations this season (Table 13). The variety has a very full season maturity, possibly 140 days. The US#1 yield was excellent at 416 cwt/A (Table 13). Six percent hollow heart was recorded with a 1.071 specific gravity. This variety does not generally have a very consistent type.

CO95086-8Rus; this variety continues to perform better than standard Norkotah, with a 356 cwt/A US#1 yield and average specific gravity (Table 13). Tuber type was blocky with a nice skin type. There are concerns this variety masks PVY. This issue alone will prevent this variety from moving forward.

Corn #8; this variety performs better than the stand Norkotah in Michigan (Table 13). The tuber type for this variety was better than the Corn #3. Yield, appearance and internal quality are good.

Canela (AC92009); this variety from the Colorado State University breeding program yielded 335 cwt/A US#1 with an above average specific gravity (Table 13). The variety has been noted to have some hollow heart, but skin type and overall appearance was good.

Table 1.

2007 MSU Processing Potato Variety Trials

Entry	Pedigree	2007 Scab Rating*	Characteristics
Atlantic (B6987-56)	Wauseon X Lenape	2.4	High yield, early maturing, high incidence of internal defects, check variety, high specific gravity
Beacon Chipper (UEC)	Unknown	1.8	High yield, mid-season maturity, some heat stress, good internal quality, scab tolerance, medium low specific gravity
MegaChip (W1201)	Wischip X FYF 85	-	High yield, medium to late maturity, slight deep eyes, early bulking, sticky stolon early out of the field, strong vine vigor, high specific gravity
Monticello (NY102 or K9-29)	Steuben X Kanona	-	Average yield, Mid to late season maturity, good long term storability, low internal defects, vine rot susceptible, medium specific gravity
Pike (NYE55-35)	Allegany X Atlantic	1.8	Average yield, early to mid-season maturity, small size tuber profile, early storage check variety, some internal defects, medium specific gravity
Snowden (W855)	B5141-6 X Wischip	2.6	High yield, late maturity, late season storage check variety, reconditions well in storage, medium to high specific gravity
AC97097-14W	Brodick X A91746-8	3.3	Average yield, mid-season maturity, medium – small size, oblong tuber type, white skin, medium specific gravity
CO95051-7W	AC88456-6W X BC0894-2W	1.5	Low – average yield, medium to late maturity, high percent of US#1 tubers, low internal defects, medium specific gravity
CO96141-4W	BC0894-2 X AC87340-2	2.3	Average yield, early – mid maturity, oval tuber type, white skin, medium specific gravity
CO97043-14W	AC91817-5 X AC87340-2	3.0	Average to high yield, medium maturity, white skin, oblong tuber type, medium specific gravity

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

Table 1 continued.

Entry	Pedigree	2007 Scab Rating*	Characteristics
CO97065-7W	AC92513-3 X Chipeta	2.0	Average to high yield, early maturity, white skin, round tuber type, medium specific gravity
FL1867	FL 162 x ATLANTIC	-	High yield, early maturity, medium-high specific gravity
FL1879	Snowden X FL 1207	2.0	High yield, late maturity, large tuber type, late season storage, medium specific gravity, check variety
FL1922	FL1533 X FL1207	-	Average yield, mid-season maturity, oval to oblong tubers, common scab and black spot bruise resistant, good chip quality out of late storage, medium to low specific gravity
FL2053	FL1922 X ‘FL1831	1.8	Average yield, mid-season maturity, round to oblong tuber type, good bruise tolerance, fresh or early season storage, highly susceptible to growth crack, medium-high specific gravity
MSH228-6	MSC127-3 OP	1.8	Average yield, mid-season maturity, blocky flat tuber type, shallow eyes, medium specific gravity
MSJ036-A	A7961-1 X Zarevo	0.8	Medium – high yield, mid-season maturity, nice round uniform tuber type, warm harvest recommended, medium high specific gravity
MSJ126-9Y	Penta OP	1.3	Medium – high yield, cold chipper from 45º F, uniform A-size tubers, attractive appearance, good internal quality, long term storage potential, low - medium specific gravity
MSJ147-1	Norvalley X S440	1.0	Average yield, mid to late season maturity, good internal quality, very good chip quality late in storage, medium specific gravity
MSJ316-A	Pike X MSB0718-3	1.9	Medium to high yield, late maturity, some internal defects noted, round tuber type, scab tolerant, good type, medium specific gravity
MSK061-4	MSC148-A X Dakota Pearl	1.0	Average yield, mid-season maturity, good chip quality, breaks dormancy easily, sprouts easily, medium specific gravity

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

Table 1 continued.

Entry	Pedigree	2007 Scab Rating*	Characteristics
MSK409-1	MSC148-A X Liberator	0.8	Medium to high yield, early to mid-season maturity, storage chipper, flat oval tuber type, medium specific gravity
MSL007-B	MSA105-1 X MSG227-2	-	Below average yield, early to mid-season maturity, uniform small tuber type, medium specific gravity
MSN191-2Y	MSI234-6Y X MSH098-2	1.5	Below average yield, early to mid-season maturity, small round uniform tuber type, medium – high specific gravity
MSN238-A	Marcy X MSH098-2	1.3	Low to average yield, early – medium vine maturity, medium specific gravity
NY 139 (Y28-9)	NY120 X NY115	1.5	High yield, mid-late season maturity, medium specific gravity
W2133-1	Snowden X RHL 167	1.8	Medium to high yield, mid to late maturity, good internal quality, nice tuber type, 42-45ºF cold chipper, medium specific gravity
W2310-3	Pike X RHL167	2.0	Below average yield, medium maturity, small round oblong tuber type, medium brown skin, medium to high specific gravity
W2324-1	Snowden X RHL166	2.5	Very high yield, late maturity, uniform tuber type, strong vine vigor, medium to high specific gravity

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

Table 2.

2007 Processing Potato Variety Trial
Overall Average - Three Locations
Allegan, Monroe, Montcalm Counties

NUMBER OF LOCATIONS	LINE	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR	CHIP SCORE[3]	TUBER QUALITY[2] HH	VD	IBS	BC	TOTAL CUT	VINE MAT[4]	COMMENTS	3-YR AVG US#1 CWT/A
3	W2324-1	474	503	94	5	86	8	1	1.078	1.3	5	13	0	0	30	3.3	pitted scab, sticky stolon, rough type	-
2	W2133-1	408	438	92	8	79	13	0	1.079	1.0	0	2	0	1	20	2.5	surface & raised scab	-
3	**FL1879**	**395**	**406**	**97**	**3**	**81**	**16**	**0**	**1.075**	**1.5**	**6**	**7**	**0**	**0**	**30**	**1.0**	**surface & pitted scab, growth cracks, large type**	**384**
3	**Snowden**	**369**	**393**	**92**	**3**	**81**	**11**	**5**	**1.074**	**1.0**	**1**	**12**	**0**	**1**	**30**	**1.8**	**sl pitted scab**	**429**
3	Monticello	358	397	89	7	88	1	4	1.073	1.3	3	7	0	0	30	2.3	small bright round tuber type, tr pitted scab	360
3	MSJ126-9Y	348	385	90	6	87	3	3	1.071	1.3	0	5	0	0	30	1.8	netted skin, round uniform type	-
3	MSK409-1	347	397	85	8	79	6	6	1.077	1.0	1	10	0	0	30	1.0	flat oval type, tr surface scab	-
2	CO97043-14W	337	364	93	7	87	6	0	1.076	1.0	2	1	0	0	20	2.0	tr pitted scab, flat round type	-
3	Beacon Chipper	336	352	95	4	86	9	1	1.074	1.2	0	7	0	0	30	2.8	sl surface scab, large type	381
2	CO97065-7W	328	341	96	4	89	7	0	1.078	1.3	0	3	0	1	20	1.0	uniform round type	-
3	MSJ036--A	325	373	87	9	85	2	4	1.076	1.0	1	4	0	0	30	3.3	nice uniform round type	387
2	MSH228-6	321	345	93	6	90	3	0	1.075	1.0	1	5	0	0	20	3.0	blocky flat type	379
3	MSK061-4	308	351	87	7	82	5	6	1.078	1.0	1	22	0	0	30	2.5	heat sprouts, vascular discoloration	354
3	CO96141-4W	302	334	90	8	85	6	2	1.067	1.0	0	6	0	0	30	1.5	sl surface & pitted scab, SED	-
3	MSN238-A	300	329	91	8	88	4	1	1.077	1.0	0	2	0	0	30	1.8	small round type, tr pitted scab	-
3	FL2053	285	327	87	7	85	2	7	1.082	1.0	0	3	0	0	30	1.5	growth cracks, sl pitted scab	-
3	AC97097-14W	269	314	83	7	78	4	10	1.070	1.2	1	4	0	4	30	1.5	oval to oblong type, internal heat necrosis noted	-
3	**Pike**	**260**	**301**	**84**	**10**	**82**	**1**	**7**	**1.076**	**1.0**	**0**	**8**	**0**	**0**	**30**	**1.5**	**tr surface scab, small bright round type**	**320**
3	MSJ147-1	259	310	83	10	79	4	6	1.080	1.0	1	3	1	0	30	2.0	bright uniform round type, tr pitted scab	323
3	W2310-3	257	295	86	9	86	1	5	1.081	1.0	0	2	0	0	30	1.8	tr surface & pitted scab	-
3	CO95051-7W	252	275	92	6	89	2	2	1.076	1.0	2	10	0	1	30	2.3	surface scab, sticky stolon	-
3	MSL007-B	250	289	86	10	86	0	4	1.073	1.0	1	3	0	0	30	2.0	heavy netted skin, uniform type	-
3	MSN191-2Y	248	292	85	11	83	2	5	1.082	1.2	0	2	0	0	30	1.5	small round uniform type, sl pitted scab, yellow flesh	-
	MEAN	319	353	89					1.076	1.1						2.0	tr = trace, sl = slight, NA = not applicable	

SED = stem end defect

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

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

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

[4]MATURITY RATING
Date Taken: 18-Sept-07
Ratings: 1 - 5
1: Early (Vines Completely Dead)
5: Late (vigorous vine, some flowering)

Table 3.

2007 "Select" Processing Potato Variety Trial
Overall Average - Crooks Farms, Inc., Five Locations
(Montcalm County): Eply, Holland, Klees, Nevins & Waterwheel Roads

NUMBER OF		CWT/A		PERCENT OF TOTAL[1]						CHIP	TUBER QUALITY[2]				TOTAL	VINE	
LOCATIONS	LINE	US#1	TOTAL	US#1	Bs	As	OV	PO	SP GR	SCORE[3]	HH	VD	IBS	BC	CUT	MAT[4]	COMMENTS
2	W2324-1	905	946	95	4	64	31	1	1.085	1.0	4	2	1	0	20	2.0	pitted scab
5	MSJ036-A (Utz)	490	557	87	13	83	4	0	1.080	1.3	1	3	3	0	50	3.2	uniform round type, SED & IBS noted
2	MSK061-4	477	513	93	7	85	8	0	1.078	1.0	0	9	0	0	20	1.5	round to oval type
2	Snowden	477	503	96	4	74	22	0	1.082	1.8	7	7	1	2	20	3.5	tr heat necrosis noted
5	MSJ036-A (Herr)	460	524	87	13	82	5	0	1.081	1.2	0	3	3	3	50	3.2	uniform round type, tr IBS,
5	MSJ036-A (Crooks)	433	504	85	15	81	4	0	1.080	1.3	1	7	5	0	50	3.2	uniform round type, good size, vascular discoloration noted, tr IBS
2	Pike	341	374	91	9	89	2	0	1.077	1.0	0	0	0	0	20	3.0	small uniform type
1	FL1867	313	355	88	12	86	2	0	1.081	1.0	0	0	0	0	10	2.0	tr pitted scab
2	MSJ126-9Y	280	328	85	15	83	2	0	1.067	1.3	0	1	0	0	20	1.5	small size, yellow flesh
2	MSJ147-1	279	348	80	19	77	3	1	1.085	1.0	0	2	0	0	20	2.0	tr surface scab, oval to round type
2	W2310-3	255	298	86	14	82	4	0	1.079	1.5	0	1	0	0	20	1.5	small flat round type
	MEAN	428	477	88					1.080	1.2						2.4	tr = trace, sl = slight, NA = not applicable
																	SED = stem end defect

[1]SIZE

Bs: < 1 7/8"

As: 1 7/8" - 3.25"

OV: > 3.25"

PO: Pick outs

[2]TUBER QUALITY (number of tubers per total cut)

HH: Hollow Heart

VD: Vascular Discoloration

IBS: Internal Brown Spot

BC: Brown Center

[3]CHIP COLOR SCORE - Snack Food Association Scale

(Out of the field)

Ratings: 1 - 5

1: Excellent

5: Poor

[4]Vine Maturity Rating

Date taken:

Ratings 1-5

1: Early (vines completely dead)

5: Late (vigorous vine, some flowering)

Table 4.

2007 Processing Potato Variety Trial
Sackett Potatoes - Mecosta County

Harvest 10-Oct-07 145 Days

DD, Base 40[5] 3361

LINE	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR	CHIP SCORE[3]	TUBER QUALITY[2] HH	VD	IBS	BC	TOTAL CUT	VINE MAT[4]	COMMENTS
MSK061-4(3)	416	467	90	9	82	8	1			0	3	0	0	10		knobs, tr surface scab
MSK061-4(2)	411	445	93	7	86	7	0			0	2	0	0	10		
MSK061-4(1)	407	440	92	7	88	4	1	1.080		1	3	0	1	10	1.0	round, flat, tr surface scab
MEAN	411	451	92						1.0	0.33	2.67	0.00	0.33			
MSJ316-A(3)	486	515	94	5	91	3	1			0	0	0	0	10		misshapen, 7 heat necrosis
MSJ316-A(1)	464	509	91	7	83	8	2	1.078		0	5	1	4	10	3.5	sticky stolon, 1 heat necrosis, tr misshapen
MSJ316-A(2)	420	459	91	7	81	10	2			0	2	2	0	10		mostly round, flat, tr surface scab
MEAN	456	494	92						1.0	0.00	2.33	1.00	1.33			tr = trace, sl = slight, NA = not applicable

SED = stem end defect

[1]SIZE	[2]TUBER QUALITY (number of tubers per total cut)	[3]CHIP COLOR SCORE - Snack Food Association Scale	[4] MATURITY RATING	Planted:	18-May-07	
Bs: < 1 7/8"	HH: Hollow Heart	(Out of the field)	Date Taken: 18-Sept-07	Vines Killed:	18-Sep-07	
As: 1 7/8" - 3.25"	VD: Vascular Discoloration	Ratings: 1 - 5	Ratings: 1 - 5	Days from Planting to Vine Kill:	123	
OV: > 3.25"	IBS: Internal Brown Spot	1: Excellent	1: Early (Vines Completely Dead)	Seed Spacing :	10"	
PO: Pick outs	BC: Brown Center	5: Poor	5: Late (vigorous vine, some flowering)	No Fumigation		[5]MAWN STATION: Entrican

Table 5.

2007 Processing Potato Variety Trial
Walther Farms - St. Joseph County

Harvest: 20-Sep-07 128 Days

DD, Base 40[5] 3345

LINE	US# 1 Yield in CWT/A	Total Yield in CWT/A	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR	CHIP SCORE[3]	TUBER QUALITY[2] HH	VD	IBS	BC	TOTAL CUT	COMMENTS
F1879	**421**	**430**	**98**	**2**	**98**	**0**	**0**	**1.078**	**1.0**	**7**	**0**	**0**	**0**	**20**	**pitted scab, pink eye**
FL1867	**380**	**406**	**93**	**4**	**85**	**8**	**3**	**1.087**	**1.0**	**7**	**0**	**0**	**0**	**20**	**sheep nose**
Beacon Chipper	375	408	92	3	87	5	5	1.074	1.0	0	0	3	0	20	greening, misshapen, 2 SED
MSL007-B	324	370	88	8	88	0	4	1.073	1.0	6	0	0	0	20	nice type, heavy netting, small
W2324-1	323	378	85	4	75	10	11	1.080	1.0	8	0	0	0	20	pitted scab, sticky stolon, greening, knobs
MSK409-1	318	360	88	8	83	5	4	1.083	1.0	2	0	0	0	20	tr pitted scab
W2133-1	311	369	85	7	82	3	8	1.080	1.0	0	0	5	0	20	uniform type
CO97065-7W	308	339	91	1	91	0	8	1.072	1.0	3	0	0	0	20	
FL2053	281	379	74	3	74	0	23	1.090	1.0	0	0	1	0	20	growth crack
Monticello	280	327	86	11	86	0	3	1.075	1.0	2	0	0	0	20	
MegaChip	280	344	81	3	77	4	16	1.081	1.5	0	0	2	0	20	greening, misshapen
MSJ126-9Y	270	305	89	8	89	0	3	1.070	1.0	2	0	1	0	20	netted skin
MSH228-6	264	295	90	4	84	6	6	1.078	1.0	1	0	0	0	20	tr scab, flat, oval, 3/20 pink eye
CO95051-7W	263	325	81	6	81	0	13	1.079	1.0	0	0	1	0	20	heat sprouts, 2 blackleg, SED, greening
AC97097-14W	257	297	87	5	84	3	8	1.077	1.0	1	0	5	0	20	pink eye, oblong, surface & pitted scab, points
W2310-3	257	295	87	4	87	0	9	1.084	1.0	2	0	0	0	20	tr scab
CO96141-4W	256	332	77	6	77	0	17	1.070	1.5	0	0	0	0	20	greening, tr scab, oblong to oval, flattened
FL1922	253	319	79	12	79	0	9	1.077	1.0	1	0	0	0	20	poor type, not uniform
CO97043-14W	249	282	89	5	89	0	6	1.073	1.0	3	0	0	0	20	tr surface scab
MSJ036-A	248	295	84	5	84	0	11	1.086	1.5	1	0	3	0	20	small, netted skin
MSN191-2Y	244	294	83	13	83	0	4	1.094	1.0	0	0	0	0	20	nice type, heavy netting
MSJ147-1	220	308	71	25	69	2	4	1.076	1.0	1	0	0	0	20	small type, good appearance, greening, misshapen
MSK061-4	213	279	76	4	76	0	20	1.073	1.0	0	0	0	0	20	oval to oblong, tr pitted scab
MSN238-A	206	276	75	3	75	0	22	1.076	1.0	5	0	0	0	20	greening, misshapen
MEAN	283	334	85					1.079	1.1						tr = (trace), sl = (slight), NA = Not applicable
															SED = stem end defect

[1]SIZE	[2]TUBER QUALITY (number of tubers per total cut)	[3]CHIP COLOR SCORE - Snack Food Association Scale		
			Planted:	15-May-07
Bs: < 2"	HH: Hollow Heart	(Out of the field)	Vines Killed:	3-Sep-07
As: 2 - 3 1/2"	VD: Vascular Discoloration	Ratings: 1 - 5	Days from Planting to Vine Kill:	111
OV: > 3 1/2"	IBS: Internal Brown Spot	1: Excellent	Seed Spacing :	10"
PO: Pickouts	BC: Brown Center	5: Poor	Fumigated	[5]MAWN STATION: Mendon

Table 6. Yield ,Size Distribution*, Specific Gravity									
	Yield (cwt/A)		**Percent Size Distribution**						
Entry	**US#1**	**TOTAL**	**US#1**	**Small**	**Mid-Size**	**Large**	**Culls**	**Specific Gravity**	
Beacon Chipper	585	600	97	2	79	18	1	1.077	
W2324-1	564	598	95	3	82	13	2	1.081	
Snowden	**487**	**501**	**97**	**3**	**81**	**16**	**0**	**1.078**	
Atlantic	**404**	**434**	**93**	**4**	**79**	**14**	**3**	**1.079**	
W2133-1	378	403	94	5	84	10	1	1.083	
CO96141-4W	366	385	95	5	92	3	0	1.067	
MSJ316-A	351	384	92	7	89	3	1	1.076	
CO95051-7W	238	279	85	15	85	0	0	1.074	
MSJ147-1	184	259	71	29	71	0	0	1.085	
MEAN	**395**	**427**	**91**					**1.078**	

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

Table 7. At Harvest Tuber Quality. Sandyland Farms, Howard City, Michigan.					
	Internal Defects[1]				
Entry	**HH**	**VD**	**IBS**	**BC**	**Total Cut**
Beacon Chipper	4	3	0	0	30
W2324-1	2	2	0	0	30
Snowden	**5**	**5**	**0**	**1**	**30**
Atlantic	**14**	**3**	**1**	**0**	**30**
W2133-1	1	2	0	0	30
CO96141-4W	0	4	0	0	30
MSJ316-A	0	2	0	1	30
CO95051-7W	0	1	0	0	30
MSJ147-1	0	0	0	0	30

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

Table 8. 2007 Post-Harvest Chip Quality[1].						
	Agtron	**SFA[2]**	**Specific**	**Percent Chip Defects[3]**		
Entry	**Color**	**Color**	**Gravity**	**Internal**	**External**	**Total**
Beacon Chipper	68.0	1	1.075	4.2	10.0	14.2
W2324-1	62.9	2	1.078	1.5	13.9	15.4
Snowden	**61.8**	**2**	**1.073**	**1.1**	**15.2**	**16.3**
Atlantic	**63.9**	**2**	**1.073**	**21.7**	**12.8**	**34.5**
W2133-1	61.4	2	1.078	2.2	6.4	8.6
CO96141-4W	61.4	2	1.062	1.6	7.9	9.5
MSJ316-A	64.0	2	1.072	4.9	3.1	8.0
CO95051-7W	64.0	2	1.074	1.2	8.2	10.0
MSJ147-1	59.7	2	1.080	2.0	3.8	5.8

[1] Samples collected at harvest October 4th and processed by Herr Foods Inc., Nottingham, PA on October 8, 2007 (4 days).

Chip defects are included in Agtron and SFA samples.

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

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

Table 9. Black spot Bruise Test																			
	A. Check Samples[1]									**B. Simulated Bruise Samples[2]**									
								Percent	**Average**									**Percent**	**Average**
	# of Bruises Per Tuber						**Total**	**Bruise**	**Bruises Per**	**# of Bruises Per Tuber**							**Total**	**Bruise**	**Bruises Per**
Entry	**0**	**1**	**2**	**3**	**4**	**5**	**Tubers**	**Free**	**Tuber**	**0**	**1**	**2**	**3**	**4**	**5**		**Tubers**	**Free**	**Tuber**
Beacon Chipper	18	7					25	76	0.3	4	10	6	4	1			25	16	1.5
W2324-1	23	2					25	92	0.1	15	5	5					25	60	0.6
Snowden	**25**						**25**	**100**	**0.0**	**12**	**8**	**4**	**1**				**25**	**48**	**0.8**
Atlantic	**22**	**0**	**2**	**1**			**25**	**88**	**0.3**	**17**	**6**	**2**					**25**	**68**	**0.4**
W2133-1	19	2	2	2			25	76	0.5	10	11	4					25	40	0.8
CO96141-4W	23	1	1				25	92	0.1	19	4	1	1				25	76	0.4
MSJ316-A	25						25	100	0.0	18	5	2					25	72	0.4
CO95051-7W	25						25	100	0.0	13	9	2	1				25	52	0.6
MSJ147-1	23	2					25	92	0.1	18	5	2					25	72	0.4

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

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

Table 10. Pre-Harvest Panels, 8.9.07								
								Average[5]
	Specific	**Glucose[1]**	**Sucrose[2]**	**Canopy**		**Number of**		**Tuber**
Entry	**Gravity**	**%**	**Rating**	**Rating[3]**	**Uniform.[4]**	**Hills**	**Stems**	**Weight**
Beacon Chipper	1.070	0.004	1.006	95	100	4	16	4.68
W2324-1	1.068	0.003	0.568	95	100	2	10	2.27
Snowden	**1.068**	**0.003**	**0.613**	**95**	**100**	**5**	**16**	**2.67**
Atlantic	**1.074**	**0.002**	**0.673**	**85**	**100**	**3**	**14**	**4.02**
W2133-1	1.075	0.001	0.497	80	90	4	14	3.51
CO96141-4W	1.069	0.001	0.243	75	90	4	15	3.48
MSJ316-A	1.063	0.014	1.860	100	100	6	14	2.74
CO95051-7W	1.072	0.001	0.514	80	90	5	19	2.92
MSJ147-1	1.067	0.004	0.776	95	100	4	13	1.87

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

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

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

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

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

Table 11. Pre-Harvest Panels, 8.21.07								
								Average[5]
	Specific	**Glucose[1]**	**Sucrose[2]**	**Canopy**		**Number of**		**Tuber**
Entry	**Gravity**	**%**	**Rating**	**Rating[3]**	**Uniform.[4]**	**Hills**	**Stems**	**Weight**
Beacon Chipper	1.077	0.002	0.546	95	90	4	12	6.37
W2324-1	1.078	0.003	0.462	90	85	3	16	4.13
Snowden	**1.079**	**0.001**	**0.368**	**95**	**90**	**4**	**16**	**5.95**
Atlantic	**1.071**	**0.002**	**0.497**	**85**	**90**	**4**	**16**	**5.23**
W2133-1	1.079	0.001	0.439	75	85	5	20	4.32
CO96141-4W	1.069	0.001	0.252	70	85	4	16	4.43
MSJ316-A	1.069	0.006	0.976	90	90	6	13	4.77
CO95051-7W	1.077	0.001	0.409	95	90	4	15	3.15
MSJ147-1	1.080	0.002	0.396	95	90	3	14	2.01

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

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

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

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

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

Table 12.

2007 MSU Freshpack Potato Variety Trials

Entry	Pedigree	2007 Scab Rating*	Characteristics
Blazer Russet (A8893-1)	A7816-14 X Norking Russet	-	High yield, mid-early maturity, oblong russet, medium-to-large tuber size, light netting, brown-to-tan skin, cream-white or white flesh, medium specific gravity, dual purpose
Boulder (MSF373-8)	MS702-80 X NY88	1.8	High yield, large tuber size, medium specific gravity, low internal defects, med.-deep eyes
Canela (AC92009-4Rus)	A83043-12 X A8784-3	0.3	Average yield, oblong blocky russet, good storability, above average specific gravity
Chieftain (Iowa 57410)	La1354 X Ia1027-18	-	High yield, slightly oval - large tuber size, red waxy skin type, low internal defects
Corn #3	Russet Norkotah Line Selection	1.5	High yield, large tuber size, mid-season maturity, tubers are white flesh, long to slightly oblong, medium to heavy russetted skin, eyes are shallow, numerous and well distributed tuber set, medium specific gravity
Corn #8	Russet Norkotah Line Selection	2.3	Average yield, early to mid-season maturity, tubers are white flesh, long to slightly oblong, medium to heavy russetted skin, eyes are shallow, numerous and well distributed tuber set, medium specific gravity
Dakota Jewel (ND3196-1R)	ND2223-8R X ND649-4R	-	Average yield, early tuber maturity, smooth round tubers, nice red color out of the field, white flesh, shallow apical eyes, stores well, low specific gravity, some brown center noted.
Defender (A90586-11)	KSA195-90 X Ranger Russet	-	Medium to high yield, late maturing, medium to large size, long tuber type, late blight resistant, common scab susceptible, high specific gravity
Freedom Russet (W1836-3rus)	ND 14-1 Rus X W 1005-Rus	-	High yield, late vine maturity, long blocky russet tubers, exhibits superior tuber bulking rate when harvested at 120 days, highly resistant to Verticillium wilt, resistant to common scab
Katahdin (USDA42667)	USDA40568 X USDA24642	-	Medium to high yield, large size, round white tuber type, excellent storability, medium specific gravity, shallow eyes, check variety

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

Table 12 continued.

Entry	Pedigree	2007 Scab Rating*	Characteristics
Onaway	USDA X96-56 X Katahdin	-	High yield, early maturity, round tuber type, low specific gravity, smooth skin, white flesh, eyes medium – deep, few internal defects, check variety
Premier Russet (A93157-6LS)	A87149-4 X A88108-7	1.0	Average yield, maintains low levels of reducing sugars even after extended storage, Med to late maturity, dual purpose usage, PVY resistant, high specific gravity
Reba (NY 87)	Monona X Allegany	1.8	High yield, bright tubers, low incidence of internal defects, mid to late season maturity, medium – low specific gravity
Rio Colorado (NDC5281-2R)	ND3196-1R X ND2224-5R	1.5	Medium to high yield, medium maturity, medium tuber size, nice red color, round to oval shape, medium to low specific gravity
Russet Norkotah (ND534-4 Rus)	ND9526-4 Rus X ND9687-5 Rus	2.0	Average yield, mid-season maturity, long to oval tubers, heavy russet skin, check variety, low specific gravity
Silverton (A83064-6)	A76147-2 x A 7875-5	-	High yield, oblong to long blocky tuber type, medium russet skin, masks PVY, medium specific gravity
Vivaldi (VDZ 87-105)	TS 77-148 x Monalisa	-	High yield, smooth oval buff skinned tuber, light yellow flesh, slightly tolerant to common scab, low specific gravity
A95109-1Rus	Blazer Russet X Summit Russet	0.7	Below average yield, early maturity, attractive appearance, fresh market use, low - medium specific gravity
AOA95154-1Rus	Bannock Russet X A89152-4	0.5	Medium yield, late maturity, long russetted tubers, high specific gravity, good fry color from storage,
AOTX95265-4Rus	A89216-9 x A86102-6	-	High yield, mid-late maturity, oblong to long russetted tubers, generally nice appearance
CO95086-8Rus	CO87009-4Rus X Silverton Russet	0.0	Good market yield, medium maturity, resistant to black spot bruise, little internal defects, good size profile, medium yield potential, dual purpose russet, medium specific gravity, good processing from storage.
CO97087-2Rus	CO87009-4 x W1005	0.5	Average yield, medium maturity, oblong flat russet, medium specific gravity, dual purpose

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

Table 12 continued.

Entry	Pedigree	2007 Scab Rating*	Characteristics
MSI005-20Y	MSA097-1Y X Penta	2.0	High yielding, early to mid-season maturity, low internal defects, strong yellow flesh color
MSL268-D	NY103 X Jacqueline Lee	1.5	Medium yield, late blight resistant, round to oval tuber type
MSM060-3	MSG007-1 X ND2676-10	1.8	Yield similar to Pike, medium specific gravity, scab resistant, round blocky tuber type
MSM171-A	Stirling X MSE221-1	1.3	High yield, late maturity, smooth shape, large round tuber type, superior skin type, late blight resistant, low specific gravity
MSN105-1	MSG141-3 X Jacqueline Lee	2.0	Average yield, early maturity, large heavy set tuber type, bright skin, medium specific gravity, moderate late blight resistance
MWTX2609-4Rus	Russet Burbank X Ontario & 4xhybrid	-	High yield, mid to late maturity, long large tuber type, light russet skin, medium specific gravity
TX 112	Russet Norkotah Line Selection	-	Yields higher than standard Norkotah, oblong to long tuber type, smooth medium russet, white flesh, good appearance, earlier maturity, low specific gravity
TX 296	Russet Norkotah Line Selection	-	High yields, later maturity than standard Norkotah, heat resistant, low specific gravity
W2609-1R	Dark Red Norland X W774R	0.8	Below average yield, early maturity, light red netted skin, small tuber type, low – medium specific gravity
W2683-2Rus	ND4093-4 X CO80011-5	0.5	High yield, medium to late maturity, oblong to long tuber type, dark brown heavy russet skin, medium low specific gravity
W3328-1Rus	W1099Rus X AC88064-6Ru3	1.0	High yield, medium to late maturity, oblong to long blocky tuber type, dark brown heavy russet skin, medium low specific gravity
W3882-1R	Nordonna X AC88064-6Rus	1.0	Below average yield, medium maturity, uniform round tuber type, netted skin, good red color, low specific gravity

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

Table 13.

2007 Freshpack Potato Variety Trial
Overall Averages - Eight Locations
Branch, Delta, Monroe, Montcalm (2), Presque Isle, St. Joseph & Washtenaw Counties

NUMBER OF LOCATIONS	LINE	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR	TUBER QUALITY[2] HH	VD	IBS	BC	TOTAL CUT	VINE MAT[3]	COMMENTS	3-YR AVG US#1 CWT/A
1	MSI 005-20Y	599	633	95	3	63	32	2	1.080	0	0	0	0	10	4.0	nice yellow flesh	456
3	MSM171-A	494	537	94	4	64	30	2	1.061	0	5	0	1	40	3.5		
1	Vivaldi	471	501	94	6	94	0	0	1.056	0	0	0	0	10	NA	yellow flesh, surface scab, oval to oblong	-
3	W3328-1Rus	463	516	89	8	59	30	3	1.072	0	0	0	0	30	4		325*
6	Corn #3	453	538	85	8	61	24	7	1.073	23	4	1	1	80	4	knobs, misshapen, tr pitted scab	-
1	Katahdin	452	465	97	3	73	24	0	1.066	0	6	0	0	10	NA	deep apical eye, tr surface scab, bright appearance	418
4	W2683-2Rus	438	531	82	5	46	36	13	1.071	3	1	0	0	40	4	not uniform type, misshapen	317*
1	Boulder	428	442	97	3	65	32	0	1.073	0	0	0	0	10	NA	pitted scab, nice type	435
3	Reba	426	442	96	3	66	30	1	1.070	0	0	0	0	30	3	uniform type	426
1	Onaway	418	439	95	5	82	13	0	1.056	0	0	0	0	10	NA	not uniform type, tr pitted scab	445
8	Freedom Russet	416	519	79	16	61	18	5	1.071	6	0	3	0	100	4	tubular type, not very uniform	-
1	Chieftain	416	458	90	4	50	40	6	1.061	1	1	1	1	10	NA	knobs, light red, growth cracks	-
3	Rio Colorado	413	469	87	12	81	6	1	1.069	0	1	0	0	30	3	slight surface scab, nice red skin color, round to oval appearance	-
2	TX 296	395	469	85	9	51	34	6	1.065	5	0	0	0	40	3		-
4	MSL268-D	380	422	90	8	79	11	2	1.074	4	3	6	4	40	NA	tr scab, uniform, small round type	-
1	MWTX2609-4Rus	378	631	60	12	44	16	28	NA	4	0	1	0	30	4	knobs, heat sprouts	-
1	AOTX95265-4Rus	374	517	72	13	53	19	15	NA	3	0	0	0	30	2		-
1	TX 112	364	403	91	9	71	20	0	1.066	0	0	0	0	10	2.5	large percentage of "As"	-

continued on next page:

Table 13 continued.

NUMBER OF LOCATIONS	LINE	CWT/A US#1	CWT/A TOTAL	PERCENT OF TOTAL[1] US#1	Bs	As	OV	PO	SP GR	TUBER QUALITY[2] HH	VD	IBS	BC	TOTAL CUT	VINE MAT[3]	COMMENTS	3-YR AVG US#1 CWT/A
7	CO95086-8Rus	356	432	82	15	64	18	3	1.069	8	3	1	0	90	3	nice blocky type, no scab, misshapen pick outs	274
6	Corn #8	341	404	84	12	61	23	4	1.061	0	7	0	0	80	3	tr pitted scab, misshapen pick outs, generally good appearance	-
5	Canela	335	392	87	6	64	23	7	1.081	8	4	0	0	70	4	misshapen	-
6	MSN105-1	334	398	83	16	79	4	1	1.074	1	1	0	0	60	4	small size, bright appearance, tr scab	343*
6	A93157-6LS	326	444	74	11	58	16	15	1.076	27	3	3	0	80	4	growth cracks, blocky type, knobs	312
5	CO97087-2Rus	325	450	72	14	57	15	14	1.074	1	2	0	0	70	3	misshapen, generally poor appearance	-
6	Russet Norkotah	320	387	82	12	64	18	6	1.065	1	2	0	0	80	3		228
4	AOA95154-1Rus	312	402	76	21	56	20	3	1.082	3	6	2	0	40	4		-
2	W2609-1R	303	318	95	5	90	5	0	1.062	0	0	0	0	20	NA	light red skin color, netted skin, small type	-
2	Silverton	301	420	65	14	57	8	21	1.044	2	0	5	0	40	3		331*
3	A95109-1 Rus	297	346	85	10	71	14	5	1.066	2	2	0	0	30	NA	tr pitted scab, nice blocky type	260
5	MSM060-3	273	332	82	13	75	7	5	1.082	3	1	3	0	50	4	tr pitted scab, growth cracks, misshapen pick outs	-
3	W3882-1R	256	282	91	7	89	2	2	1.066	3	2	0	0	30	3	uniform type, netted skin, good red color	-
1	Blazer Russet	256	361	71	27	61	10	2	1.062	6	1	2	0	10	NA	tubular, no scab, heavy russeting, uniform type	-
2	Dakota Jewel	227	266	86	10	79	7	4	1.066	6	1	0	1	20	2	good red skin color, uniform round type	227
1	Defender	158	417	38	54	38	0	8	1.068	1	0	0	0	10	NA	severe scab	-
	MEAN	367	441						1.068						3.3	tr = trace, sl = slight, NA = not applicable	
																SED = stem end defect	

[1]SIZE

Bs: < 1 7/8" or < 4 oz.

As: 1 7/8" - 3.25" or 4 - 10 oz.

OV: > 3.25" or > 10 oz.

PO: Pick outs

[2]TUBER QUALITY (number of tubers per total cut)

HH: Hollow Heart

VD: Vascular Discoloration

IBS: Internal Brown Spot

BC: Brown Center

[3]MATURITY RATING

Ratings: 1 - 5

1: Early (Vines Completely Dead)

5: Late (vigorous vine, some flowering)

* Two-Year Average

Response of potato to phosphorus and *AVAIL*. 2007

Darryl Warncke
Department of Crop & Soil Sciences
Michigan State University

SUMMARY

Increasing the amount of P_2O_5 applied tended to increase total tuber yield and yield of grade A tubers, although the differences were not significant at $p<0.05$. Manganese was the only element to increase in concentration in the leaf at mid-season in response to P application. P rate did not increase the P concentration in the leaf. The P concentration in the leaf was consistently higher when *AVAIL* was applied, although the difference was not significant at $p<0.05$.

…………………………

A study was conducted on a Hillsdale-Spinks sandy loam at the Michigan State University Montcalm Potato Research Farm to evaluate the response of potatoes to phosphorus applied without and with *AVAIL*, a product of Specialty Fertilizer Products, Inc. which is indicated to improve phosphorus availability. The previous crop was alfalfa. It was killed with roundup and plowed in the fall. The initial available nitrogen content of the soil averaged about 25 lb N per acre in the top foot. Soil test values averaged: pH 5.4, P-150 ppm, K-123 ppm with a CEC near 8.7 and organic matter near 1.9%. Potash, 200 lbs K_20 per acre, was spread in the spring prior to tilling the soil. The P treatments are indicated in Tables 1 to 3. Phosphorus was supplied as 10-34-0 and was blended with 28-0-0 to supply a constant amount of nitrogen (35 lb/a). The fertilizer was applied in bands 2 inches to each side and slightly below the seed pieces. The plots were two rows 32 inches apart and 50 feet long. Two untreated rows were between the treatment rows. The potatoes (cv. FL 1879) were planted on May 10. Admire, a systemic insecticide, was sprayed over the seed pieces before covering with soil. All rows received a topdress application of 150 lbs N/a as urea just prior to hilling. All treatments were replicated four times. Samples of the youngest fully expanded leaves, including petioles, were collected on July 11 for determination of phosphorus and other elements. Temperatures were well above normal during July and August with rainfall being below normal. The plots were irrigated as needed with a center pivot irrigation system. On September 21 tubers were harvested from 35 feet of each of the two treatment rows. The tubers were washed and graded for size. Specific gravity was determined for the A size tubers, 2 to 3.25 inch.

Results:

The concentrations of the primary elements in the potato leaves on July 11 are shown in Table 1. Sulfur was the only element to show a significant difference. Potatoes receiving

Use of commercial products does not imply endorsement.

no P and no *AVAIL* had a lower S concentration than potatoes receiving the other treatments. Although the average P concentration in the leaves was consistently higher in the leaves of potatoes receiving the *AVAIL*, the difference was not statistically significant due to variability.

Table 1. Primary element content of potato leaves in relation to phosphorus and *AVAIL* treatments.

Phosphate Rate	*AVAIL** Applied	N	P	K	Ca	Mg	S
lbs P_2O_5/a		- - - -		%	- - - -		
00	No	4.98	0.24	3.55	1.62	0.74	0.28
40	No	5.13	0.25	2.92	1.74	0.80	0.31
80	No	4.90	0.25	3.08	1.66	0.77	0.30
120	No	5.10	0.25	3.05	1.72	0.76	0.31
00	Yes	5.17	0.28	3.19	1.58	0.74	0.32
40	Yes	5.11	0.27	3.35	1.63	0.75	0.32
80	Yes	5.00	0.27	2.85	1.77	0.85	0.32
120	Yes	5.24	0.27	2.69	1.61	0.74	0.31
$Lsd_{.05}$		ns	ns	ns	ns	ns	0.02
CV, %		3.6	10.6	11.6	7.1	9.4	4.6

* Product of Specialty Fertilizer Products, Inc.

Table 2. Micro-element content of potato leaves in relation to phosphorus and *AVAIL* treatments.

Phosphate Rate	*AVAIL** Applied	B	Cu	Mn	Zn	Fe	Al
lbs P_2O_5/a		- - - -		%	- - - -		
00	No	30.2	7.5	201	40.7	115	33
40	No	27.5	8.2	232	37.2	152	44
80	No	27.5	7.5	236	36.7	97	30
120	No	28.0	8.2	314	42.5	125	33
00	Yes	27.7	8.7	194	34.0	111	31
40	Yes	29.0	8.5	205	34.5	110	32
80	Yes	28.5	8.0	209	33.0	104	33
120	Yes	26.2	7.0	306	38.7	119	35
$Lsd_{.05}$		ns	ns	72	ns	ns	ns
CV, %		10.3	15.0	20.7	24.6	28.5	25.7

* Product of Specialty Fertilizer Products, Inc.

Concentrations of the micronutrients, except manganese, in the potato leaves were not affected by the various treatments (Table 2). The manganese concentration was higher in potatoes receiving 120 lbs P_2O_5 per acre, but was unaffected by the other rates of phosphorus.

Without *AVAIL* total tuber yield topped out with 80 lbs P_2O_5 per acre (Table 3). When AVAIL was included with the P fertilizer the highest total tuber yield was achieved with 120 lbs P_2O_5 per acre. However, this was not significantly better than the yield with the 80 lbs P_2O_5 per acre with or without *AVAIL*. Application of *AVAIL* at the other phosphorus rates did not improve total tuber yield. Effects of the treatments on yield of tubers 2 to 3.25 inches in diameter (A grade) were similar to those of total tuber yields. Yields of the large (> 3.25 inch) tubers and culls were not related to treatment. Although there were significant differences in cull tubers, there was no consistent relation to treatment. Specific gravity of the tubers was similar across all phosphorus rates and *AVAIL* treatments.

Table 3. Influence of phosphorus rate and *AVAIL** on potato (FL 1879) tuber yield and specific gravity.

Phosphate Rate	AVAIL* Applied	Tuber Yield Total	>3.25”	A’s	B’s	Culls	Specific Gravity
lbs P_2O_5/a		- - - -		cwt/a	- -	- -	
00	No	370	104	240	9.1	17.4	1.073
40	No	393	83	277	10.5	22.7	1.074
80	No	415	107	271	9.6	27.4	1.073
120	No	395	109	254	11.3	20.5	1.073
00	Yes	384	99	251	10.9	23.3	1.074
40	Yes	397	89	268	9.2	30.7	1.074
80	Yes	425	114	273	11.0	26.6	1.074
120	Yes	458	107	316	12.1	22.7	1.075
$Lsd_{.05}$		46.3	ns	33.5	ns	3.5	ns
CV		7.8	22.5	9.7	22.7	22.0	0.14

* Product of Specialty Fertilizer Products, Inc.

Evaluation of control release N materials for use in potato production. 2007

Darryl Warncke
Department of Crop & Soil Sciences
Michigan State University

SUMMARY

A number of slow or controlled release nitrogen materials were evaluated in comparison with a standard N management program and a planting time only N treatment for potato production. The low N potatoes had a lower N content in the leaves and appeared yellowish throughout much of July and August whereas potatoes receiving adequate N remained green until near senescence. There were no appearance differences among the N sources. Differences in tuber yield were observed only in the 2 to 3½ inch size. Total and U.S. No. 1 tuber yields did not differ among the N sources or N programs.

Introduction:

This study was conducted to evaluate the use of several controlled-release N products in comparison to a standard nitrogen management program for production of potatoes. The control release/ slow release N products (CRN) were Nitamin 30L, Nitamin GP-43G, Dicyanamide and ESN. The Nitamin materials are products of the Georgia Pacific company and ESN is a product of Agrium. Each of these materials were applied over the row at cracking just prior to cultivation. At planting a 19-17-0 liquid fertilizer was applied in bands 3 inches to sides of the side piece. This supplied 40 lbs N/ acre. Seed pieces of Frito Lay variety 1879, a commonly grown chipping potato, were planted 9 inches apart in rows 32 inches apart. Planting took place on May 10. Admire, a systemic insecticide, was sprayed over the seed pieces before covering with soil. ESN was broadcasted to supply 135 lbs N/ acre just prior to planting. The CRN materials were applied over the row at cracking just prior cultivation to supply 135 lbs N/acre. The standard N management program included, 40 lbs N/acre at planting, 75 lbs N/acre as UAN at cracking and 60 lbs N/acre as Urea at hilling. A summary of the treatments is presented in Table 1. Each of the treatments were replicated four times with a randomized complete block design. Plots were 4 rows 50 feet long.

This study was conducted at the Michigan State University Montcalm Research Farm in Montcalm County. It is the main potato research station in Michigan. The research plots were in an area of Hillsdale-Spinks sandy loam soil. The previous crop was alfalfa. It was killed with roundup and plowed in the fall. The initial available nitrogen content of the soil averaged about 25 lb N per acre in the top foot. Soil test values averaged: pH 5.4, P-150 ppm, K-123 ppm with a CEC near 8.7 and organic matter near 1.9 %. Potash, 200 lbs K_20 per acre, was spread in the spring prior to tilling the soil. Temperatures were well above normal during July and August with rainfall being below normal. The plots were irrigated as needed with a center pivot irrigation system. Leaf samples (20 per plot) were collected from the two center rows on July 11 to provide a mid-season evaluation of the nitrogen treatments. At harvest on September 21 the two center rows were dug for determination of tuber yield. The tubers were washed and graded according to size. Specific gravity was determined on washed samples.

Table 1. Controlled release nitrogen materials, application rates and times used in potato (cv. FL 1879) production study.

Primary N Source		Timing		
	Total N[1]	Planting[2]	Cracking[3]	Hilling[4]
	- - - - - -	lb N per acre	- - - - - -	
19-17-0	65	40	zero	00
UAN	200	40	75 - UAN	60
Nitamin 30L	200	40	135 - Nita.30L	00
GP-43G	200	40	135 - GP-43G	00
Dicyanamide	200	40	135 - Dicyan.	00
ESN	200	40+135-ESN	00	00

[1] Includes soil N credit of 25 lbs N/acre.
[2] Applied as 19-17-0 (liquid)
[3] UAN = urea-ammonium nitrate, Nita. 30L = Nitamin 30L, GP-G43 = granular Nitamin, Dicyan.=Dicyandiamide, ESN=ESN.
[4] Applied as UAN.

Results:

Beginning in early July the potatoes receiving only starter nitrogen began to appear lighter green than the rest of the potatoes. On July 26, Potato Field Day, the low N potatoes could easily be distinguished by the yellow color from the other potatoes. No visual differences could be discerned among potatoes receiving the other treatments. On July 11 the total N content of the potato leaves, including petiole, was lower in the potatoes receiving only the 40 lbs N/a at planting time than potatoes receiving 175 lbs N/a (Table 2). Application of adequate N tended to improve P content in the leaves, but there was no difference about N sources. Concentrations of K, Ca, Mg and S in the leaves varied among N sources, but there no one source consistently resulted in higher or lower nutrient concentrations. The same was true with the micronutrient concentrations in the leaves. Boron, Cu and Zn concentrations were relatively consistent among N sources. The unusually high Mn levels probably reflect the spraying of a Mn containing fungicide.

Even though the foliage of the low N potatoes had a lower leaf N content and appeared yellowish through much of July and August, the total tuber yield was nearly comparable to potatoes receiving the standard N program or the controlled release N (CRN) materials at 175 lbs supplemental N per acre (Table 4). Significant differences in yield occurred only within the 2 to 3½ inch diameter tubers. Yields of this size tuber were significantly less with GP-43G, Dicyanamide, and ESN than with Nitamin 30L, UAN+urea, or starter N only.

Table 2. Total content of N and other selected elements in the youngest fully developed potato leaves including petiole. July 11.

Primary N Source	N	P	K	Ca	Mg	S
	%	%	%	%	%	%
starter only	4.43	0.27	3.44	1.70	0.75	0.34
UAN	5.55	0.33	2.72	1.75	0.83	0.35
Nitamin 30L	5.43	0.34	3.05	1.63	0.80	0.35
GP-43G	5.37	0.29	3.37	1.65	0.78	0.33
Dicyanamide	5.68	0.33	2.99	1.55	0.79	0.34
ESN	5.30	0.28	3.00	1.76	0.86	0.33
CV	4.0	10.9	12.3	6.7	7.7	1.0
$Lsd_{.05}$	0.31	0.5	0.56	0.16	0.09	0.3

Table 3. Total content of N and other selected elements in the youngest fully developed potato leaves including petiole. July 11.

Primary N Source	B	Cu	Mn	Zn	Fe
	ppm	ppm	ppm	ppm	ppm
starter only	32	8	213	39	94
UAN + Urea	27	9	325	39	155
Nitamin 30L	27	11	312	32	199
GP-43G	29	9	380	39	105
Dicyanamide	31	11	206	32	118
ESN	29	9	436	43	102
CV	7.1	24.5	21.3	21.0	58.0
$Lsd_{.05}$	2.9	3.6	100.	11.0	102.

Table 4. Effect of N management and control-release N materials on potato (cv. FL 1879) tuber size, yield and specific gravity. Spinks sandy loam.

Primary N	Non-Starter	Yield	Specific

Source[1]	N Rate	Total	No. 1	2 to 3½	B Size	Gravity
	lb/acre	- -	cwt/ acre	- -		
starter only	0	407	374	284	9.9	1.078
UAN	135	431	397	283	10.4	1.076
Nitamin 30L	135	421	401	284	10.8	1.075
GP-43G	135	397	378	240	8.7	1.076
Dicyanamide	135	421	396	266	14.1	1.075
ESN[2]	135	392	360	264	9.6	1.075
$Lsd_{.05}$		36.5	41.1	17.9	4.1	.0016
$Lsd_{.10}$		30.2	34.0	14.8	3.4	.0014
CV (%)		6.1	7.3	7.2	25.1	0.10
P <		0.25	0.41	0.029	0.11	0.029

[1] Materials applied at cracking and/or hilling.

Weed Control and Potato Crop Tolerance

Christy Sprague and Gary Powell
MSU Crop and Soil Science

Several herbicides were evaluated for preemergence (*PRE*) and postemercence (*POST*) weed control in potato. The variety 'Snowden' was planted May 9, with *PRE* applications May 23, after hilling. POST applications were made June 15, with potato at 12" height, and annual weeds ½ to 6 inch height.

Common lambsquarters was the most difficult weed species to control. *PRE* application of Dual Magnum (trt #13) resulted in very poor control of both lambsquarters and redroot pigweed. The addition of Reflex to the *PRE* application of Dual (trt #14) greatly improved lambsquarters control and resulted in excellent pigweed control. A *PRE* tank-mix of Matrix + Dual followed by Matrix *POST* (trt #9) resulted in fair lambsquarters control; this same *PRE* tank-mix followed by Valent's experimental V-10142 *POST* (trt #10) resulted in excellent lambsquarters control. A *PRE* application of V-10142 resulted in fair to good lambsquarters control (trt #1-3), while this same *PRE* application followed by V-10142 applied *POST* resulted in good to excellent lambsquarters control (trt #4,5,6,8). Boundary (a premix of Dual + Sencor) applied *PRE* alone or tank-mixed with Reflex (trt #15,16) resulted in excellent weed control.

A *PRE* application of Valent's Chateau (trt # 12) resulted in the only injury to potato. Injury consisted of severe potato stunting and stand reduction.

MSU Weed Science Research Program

Weed Control and Potato Crop Tolerance

Trial ID:	POT01-07	**Study Dir.:**	Sprague, Powell
Conducted:	Montcalm	**Investigator:**	Christy Sprague

Date Planted:	5/9/07	**Row Spacing:**	34" IN
Variety:	Snowden	**No. of Reps:**	4
Population:	12" Seed Spacing	**% OM:**	2.5
Soil Type:	Loamy Sand	**pH:**	4.9
Plot Size:	10 **X** 30 **FT**	**Design:**	RANDOMIZED COMPLETE BLOCK

Tillage: Moldboard Plowed and raked 5/9/07
Fertilizer: 250lb Potash Plowdown

20 gallon 19-17-0 with planter

8oz Admire with planter

Crop and Weed Description

Weed	Code	Common Name	Scientific Name
1.	CHEAL	LAMBSQUARTERS, COMMON	CHENOPODIUM ALBUM L.
2.	ECHCG	BARNYARDGRASS	ECHINOCHLOA CRUS-GALLI
3.	AMARE	PIGWEED, REDROOT	AMARANTHUS RETROFLEXUS L.

Crop	Code	Common Name
1.	SOLTU	POTATO

Application Description

	A	B
Application Timing:	PRE	POST
Date Treated:	5/23/07	6/15/07
Time Treated:	8:15 pm	9:30 am
% Cloud Cover:	10	15
Air Temp., Unit:	80 F	80 F
% Relative Humidity:	25	36
Wind Speed/Unit/Dir:	2 mph W	1 mph W
Soil Temp., Unit:	76 F	77 F
Soil/Leaf Surface M:	5 5	5 5
Soil Moist (1=w 5=d):	5	5

Crop Stage at Each Application

	A	B
Crop Name:	SOLTU	SOLTU
Height (In.):	-	10-12
Stage (L):	-	many

Weed Stage at Each Application

	A	B
Weed 1 Name:	CHEAL	CHEAL
Height (In.):	-	1/2-3"
Stage (L):	-	coty-12
Weed 2 Name:	ECHCG	ECHCG
Height (In.):	-	2"
Stage (L):	-	1-2
Weed 3 Name:	AMARE	AMARE
Height (In.):		1"
Stage (L):		6

Weed Density (plants/sq. ft.)

	1	2	3	4
Date:	7/16/07	7/16/07	7/16/07	7/16/07
Weed Name:	ECHCG	CHEAL	AMARE	POLCO
Density:	<1	2	<1	<1

Application Equipment

Appl	Sprayer Type	Speed MPH	Nozzle Type	Nozzle Size	Nozzle Height	Nozzle Spacing	Boom Width	GPA	Carrier	PSI
A	Cub	3.8	AirMix	11003	22"	20	100	19	water	27
B	Cub	3.8	AirMix	11003	20"	20	100	19	water	27

Weed Control and Potato Crop Tolerance

Trial ID: POT01-07 Study Dir.: Sprague, Powell
Conducted: Montcalm Investigator: Christy Sprague

Weed Code										CHEAL	ECHCG		ECHCG	CHEAL	AMARE
Crop Code								SOLTU	SOLTU			SOLTU			
Rating Data Type								injury	injury	control	control	injury	control	control	control
Rating Unit								percent	percent	percent	percent	percent	percent	percent	percent
Rating Date								6/7/07	6/15/07	6/15/07	6/15/07	6/28/07	6/28/07	6/28/07	6/28/07
Trt-Eval Interval								15 DA-A	23 DA-A	23 DA-A	23 DA-A	36 DA-A	36 DA-A	36 DA-A	36 DA-A
Trt No.	Treatment Name	Form Conc	Form Type	Rate	Rate Unit	Grow Stg	Appl Code								
1	V-10142	75	WG	6.4	oz/a	PRE	A	0	0	78	94	0	92	73	99
2	V-10142	75	WG	8.5	oz/a	PRE	A	0	0	91	99	0	99	73	99
3	V-10142	75	WG	10.67	oz/a	PRE	A	0	0	92	97	0	91	79	99
4	V-10142	75	WG	6.4	oz/a	PRE	A	0	0	81	97	0	98	73	99
4	V-10142	75	WG	6.4	oz/a	POST	B								
4	Acitvator 90 (NIS)		L	0.25	% v/v	POST	B								
5	V-10142	75	WG	8.5	oz/a	PRE	A	0	0	92	99	0	99	92	99
5	V-10142	75	WG	8.5	oz/a	POST	B								
5	Acitvator 90 (NIS)		L	0.25	% v/v	POST	B								
6	V-10142	75	WG	10.67	oz/a	PRE	A	0	0	92	99	0	97	95	99
6	V-10142	75	WG	8.5	oz/a	POST	B								
6	Acitvator 90 (NIS)		L	0.25	% v/v	POST	B								
7	Untreated							0	0	0	0	0	0	0	0
8	V-10142	75	WG	6.4	oz/a	PRE	A	0	0	94	99	0	99	96	99
8	Dual Magnum	7.62	EC	1	pt/a	PRE	A								
8	V-10142	75	WG	8.5	oz/a	POST	B								
8	Acitvator 90 (NIS)		L	0.25	% v/v	POST	B								
9	Matrix	25	WG	1	oz/a	PRE	A	0	0	35	99	0	99	75	99
9	Dual Magnum	7.62	EC	1	pt/a	PRE	A								
9	Matrix	25	WG	1	oz/a	POST	B								
9	Acitvator 90 (NIS)		L	0.25	% v/v	POST	B								
10	Dual Magnum	7.62	EC	1	pt/a	PRE	A	0	0	98	99	0	99	99	99
10	Sencor	75	WG	4	oz/a	PRE	A								
10	V-10142	75	WG	8.5	oz/a	POST	B								
10	Acitvator 90 (NIS)		L	0.25	% v/v	POST	B								
11	Dual Magnum	7.62	EC	1	pt/a	PRE	A	0	0	98	99	0	99	98	99
11	Sencor	75	WG	4	oz/a	PRE	A								
11	Matrix	25	WG	1	oz/a	POST	B								
11	Acitvator 90 (NIS)		L	0.25	% v/v	POST	B								
12	Chateau	51	WG	1.5	oz/a	PRE	A	73	45	99	96	33	85	98	97
13	Dual Magnum	7.62	EC	1	pt/a	PRE	A	0	0	15	99	0	99	30	25
14	Dual Magnum	7.62	EC	1	pt/a	PRE	A	0	0	96	99	0	99	79	99
14	Reflex	2	L	1	pt/a	PRE	A								
15	Boundary	6.5	EC	1.5	pt/a	PRE	A	0	0	99	99	0	99	96	98
16	Boundary	6.5	EC	1.5	pt/a	PRE	A	0	0	98	99	0	99	92	99
16	Reflex	2	L	0.5	pt/a	PRE	A								
LSD (P=.05)								1.0	2.1	8.4	4.4	9.0	9.0	11.3	2.6
Standard Deviation								0.7	1.4	5.9	3.1	6.3	6.3	7.9	1.8
CV								15.93	51.32	7.5	3.35	311.77	6.95	10.12	2.08

Weed Control and Potato Crop Tolerance

Trial ID: POT01-07 Study Dir.: Sprague, Powell
Conducted: Montcalm Investigator: Christy Sprague

Weed Code								AMBEL	ECHCG	CHEAL	AMARE
Crop Code											
Rating Data Type								control	control	control	control
Rating Unit								percent	percent	percent	percent
Rating Date								6/28/07	7/26/07	7/26/07	7/26/07
Trt-Eval Interval								36 DA-A	64 DA-A	64 DA-A	64 DA-A
Trt No.	Treatment Name	Form Conc	Form Type	Rate	Rate Unit	Grow Stg	Appl Code				
1	V-10142	75	WG	6.4	oz/a	PRE	A	99	87	74	99
2	V-10142	75	WG	8.5	oz/a	PRE	A	99	99	85	99
3	V-10142	75	WG	10.67	oz/a	PRE	A	99	98	88	99
4	V-10142	75	WG	6.4	oz/a	PRE	A	99	99	86	99
4	V-10142	75	WG	6.4	oz/a	POST	B				
4	Acitvator 90 (NIS)		L	0.25	% v/v	POST	B				
5	V-10142	75	WG	8.5	oz/a	PRE	A	99	99	91	99
5	V-10142	75	WG	8.5	oz/a	POST	B				
5	Acitvator 90 (NIS)		L	0.25	% v/v	POST	B				
6	V-10142	75	WG	10.67	oz/a	PRE	A	99	98	95	99
6	V-10142	75	WG	8.5	oz/a	POST	B				
6	Acitvator 90 (NIS)		L	0.25	% v/v	POST	B				
7	Untreated							0	0	0	0
8	V-10142	75	WG	6.4	oz/a	PRE	A	99	99	98	99
8	Dual Magnum	7.62	EC	1	pt/a	PRE	A				
8	V-10142	75	WG	8.5	oz/a	POST	B				
8	Acitvator 90 (NIS)		L	0.25	% v/v	POST	B				
9	Matrix	25	WG	1	oz/a	PRE	A	93	99	84	99
9	Dual Magnum	7.62	EC	1	pt/a	PRE	A				
9	Matrix	25	WG	1	oz/a	POST	B				
9	Acitvator 90 (NIS)		L	0.25	% v/v	POST	B				
10	Dual Magnum	7.62	EC	1	pt/a	PRE	A	99	99	97	99
10	Sencor	75	WG	4	oz/a	PRE	A				
10	V-10142	75	WG	8.5	oz/a	POST	B				
10	Acitvator 90 (NIS)		L	0.25	% v/v	POST	B				
11	Dual Magnum	7.62	EC	1	pt/a	PRE	A	99	99	99	99
11	Sencor	75	WG	4	oz/a	PRE	A				
11	Matrix	25	WG	1	oz/a	POST	B				
11	Acitvator 90 (NIS)		L	0.25	% v/v	POST	B				
12	Chateau	51	WG	1.5	oz/a	PRE	A	99	86	89	92
13	Dual Magnum	7.62	EC	1	pt/a	PRE	A	99	99	30	80
14	Dual Magnum	7.62	EC	1	pt/a	PRE	A	99	99	78	99
14	Reflex	2	L	1	pt/a	PRE	A				
15	Boundary	6.5	EC	1.5	pt/a	PRE	A	99	99	94	98
16	Boundary	6.5	EC	1.5	pt/a	PRE	A	99	99	95	99
16	Reflex	2	L	0.5	pt/a	PRE	A				
LSD (P=.05)								4.3	10.5	12.6	9.8
Standard Deviation								3.0	7.4	8.8	6.8
CV								3.28	8.1	10.98	7.5

Funding: MPIC and Aghem Industry

Seed, in-furrow and emergence treatments for control of seed- and soil-borne Rhizoctonia, 2007.

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Potatoes (FL1879) with R*hizoctonia solani* (black scurf), 2- 5% tuber surface area infected, were selected for the trials. Potato seed was prepared for planting by cutting and treating with fungicidal seed treatments two days prior to planting. Seed were planted at the Michigan State University Muck Soils Experimental Station, Bath, MI on 10 Jun into two-row by 20-ft plots (ca. 10-in between plants to give a target population of 50 plants at 34-in row spacing) replicated four times in a randomized complete block design. The two-row beds were separated by a five-foot unplanted row. Dust formulations were measured and added to cut seed pieces in a Gustafson revolving drum seed treater and mixed for two minutes to ensure even spread of the fungicide. Fungicides applied as pre-planting potato seed liquid treatments were applied in water suspension at a rate of 0.2 pt/cwt onto the exposed seed tuber surfaces, with the entire seed surface being coated in the Gustafson seed treater. Foliar applications were applied with a R&D spray boom delivering 25 gal/A (80 p.s.i.) and using three XR11003VS nozzles per row. Fertilizer was drilled into plots before planting, formulated according to results of soil tests. Additional nitrogen (final N 28 lb/A) was applied to the growing crop with irrigation 45 DAP (days after planting). Previcur Flex was applied at 0.7 pt/A on a seven day interval, total of four applications, starting 1 day after inoculation of adjacent plots with *Phytophthora infestans*. A permanent irrigation system was established prior to the commencement of fungicide sprays and the fields were maintained at soil moisture capacity throughout the season by frequent (minimum 5 day) irrigations. Weeds were controlled by hilling and with Dual 8E at 2 pt/A 10 DAP, Basagran at 2 pt/A 20 and 40 DAP and Poast at 1.5 pt/A 58 DAP. Insects were controlled with Admire 2F at 1.25 pt/A at planting, Sevin 80S at 1.25 lb/A 31 and 55 DAP, Thiodan 3 EC at 2.33 pt/A 65 and 87 DAP and Pounce 3.2EC at 8 oz/A 48 DAP. Vines were killed with Reglone 2EC (1 pt/A on 20 Sep). Plots (20-ft row) were harvested on 29 Oct and individual treatments were weighed and graded. Four plants per plot were harvested 10-days after the final treatment application (13 Jul) and the percentage of stems and stolons with greater than 5% of the total surface area were counted. Samples of 50 tubers per plot were harvested 14 days after desiccation and assessed for black scurf (*R. solani*) incidence (%) and severity 40 days after harvest. Severity of black scurf was measured as an index calculated by counting the number of tubers (n = 50) falling in class 0 = 0%; 1 = 1 - 5%; 2 = 6 - 10%; 3 = 11 - 15; 4 >15% surface area of tuber covered with sclerotia. The number in each class is multiplied by the class number and summed. The sum is multiplied by a constant to express as a percentage. Indices of 0 - 25 represent 0 - 5%; 26 - 50 represent 6 - 10%; 51 - 75 represent 11 - 15% and 75 - 100 >15% surface area covered with sclerotia. Maximum, minimum and average daily air temperature (^{o}F) were 91.3, 36.1 and 66.6 and 2-d with maximum temperature >90^{o}F (Jun); 95.2, 37.7 and 67.0 and 4-d with maximum temperature >90^{o}F (Jul); 93.4, 36.3 and 68.7 and 4-d with maximum temperature >90^{o}F (Aug); 90.0, 34.1 and 63.4 and 1-d with maximum temperature >90^{o}F (Sep). Maximum, minimum and average daily soil temperature (^{o}F) were 75.1, 53.1 and 65.8 (May); 82.1, 53.2 and 68.2 (Jun); 83.1, 53.7 and 65.3 (Jul); 80.5, 54.5 and 67.1 (Aug); 77.1, 51.3 and 66.4 (Sep). Maximum. minimum and average soil moisture (% of field capacity) 79.0, 75.2 and 77.3 (May); 91.7, 77.2 and 81.3 (Jun); 82.1, 74.1 and 77.9 (Jul); 98.1, 75.4 and 80.7 (Aug); 76.2, 66.6 and 69.8 (Sep). Precipitation was 0.99 in. (May), 3.91 in. (Jun), 0.80 in. (Jul), 6.18 in. (Aug) and 1.09 in. (Sep). Plots were irrigated to supplement precipitation to about 0.1 in./A/4 day period with overhead sprinkle irrigation.

No treatment affected final plant stand or RAUEPC and were not significantly different from the untreated control. Marketable yield ranged from 189 to 287 cwt/A (not-treated check = 195 cwt/A) and treatments with greater than 247 cwt/A were significantly different from the untreated check and Maxim FS (ST). Total yield ranged from 229 to 325 cwt/A (untreated check = 239 cwt/A) and treatment with greater than 289 cwt/A had significantly greater total yield than the untreated check and Maxim FS (ST). No treatment affected the total number of stolons or stem number per plant. Treatments with less than 8.7% incidence of stolon canker and less than 5.5% incidence of stems with greater than 5% girdling due to stem canker were significantly different from the untreated control. No treatment affected the incidence or severity of black scurf on tubers evaluated 40 days after harvest. Seed treatments and seed treatment plus fungicide applications of fungicides were not phytotoxic.

Funding: MPIC and Aghem Industry

Table 1

Treatment and rate/1000 row feet and rate/cwt potato seed[z]	Final plant stand (%)	RAUEPC	Yield (cwt/A) US1		Yield (cwt/A) Total	
LEM 17 200EC 0.67 fl oz (B)….	96.3	31.3	235	b-e	268	b-e
LEM 17 200EC 1.63 fl oz (B)….	87.5	35.9	275	abc	314	ab
LEM 17 200EC 3.26 fl oz (B)….	86.3	35.5	249	a-d	289	abc
LEM 200SC 0.67 fl oz (B)……..	82.5	29.8	279	ab	318	a
LEM 200SC 1.63 fl oz (B)……..	85.6	37.6	272	a-d	317	a
LEM 200SC 3.26 fl oz (B)……..	88.8	30.9	228	def	265	cde
Quadris 2.08SC 0.4 fl oz (B)……	87.5	32.8	287	a	325	a
Evito 4FL 0.26 fl oz (B)………...	87.5	31.1	230	c-f	267	cde
Evito 4FL 0.26 fl oz (C)………...	85.0	31.2	228	def	268	b-e
Maxim 4FS 0.16 fl oz/cwt (A)….	72.5	24.5	189	f	229	e
Weco 0406 4FS 0.5 fl oz/cwt (A).	84.4	32.4	247	a-d	282	a-d
Weco 143 4FS 0.5 fl oz/cwt (A)...	88.1	35.1	277	ab	317	a
Untreated Check………………...	85.6	35.3	195	ef	239	de
$HSD_{0.05}$	12.81	8.03	45.5		46.2	

Treatment and rate/1000 row feet and rate/cwt potato seed	Stolons (55 DAP) Number	Stolons (55 DAP) Percent infected		Stems (55 DAP) Number/ plant	Stems (55 DAP) Girdling > 5%		Tuber black scurf Incidence (%)	Tuber black scurf Severity scale (0 - 100)
LEM 17 200EC 0.67 fl oz (B)….	23.5	22.7	bcd	3.5	17.4	bcd	96.3	37.5
LEM 17 200EC 1.63 fl oz (B)….	21.2	15.1	c-f	3.6	13.2	cde	88.8	39.7
LEM 17 200EC 3.26 fl oz (B)….	25.3	10.0	def	3.3	8.9	de	90.0	38.8
LEM 200SC 0.67 fl oz (B)……..	23.0	14.0	c-f	3.3	12.9	cde	91.3	37.8
LEM 200SC 1.63 fl oz (B)……..	21.0	16.7	c-f	3	14.2	cde	100.0	42.5
LEM 200SC 3.26 fl oz (B)……..	24.4	8.7	ef	4	5.5	de	92.5	35.6
Quadris 2.08SC 0.4 fl oz (B)……	23.4	21.2	b-e	3.4	18.4	b-e	100.0	44.7
Evito 4FL 0.26 fl oz (B)………...	20.4	32.9	ab	3.2	16.6	ab	83.8	35.9
Evito 4FL 0.26 fl oz (C)………...	20.8	43.3	a	3.1	33.4	a	100.0	49.7
Maxim 4FS 0.16 fl oz/cwt (A)….	23.7	6.7	f	3.6	3.7	e	81.3	33.1
Weco 0406 4FS 0.5 fl oz/cwt (A).	25.6	11.7	c-f	3.9	6.4	cde	100.0	42.8
Weco 143 4FS 0.5 fl oz/cwt (A)...	21.8	17.5	b-f	3.4	7.1	cde	95.0	41.9
Untreated Check………………...	22.4	26.0	abc	3.3	22.0	bc	97.5	50.6
$HSD_{0.05}$	4.30	14.82		1.10	2.93		32.69	25.47

[z] Stems with greater than 5% of area with stem canker due to *Rhizoctonia solani*.
[y] Stolons with greater than 5% of area with stolon canker due to *Rhizoctonia solani*.
[x] Application dates: A= 13 Jun (liquid formulations for seed piece application at 0.2 pt/cwt; B= 13 Jun (in-furrow); C= 29 Jun (banded over row).
[w] Values followed by the same letter are not significantly different at p = 0.05 (Tukey Multiple Comparison).

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In-furrow at planting and foliar treatments for control of common scab in potato, 2007

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Potato seed, 'Goldrush' was prepared for planting by cutting seven days prior to planting. Seed were planted at the Michigan State University Muck Soils Farm, East Lansing, MI, mineral soil block, on 13 Jun into four-row by 12-ft plots with 10-in between plants at 34-in row spacing replicated eight times in a randomized complete block design. The four-row beds were separated by a five-foot unplanted row. Fertilizer was drilled into plots before planting, formulated according to results of soil tests. Additional nitrogen (final N 28 lb/A) was applied to the growing crop with irrigation 45 DAP (days after planting). Potatoes had been grown at this site for 3 of 5 previous years at this site, which had a history of moderate common scab. Additional inoculum was added to the site by spraying a water solution (20 gal/A) containing 2 x 10^3 spores/fl oz of *Streptomyces scabies* over the whole field at plant emergence. In-furrow applications were made at planting, applied with a single nozzle R&D spray boom delivering 8 gal/A (80 p.s.i.) and using one XR11003VS nozzle per row. Bravo WS 6SC was applied at 1.5 pt/A on a 7-day interval, total of 8 applications, starting after the canopy was about 50% closed. Minimal supplemental irrigation was applied to the trial, and soil moisture was maintained at about 60-70% field capacity. Weeds were controlled by hilling and with Dual 8E at 2 pt/A 10 DAP, Basagran at 2 pt/A 20 and 40 DAP and Poast at 1.5 pt/A 58 DAP. Insects were controlled with Admire 2F at 1.25 pt/A at planting, Sevin 80S at 1.25 lb/A 31 and 55 DAP, Thiodan 3 EC at 2.33 pt/A 65 and 87 DAP and Pounce 3.2EC at 8 oz/A 48 DAP. Vines were killed with Reglone 2EC (1 pt/A on 3 Oct). Plots (24-ft row, center 2-rows) were harvested on 17 Oct and individual treatments were weighed and graded. Samples of 100 tubers per plot were stored at 50^{o}F and evaluated 14 days after desiccation (126 DAP). Tubers were washed and assessed for common scab (*S. scabies*) incidence (%) and severity. Severity of common scab was measured as an index calculated by counting the number of tubers (n = 100) falling in class 0 = 0%; 1 = 1 - 5%; 2 = 6 -10%; 3 = 11 - 15; 4 >16% surface area of tuber covered with tuber lesions (surface and pitted). The number in each class was multiplied by the class number and summed. The sum was multiplied by a constant to express as a percentage. Indices of 0 - 25 represent 0 - 5%; 26 - 50 represent 6 - 10%; 51 - 75 represent 11 - 15% and 75 - 100 >15% surface area covered with lesions.

Very little common scab developed on tubers in this trial in part due to the relative resistance of cv. Goldrush to *S. scabies*. There were no differences among treatments in terms of incidence or severity of common scab. Messenger applied two weeks after canopy closure (C) and 14 days later (D) significantly increased marketable (US-1) yield in comparison with the non-treated control, Blocker applied in-furrow at planting and the triple-applications of Messenger. There appears to be a complex response in cv. Goldrush to timing of applications of Messenger. No phytotoxicity was observed in this trial.

Table 1. Efficacy of in-furrow at-planting fungicide application of Blocker and of Messenger applied to foliage on incidence and severity of common scab and yield in cv. Goldrush.

	Common scab		Yield (cwt/A)	
Treatment rate/A or rate/1000 ft row	Percentage in Class 0[z]	Scab severity index[y]	US-1 grade	b-grade
Untreated	62.5	11.5	241 b[x]	56
Blocker 38.3F 2.6 pt/1000 ft row (A[w])	70.4	9	244 b	53
Blocker 38.3F 2.6 pt/1000 ft row (A) Messenger 3WDG 3 oz (B,C,D)	72.9	7.9	291 ab	65
Messenger 3WDG 3 oz (B,C,D)	64.6	11.9	237 b	56
Messenger 3WDG 3 oz (C,D)	67.9	10.3	327 a	68
LSDp=0.05[v]	10.32	3.71	68.0	20.9

[z] Scab-free tubers.

[y] Severity of common scab was measured as an index calculated by counting the number of tubers (n = 200) falling in class 0 = 0%; 1 = 1 - 5%; 2 = 6 -10%; 3 = 11 - 15; 4 >16% surface area of tuber covered with tuber lesions (surface and pitted).

[x] Values followed by the same letter are not significantly different at P = 0.05 (Fishers protected LSD).

[w] Application dates: A= 13 Jun; B= 11 Jul; C= 25 Jul; D= 8 Aug.

[v] $LSD_{p=0.05}$ included if no significant difference among mean values.

Funding: MPIC and MSU

Host Plant Resistance and Reduced Rates and Frequencies of Fungicide Application to Control Potato Late Blight (2007).

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Late blight of potato caused by *Phytophthora infestans* (Mont de Bary), is a major threat to the production of high quality potatoes. Unchecked, *P. infestans* can rapidly defoliate plants in the field and can infect potato tubers when spores are washed into the soil. Potato late blight control strategies changed following the migration of mefenoxam/metalaxyl-resistant populations of *P. infestans* from Mexico to North America and necessitate cultural control methods and crop protection strategies that rely primarily on protectant foliar fungicide applications. There are several potential methods for reducing fungicide inputs in potato crop management. These include the use of fungicides with less active ingredient, reduced application rates, longer application intervals and a combination of any of these strategies. There are currently few late blight resistant potato cultivars that meet commercial standards in the United States. Typical fungicide application programs use a 5-7 day spray interval depending on environmental conditions and grower preference. The frequent fungicide spray intervals and rates currently used by growers to control late blight are expensive and more economical control measures are needed.

Therefore, the objective of this research was to determine if acceptable control of foliar late blight can be achieved by using increased fungicide spray intervals and reduced application rates of residual contact fungicides on potato germplasm with a range of susceptibility to late blight developed at the potato breeding program at Michigan State University.

MATERIALS AND METHODS

Potato Germplasm, *agronomy and experimental design*

Previous experiments from the MSU breeding program identified potato cultivars and advanced breeding lines (ABL) with different responses to foliar late blight.

All experiments were conducted at the Michigan State University Muck Soils Research Station, Bath, MI (90% organic muck soil). Soils were plowed to 9” cm depth during Oct following harvest of preceding crops. Soils were prepared for planting with a mechanical cultivator in early May and fertilizer applied during final bed preparation on the day of planting. Cultivars/ABL were planted on 4 Jun, 2005 in two-row by 50 ft plots (34” row spacing). The experimental design for the fungicide application interval and reduced dose rate trials was a randomized complete block design with four replications. Fertilizers were applied in accordance with results from soil testing carried out in the spring of each year and about 200 cwt N/A (total N) was applied in two equal doses at planting and hilling. Additional micronutrients were applied according to petiole sampling recommendations and in all years. Approximately 0.2, 0.3 and 0.2 cwt/A boron, manganese and magnesium, respectively were applied as chelated formulations. Cut and whole seed pieces (2.5 -5.0 oz) of selected cultivars and ABL were used in all experiments.

When relative humidity (RH) dipped below 80% (measured with RH sensors mounted within the canopy, described below), a mist irrigation system (described below) was turned on to maintain RH at >95% within the plant canopy. Plots were irrigated as necessary to maintain canopy and soil moisture conditions conducive for development of foliar late blight with turbine rotary garden sprinklers (Gilmour Group, Somerset, PA, U.S.A.) at 112 gal H_2O A/hr and managed under standard potato agronomic practices. Weeds were controlled by hilling and with Dual 8E (2 pt/A on 28 Jun), Basagran (2 pt/A on 28 Jun and 25 Jul) and Poast (1.5 pt/A on 25 Jul). Insects were controlled with Admire 2F (20 fl oz/A at planting on 28 Jun), Sevin 80S (1.25 lb/A on 11 and 25 Jul), Thiodan 3EC (2.33 pt/A on 1 and 21 Aug) and Pounce 3.2EC (8 oz/A on 25 Jul).

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Residual Contact Fungicides

Bravos WS 6SC (Syngenta) was used for this experiment. Fungicides were applied with an ATV rear-mounted spray boom (R&D Sprayers, Opelousas, LA) 20 gal H_2O/A (80 psi pressure) with three XR11003VS nozzles per row positioned 12" apart and 18" above the canopy. In the fungicide application interval and reduced dose rates trial, Bravo WS was applied at 7 and 14 day intervals at 0, 50 and 100% MRAR to the ABL and cultivars described in Table 1. The first fungicide application occurred at 32 days after planting (DAP; 5 Jul, 2005) when potato plants were approximately 6" tall. Fungicides were applied until non-treated plots of susceptible controls reached about 100% diseased foliar area (4 Sep). The 7, and 14-day interval treatments received eight and four applications in 2007, respectively.

Pathogen Preparation and Inoculation.

Zoospore suspensions were made from *P. infestans* cultures of several isolates from different genetic backgrounds, including (US8 and US14 genotypes, insensitive to mefenoxam/metalaxyl, A2 mating types) grown on rye agar plates for 14 days in the dark at 15^{o}C. Sporangia were harvested from the rye agar plates by rinsing the mycelial/sporangial mat in cold (4^{o}C) sterile, distilled water and scraping the mycelial/sporangial mat from the agar surface with a rubber policeman. The mycelial/sporangial suspension was stirred with a magnetic stirrer for 1 hour. The suspension was strained through four layers of cheesecloth and the concentration of sporangia was adjusted to about 1 x 10^2 sporangia/fl oz using a hemacytometer. Sporangial cultures were incubated for 2-3 hours at 40^{o}F to stimulate zoospore release. All plots were inoculated simultaneously through an overhead sprinkler irrigation system, on 27 Jul, 2005; by injecting the zoospore suspension of *P. infestans* into the irrigation water feed pipeline at 20 psi CO_2 pressure and applied at a rate of about at 10^4 spores/fl oz over the whole trial area. The amount and rate of inoculum applied was estimated from prior calibration of the irrigation system (described above) and was intended to expose all potato foliage to inoculum of *P. infestans*.

Disease Evaluation and Data Analysis

As soon as late blight symptoms were detected (about 10 days after inoculation, DAI), each plant within each plot was visually rated at 3 to 5 day intervals for percent leaf and stem (foliar) area with late blight lesions on 30 Jul; 11, 17, 24 Aug and 2 and 13 Sep [13 days after final application (DAFA), 41 DAI in 2007] when there was about 100% foliar infection in the untreated plots. The mean percent blighted foliar area per treatment was calculated. In the present study, any cultivar/ABL with foliar late blight severity measured as the Relative Area Under the Disease Progress Curve [RAUDPC]. Fungicide treatments were classified into three groups; non-effective if the RAUDPC was not significantly different from the non-treated control value for the susceptible variety (NE); partially effective if significantly less than the non-treated control for the susceptible variety and significantly greater than the 100% MRAR, 7-day frequency application for the resistant variety (PE); and effective if the RAUDPC was not significantly different from 100% MRAR, 5-day frequency application for the resistant variety (E).

Microclimate Measurement

Climatic variables were measured with a Campbell Weather Station equipped with air temperature and humidity sensors located within the potato canopy on site. Microclimate within the potato canopy was monitored beginning when 50% of the potato plants had emerged and ending when canopies of healthy plants reached 100% senescence. The Wallin Late Blight Prediction Model was developed in the Eastern United States under conditions similar to those in Michigan and was adapted to local conditions. Late blight disease severity values (DSV) were estimated from the Wallin Late Blight Prediction Model and accumulated from inoculation to final evaluation to estimate

Funding: MPIC and MSU
the conduciveness of the environment for late blight development.

RESULTS

Microclimate conditions

Late blight developed slowly during August due to high temperatures; non-treated susceptible controls reached about 100% diseased foliar area 42 DAI. Meteorological variables were measured with a Campbell weather station located at the farm, latitude 42.8269 and longitude -84.365deg. Maximum, minimum and average daily air temperature (^{o}F) were 88.0, 39.6 and 64.9 and 0-d with maximum temperature >90^{o}F (May); 91.3, 36.1 and 66.6 and 2-d with maximum temperature >90^{o}F (Jun); 95.2, 37.7 and 67.0 and 4-d with maximum temperature >90^{o}F (Jul); 93.4, 36.3 and 68.7 and 4-d with maximum temperature >90^{o}F (Aug); 90.0, 34.1 and 63.4 and 1-d with maximum temperature >90^{o}F (Sep). Maximum, minimum and average daily soil temperature (^{o}F) were 75.1, 53.1 and 65.8 (May); 82.1, 53.2 and 68.2 (Jun); 83.1, 53.7 and 65.3 (Jul); 80.5, 54.5 and 67.1 (Aug); 77.1, 51.3 and 66.4 (Sep). Maximum, minimum and average soil moisture (% of field capacity) were 79.0, 75.2 and 77.3 (May); 91.7, 77.2 and 81.3 (Jun); 82.1, 74.1 and 77.9 (Jul); 98.1, 75.4 and 80.7 (Aug); 76.2, 66.6 and 69.8 (Sep). Precipitation was 0.99 in. (May), 3.91 in. (Jun), 0.80 in. (Jul), 6.18 in. (Aug) and 1.09 in. (Sep). The total number of late blight disease severity values (DSV) over the disease development period was 62 using 90% ambient %RH as a base for DSV accumulation. This indicated that environmental conditions were conducive to late blight development (DSV > 18).

Foliar late blight developed steadily from inoculation to 35 days after inoculation when the most susceptible variety (Snowden) was completely defoliated in one replicate. The late blight responses of the different cvs/ABLs are shown in Table 1. The RAUDPC of the susceptible cultivars ranged from 13.6 to 19.9 mean RAUDPC and included MSE69.06, MSE69.03, MSI211-3 and Snowden (19.9). The transgenic variety RB Spunta was intermediate between susceptible and resistant groups with an RAUDPC of 5.3 in the untreated control. No late blight developed on any other MSJ461-1 and Stirling and they were classified as resistant (Table 1).

Application of Bravo WS at full rate of application at 7 or 14-day intervals resulted in effective control of late blight in all varieties except MSI211-3 (Table 1). Application of Bravo WS at 50% rate of application at 7 or 14-day intervals resulted in effective control of late blight in MSE69.03, Snowden, and MSE69.06. In MSI211-3, application of Bravo WS resulted in non-effective control of potato late blight. In RB Spunta, the application of fungicides at any rate or frequency numerically reduced the RAUDPC but not significantly in comparing to the non-treated control. The RAUDPC and the final late blight severity scores for the non-treated RB Spunta plots were not significantly different from those of the MSJ461-1 or Stirling responses (which were = 0 for all rates and application frequencies).

DISCUSSION

The results of this study were consistent with previous studies and indicate that a combination of cultivar/ABL resistance and managed application of protective fungicides will reduce foliar late blight to acceptable levels in most situations. When conditions were less conducive to late blight development (as in 2007), reduced amounts of Bravo WS were either fully or partially effective at most application rates tested on all cultivars/ABL compared to the non-treated controls. However, in some cultivars/ABL, 50% of the MRAR of fungicide was sufficient to achieve acceptable control, whereas other cultivars/ABL required 100% MRAR to control late blight. On late blight susceptible cultivars, applications of Bravo WS at either 7 or 14-day intervals were at least partially effective for controlling late blight at the doses tested. However, in the resistant cultivars the fungicides did not reduce the RAUDPC in comparison with untreated plots of these cultivars and fungicides are not required for late blight control in these entries.

The opportunity to manage late blight by applying reduced rates of fungicides at increased

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spray intervals to cultivars less susceptible to late blight was demonstrated in this study. In addition, the efficacy of reduced rates and increased application intervals of fungicides against other potato pathogens such as early blight has not been established and may prove to be a major constraint in the adoption of managed fungicide applications. As new cultivars with enhanced late blight resistance are developed and released it will be important to provide growers with recommendations for the most effective and economical chemical control of late blight in these new cultivars. In the future, the type of information gathered in this study will be used to develop models, based on cultivar resistance and response to fungicide application, to advise and guide growers as to which fungicide, rate and frequency of application is required to provide protection against late blight. Climatic conditions within the canopy will also impact choice of fungicide and rate and frequency of application. Therefore, new cultivars will need to be carefully screened in the manner described in this study, over several seasons in order to develop accurate models for fungicide application.

ACKNOWLEDGMENTS
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Funding: MPIC and MSU

Table 1.

Cultivar/ ABL	Fungicide rate (pt/a)	Application frequency (days)	Foliar late blight (%) 15 DAI		22 DAI		29 DAI		35 DAI		RAUDPC (Max = 100) 0 – 35 DAI	
E69.03	0.75	7	0	b	0.5	d	2.3	de	7.5	f	1.2	e
		14	0	b	1	cd	5.8	cde	27.5	c-f	3.7	de
	1.5	7	0	b	0	d	0.5	de	2.5	f	0.3	e
		14	0	b	0	d	0.5	e	2.3	f	0.3	e
	0	0	1	b	5.8	bcd	32.5	ab	71.3	ab	13.6	abc
Stirling	0.75	7	0	b	0	d	0	e	0	f	0	e
		14	0	b	0	d	0	e	0	f	0	e
	1.5	7	0	b	0	d	0	e	0	f	0	e
		14	0	b	0	d	0	e	0	f	0	e
	0	0	0	b	0	d	0	e	0	f	0	e
MSI211-3	0.75	7	0.3	b	11	a-d	27.5	abc	58.8	abc	12.1	a-d
		14	4.3	a	20	a	43.8	a	88.8	a	20.5	a
	1.5	7	0	b	1.8	bcd	6.5	cde	18.8	ef	3.2	e
		14	0.5	b	4	bcd	15.5	b-e	51.3	bcd	8.3	b-e
	0	0	1.3	ab	13.3	abc	23.8	a-d	83.8	a	14.5	ab
MSJ461-1	0.75	7	0	b	0	d	0	e	0	f	0	e
		14	0	b	0	d	0	e	0	f	0	e
	1.5	7	0	b	0	d	0	e	0	f	0	e
		14	0	b	0	d	0	e	0	f	0	e
	0	0	0	b	0	d	0	e	0	f	0	e
Snowden	0.75	7	0	b	1.5	bcd	6.8	cde	20	def	3.3	de
		14	0.3	b	2.5	bcd	15.8	b-e	48.8	b-e	7.8	b-e
	1.5	7	0	b	1.3	cd	0.5	de	1.3	f	0.4	e
		14	0	b	1.8	bcd	7.5	cde	28.8	c-f	4.3	de
	0	0	4.3	a	20	a	45	a	80	ab	19.9	a
E69.06	0.75	7	0	b	0.8	d	6.6	cde	16.8	f	2.8	e
		14	0	b	0	d	1.5	de	13.8	f	1.5	e
	1.5	7	0	b	0.3	d	0.3	e	0.8	f	0.2	e
		14	0	b	0.5	d	2	de	8.8	f	1.2	e
	0	0	2.3	ab	13.8	ab	32.5	ab	76.3	ab	15.7	ab
RB Spunta	0.75	7	0.3	b	2	bcd	7	cde	20	def	3.5	de
		14	0	b	1.8	bcd	7.5	cde	21.3	def	3.6	de
	1.5	7	0	b	0.5	d	2.1	de	6.5	f	1	e
		14	0.3	b	1	cd	3.3	de	10.8	f	1.8	e
	0	0	0.5	b	3.5	bcd	11.3	b-e	27.5	c-f	5.3	cde
			3.15		12.44		23.29		31.49		8.95	

[1] Varieties and advanced breeding lines from the Quad State potato breeding programs.
[2] Relative area under the disease progress curve from inoculation to 100% late blight (max = 100).
[3] Susceptibility of non-treated control to late blight; R = Resistant, not significantly different from Torridon (non-treated); S = Susceptible, not significantly different from Snowden (non-treated); I = Intermediate, significantly different from both Torridon and Snowden (non-treated).
[4] Means followed by the same letter were not significantly different at p = 0.05.

Funding: MPIC and Industry

Evaluation of fungicide programs for potato early blight and brown leaf spot control, 2007.

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Potatoes (Russet Norkotah, cut seed, treated with Maxim FS at 0.16 fl oz/cwt) were planted at the Michigan State University Muck Soils Experimental Station, Bath, MI on 25 May into two-row by 25-ft plots (34-in row spacing), separated by a five-foot unplanted row and replicated four times in a randomized complete block design. Plots were irrigated as needed with sprinklers and were hilled immediately before sprays began. All fungicides in this trial were applied on a 7-day interval from 5 Jul to 29 Aug (9 applications) with an ATV rear-mounted R&D spray boom calibrated to deliver 25 gal/A (80 p.s.i.) using three XR11003VS nozzles per row. Weeds were controlled by hilling and with Dual 8E (2 pt/A on 25 May), Basagran (2 pt/A on 28 Jun and 11 Jul) and Poast (1.5 pt/A on 11 Jul). Insects were controlled with Admire 2F (20 fl oz/A at planting and on 28 Jun), Sevin 80S (1.25 lb/A on 11 and 25 Jul), Thiodan 3EC (2.33 pt/A on 1 and 21 Aug) and Pounce 3.2EC (8 oz/A on 11 Jul). Plots were rated visually for percentage foliar area affected by early blight and brown leaf spot on 15, 22, 29 Aug and 5 Sep [7 days after final application (DAFA)]. The relative area under the disease progress curve was calculated for each treatment from 5 Aug to 5 Sep, a period of 31 days. Vines were killed with Reglone 2EC (1 pt/A on 6 Sep). Plots (2 x 25-ft row) were harvested on 17 Sep and individual treatments were weighed and graded. Meteorological variables were measured with a Campbell weather station located at the farm, latitude 42.8269 and longitude -84.365deg. Maximum, minimum and average daily air temperature (^{o}F) were 88.0, 39.6 and 64.9 and 0-d with maximum temperature >90^{o}F (May); 91.3, 36.1 and 66.6 and 2-d with maximum temperature >90^{o}F (Jun); 95.2, 37.7 and 67.0 and 4-d with maximum temperature >90^{o}F (Jul); 93.4, 36.3 and 68.7 and 4-d with maximum temperature >90^{o}F (Aug); 90.0, 34.1 and 63.4 and 1-d with maximum temperature >90^{o}F (Sep). Maximum, minimum and average daily soil temperature (^{o}F) were 75.1, 53.1 and 65.8 (May); 82.1, 53.2 and 68.2 (Jun); 83.1, 53.7 and 65.3 (Jul); 80.5, 54.5 and 67.1 (Aug); 77.1, 51.3 and 66.4 (Sep). Maximum, minimum and average soil moisture (% of field capacity) were 79.0, 75.2 and 77.3 (May); 91.7, 77.2 and 81.3 (Jun); 82.1, 74.1 and 77.9 (Jul); 98.1, 75.4 and 80.7 (Aug); 76.2, 66.6 and 69.8 (Sep). Precipitation was 0.99 in. (May), 3.91 in. (Jun), 0.80 in. (Jul), 6.18 in. (Aug) and 1.09 in. (Sep). The total number of late blight disease severity values (DSV) over the disease development period was 62 using 90% ambient %RH as a base for DSV accumulation. Plots were irrigated to supplement precipitation to about 0.1 in./A/4 day period with overhead sprinkle irrigation.

Early blight and brown leaf spot (Alternaria complex) developed steadily in about equal proportions and untreated controls reached about 65% foliar infection by 5 Sep. Up to 5 Aug, fungicide programs with 0% Alternaria complex were significantly different from the untreated control. Alternaria developed to 8% by 22 Aug in the untreated control and programs with less than 1.5% Alternaria complex were significantly different to the untreated control but not from any other treatment. Alternaria developed to 20.0% in the untreated control by 29 Aug. Programs with 2.0 to 12.5%, 2.5 to 13.3% and 11.3 to 20.0% Alternaria complex were not significantly different. Alternaria developed to 63.8% in the untreated control by 5 Sep. All treatments had significantly less Alternaria complex in comparison to the untreated control. Programs with 7.3 to 27.5% and 11.3 to 32.5% Alternaria complex were not significantly different. All fungicide programs significantly reduced the average amount of Alternaria complex over the season (RAUDPC, 0 to 31 days after the first evaluation) compared to the untreated control. Application programs with RAUDPC values from 1.2 to 5.7 and 1.4 to 6.7 were not significantly different. There were no significant differences in marketable or total yield among treatments. Alternaria tuber blight was not observed after harvest. Phytotoxicity was not noted in any of the treatments. The Penncozeb plus Super Tin program was not within label guidelines and was included to determine if the addition of Penncozeb could ameliorate potential phytotoxic effects associated with Super Tin 80WDG.

Treatment and rate/A	Foliar early blight and brown leaf spot (%) 5 Aug	22 Aug	29 Aug	5 Sep 7 DAFA[z]	RAUDPC Max = 100[y] 0 - 40 DAI	Yield (cwt/A) US1	Total
Sonata 500SC 4.0 pt + Dithane RS 75DF 1.5 lb + Biotune 1EC 4.5 fl oz (A,C,E[x]); Headline 2.08EC 6 fl oz (B,D,F)………………………..	0.0b[w]	0.8ab	4.3b	12.5bcd	2.2b	240abc	361a
Headline 2.08EC 9.0 fl oz (A,E,H); Bravo ZN 6SC 1.5 pt (B,D,F,I); Endura 70WDG 2.5 oz (C,G)…………………………..…	0.0b	0.3b	2.8b	8.8cd	1.4b	268a	384a
Penncozeb 75DF 2.0 lb (A,B,C,D,E); Penncozeb 75DF 2.0 lb + Super Tin 80WP 5 oz (F,G,H,I)…………………………	0.5ab	4.8ab	12.5ab	31.3bc	6.5ab	254abc	384a
BravoWS 6SC 1.5 pt (A,C,E,F,G,H,I) Evito 4FL 3.8 fl oz + 0.125% NIS (B,D)……..……...…	0.3ab	1.8ab	5.8b	20.0bcd	3.5b	223abc	333a
BravoWS 6SC 1.5 pt (A,C,E,F,G,H,I) Evito 4FL 1.9 fl oz + 0.125% NIS (B,D)……..………...	0.0b	2.0ab	5.8b	22.5bcd	3.7b	247abc	375a
Polyoxin D 2.5 WP 2.0 lb (A-I)…………….….………	0.5ab	4.0ab	13.3ab	32.5b	6.7ab	236abc	367a
LEM 17 200EC 9.6 fl oz (A-I)………………………….	0.5ab	3.8ab	11.3ab	27.5bcd	5.7b	209abc	334a
LEM 17 200EC 16.8 fl oz (A-I)…………….………..	0.3ab	0.5b	5.0b	12.5bcd	2.4c	230abc	344a
LEM 17 200EC 24.0 fl oz (A-I)……………………..….	0.3ab	2.8ab	6.8b	20.0bcd	3.9b	238abc	358a
LEM 17 200SC 16.8 fl oz (A-I)………...……….…..…	0.3ab	0.5b	2.5b	11.3bcd	1.8b	210abc	349a
LEM 17 200SC 24.0 fl oz (A-I)……….…………......…	0.0b	0.5b	2.0	7.3d	1.2b	212abc	329a
Tanos 50 WDG 6.0 oz + Manzate 75DF 1.5 lb (A,C,E); Manzate 75DF 1.5 lb (G); Endura 2.5 oz (B,D,F,H)……	0.0b	0.5b	3.3b	8.8cd	1.6b	258ab	364a
Untreated...	1.5a	8.0a	20.0a	63.8a	12.1a	192c	327a
$HSD_{0.05}$	1.34	7.33	11.21	23.27	5.81	53.7	74.8

[z] Days after final application of fungicide.
[y] RAUDPC, relative area under the disease progress curve calculated from day of inoculation to last evaluation of late blight.
[x] Application dates: A= 5 Jul; B= 12 Jul; B= 19 Aug; D= 25 Aug; E= 1 Aug; F= 8 Aug; G= 15 Aug; H= 22 Aug; I = 29 Aug.
[w] Values followed by the same letter are not significantly different at $p = 0.05$ (Tukey Multiple Comparison).

Funding: MPIC and MSU GREEEN

Effect of different genotypes of *Phytophthora infestans* and temperature on tuber disease development.

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Potato late blight (*Phytophthora infestans* Mont. de Bary) is a significant global constraint to potato production and due to conducive climatic conditions and growing practices the mid western states of the US are particularly vulnerable. The emergence and spread of new genotypes of *P. infestans* in North America have resulted in significant economic loss to the potato industry. The mid-west states produce about 10 million tons of potato from 150,000 planted hectares, which represents about 40% of total US production. Potato late blight affects the health of foliage and tubers limiting profitable potato production. Significant financial costs in terms of crop protection (up to $700/ha) and crop losses (up to $5,000/ha) are incurred when intervention measures to control potato late blight are unsuccessful.

The newer genotypes have rapidly displaced the US-1 clonal lineage which previously had global occurrence (1, 2). In Michigan for example, the occurrence of diverse *P. infestans* genotypes (US-8, US-10, US-11 and US-14) has been documented in recent years (3). Rapid changes in the genetic diversity of the population of *P. infestans* are not predictable, but the sudden appearance and resultant predominance of the US-8 genotype, must pre-empt efforts in potato pathology and breeding to prepare for further genetic disturbance. Knowledge of competitive interactions among pathogen genotypes, fitness components and the role of resistant cultivars will enable us to develop a better understanding of the factors which govern strain selection and stability. The factors which affect frequency of occurrence of *P. infestans* genotypes and strain composition have not been adequately addressed. However, fungicide resistance clearly played an important role in genotype selection when phenylamide-resistant genotypes appeared globally in the 1990's (2). Other fitness components such as temperature tolerance have not been well evaluated but their importance has recently gained credibility (5). In previous field and growth chamber studies, late blight experiments were often inoculated with single or sequential pathogen genotypes, or epidemic development was monitored under field conditions prior to determination of fungal genotype composition. Therefore, this did not address the various host – pathogen genotype interactions. Furthermore, previous studies have not taken into account the susceptibility of potato tubers to different *P. infestans* genotypes. This is important as late blight is readily transmitted by seed-borne inoculum (6) and consequently, immature stems and leaves may be exposed to late blight from infected seed pieces. Recent work has indicated that the new immigrant clones, especially US-8, are more aggressive in tubers and sprouts. Research at MSU has shown that most of the commonly grown potato cultivars with foliar resistance to late blight are susceptible to tuber late blight. However, several advanced breeding lines (ABL) in the MSU potato breeding program have recently been identified with tuber late blight resistance. In 2005, we evaluated 104 ABL in replicated trials and 801 early generation lines in single observation plots which resulted in 41 and 98 lines, respectively being classified as having little to no late blight infection. The value of this advanced germplasm pool is that the resistance sources are diverse suggesting that we can now combine resistance sources.

Funding: MPIC and MSU GREEEN

The US-8 genotype of *P. infestans* displaced the US-1 genotype within five years of its appearance in North America, and it is vital that the industry is prepared for the supplanting of the US-8 genotype by other equally aggressive and stable genotypes of the pathogen. The proposed project, using field and controlled environment studies on potato foliage and tubers, will document whether the competitive ability of diverse *P. infestans* genotypes, potato cultivars/ABL with variable levels of host resistance, or environmental factors are important criteria for *P. infestans* genotype composition, maintenance and stability. The overall objective of this project is to develop an understanding of the factors (e.g., pathogen temperature tolerance, fitness, and host resistance) which govern pathogen genotype selection and stability.

Specific objectives are to:

1. Evaluate the fitness of a variety of *P. infestans* genotypes on tubers of ABL (identified in objective 1) at different commonly used storage temperatures (3, 7 and 10°C).

The portion of the project devoted to tuber response was initiated in 2006 and the results from the first round of experiments carried out in 2005/06 are shown in Tables 1 and 2 of the report in MIPC research report 2006/07. The main effects indicated that some varieties were more resistant to *P. infestans* regardless of genotype or storage temperature. The varieties MSL 183-AY, Torridon, Jacqueline-Lee and MSM 171-A were the most resistant followed by other MSU bred lines MSI 211-3. MSN 10-1, MSM 051-3 and MSJ461-1 were the most susceptible lines. The most aggressive genotype of *P. infestans* was US-8, followed by US-14 and US-10 then US-6. US-1 and US-11 genotypes were not particularly aggressive on the lines tested. Most tuber blight (measured as %RARI) developed at 10C followed by 7 and 3C. These results indicate that the lines MSL 183-AY, Torridon, Jacqueline-Lee and MSM 171-A could contribute to tuber blight resistance breeding efforts in the future. All three lines are partially resistant to US-8 genotype of *P. infestans* which is predominant in MI. The genotype was isolated from all three loci where epidemics established in MI in 2006.

The results were presented as the mean tuber disease response as affected by the components of variety and storage temperature (Table 2). All varieties were partially resistant to the US-1 genotype regardless of storage temperature although some disease developed in certain varieties. Values close to zero (including negative values) indicate no establishment of *P. infestans* within the tubers. In some varieties late blight developed to some extent at 3C but not at higher temperatures. This is unusual but it is known that many isolates of *P. infestans* can survive well at temperatures close to 0C.

These results indicate that *P. infestans* can survive well at temperatures close to 3C, the seed tuber storage temperature, which presents a risk for commercial growers even with resistant cultivars. Although varieties with partial resistance to foliar and tuber phases of potato late blight are important in the overall management of the disease these results indicate that varietal resistance is not the only component of disease management, For this reason we are proposing that varieties (close to commercial release) with partial resistance to the US-8 genotype of *P. infestans* are further profiled in a variety x fungicide interaction this coming year.

Funding: MPIC and MSU GREEEN

Table 1. Main effects analyses of variety, genotype of *Phytophthora infestans* and temperature on tuber tissue darkening [Mean RARI (%)] in potato tubers.

Variety	Mean RARI (%)[a]		Genotype of *P. infestans*	Mean RARI (%)[a]		Temp-erature (^{o}C)	Mean RARI (%)[a]	
MSN105-1	16.6	a[b]	US-8	15.7	a	10	12.3	a
MSM051-3	16.0	a	US-10	12.7	b	7	9.6	b
MSJ461-1	15.6	a	US-14	12.1	b	3	6.9	c
MSL 211-3	13.9	b	US-6	10.4	c			
MSL 183-AY	5.9	c	US-11	6.3	d			
Torridon	3.3	d	US-1	0.6	e			
Jacqueline-Lee	3.1	d						
MSM171-A	2.6	d						

[a] Normalized tuber tissue darkening score expressed % RARI = [1- Mean ARI $_{treatment}$ / Mean ARI $_{control}$] *100; % RARI has a minimum value of zero (no darkening, but if the value is negative the tuber tissue was lighter than the control) and maximum value of 100 (cut tuber surface is completely blackened). The numbers are derived from the mean average reflective intensity of three surfaces cut latitudinally 25, 50 and 75% from the apex of n = 10 tubers per treatment combination.

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

Table 2. Tuber tissue darkening [Mean RARI (%)] in different varieties and advanced breeding lines of potatoes after inoculation with different genotypes of *Phytophthora infestans*.

Variety	Temper-ature (°C)	Tuber tissue darkening caused by different genotypes of *P. infestans* [Mean RARI (%)[a]] US-1		US-6		US-8		US-10		US-11		US-14	
Torridon	3	-3.1	gh[b]	2.5	g	0.1	h	11.2	b-e	0.7	h	-1.4	k
	7	0.7	b-f	4.7	fg	5.3	gh	14.3	a-e	5.9	e-g	0.9	jk
	10	-0.1	c-f	3.0	fg	3.6	h	11.8	a-e	4.2	f-h	9.9	f-k
MSN105-1	3	2.4	a-d	21.9	ab	20.8	cd	10.0	c-e	9.1	d-f	15.4	d-f
	7	-1.2	e-h	22.7	ab	30.7	ab	14.0	a-e	10.7	c-e	18.2	b-d
	10	3.1	ab	18.5	bc	18.3	c-e	13.4	a-e	15.3	a-c	27.1	a
MSM171-A	3	-0.6	e-h	3.9	fg	6.9	gh	18.0	ab	1.8	gh	0.9	jk
	7	-1.7	f-h	2.8	g	5.9	gh	11.0.	b-e	2.3	gh	4.4	i-k
	10	-3.5	h	1.1	g	4.3	gh	8.4	de	1.6	gh	11.6	e-h
MSM051-3	3	-0.7	e-h	8.1	ef	18.1	c-f	12.3	a-e	11.0	b-d	14.4	d-f
	7	1.4	b-d	13.1	de	23.3	c	12.3	b-e	15.9	ab	26.7	a
	10	2.7	a-c	18.1	bc	31.6	a	12.8	a-e	17.4	a	28.0	a
MSL211-3	3[c]							8.4	b-e				
	7	1.5	b-e	21.0	b	13.8	ef	13.8	a-e	3.9	gh	17	c-e
	10	1.3	b-e	18.4	bc	32.1	a	15.1	a-d	9.4	de	23	a-c
MSL183-AY	3	1.5	b-e	3.8	fg	11.2	fg	12.8	a-e	2.2	gh	5.3	h-j
	7	2.6	a-d	5.2	fg	14.6	d-f	14.0	a-e	3.7	gh	6.8	g-j
	10	-0.5	e-g	3.8	fg	24.1	bc	10.6	c-e	1.1	gh	4.3	i-k
Jacqueline-Lee	3	0.3	b-f	3.2	fg	3.3	h	15.7	a-c	0.8	h	2.3	jk
	7	-0.3	d-g	4.3	fg	5.0	gh	12.8	a-e	2.0	gh	1.9	jk
	10	0.8	b-f	3.8	fg	14.7	d-f	8.9	c-e	-0.5	h	6.7	g-j
MSJ461	3	0.3	b-f	13.1	de	17.4	c-f	11.3	a-e	2.6	gh	11.8	e-g
	7	1.3	b-e	13.8	cd	20.7	cd	7.5	e	10.3	de	17.8	c-e
	10	4.6	a	27.1	a	33.1	a	18.6	a	12.1	b-d	24.1	ab

[a] Normalized tuber tissue darkening score expressed % RARI = [1- Mean ARI $_{treatment}$ / Mean ARI $_{control}$] *100; % RARI has a minimum value of zero (no darkening, but if the value is negative the tuber tissue was lighter than the control) and maximum value of 100 (cut tuber surface is completely blackened). The numbers are derived from the mean average reflective intensity of three surfaces cut latitudinal at 25, 50 and 75% from the apex of n = 10 tubers per treatment combination.
[b] Values followed by the same letter are not significantly different at P = 0.05 for comparisons of mean RARI values within different *P. infestans* genotypes of cultivar/ABL combinations and temperature treatments (Tukey Multiple Comparison). The $LSD_{0.05}$ for comparisons of all RARI values = x.xxx.
[c] Data from 3°C treatment missing for MSL211-3 because of tuber shortage.

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Evaluation of fungicide programs for potato late blight control: 2007.

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Potatoes (FL1879, cut seed, treated with Maxim FS at 0.16 fl oz/cwt) were planted at the Michigan State University Muck Soils Experimental Station, Bath, MI on 25 May into two-row by 25-ft plots (34-in row spacing), separated by a five-foot unplanted row and replicated four times in a randomized complete block design. Plots were irrigated as needed with sprinklers and were hilled immediately before sprays began. All rows were inoculated (3.4 fl oz/25-ft row) with a zoospore suspension of *Phytophthora infestans* [US8 biotype (insensitive to mefenoxam, A2 mating type)] at 10^4 spores/fl oz on 27 Jul. All fungicides in this trial were applied on a 7-day interval from 5 Jul to 22 Aug (8 applications) with an ATV rear-mounted R&D spray boom calibrated to deliver 25 gal/A (80 p.s.i.) using three XR11003VS nozzles per row. Weeds were controlled by hilling and with Dual 8E (2 pt/A on 25 May), Basagran (2 pt/A on 28 Jun and 11 Jul) and Poast (1.5 pt/A on 11 Jul). Insects were controlled with Admire 2F (20 fl oz/A at planting and on 28 Jun), Sevin 80S (1.25 lb/A on 11 and 25 Jul), Thiodan 3EC (2.33 pt/A on 1 and 21 Aug) and Pounce 3.2EC (8 oz/A on 11 Jul). Plots were rated visually for percentage foliar area affected by late blight on 30 Jul; 15, 22, 29 Aug and 5 Sep [14 days after final application (DAFA), 40 days after inoculation (DAI)] when there was about 100% foliar infection in the untreated plots. The relative area under the disease progress curve was calculated for each treatment from date of inoculation, 30 Jul to 5 Sep, a period of 36 days. Vines were killed with Reglone 2EC (1 pt/A on 6 Sep). Plots (2 x 25-ft row) were harvested on 17 Sep and individual treatments were weighed and graded. Samples of 50 tubers per plot were stored after harvest in the dark 50^{o}F and incidence of tuber late blight was evaluated after 40 days. Meteorological variables were measured with a Campbell weather station located at the farm, latitude 42.8269 and longitude -84.365deg. Maximum, minimum and average daily air temperature (^{o}F) were 88.0, 39.6 and 64.9 and 0-d with maximum temperature >90^{o}F (May); 91.3, 36.1 and 66.6 and 2-d with maximum temperature >90^{o}F (Jun); 95.2, 37.7 and 67.0 and 4-d with maximum temperature >90^{o}F (Jul); 93.4, 36.3 and 68.7 and 4-d with maximum temperature >90^{o}F (Aug); 90.0, 34.1 and 63.4 and 1-d with maximum temperature >90^{o}F (Sep). Maximum, minimum and average daily soil temperature (^{o}F) were 75.1, 53.1 and 65.8 (May); 82.1, 53.2 and 68.2 (Jun); 83.1, 53.7 and 65.3 (Jul); 80.5, 54.5 and 67.1 (Aug); 77.1, 51.3 and 66.4 (Sep). Maximum, minimum and average soil moisture (% of field capacity) were 79.0, 75.2 and 77.3 (May); 91.7, 77.2 and 81.3 (Jun); 82.1, 74.1 and 77.9 (Jul); 98.1, 75.4 and 80.7 (Aug); 76.2, 66.6 and 69.8 (Sep). Precipitation was 0.99 in. (May), 3.91 in. (Jun), 0.80 in. (Jul), 6.18 in. (Aug) and 1.09 in. (Sep). The total number of late blight disease severity values (DSV) over the disease development period was 62 using 90% ambient %RH as a base for DSV accumulation. Plots were irrigated to supplement precipitation to about 0.1 in./A/4 day period with overhead sprinkle irrigation.

Table 1 (Set A). Late blight developed steadily after inoculation and untreated controls reached 100% foliar infection by 5 Sep. Up to 40 DAI, all fungicide programs reduced foliar late blight significantly compared to the untreated control and up to 26 DAI were not significantly different from each other. On 29 Aug, 33 DAI, programs with 4.3 to 12.5%, 5.5 to 13.8% and 7.5 to 16.3% foliar late blight were not significantly different. On 5 Sep, 40 DAI, programs with 18.8 to 36.3%, 26.3 to 45.0%, 33.8 to 51.3% and 73.8% foliar late blight were not significantly different. All fungicide programs significantly reduced the average amount of foliar late blight over the season (RAUDPC, 0 to 40 DAI) compared to the untreated. Application programs with RAUDPC values from 3.0 to 6.4, 4.4 to 7.6, 4.7 to 8.1, 6.1 to 9.2 and 9.2 to 11.8 were not significantly different. There were no significant differences in marketable or total yield among treatments. There were no significant differences in the incidence of tuber late blight 60 days after harvest among treatments. Phytotoxicity was not noted in any of the treatments.

Table 2 (Set B). Late blight developed steadily after inoculation and untreated controls reached 100% foliar infection by 5 Sep. Up to 40 DAI, all fungicide programs reduced foliar late blight significantly compared to the untreated control but were not significantly different from each other. On 5 Sep, 40 DAI, programs with 12.5 to 30.0%, 16.3 to 36.3% and 28.8 to 37.5% foliar late blight were not significantly different. All fungicide programs significantly reduced the average amount of foliar late blight over the season (RAUDPC, 0 to 40 DAI) compared to the untreated. Application programs with RAUDPC values from 2.1 and 6.2 and 3.6 to 6.6 were not significantly different. There were no significant differences in marketable or total yield among treatments. There were no significant differences in the incidence of tuber late blight 60 days after harvest among treatments. Phytotoxicity was not noted in any of the treatments.

Table 1 Set A

Treatment and rate/A	Foliar late blight (%) 5 Aug 9 DAI[z]	22 Aug 26 DAI	29 Aug 33 DAI	5 Sep 40 DAI 5 DAFA[y]	RAUDPC[x] Max (100) 0 - 40 DAI	Tuber Yield (cwt/A US1	Total	Tuber blight (%)[w]
BravoWS 6SC 1.5 pt (A,B,C,D,E,F,G,H,I[v])……	0.3 b[u]	1.0 b	8.3 b	28.8 bcd	4.7 bc	330	405	0.1
Equus 720 6SC 1.5 pt (A,B,C,D,E,F,G,H,I)……	0.8 b	2.8 b	11.3 b	36.3 bc	6.5 b	315	387	0.0
Equus ZN 4.17SC 2.16 pt (A,B,C,D,E,F,G,H,I)..	0.3 b	1.8 b	8.8 b	28.8 bcd	4.9 bc	290	358	0.0
Bravo ZN 6SC 1.5 pt (A,B,C,D,E,F,G,H,I)…….	0.3 b	2.3 b	7.5 b	33.8 bc	5.3 bc	314	378	0.6
Equus 82.5 WDG 1.36 lb (A,B,C,D,E,F,G,H,I)..	0.3 b	2.8 b	12.5 b	30.0 bcd	6.0 bc	301	371	0.6
Dithane DF 2 lb (A,B,C,G,H,I) IR6141 MZ 69WG 2.5 lb (D,E,F)………………	0.8 b	2.8 b	6.5 b	16.3 cd	3.6 bc	288	361	0.0
Dithane DF 2 lb (A,B,C,G,H,I) Ridomil Gold MZ 67.9WG 2.5 lb (D,E,F)……..	0.8 b	2.5 b	11.3 b	33.8 bc	6.2 bc	288	361	0.6
Dithane DF 2 lb (A,B,C,G,H,I) IR5885 MZ 66WG 1.35 lb (D,E,F)…………….	0.5 b	3.3 b	10.8 b	36.3 bc	6.4 b	292	365	0.0
BravoWS 6SC 1.5 pt (A,B,C,G,H,I) IR5885 CTL 76WG 2.5 LB (D,E,F)……………	0.5 b	3.0 b	11.3 b	37.5 b	6.6 b	344	410	0.0
BravoWS 6SC 1.5 pt (A,B,C,G,H,I) Ridomil Gold Bravo 3.67SC 2.5 pt (D,E,F)……	0.0 b	1.3 b	10.0 b	36.3 bc	5.7 bc	302	379	1.3
Tanos 50WDG 0.5 lb + BravoWS 6SC 1.5 pt (A,C,E,G,I); Curzate 76WDG 0.2 lb + BravoWS 6SC 1.5 pt (B,D,F,H)………………..	0.5 b	2.3 b	10.0 b	37.5 b	6.2 bc	309	380	0.1
JE874 2.1SC 0.5 pt + Manzate 75DF 1.5 lb (A,C,E,G,I) Bravo WS 6SC 1.5 pt (B,D,F,H)……………….	0.0 b	1.3 b	3.3 b	12.5 d	2.1 c	302	339	0.1
Untreated...	4.8a	32.5a	75.0a	100.0a	32.1a	302	339	0.0
$HSD_{0.05}$	2.94	4.82	11.39	21.14	4.23	81.3	96.2	1.93

[z] Days after inoculation with *Phytophthora infestans*, US8, A2.
[y] Days after final application of fungicide.
[x] RAUDPC, relative area under the disease progress curve calculated from day of inoculation to last evaluation of late blight.
[w] Incidence of tuber late blight after storage for 40 days after harvest at 50°F.
[v] Application dates: A= 5 Jul; B= 12 Jul; B= 20 Aug; D= 28 Aug; E= 3 Aug; F= 10 Aug; G= 17 Aug; H= 24 Aug; I = 31 Aug.
[u] Values followed by the same letter are not significantly different at $p = 0.05$ (Tukey Multiple Comparison).

Funding: MPIC and Agchem Industry

Table 2 Set B.

Treatment and rate/A	Foliar late blight (%) 5 Aug 9 DAI[z]	22 Aug 26 DAI	29 Aug 33 DAI	5 Sep 40 DAI 5 DAFA[y]	RAUDPC Max = 100[x] 0 - 40 DAI	Yield (cwt/A) US1	Total	Tuber blight (%)[w]
Revus Opti 3.67SC 2.5 pt + 0.125% NIS (A,B,C,D[v]); BravoWS 6SC 1.5 pt (E,F,G,H,I)……………………..	0.3b[u]	1.0b	5.5cd	18.8f	3.2f	350	421	0.6
Revus Top 4.17SC 5.5 fl oz + 0.125% NIS (A,B,C,D); BravoWS 6SC 1.5 pt (E,F,G,H,I)……………………..	1.0b	2.5b	12.5bcd	30.0def	6.1c-f	294	368	0.6
Revus Top 4.17SC 7.0 fl oz + 0.125% NIS (A,B,C,D); BravoWS 6SC 1.5 pt (E,F,G,H,I)……………………..	1.3b	3.5b	13.8bc	45.0cd	8.1cd	297	367	0.0
Quadris Opti 1.6 fl oz (A,C); Revus Top 4.17SC 5.5 fl oz + 0.125% NIS (B,D); BravoWS 6SC 1.5 pt (E,F,G,H,I)……………………..	2.0b	5.0b	13.8bc	51.3c	9.2bc	306	377	0.0
Forum 3.6SC 6 fl oz + Dithane RS 1.5 lb (A,B,D,F,H); Dithane RS 1.5 lb (C,E,G,I)…………………………...	0.0b	1.5b	6.5cd	31.3c-f	4.6ef	333	415	0.6
Forum 3.6SC 6 fl oz + COC 8.0 fl oz (A,B,D,F,H); Dithane RS 1.5 lb (C,E,G,I)…………………………...	0.0b	1.5b	8.3bcd	26.3def	4.4ef	311	377	0.6
Forum 3.6SC 6 fl oz + Dithane RS 1.5 lb + COC 8.0 fl oz (A,B,D,F,H); Dithane RS 1.5 lb + COC 8.0 fl oz (C,E,G,I)…………	0.0b	1.0b	7.5bcd	30.0def	4.6ef	323	388	0.6
MicroFlo Chlorothalonil 6SC 1.5 pt (A-I)………….....	0.0b	1.3b	5.8cd	26.3def	3.9f	298	382	0.6
BravoWS 6SC 1.5 pt (A,C,E,F,G,H,I) Evito 4SC 3.8 fl oz + 0.125% NIS (B,D)…………..…	0.3b	2.5b	10.0bcd	40.0cde	6.4c-f	301	378	1.3
BravoWS 6SC 1.5 pt (A,C,E,F,G,H,I) Evito 4SC 1.9 fl oz + 0.125% NIS (B,D)……………...	0.8b	3.3b	12.0bcd	45.0cd	7.6cde	305	369	0.0
Polyoxin D 2.5 WDG 2 lb (A-I)………………………	1.3b	5.5b	16.3b	73.8b	11.8b	300	378	0.0
Dithane RS 2.0 lb (A-I)……………………………..	0.5b	2.3b	8.8bcd	35.0c-f	5.7def	302	376	0.0
Echo ZN 2.125 pt (A-I)……………………………..	0.3b	2.3b	8.3bcd	35.0c-f	5.5def	330	401	0.0
Echo 720 1.5 pt (A-I)…………………………………..	0.3b	1.5b	11.3bcd	36.3c-f	6.1c-f	313	387	1.9
SA 010903 4SC 1.5 pt (A-I)…………………………...	0.0b	1.0b	4.3d	20.0ef	3.0f	298	375	0.0
Untreated..	4.8a	32.5a	75.0a	100a	32.1a	236	331	0.0
$HSD_{0.05}$	2.64	4.86	9.37	20.03	3.51	88.8	97.3	2.79

[z] Days after inoculation with *Phytophthora infestans*, US8, A2.
[y] Days after final application of fungicide.
[x] RAUDPC, relative area under the disease progress curve calculated from day of inoculation to last evaluation of late blight.
[w] Incidence of tuber late blight after storage at 50°F.
[v] Application dates: A= 5 Jul; B= 12 Jul; B= 20 Aug; D= 28 Aug; E= 3 Aug; F= 10 Aug; G= 17 Aug; H= 24 Aug; I = 31 Aug.
[u] Values followed by the same letter are not significantly different at $p = 0.05$ (Tukey Multiple Comparison).

Funding: MPIC and Agchem Industry

Evaluation of fungicide programs for Pythium leak control, 2007.

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Potatoes (FL1879, cut seed, treated with Maxim FS at 0.16 fl oz/cwt) were planted at the Michigan State University Muck Soils Experimental Station, Bath, MI on 13 Jun into two-row by 25-ft plots (34-in row spacing), separated by a five-foot unplanted row and replicated four times in a randomized complete block design. Plots were irrigated as needed with sprinklers and were hilled immediately before sprays began. All rows were inoculated (3.4 fl oz/25-ft row) with an oospore suspension of *Pythium ultimum* (sensitive to mefenoxam) at 10^2-oospores/fl oz on 20 Jun [7 days after planting (DAP)]. In-furrow and foliar-banded applications were applied with an R&D spray boom delivering 8 gal/A (80 p.s.i.) and using one XR11003VS nozzle per row. Foliar applications were applied with an ATV rear-mounted R&D spray boom calibrated to deliver 25 gal/A (80 p.s.i.) using three XR11003VS nozzles per row. Bravo WS 6SC was applied on a 14-day interval from 27 Jul to 15 Sep (4 applications) to protect against foliar late blight. Weeds were controlled by hilling and with Dual 8E (2 pt/A on 25 May), Basagran (2 pt/A on 28 Jun and 11 Jul) and Poast (1.5 pt/A on 11 Jul). Insects were controlled with Admire 2F (20 fl oz/A at planting and on 28 Jun), Sevin 80S (1.25 lb/A on 11 and 25 Jul), Thiodan 3EC (2.33 pt/A on 1 and 21 Aug) and Pounce 3.2EC (8 oz/A on 11 Jul). Tuber number per plant was rated on 27 Jul and 27 Aug from samples of four plants per plot. Vines were killed with Reglone 2EC (1 pt/A on 21 Sep). Plots (2 x 25-ft row) were harvested on 10 Oct and individual treatments were weighed and graded and tuber number in size grades US-1 and b-grade determined. Samples of 50 tubers/plot were stored in the dark at 50oF and 95% RH for 60 days after harvest and the percentage of tubers with Pythium leak determined. Meteorological variables were measured with a Campbell weather station located at the farm, latitude 42.8269 and longitude -84.365deg. Maximum, minimum and average daily soil temperature (^{o}F) were 75.1, 53.1 and 65.8 (May); 82.1, 53.2 and 68.2 (Jun); 83.1, 53.7 and 65.3 (Jul); 80.5, 54.5 and 67.1 (Aug); 77.1, 51.3 and 66.4 (Sep). Maximum, minimum and average soil moisture (% of field capacity) were 79.0, 75.2 and 77.3 (May); 91.7, 77.2 and 81.3 (Jun); 82.1, 74.1 and 77.9 (Jul); 98.1, 75.4 and 80.7 (Aug); 76.2, 66.6 and 69.8 (Sep). Precipitation was 0.99 in. (May), 3.91 in. (Jun), 0.80 in. (Jul), 6.18 in. (Aug) and 1.09 in. (Sep). Plots were irrigated to supplement precipitation and enhance Pythium leak development to about 0.1 in./A/4 day period with overhead sprinkle irrigation.

No treatments had any effect on tuber number per plant measured pre-harvest. All treatments had significantly more US-1 grade tubers per plot at harvest in comparison with the untreated control except IR6141 69WG 0.21 lb/A applied during early senescence (timing D). Treatments with greater than 46.3 b-grade tubers per plot at harvest had significantly more tubers than the untreated control. All treatments had significantly greater US-1 grade yield in comparison with the untreated control. Pythium leak was evident in all plots at harvest but there was no difference in the percentage measured among any treatments. After about 60-days in storage, no treatments had significantly less incidence of tubers with Pythium leak than the untreated control although the incidence was low.

	Tuber number per plant		Tuber number/plot at harvest		Yield (cwt/A)		Pythium leak (% incidence)	
Treatment and rate/A or rate/1000 row ft	27 Jul	27 Aug	US-1	b-size	US-1	b-size	Harvest	Storage
Ridomil Gold 4EC 0.42 fl oz/1000 row ft (A)…	9.8	9.6	80.8 b	43.0abc	202 b	61abc	0.8	0.0
Ridomil Gold 4EC 0.42 fl oz 1000 row ft (A); Ridomil Gold 4EC 0.42 fl oz/A (B)……………	10.9	9.6	109.3a	51.0a	290a	74a	0.7	1.0
Phostrol 6.69SC 0.66 fl oz/1000 row ft + Ultra Flourish 4SC 0.84 fl oz/1000 row ft (A)…	13.4	9.9	83.0 b	46.3ab	212 b	64ab	1.4	2.0
Ranman 400SC 0.42 fl oz 1000 row ft (A); Ranman 400SC 2.7 fl oz/A + Silwet SL 2.0 fl oz/A + Phostrol 6.69SC 8.0 pt/A (B); Phostrol 6.69SC 10.0 pt/A (C,D)………………	12.2	9.9	86.5 b	46.8ab	221 b	66ab	0.9	1.0
IR6141 69WG 0.21 lb/A (C,D)………………..	12.9	9.9	81.8 b	40.8abc	219 b	56a-d	0.9	2.0
IR6141 69WG 0.21 lb/A (C)…………………..	12.3	10.1	83.5 b	36.5 bcd	221 b	53 bcd	1.3	2.0
IR6141 69WG 0.21 lb/A (D)…………………..	13.4	10.3	75.3 bc	27.5 d	191 b	37 d	0.7	1.0
Untreated..	13.4	10.3	63.8 c	32.3 cd	154 c	44 cd	1.7	5.0
$LSD_{0.05}$	3.04	1.95	13.30	12.24	36.8	19.9	1.01	2.80

[z] Application dates: A= 13 Jun (in-furrow at planting); B= 29 Jun (95% emergence, banded application); C= 25 Jul; D= 8 Aug.

[y] Values followed by the same letter are not significantly different at p = 0.05 (Fishers protected LSD).

Potato Insect Biology and Management

Report to the Michigan Potato Industry Commission
24 January 2008

Adam M. Byrne, Walter L. Pett, Beth A. Bishop, and Edward J. Grafius

Outline.

I. Resistance of Colorado potato beetle populations to imidacloprid and thiamethoxam was evaluated for field populations from Michigan, as well as other locations in the Midwest and locations in the northeastern U.S.

II. Field insecticide evaluations of registered and experimental insecticides.

III. Managing neonicitinoid-resistant Colorado potato beetles with trap crops.

I. Resistance of Colorado potato beetle populations to imidacloprid and thiamethoxam.

Potato growers across the United States continue to rely heavily on imidacloprid (Admire Pro®) and thiamethoxam (Platinum®, Actara®) for Colorado potato beetle control. In 2005, these compounds were applied to greater than 80% of the acreage in Michigan, Wisconsin, and Minnesota (NASS 2006). This consistent and heavy dependency on these compounds sets the stage for resistance development. Further complicating the issue is the availability of generic imidacloprid formulations; these formulations drive down product cost, which may result in even more field exposure to this compound. All of these reasons strongly support the need to continue monitoring resistance develop and to encourage growers to adopt strong resistance management strategies.

Our objectives were to continue gathering data on susceptibility to imidacloprid and thiamethoxam in Colorado potato beetle populations collected from commercial potato fields in Michigan and other regions of the United States. A second objective was to monitor the correlations between imidacloprid and thiamethoxam susceptibility. To accomplish these objectives, 53 Colorado potato beetle populations (32 Michigan populations, 16 populations collected in other states, and five laboratory populations) were bioassayed with imidacloprid and/or thiamethoxam.

Methods

During 2007, 32 Colorado potato beetle populations were collected from two different Michigan counties (Mecosta and Montcalm). Cooperators also provided one population from Delaware, two populations from Idaho, three populations from Minnesota, four populations from Maine, and six populations from Wisconsin. Five laboratory strains were also tested (Table I.1).

Colorado potato beetle adults were either kept at room temperature (25±1° C) and fed foliage daily or, for longer term storage, kept in controlled environment chambers (11±1° C) and fed weekly. Beetles were treated with 1 µl of acetone/insecticide solution of known concentration applied to the ventral surface of the abdomen using a 50 µl Hamilton® microsyringe. Following treatment, beetles were placed in 100 mm diameter petri dishes lined with Whatman® No. 1 filter paper and provided with fresh potato foliage. They were kept at 25±1° C and the foliage and filter paper were checked daily and changed as needed.

A preliminary screen was conducted on most populations (for populations tested in previous years, screening was sometimes not necessary) to determine relative susceptibility to imidacloprid and thiamethoxam by testing 10 beetles each with one concentration of insecticide/acetone solution. Based on the results from these screens, a range of five concentrations was selected for each population to be assayed and each bioassay was replicated up to three times. In each replicate, 10-15 beetles were treated with each concentration (four to five beetles per dish and two to three dishes per concentration).

Beetle response was assessed 7 days post treatment. A beetle was classified as dead if its abdomen was shrunken, it did not move when its legs or tarsi were pinched, and its elytra were darkened. Beetles that had died due to *Beauvaria* sp. infection were excluded from analysis; these beetles were easily recognized by their pale petrified appearance or presence of white filamentous fungi. A beetle was classified as walking and healthy if it was able to grasp a pencil and walk forward normally. A beetle was classified as poisoned if its legs were extended and shaking, it was unable to right itself or grasp a pencil, and it was unable to walk forward normally at least one body length. Dead and poisoned beetle numbers were pooled for analysis. Data were analyzed using standard log-probit analysis (SAS® System v9.1.3).

<u>Results</u>

The imidacloprid LD_{50} value (dose lethal to 50% of the beetles) for the susceptible laboratory strain (New Jersey) was 0.036 µg/beetle. The LD_{50} values for imidacloprid ranged from 0.034 µg/beetle (Anderson Bros. field 7) to 1.563 µg/beetle (Sackett Potatoes, field 155) for Michigan populations (Figure I.1A) and from 0.009 µg/beetle (Idaho and Kimberly, ID) (Figure I.2.A) to 3.536 µg/beetle (Delaware, DE) (Table I.2) for out-of-state populations.

Significant levels of resistance to imidacloprid were again present in Michigan. Beetles from Sackett Potatoes, fields 26-29 were 32-fold resistant to imidacloprid, compared to the susceptible strain. An additional five fields on the home farm (field 1, field 4, fields 5-8&31-32, field 12, and field 25) were also greater than 20-fold resistant to imidacloprid. In total, 14 samples were tested with imidacloprid from the Sackett Potatoes home farm, all but two were greater than 10-fold resistant to imidacloprid (Figure I.1.B).

In 2007, 14 additional sites away from the Sackett Potatoes home farm showed greater than 20-fold resistance to imidacloprid, contrasted with only three sites in 2006, and all Michigan samples had significantly higher LD_{50} values than the susceptible New Jersey strain. These sites were all within approximately 10-12 km from Sackett Potatoes home farm, but in several different directions (i.e. Paul Main Rodney Farm to the northwest, Paul Main HB-S site to the southwest, and Sackett Potatoes fields 101-103 to the northeast). The overall LD_{50} values were lower than last year; this year's highest LD_{50} value was 1.563 µg/beetle (Sackett Potatoes field 155) compared to last year's 3.244 µg/beetle (Sackett Potatoes fields 47&48), but the proportion of samples greater than 10-fold resistant was up from 50% in 2006 to 67% in 2007.

The lower LD_{50} values detected throughout the region is a positive sign, but needs to be contrasted with the increase in sites showing elevated levels of resistance. Continued monitoring of these sites, along with testing of new sites surrounding them, will be integral in our tracking and understanding of the spread of resistance and the impacts of the various control approaches being used (ie. trap crops, alternate insecticides, etc.).

Two populations tested from Maine showed high levels of resistance to imidacloprid, despite avoidance of neonicotinoid insecticides at those sites for the past four growing seasons. Simply switching to a new compound won't be enough to suppress a resistance problem, this example drives home the importance of managing available compounds wisely, before problems develop. Populations tested from Wisconsin and Minnesota all had significantly greater LD_{50} values compared to the susceptible strain, and for the first time, greater than 10-fold resistance was detected in Wisconsin. The two populations tested from Idaho were very susceptible, consistent with results found in previous years.

The thiamethoxam LD_{50} value for the susceptible laboratory strain (New Jersey) was 0.056 µg/beetle; this value is greater than last year's 0.032 µg/beetle, but was statistically similar based upon overlapping confidence intervals. The LD_{50} values for thiamethoxam ranged from 0.077 µg/beetle (Sackett Potatoes field 3) to 0.292 µg/beetle (Paul Main field HB-YN) for Michigan populations (Figure I.3.A) and from 0.045 µg/beetle (Aroostook, ME) to 0.383 µg/beetle (Delaware, DE) for out-of-state populations (Figure I.2.B, Table I.3).

No Michigan populations had greater than 10-fold resistance to thiamethoxam. However, of the 34 sites sampled, all but four had LD_{50} values significantly higher than the susceptible New Jersey strain. The thiamethoxam results mirrored those of imidacloprid, overall resistance values were lower this year, but the proportion of sites exhibiting significant differences from the susceptible strain increased from the previous year.

Susceptibility to imidacloprid (as measured by LD_{50}) in field-collected Colorado potato beetle populations was highly correlated with susceptibility to thiamethoxam (Figure I.4). This result was also found in 1998, 1999, 2000, 2002, 2003, 2004, 2005, and 2006 (e.g. Grafius et al. 2004, 2005; Byrne et al. 2006, 2007). This high correlation is a strong indicator that alternation between imidacloprid and thiamethoxam would not be an effective or wise management technique.

The Evans and NY-Sel strains have been selected for imidacloprid resistance, while Hadley and Sloth were selected for resistance to thiamethoxam. Adults from each generation were selected with their corresponding compound, using doses causing 30-90% mortality. Survivors from selections were used to maintain the laboratory strains. Bioassays are conducted roughly every third generation, allowing us to follow resistance development under a high selection pressure scenario.

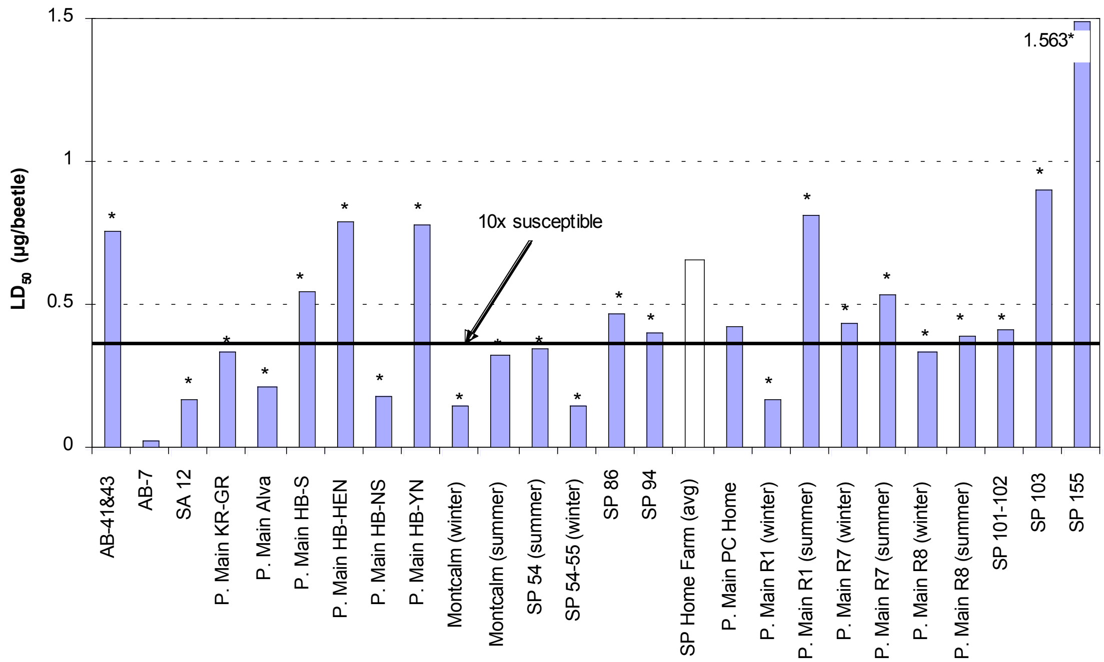
Table I.1. Colorado potato beetle populations tested for susceptibility to imidacloprid and thiamethoxam in 2007.

Michigan populations
Andersen Brothers Farm Adults were collected by Mark Otto, AgriBusiness Consultants, Inc. from commercial potato fields in Montcalm Co., MI.
Field 7 Adults were collected on 7 July 2007.
Fields 41&43 Adults were collected on 19 July 2007.
Montcalm Farm Overwintered adults were collected on 12 June 2007 and summer adults on 10 July 2007 from the Michigan State University Montcalm Potato Research Farm in Entrican, MI.
Paul Main Farm Adults were collected by Mark Otto, AgriBusiness Consultants, Inc. from commercial potato fields in Mecosta Co.
Field ALVA Adults were collected on 1 June 2007.
Field HB-HEN Adults were collected on 5 July 2007.
Field HB-NS Adults were collected on 5 June 2007.
Field HB-S Adults were collected on 31 May 2007.
Field HB-YN Adults were collected on 7 July 2007.
Field KR-GR Adults were collected on 17 July 2007.
Field PC Home Adults were collected on 21 August 2007.
Field R1 Overwintered adults were collected on 14 June 2007 and summer adults on 11 July 2007.
Field R7 Overwintered adults were collected on 31 May 2007 and summer adults on 12 July 2007.
Field R8 Overwintered adults were collected on 31 May 2007 and summer adults on 12 July 2007.
Sackett Acres *Field 12* Adults were collected on 17 July 2007 by Mark Otto, AgriBusiness Consultants, Inc., from a commercial potato field in Mecosta Co., MI.
Sackett Potatoes Adults were collected by Mark Otto, AgriBusiness Consultants, Inc., and Michigan State University researchers from commercial potato fields in Mecosta Co., MI.
Field 1 Overwintered adults were collected on 9 June 2007 and summer adults on 17 July 2007.
Field 3 Overwintered adults were collected on 6 June 2007 and summer adults on 17 July 2007.
Field 4 Adults were collected on 17 July 2007.

Table I.1 cont'd. Colorado potato beetle populations tested for susceptibility to imidacloprid and thiamethoxam in 2007.
Fields 5-8 & 31-32 Adults were collected on 22 August 2007.
Field 12 Adults were collected on 5 July 2007.
Field 15 Adults were collected on 29 May 2007.
Field 18 Adults were collected on 11 June 2007.
Field 21 Adults were collected on 22 May 2007.
Field 25 Adults were collected on 17 July 2007.
Fields 26-29 Adults were collected on 23 August 2007.
Fields 41-42 Adults were collected on 22 August 2007.
Field 43 Adults were collected on 17 July 2007.
Fields 54-55 Overwintered adults were collected on 11 June 2007 and summer adults on 18 July 2007.
Fields 86 Adults were collected on 17 July 2007.
Field 94 Adults were collected on 5 July 2007.
Fields 101-102 Adults were collected on 5 June 2007.
Field 103 Adults were collected on 10 July 2007.
Field 155 Adults were collected on 17 July 2007.
Out-of-state populations
Aroostook, Maine Adults were collected on 13-14 August 2007 by Gary Sewell, University of Maine, from untreated potato research plots near Presque Isle, ME.
Becker, Minnesota Adults were collected on 29 August 2007 by Brian McCornack, University of Minnesota, from a commercial potato field near Becker, MN.
Bridgewater, Maine Adults were collected on 9 August 2007 by Jim Gerritsen, Wood Prairie Farm, from an organic potato field, treated with copper hydroxide, near Bridgewater, ME.
C-05, Wisconsin Adults were collected on 7 June 2007 by Russell L. Groves, University of Wisconsin-Madison.
Delaware, Delaware Adults were collected on 12 July 2007 by Joanne Whalen, University of Delaware, from a commercial potato field, treated with Actara, Kryocide, and Spintor, near Little Creek, DE.
Fryeburg-140A, Maine Adults were collected on 19 June 2007 by Andrei Alyokhin, University of Maine, from a commercial potato field near Fryeburg, ME.
Fryeburg-Jimmy Hill, Maine Adults were collected on 19 June 2007 by Andrei Alyokhin, University of Maine, from a commercial potato field near Fryeburg, ME.
H-02, Wisconsin Adults were collected on 7 June 2007 by Russell L. Groves, University of Wisconsin-Madison.
H-11, Wisconsin Adults were collected on 14 June 2007 by Russell L. Groves, University of Wisconsin-Madison.
H-41, Wisconsin Adults were collected on 7 June 2007 by Russell L. Groves, University of Wisconsin-Madison.
H-53, Wisconsin Adults were collected on 7 June 2007 by Russell L. Groves, University of Wisconsin-Madison.

Table I.1 cont'd. Colorado potato beetle populations tested for susceptibility to imidacloprid and thiamethoxam in 2007.
Hancock, Wisconsin Adults were collected on 9 July 2007 by Russell L. Groves, University of Wisconsin-Madison, from untreated potatoes at the Hancock Agricultural Experiment Station, Waushara Co., WI.
Idaho, Idaho Adults were collected on 14 June 2007 by Juan Alvarez, University of Idaho, from a commercial potato field near Kimberly, ID.
Kimberly, Idaho Adutls were collected on 14 June 2007 by Juan Alvarez, University of Idaho, from a commercial potato field near Kimberly, ID.
Minnesota, Minnesota Adults were collected in mid-August 2007 by Ian MacRae, University of Minnesota.
Sand Plains, Minnesota Adults were collected on 15 August 2007 by Brian McCornack, University of Minnesota, from the Sand Plain Research Farm near Becker, MN.
Laboratory strains
Evans Collected from Montcalm Co., MI in summer 1997. Adults from most generation have been selected with imidacloprid doses targeting 60-80% mortality.
Hadley Collected from Hadley, MA in July 2003. Adults from each generation have been selected with thiamethoxam doses targeting 60-80% mortality.
New Jersey Adults obtained from the Phillip Alampi Beneficial Insects Rearing Laboratory, New Jersey Department of Agriculture.
NY-Select Collected from Long Island, NY in 1997. Adults from most generations selected with imidacloprid doses targeting 60-80% mortality.
Sloth Collected from Sackett Potatoes, Mecosta Co., MI in summer 2005. Adults from each generation have been selected with thiamethoxam doses targeting 60-80% mortality.

A. Michigan populations



B. Sackett Potatoes Home Farm

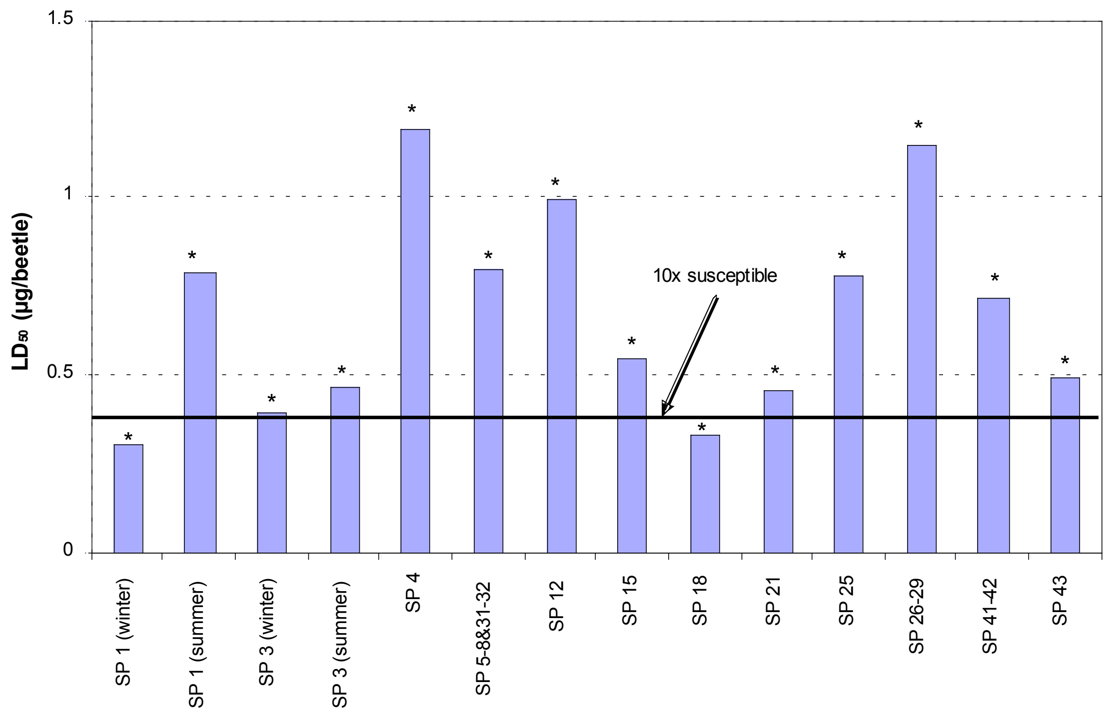
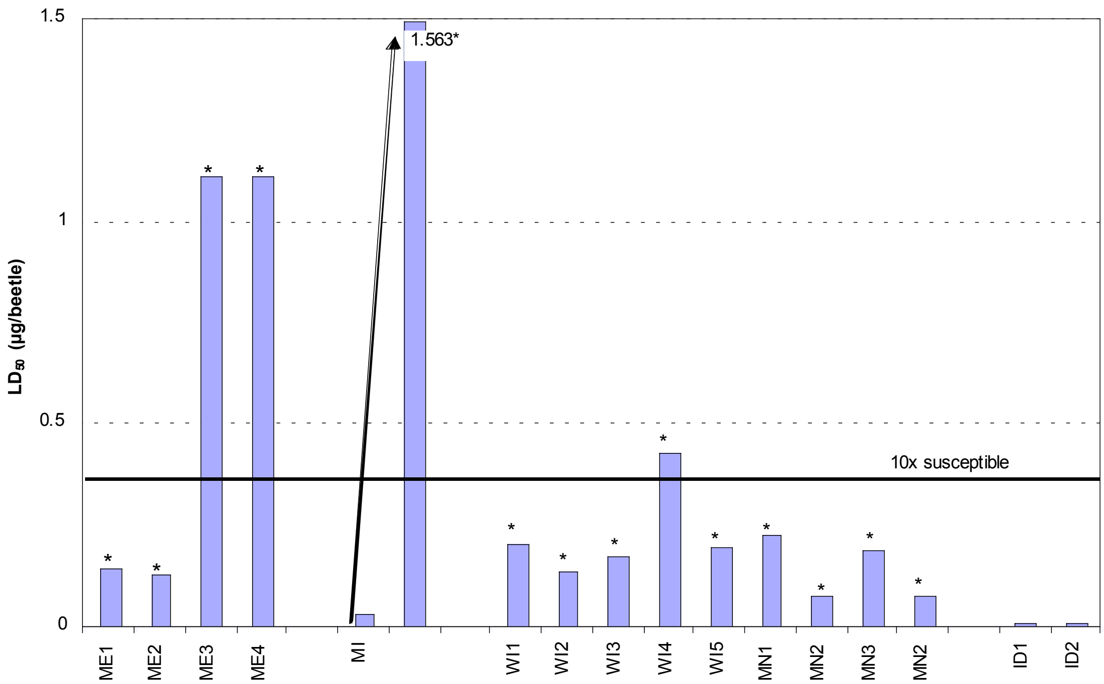


Figure I.1. Susceptibility of Michigan field populations of Colorado potato beetle to imidacloprid. The SP Home Farm value in figure A is an average of all populations presented in figure B. An asterisk (*) denotes values significantly greater than the susceptible strain.

A. Imidacloprid



B. Thiamethoxam

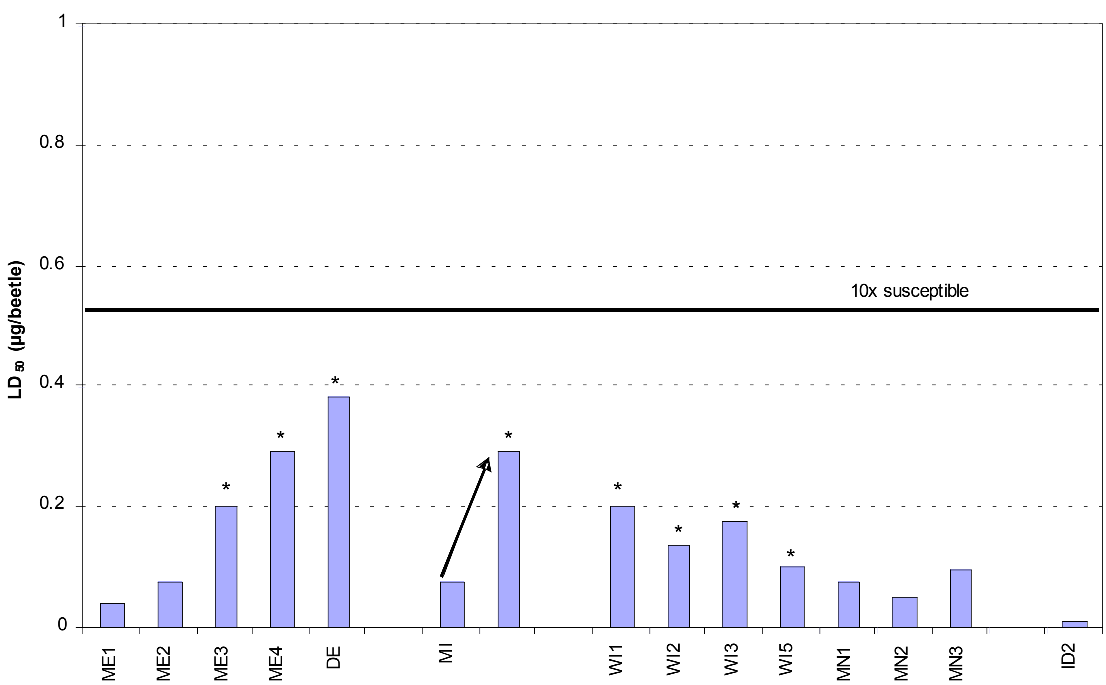


Figure I.2. Susceptibility of field populations of Colorado potato beetle to imidacloprid (A) and thiamethoxam (B). Michigan values presented as a range from lowest to highest value. An asterisk (*) donotes values significantly greater than the susceptible strain.

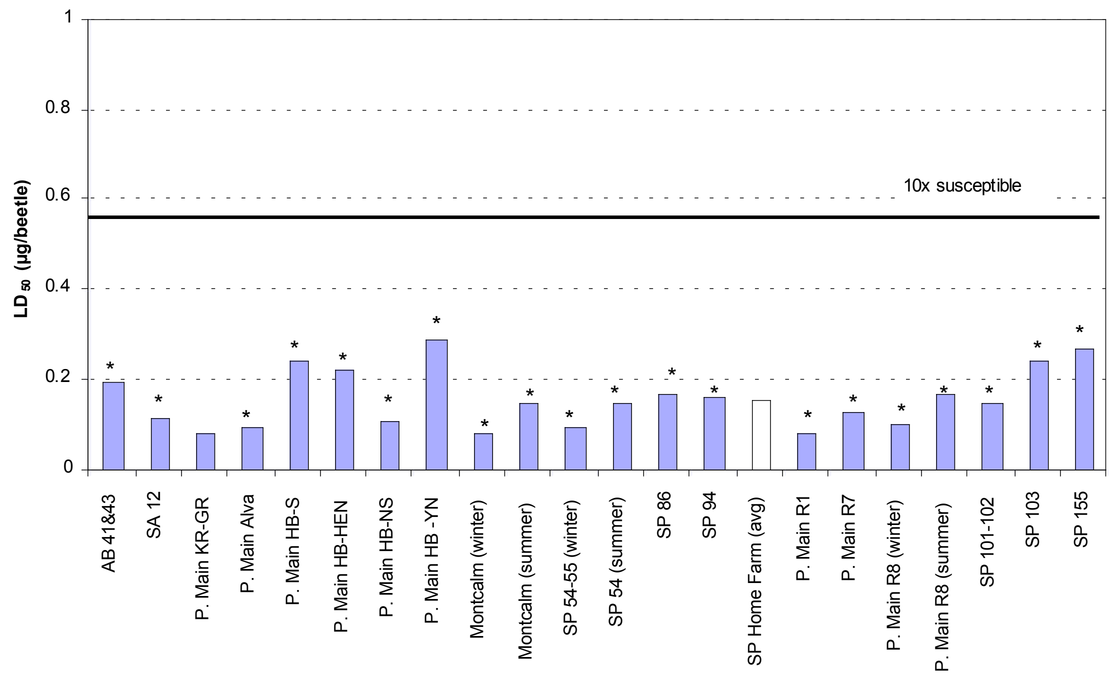
Table I.2. LD_{50} values (µg/beetle) and 95% fiducial limits for Colorado potato beetle populations treated with imidacloprid at 7 days after treatment.

	LD_{50}	95% fiducial limits
Michigan populations		
Andersen Bros Field 7	0.034	0.019-0.047
Andersen Bros Fields 41&43	0.760[2]	0.503-1.074
Montcalm Farm (winter)	0.151[1]	0.091-0.354
Montcalm Farm (summer)	0.331[1]	0.251-0.449
Montcalm Farm (lab reared)	0.225[1]	0.167-0.289
Paul Main Farm		
Field ALVA	0.222[1]	0.159-0.337
Field HB-HEN	0.800[2]	0.617-0.960
Field HB-NS	0.189[1]	0.081-0.297
Field HB-S (winter)	0.550[2]	0.298-0.801
Field HB-S (lab-reared)	0.683[2]	0.439-0.864
Field HB-YN	0.789[2]	0.374-1.125
Field KR-GR	0.241[1]	0.196-0.329
Field PC Home	0.426	0.039-0.673
Field R1 (winter)	0.170[1]	0.126-0.214
Field R1 (summer)	0.820[2]	0.621-0.980
Field R7 (winter)	0.446[2]	0.338-0.696
Field R7 (summer)	0.545[2]	0.467-0.624
Field R7 (lab-reared)	0.619[2]	0.403-1.106
Field R8 (winter)	0.342[1]	0.233-0.828
Field R8 (summer)	0.394[2]	0.320-0.504
Sackett Acres Field 12	0.178[1]	0.121-0.380
Sackett Potatoes		
Field 1 (winter)	0.304[1]	0.242-0.370
Field 1 (summer)	0.791[2]	0.612-0.934
Field 3 (winter)	0.396[2]	0.205-0.648
Field 3 (summer)	0.472[2]	0.331-0.585
Field 3 (lab-reared)	0.463[2]	0.389-0.548
Field 4	1.379[2]	1.097-1.815
Fields 5-8 & 31-32	0.825[2]	0.659-1.136
Field 12	1.000[2]	0.535-1.310
Field 15	0.550[1]	0.471-0.643
Field 18	0.339	$8.86E^{-42}$-0.582
Field 25	0.783[2]	0.644-0.967

Table I.2. cont'd. LD_{50} values (µg/beetle) and 95% fiducial limits for Colorado potato beetle populations treated with imidacloprid at 7 days after treatment.		
	LD_{50}	95% fiducial limits
Sackett Potatoes cont'd		
Fields 26-29	1.153[2]	0.698-4.455
Fields 41-42	0.719[2]	0.540-0.893
Field 43	0.492[2]	0.387-0.592
Fields 54-55 (winter)	0.152[1]	0.090-0.206
Fields 54-55 (summer)	0.352[1]	0.237-0.500
Field 86	0.477[2]	0.226-0.834
Field 94	0.413[2]	0.289-0.513
Fields 101-102	0.417[2]	0.289-0.813
Field 103	0.904[2]	0.763-1.073
Field 155	1.563[2]	1.290-1.934
out-of-state populations		
Aroostook, ME	0.141	0.111-0.174
Becker, MN	0.224[1]	0.159-0.292
Bridgewater, ME	0.126[1]	0.089-0.251
C-05, WI	0.464[2]	0.083-0.735
Delaware, DE	3.536	*
Fryeburg-140A, ME	1.118[2]	0.400-1.599
Fryeburg-Jimmy Hill, ME	1.352[2]	0.954-1.780
H-02, WI	0.412[2]	0.330-0.483
H-11, WI	0.135	*
H-41, WI	0.504[2]	0.204-0.755
H-53, WI	0.434[2]	0.338-0.517
Hancock, WI	0.198[1]	0.104-3.575
Idaho, ID	0.009	0.004-0.011
Kimberly, ID	0.009	0.006-0.011
Minnesota, MN	0.075[1]	0.059-0.090
Sand Plains, MN	0.193[1]	0.082-0.505
laboratory strains		
Evans	5.881[2]	3.808-7.923
Hadley	18.748[2]	15.530-29.583
New Jersey	0.036	0.032-0.042
Sloth	1.033[2]	0.869-1.308

[1] significantly greater than LD_{50} value for susceptible New Jersey strain
[2] greater than 10 times the LD_{50} value for susceptible New Jersey strain

A. Michigan populations



B. Sackett Potatoes Home Farm

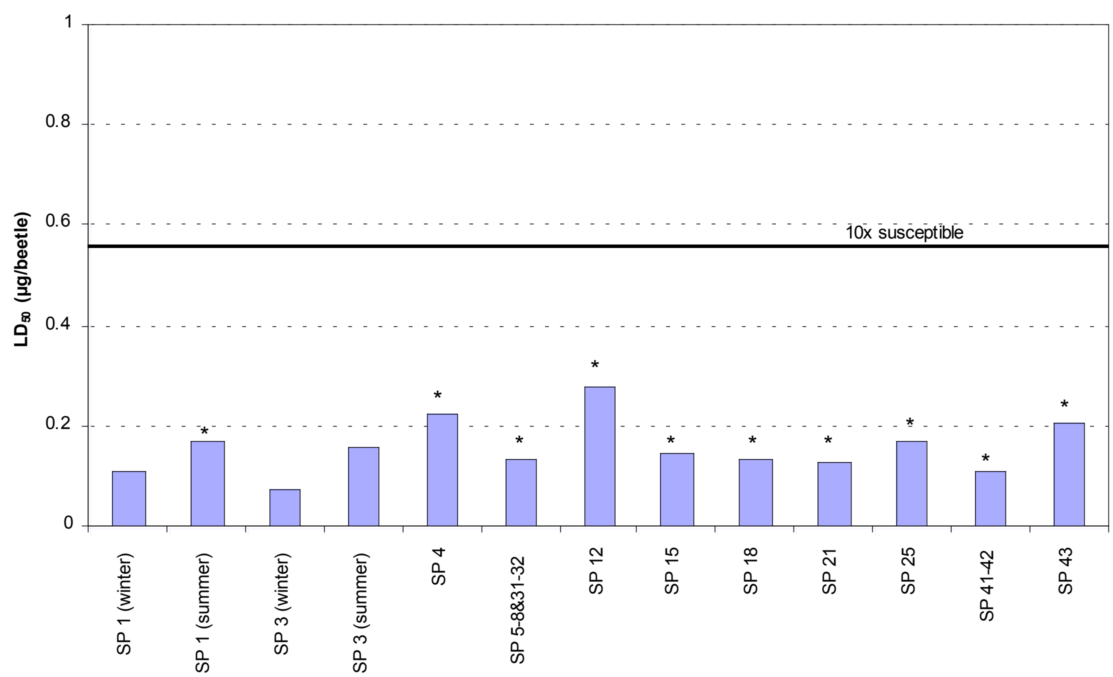


Figure I.3. Susceptibility of Michigan field populations of Colorado potato beetle to thiamethoxam. The SP Home Farm value in figure A is an average of all populations presented in figure B. An asterisk (*) denotes values significantly greater than the susceptible strain.

Table I.3. LD$_{50}$ values (µg/beetle) and 95% fiducial limits for Colorado potato beetle populations treated with thiamethoxam at 7 days after treatment.		
	LD$_{50}$	95% fiducial limits
Michigan populations		
Andersen Bros Fields 41&43	0.195[1]	0.129-0.304
Montcalm Farm (winter)	0.082[1]	0.066-0.106
Montcalm Farm (summer)	0.146[1]	0.121-0.182
Paul Main Farm		
Field ALVA	0.096[1]	0.070-0.118
Field HB-HEN	0.224[1]	0.064-0.339
Field HB-NS	0.110[1]	0.095-0.127
Field HB-S (winter)	0.242[1]	0.192-0.317
Field HB-YN	0.292[1]	0.249-0.340
Field KR-GR	0.085	0.063-0.120
Field PC Home	0.113	*
Field R1 (winter)	0.085[1]	0.064-0.106
Field R7 (summer)	0.128[1]	0.097-0.159
Field R8 (winter)	0.101[1]	0.084-0.120
Field R8 (summer)	0.167[1]	0.140-0.199
Sackett Acres Field 12	0.118[1]	0.068-0.206
Sackett Potatoes		
Field 1 (winter)	0.112	0.060-0.177
Field 1 (summer)	0.170[1]	0.138-0.204
Field 3 (winter)	0.077	0.061-0.094
Field 3 (summer)	0.163	0.039-0.246
Field 4	0.224[1]	0.182-0.263
Fields 5-8 & 31-32	0.137[1]	0.108-0.209
Field 12	0.283[1]	0.240-0.329
Field 15	0.146[1]	0.127-0.167
Field 18	0.135[1]	0.118-0.156
Field 21	0.128[1]	0.102-0.154
Field 25	0.172[1]	0.146-0.202
Fields 41-42	0.112[1]	0.065-0.179
Field 43	0.208[1]	0.174-0.247
Fields 54-55 (winter)	0.095[1]	0.076-0.113
Fields 54-55 (summer)	0.147[1]	0.119-0.177

Table I.3. cont'd. LD_{50} values (µg/beetle) and 95% fiducial limits for Colorado potato beetle populations treated with thiamethoxam at 7 days after treatment.		
	LD_{50}	95% fiducial limits
Sackett Potatoes cont'd		
Field 86	0.172[1]	0.148-0.204
Field 94	0.160[1]	0.138-0.186
Fields 101-102	0.147[1]	0.129-0.171
Field 103	0.242[1]	0.202-0.290
Field 155	0.271[1]	0.230-0.317
out-of-state populations		
Aroostook, ME	0.045	0.033-0.055
Becker, MN	0.076	0.063-0.089
Bridgewater, ME	0.075	0.053-0.132
C-05, WI	0.203[1]	0.159-0.247
Delaware, DE	0.383[1]	0.268-0.494
Fryeburg-140A, ME	0.204[1]	0.149-0.245
Fryeburg-Jimmy Hill, ME	0.293[1]	0.238-0.343
H-02, WI	0.136[1]	0.113-0.161
H-41, WI	0.176[1]	0.148-0.208
Hancock, WI	0.102[1]	0.083-0.128
Kimberly, ID	0.011	0.008-0.014
Minnesota, MN	0.054	0.043-0.062
Sand Plains, MN	0.096	0.052-0.212
laboratory strains		
Evans	0.597[2]	0.464-0.732
Hadley	4.453[2]	3.597-5.722
New Jersey	0.056	0.048-0.063
NY-Sel	0.205[1]	0.159-0.256
Sloth	0.248[1]	0.216-0.287

[1] significantly greater than LD_{50} value for susceptible New Jersey strain
[2] greater than 10 times the LD_{50} value for susceptible New Jersey strain

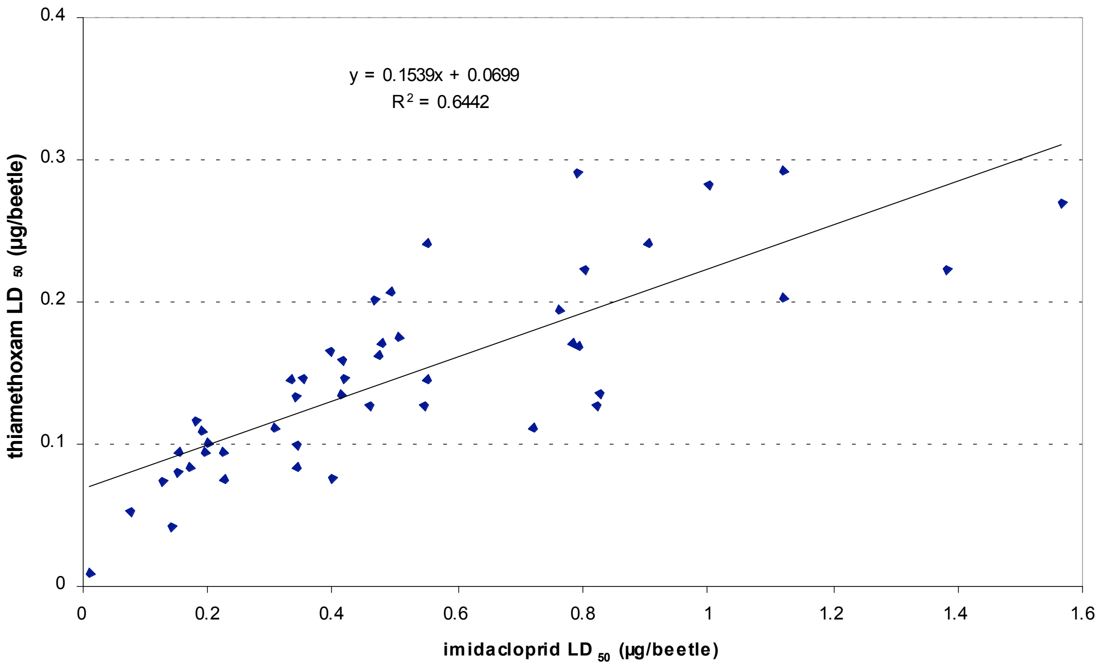


Figure I.4. Correlation between susceptibility to imidacloprid and thiamethoxam for all field populations tested in 2007 (n=48).

II. Field insecticide evaluations of registered and experimental insecticides.

Evaluation of registered and potential insecticides for control of Colorado potato beetle provides data on comparative effectiveness of products and data to support future product registrations.

<u>Methods.</u>

Thirteen insecticide treatments plus an untreated check (Table II.1) were tested at the Michigan State University Montcalm Research Farm, for control of CPB. ‘Atlantic’ seed pieces were planted 12 in. apart, with 34 in. row spacing on 11 May 2007. Treatments were replicated four times in a randomized complete block design. Plots were 50 ft long and three rows wide.

Admire Pro, Platium, and V10170 treatments were applied in-furrow at planting using a single nozzle hand-held boom (30 gpa, 30 psi). Foliar treatments were first applied at greater than 50% egg hatch on 14 June. Subsequent first-generation sprays for most treatments were applied on 21 June, 28 June and 5 July, depending on treatment (Table II.1).

Post-spray counts of CPB Adults, egg masses, small larvae (1st and 2nd instars), and large larvae (3rd and 4th instars) on five randomly selected plants from the middle row of each plot were made 5 to 6 days after each foliar application. On 7 September, the middle row of each plot was harvested mechanically and the total tuber weight was recorded. Data was analyzed using two-way ANOVA (treatment and block) and significant differences were determined with Fisher's Protected LSD test ($p=0.05$).

Results.

The seasonal average number of large larvae was significantly lower in treated plots compared to untreated plots (Table II.1). All treatments resulted in significantly fewer large larvae than the untreated plots. The insecticide treatments kept large larvae below the economic threshold of 1 to 2 large larvae per plant compared to 18 large larvae per plant in the untreated plots. The seasonal average number of egg masses and small larvae, included larvae that had recently hatched and were still on the egg mass, resulting in high variability in these results. All treatments resulted in significantly higher yields than the untreated plots (Table II.2).

The 2007 insecticide evaluations tested several non-neonicotinoid insecticides, and combinations of non-neonicotinoid insecticides, all proved to be to effective for the control of CPB. Although these chemicals may have cost limitations, restrictions in number of applications, and timing of application, they are valuable chemicals to slow CPB resistance to neonicotinoids.

Table II.1. The seasonal average number of first generation Colorado potato beetle adults, egg masses, small larvae, and large larvae per plant.

Treatment/ formulation	Rate	Adults	Egg Masses	Small Larvae	Large Larvae
A15645 (Chili)[6]	5.35 oz/A	0.4a	0.3 def	10.7 bcd	0.1a
A9545C[6]	2.6 oz/A	0.7a	0.1 abcd	11.9 cd	0.1a
Actara[5]	5.5 oz/A	0.3a	0.2 bcde	12.7 de	0.0a
Admire Pro[1]	8.0 fl oz/A	0.3a	0.1 abcd	11.4 bcd	0.0a
Altocor[4]	2.0 oz/A	0.2a	0.1 abc	11.0 bcd	0.6a
Altocor[4]	3.0 oz/A	0.5a	0.2 abcd	10.0 b	0.5a
Alverde[5]	4.5 fl oz/A	0.2a	0.2 abcd	11.4 bcd	1.0a
Alverde then Spintor[5]	4.5 fl oz/A 6.0 fl oz/A	0.4a	0.2 abcd	10.4 bc	1.0a
Platium[1]	8.0 fl oz/A	0.3a	0.04ab	11.0 bcd	0.0a
Rimon[5]	12.0 fl oz/A	1.0a	0.5 g	14.5 e	1.1a
Rimon[2]	6.0 fl oz/A	0.4a	0.4 fg	11.0 bcd	0.6a
Rimon[3]	8.0 fl oz/A	0.6a	0.3 efg	11.0 bcd	0.6a
V10170[1]	12.0 fl oz/A	0.3a	0.02a	11.5 bcd	0.0a
Untreated	------	2.2 b	0.06abc	11.1 bcd	17.9b

Average numbers within a column followed by a different letters are significantly different (P,0.05, Fisher's Protected LSD). Data transformed for analysis with log (x+1), presented in non-transformed units.
[1]Treatments applied in-furrow at planting May 11, 2007
[2]Treatments applied: 14 Jun, 21 Jun, 28 Jun, 5 Jul
[3]Treatments applied: 14 Jun, 21 Jun, 28 Jun
[4]Treatments applied: 14 Jun, 28 Jun, 5 Jul
[5]Treatments applied: 14 Jun, 28 Jul
[6]Treatments applied: 14 Jun

Table II.2. The average yield (lbs/50 row feet) of harvested 'Atlanta' potatoes.

Treatment/formulation	Rate	Total Harvest Weight (lbs)/ 50 row ft.
A15645 (Chili)[6]	5.35 oz/A	58.1 cdef
A9545C[6]	2.6 oz/A	71.1 cdef
Actara[5]	5.5 oz/A	68.9 cdef
Admire Pro[1]	8.0 fl oz/A	68.6 cdef
Altocor[4]	2.0 oz/A	58.1 cdef
Altocor[4]	3.0 oz/A	55.4 cde
Alverde[5]	4.5 fl oz/A	51.0 cd
Alverde then Spintor[5]	4.5 fl oz/A 6.0 fl oz/A	46.2 bc
Platium[1]	8.0 fl oz/A	78.9 ef
Rimon[5]	12.0 fl oz/A	76.8 def
Rimon[2]	6.0 fl oz/A	56.5 cdef
Rimon[3]	8.0 fl oz/A	50.8 cd
V10170[1]	12.0 fl oz/A	81.8 f
Untreated	------	19.0a

Average numbers within a column followed by a different letters are significantly different (P,0.05, Fisher's Protected LSD). Data transformed for analysis with log (x+1), presented in non-transformed units.

[1]Treatments applied in-furrow at planting May 11, 2007
[2]Treatments applied: 14 Jun, 21 Jun, 28 Jun, 5 Jul
[3]Treatments applied: 14 Jun, 21 Jun, 28 Jun
[4]Treatments applied: 14 Jun, 28 Jun, 5 Jul
[5]Treatments applied: 14 Jun, 28 Jul
[6]Treatments applied: 14 Jun

III. Managing neonicitinoid-resistant Colorado potato beetles with trap crops. Now that neonicitinoid resistance is present in CPB populations from Michigan, we must help growers manage resistant CPB without increasing the resistance or encouraging dispersal of resistant individuals (thus spreading the resistance).

For the past three years we have used trap crops and alternative (non-neonicitinoid) insecticides in a crop rotation system to manage resistant CPB and limit dispersal. In 2005 we attracted over 100,000 overwintered adult CPB with an-early planted trap crop. The trap crop was disced down on 1 Jul, before the larvae could mature and enter the ground to pupate. Alternative insecticides were applied only to the trap crop and cost to the grower was less than $600, compared with a cost of $4,500 for treatment of the entire 75-acre potato field. In 2006 we again used trap crops and alternative insecticides to manage neonicitinoid-resistant CPB at this location. Four to eight rows of potatoes were planted early (mid-April) along 5 edges of a rotated field (planted to corn in 2006, planted to potatoes in 2005). The weather conditions in 2006 were not ideal for using trap crops to manage CPB. Cool weather in early May delayed potato growth and Colorado potato beetle emergence. Late in May the weather warmed to much above-normal temperatures. Potatoes (both trap crop and main crop) grew quickly; by mid-June there was no difference in size (or attractiveness) between the trap crop and the main potato field. In addition, the high temperatures meant that CPB emerged from overwintering quickly and in large numbers and many flying beetles were observed. Such conditions are ideal for CPB dispersal. However, the trap crop concentrated most of the beetles during their emergence period and the grower was able to spot-treat the trap crop and the potato field edges with alternative insecticides to control CPB. More marked beetles were found in the trap crop that they were released into than were found in the main potato field. Beetles may have dispersed out of the sampling area, but remained in the trap crop, but these areas were not inspected for marked beetles. The grower was able to control CPB by using a reduce rate of Admire Pro in most of the new potato fields (some fields had no neonicitinoids) at planting. Besides the spot-treatments of the trap crop, the grower used treatments of Agri-Mek in June and July to sections of the fields where needed

In 2007 we again tested trap crops and alternative insecticides for control of resistant CPB. We included different potato varieties in the trap crop to test their relative attractiveness to CPB.

<u>Methods.</u>

A trap crop consisting of four rows of potatoes (cv 'Atlantic') was planted Apr 23 along the edges of fields that were in potatoes in 2006 and were to be planted in corn in 2007. Fields to be planted in potatoes to 2007 were directly across from the trap crop (Figure III.1). On May 3 we established plots within the trap crop; each plot was 10 m long. In each plot we hand-planted a fifth row of trap crop along the inner edge of the existing rows (nearest to the corn so that beetles emerging from the overwintering and walking toward the main crop would encounter this row first. The fifth row consisted of one of three different potato varieties: Atlantic, Dakota Diamond, or NewLeaf. We planted each variety in each of nine plots. The main potato fields were not planted until May 7 -

11. Trap crops emerged well before the main crop and remained larger (and more attractive to beetles) thorough June.

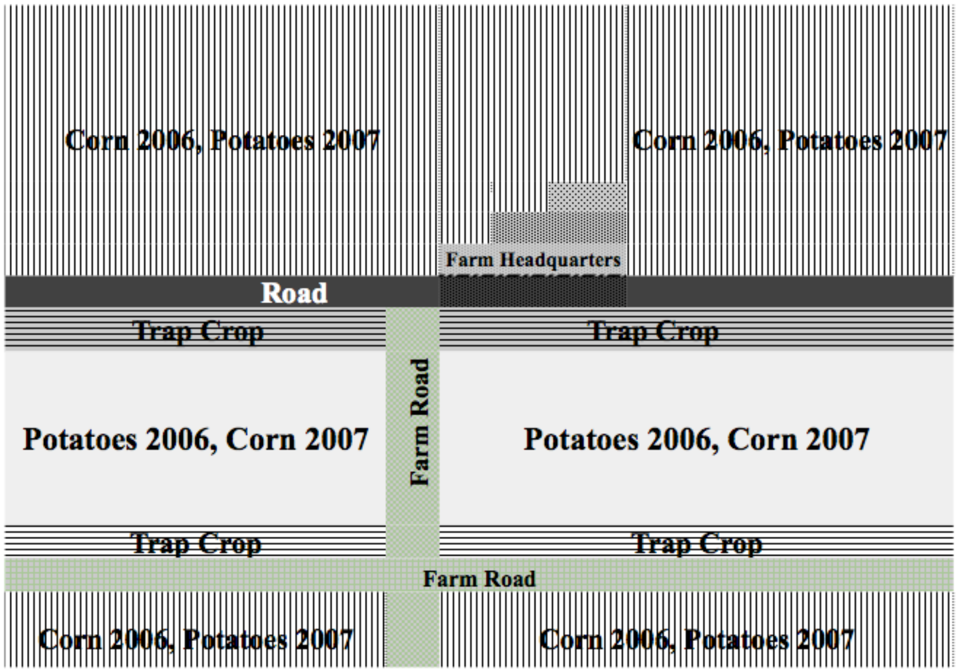


Figure III.1. Map of 2007 trap crop study.

Potatoes in the trap crop plots were searched for Colorado potato beetles one to two times per week from May 25 to June 26, 2007. Areas in the main crop (potatoes 2007) opposite the trap crops were also searched periodically during this period.

To examine the dispersal of beetles from the trap crop we marked and released adult CPB in each plot. Adults were either marked in the field or were collected and transported back to the lab for marking. Beetles were marked on the elytra with felt tipped paint pens (DecoColor, Uchida of America Corp). Marked beetles were released next to the 5th trap crop row (which consisted of Dakota Diamond, Atlantic or NewLeaf potatoes). The color and pattern of each marking denoted the date and location of their release. Beetles were released on 25 May and another group of beetles were released on 6 June.

Each plot in the trap crop was searched for marked beetles on May 30, June 6, June 12 and June 21. When encountered, the color and pattern of each marked beetle found was recorded, dead beetles were collected, but live beetles were left in the plot. The main potato field just opposite each sampling area was also searched for marked beetles on June 12 and 14 and all marked beetles encountered were collected.

Results:
Trap crops attracted overwintered potato beetles emerging from diapause as they walked from the corn to the potato field. Between mid-May and mid-June, beetle densities in the trap crop ranged from ca 10 to 16 beetles per meter of row (Figure III.2). Beetle density peaked on May 30 and then decreased. Unlike in 2006, beetles tended to remain in the trap crop and few dispersed to the main crop; few beetles, marked or unmarked, were

found in the main potato field. Temperatures were more moderate in 2007 compared with those in 2006, and the trap crop remained larger than the main crop throughout the spring and was thus more attractive to CPB. The relatively lower temperatures did not promote much beetle flight. The grower made one application of non-neonicitinoid insecticide (Spintor) to the trap crop rows on June 5. This killed beetles before they could disperse to the main crop and kept the trap crop from getting defoliated. Spintor was again applied to trap crop rows and sections of the main potato field, as needed, on July 3. The trap crop remained attractive until late June.

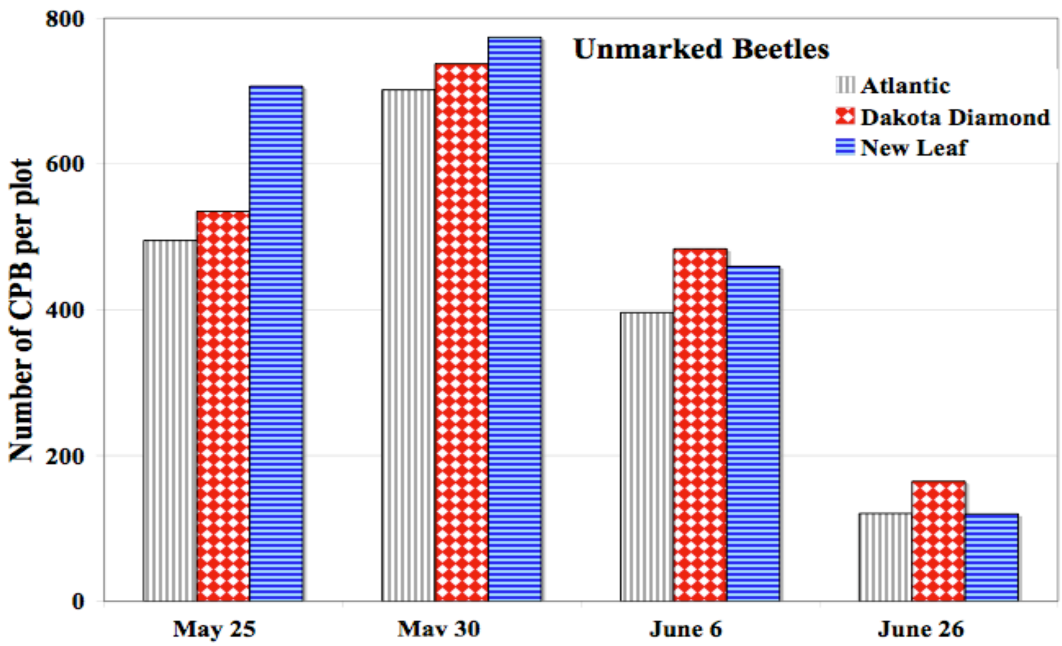


Figure III.2. Number of overwintered Colorado potato beetle adults captured in trap crop plots with different potato varieties planted in the last row.

Almost no marked beetles were found in the main potato crop. Many marked beetles were found in the trap crop (Figure III.3). This proportion varied depending on the potato variety in the plot. Variety is one component of the trap crop system that can be manipulated to maximize effectiveness.

In summary, trap crops attracted and retained overwintered Colorado potato beetles and kept them from colonizing the main potato field. The growing conditions in 2007 enabled the trap crop to remain larger than, and thus more attractive to beetles than, the main potato crop for a considerable period in the spring. Beetles in the trap crop were controlled with targeted applications of non neonicitinoid insecticides. Trap crops reduced selection pressure for insecticide resistance and discouraged dispersal of resistant beetles.

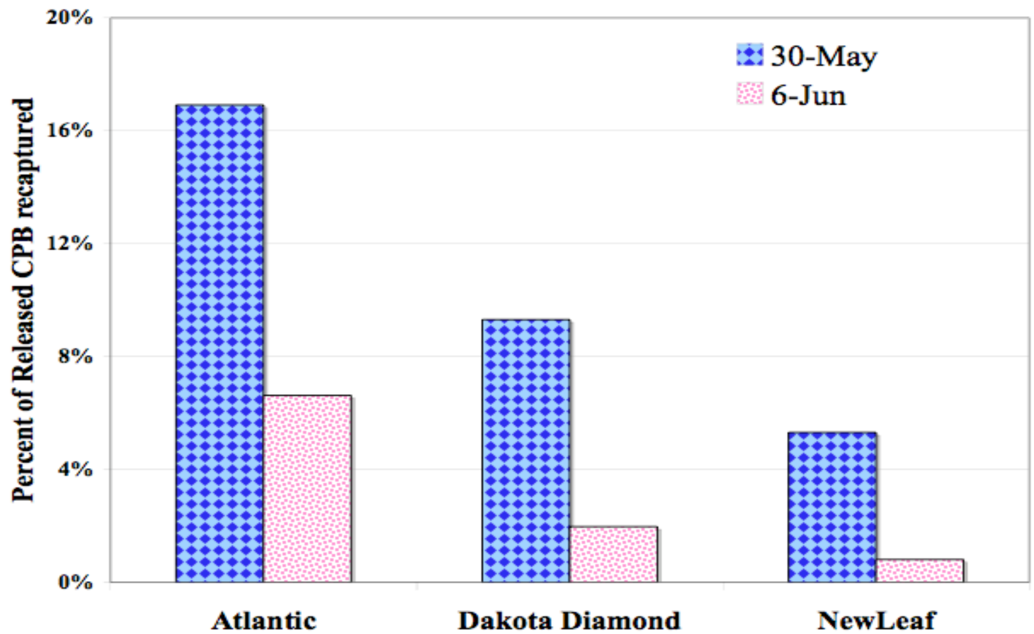


Figure III.3. Proportion of marked beetles released on 25 May into trap crops of different potato varieties that were recaptured in the same plot.

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2007 Potato Research Report
to
Michigan Potato Industry Commission

George W. Bird, Professor
Department of Entomology
Michigan State University

Soil Quality Restoration (BOKS Trial)

In 2003, a soil quality restoration research site was established at the Montcalm Potato Research Farm. This was a cooperative projective with George Bird, Sieglinde Snapp, Willie Kirk and Mark Otto serving as co-principal investigators. The trial consisted of four soil management systems: 1) Fumigated control (wheat/rye/potato), 2) Biofumigant (mustard and rye/sudax/mustard & rye/potato 3) Wheat and mustard (wheat/mustard and rye/potato), and 4) Legume (hairy vetch and rye/soybean green manure/vetch and rye/potato (Table 1) . Each management system was replicated four times at the Montcalm Potato Research Farm.

Table 1. 2004-2007 BOKS Trial management systems.

Treatment	2004	2005	2006	2007
1.	Wheat/Rye	Vapam/Potato	Wheat/Rye	Vapam/Potato
2.	Mus/Rye/Sudax/Rye	Potato	Mus/Rye/Sudax/Rye	Potato
3.	Wheat/Mustard/Rye	Potato	Wheat/Mustard/Rye	Potato
4.	Soybean/Vetch/Rye	Potato	Soybean/Vetch/Rye	Potato

Based on nematode community structure analysis (Appendix A), the overall soil quality was poor at the end of the 2004 growing season (Table 2). There were, however, significant differences among the four management systems. The fumigated system had the highest relative density of fungivores. The biofumigation system had the highest population density of bacterivores and the highest overall absolute density. The legume system had highest relative and absolute population densities of herbivores, leading to a significant negative impact on tuber yield.

Table 2. Nematode community structure [relative (%) and absolute population densities per (100 cm^3 soil)] at end of the first year of the soil quality restoration trial (BOKS Trial) Montcalm Potato Research Farm Soil Quality Restoration Trial.

Nematode Guild (P)	Fumigation	Biofumigation	Wheat/Mustard	Legume
Bacterivores (0.001)	0.75	0.91	0.79	0.68
Fungivores (0.252)	0.15	0.04	0.04	0.08
Herbivores (0.088)	0.03	0.02	0.10	0.21
Omnivores (0.300)	0.07	0.02	0.06	0.04
Carnivores (1.000)	0.00	0.00	0.00	0.00
Absolute Density	59	633	290	391

Tuber yields in 2005 were highly correlated with cover-crop and early-season population densities of root-lesion nematodes (Fig. 1.). The highest nematode population densities (200/g root tissue) and lowest tuber yields (<350 cwt/acre) were associated with the legume system (Fig. 2) . The lowest nematode population densities (very close to 0) and the highest potato tuber yields (438 cwt/acre) were associated with the fumigant system. Yields from the fumigated and bio-fumigated plots, however, were not significantly different from each other.

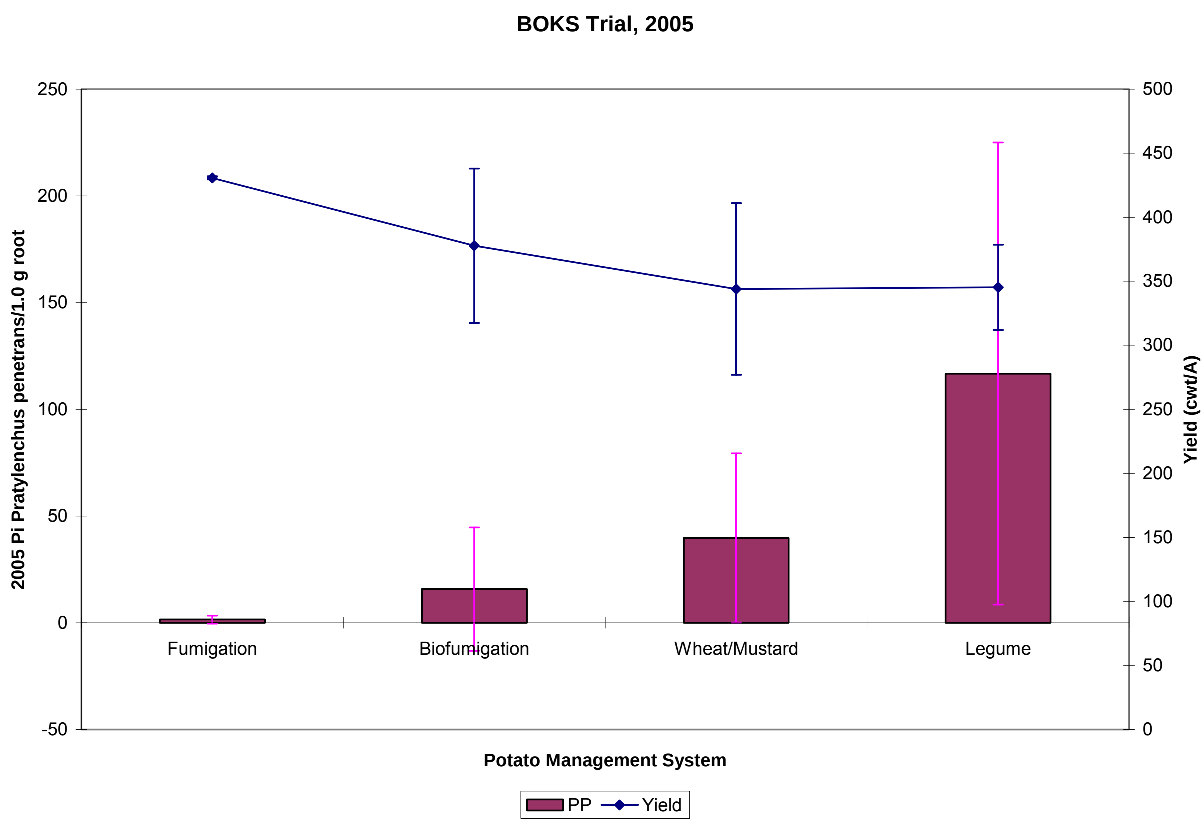
In the 2005 Research Report, it was reported that *the bio-fumigation system looks very promising and will be improved on during the second two-year cycle of the project. The post-fumigation recovery of beneficial nematodes (from a potato production point-of-view) appears to be more rapid with the bio-fumigation than following chemical fumigation with metham. The highest yielding plot (>460 cwt/are) was a bio-fumigation plot (Figure 2). Yields associated with all of the fumigation plots were nearly identical. The low yields in three of the four legume plots, one wheat/mustard plot and one failed bio-fumigation plot were all associated with early-season cover-crop root-lesion nematode population densities greater than 50/1.0 gram of root tissue. Although the bio-fumigation associated with this trial looks very promising, the two-year nature of the trial may be inadequate. It is estimated that at least three cycles of the soil enhancement systems will be required to see a significant improvement in overall soil quality.*

By the end of the 2006 growing season, nematode population densities associated with the Management Systems 2-4 had increased, compared to the 2004 data (Table 3) and those associated with the fumigation treatment were significantly less (P = 0.05) than those associated with the wheat-mustard, biofumigant and legume systems.

Table 3. End of 2006 growing season nematode community structure (absolute population densities) associated with the four BOKS Trial management systems.

Treatment	Total	Bacterivores	Fungivores	Omnivores	Herbivores
1.	755 a	668 a	25 a	38 a	30 a
2.	2019 b	1919 b	45 a	10 a	40 a
3.	2036 b	1930 b	45 a	35 a	40 a
4.	1869 b	1729 b	53 a	60 a	25 a

Figure 1. 2005 potato tuber yields (cwt/A) and root-lesion nematode (*Pratylenchus penetrans*) population densities per 1.0 g cover-crop root tissue at the beginning of the growing season in the soil restoration (BOKS) trial at the Montcalm Potato Research Farm.



The 2007 tuber yields (total, As and jumbos) associated with the soil fumigation management system were significantly greater (P = 0.05) than those associated with the wheat-mustard, biofumigation or legume systems (Table 4). There were no significant difference among the systems for the B grade tubers.

Figure 2. Relationships among 2005 potato tuber yields, early-season root-lesion nematode (*Pratylenchus penetrans*) population densities and management systems.

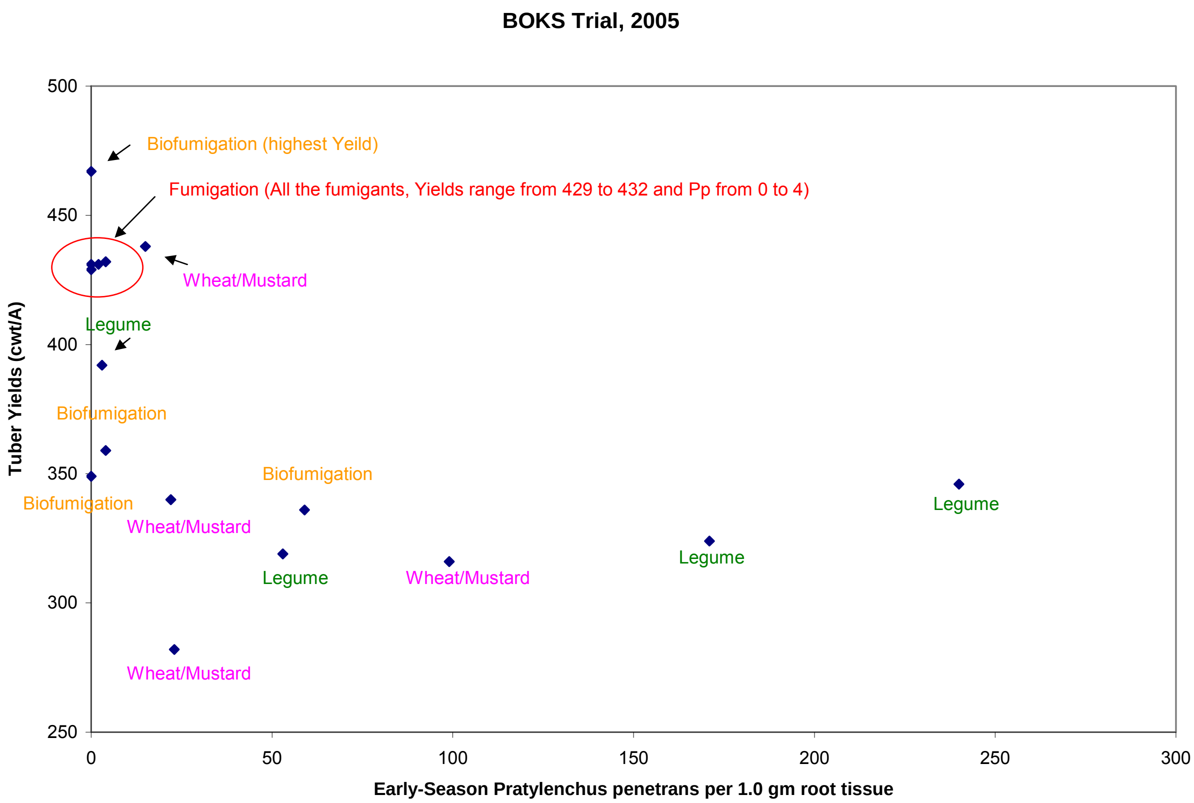


Table 4. 2007 potato tuber yields associated with the BOKS soil management system trial.

Treatment	Yield (cwt/A)	A Grade	Jumbo Grade	B Grade
1.	327 a	285 a	94 a	9 a
2.	231 b	208 b	19 b	9 a
3.	229 b	210 b	15 b	11 a
4.	242 b	216 b	9 b	11 a

The 2007 mid-season root-lesion nematode population density associated with the fumigated system was significantly (P = 0.05) greater than the population densities associated with the biofumigation, wheat-mustard or legume systems (Table 5). In general, scab associated with the fumigated system was lower than that associated with the other management systems (Table 5).

Table 5. 2007 mid-season root-lesion nematode and scab associated with four potato management systems.

Treatment	Root-lesion Nematodes (08)	Scab Index (0-5)
1.	3 a	2.6 a
2.	20 b	3.5 a
3.	11 b	3.6 a
4.	56 c	3.6 a

Cover-Crop/Root-Lesion Nematode Host Assessment

Cover crops can be used in agricultural for many different production system objectives. These include:

- Soil Quality Enhancement (Soil Organic Matter Quality and Quantity)
- Soil Quality Maintenance (SOM Quality and Quantitly)
- Erosion Management
- Crop Nutrition (Nitrogen Fixation, Green Manure)
- Soil Water Enhancement (Decrease in Irrigation Requirements)
- Weed Management (Numerous Mechanisms)
- Non-Hosts (Lowering Plant Pathogen Populations)
- Trap Crops (Trapping and Killing Pathogens)
- Bio-Fumigation (Lowering Plant Pathogen Populations)
- Livestock Grazing
- Hay Crop
- Silage Crop
- Seed Crop

During the past five years it has been learned that selecting the appropriate variety of the cover crop is essential. For example, Michigan sugar beet growers use Adagio or Colonel oil seed radish as a trap crop for management of the sugar beet cyst nematode. These varieties were developed specifically for this purpose. Both are good hosts for the penetrans root-lesion nematode and are not appropriate for use by Michigan potato growers for management of potato early-die.

Because of the diversity of the host range of the penetrans root-lesion nematode, identification of cover crops that are non-hosts for this nematode has been difficult. In 2005, the University of Wisconsin reported that Pearl Millet may have this property. This hypothesis was tested in 2006 at the Montcalm Potato Research Farm in a twelve cover crop trial, with each variety being replicated six times. In this trial, Pearl Millet 444 and Pearl Millet Millex 32 were the poorest hosts for the root-lesion nematode and should have excellent potential for use in Michigan potato production systems (Table 6). This site was planted to corn in 2007. The best early-season corn growth was associated with the pearl millet cover crops (Table 6).

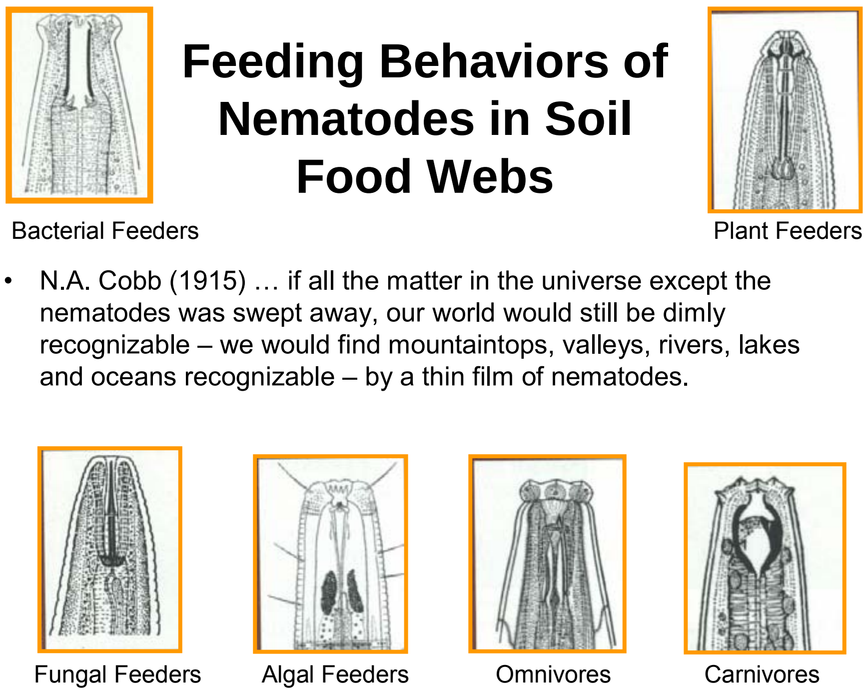
Table 6. 2006 root-lesion nematode reproduction and 2007 corn growth associated with 12 cover crops at the Montcalm Potato Research Farm.

Cover crop	2006 Root –lesion	2007 Corn Growth Index (1-4)
Millet pearl 444	3	**3.5**
Millet Pearl Millex 32	5	**4.0**
Millet Pearl Leafy 23	14	**4.0**
White Mustard	10	2.0
Mustard Mix	34	3.0
Yellow Mustard	37	1.5
Mustard Bio-Fumigation Blend	26	1.8
Oil Seed Radish, Common	21	2.8
Oil Seed Radish, Colonel	53	2.3
Rape	60	2.0
Sudax	16	3.3
Wheeler Rye	155	2.5

Summary

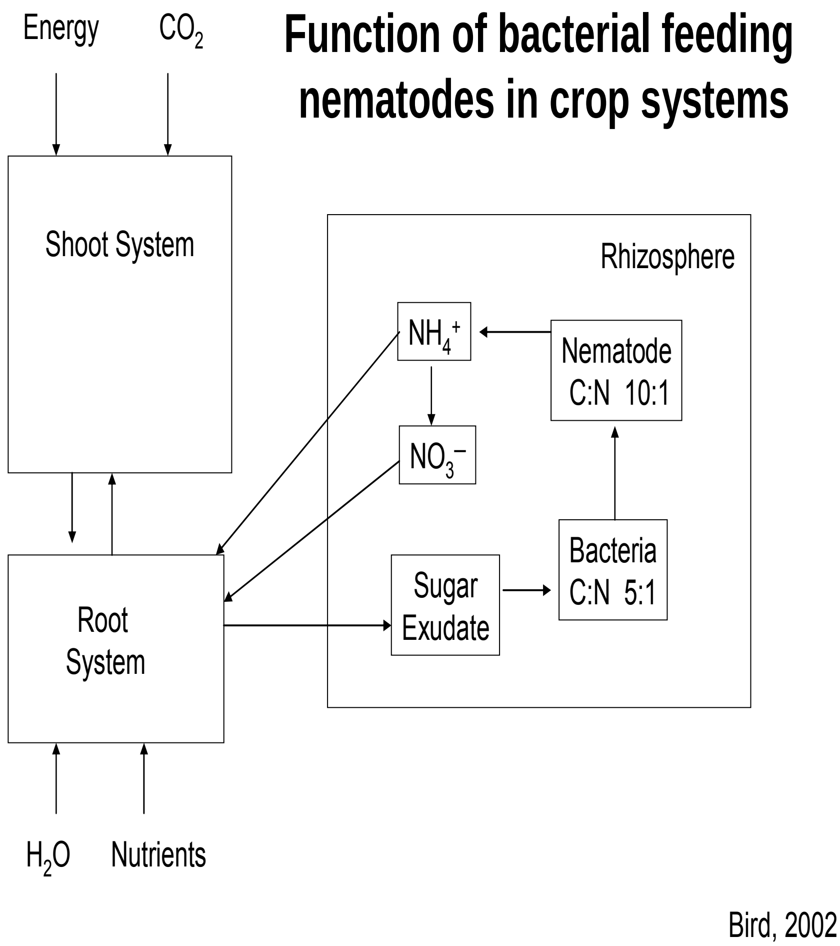
The BOKS Trial was an excellent research investment. It was shown that it takes more than two years to significantly enhance the overall quality of soil It was also demonstrated that proper cover crop selection and management is imperative to obtain the desired system objectives from these plants. Much has been learned about soil quality and associated management systems during the past five years. Much, however, remains to be learned. The BOKS Trial has set the environment for the next stage of development associated with the long-term development and maintenance of soil, an essential natural resource. It also provides a foundation for the future work of the Michigan Potato Industry and its future work with Dr. Grandy, the new Assistabnt Professor of Soil Biology at Michigan State University.

Appendix A. Today, modern science estimates that four out of every five animals currently alive on our planet are nematodes. Their feeding behaviors are highly diverse as indicated in the following illustration (modified from the 2005 and 2006 Annual Reports).



The bacterial and fungal feeding nematodes are of major significance in agriculture because of their role in making soil nutrients available for plant growth and development. As illustrated in the following figure, nitrogen mineralization takes place in the immediate root environment (rhizosphere) where it is taken up and used by the plant before having the opportunity to be transformed and transported to other parts of the environment, such as groundwater or the atmosphere.

Appendix A (continued)



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Recent research shows that nematode community structure varies greatly among different types of Michigan ecosystems. In 2006, a Nematode Community Structure Standard was developed and is being used for assessment of soil quality. In the following figure, the numbers in the bottom row represent the total nematode population density present (number of nematode) present in a cup of soil, for each of four different ecosystems (wood lot, old field succession, conventional agriculture, organic agriculture). The other numbers in each column represent the % of the population in each of the six different feeding behavior groups for each specific ecosystem. More than 50% of the nematodes associated with the conventional corn-soybean system were plant root feeders and very few bacterial or fungal feeding nematodes detected. This is not a desirable situation.

Appendix A (continued)

Nematode Community Structure
Michigan Relative Density Standard

(G.W.Bird, based on the Works of J. Smith and M. Berney)

Feeding Behavior	Woodlot	Old Field Succession	High Soil Quality	Poor Soil Quality
 Bacterivore	51	83	73	28
 Fungivore	18	7	26	14
 Herbivore	28	7	0.6	57
 Omnivore	3	2	0.2	0.2
 Carnivore	1	1	0.003	0.05
 Algavore	NA	0.03	NA	NA
Absolute Density	500	1700	3500	200

Funding: MPIC and NPC

Evaluation and comparison of biofungicides and fungicides for the control of post harvest potato tuber diseases.

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Summary
Potatoes are susceptible to a variety of storage pathogens, including late blight (*Phytophthora infestans*), Fusarium dry rot (*Fusarium sambucinum*), Pythium leak (*Pythium ultimum*), tuber soft rot (*Erwinia* spp.), and silver scurf (*Helminthosporium solani*). Current recommendations for potato storage diseases include sanitation and exclusion as the primary controls for these pathogens in storage facilities. No fungicides are registered for direct application to tubers for control of these important pathogens and few compounds are available for potato tuber treatment in storage, including chlorine-based disinfectants such as, sodium hypochlorite, calcium hypochlorite and chlorine dioxide. In recent years several new biofungicides based on the biocontrol bacteria *Bacillus subtilis* Serenade) and *B. pumilis* (Sonata) have been registered or are awaiting EPA approval for use on potato, and have shown promise in the control of seed and soil borne diseases such as late blight, black scurf and pink rot. None of these products has been evaluated for the control of these pathogens under post-harvest potato tuber storage conditions. Thus, studies were initiated to evaluate the efficacy of these biofungicides for the control of potato storage pathogens under post-harvest conditions. For a comparison, several commercial storage products Phostrol (sodium, potassium and ammonium phosphates), and Oxidate (hydrogen dioxide) and experimental treatment Quadris (azoxystrobin) were evaluated for their effectiveness under storage conditions. Preliminary results show that in general conventional fungicide Quadris provided the most effective disease control. The biofungicides provided more limited control. However, in all cases results for the biofungicides were not significantly different from those for Quadris. In the case of *Pythium*, the biofungicides were as effective in controlling disease as Quadris and results were not significantly different from the non-inoculated control.

Introduction
Potatoes are susceptible to a variety of storage pathogens, including late blight (*Phytophthora infestans*), Fusarium dry rot (*Fusarium sambucinum*), Pythium leak (*Pythium ultimum*), pink rot (*Phytophthora erythroseptica*) and tuber soft rot (*Erwinia* spp). These pathogens are of major concern to potato producers due to the great losses they cause in stored potatoes. Current recommendations for potato storage diseases include sanitation and exclusion as the primary controls for these pathogens. No fungicides are registered for direct application to tubers for control of these pathogens and few compounds are available for potato tuber treatment in storage. In recent years, several new biofungicides based on the biocontrol bacteria *Bacillus subtilis* (Serenade) and *B. pumilis* (Sonata) have been registered or are awaiting EPA approval for use on potato. These have shown promise in the control of seed and soil borne diseases such as late blight and pink rot. Neither of these products has been evaluated for the control of potato storage pathogens under post-harvest conditions. Thus, studies were initiated to evaluate the efficacy of these biofungicides under post-harvest storage conditions. For a comparison, several commercial storage products Oxidate (hydrogen dioxide), and Phostrol (sodium, potassium and ammonium phosphates) and experimental treatment Quadris (azoxystrobin) were evaluated for their effectiveness under storage conditions.

Materials and Methods
Experiments were carried out in November 2006 with potato cultivar “FL1879”. Potatoes free from visible diseases were selected for the trials from tubers harvested in October 2006. Tubers were

prepared for inoculation by grazing with a single light stroke with a wire brush, sufficient to abrade the skin of the tubers to a depth of 0.01 mm. Solutions (1 x 10^3/ml) of sporangia/zoosporangia of *P. infestans* (late blight), oospores/sporangia of *P. erythroseptica* (pink rot), oospores of *P. ultimum* (Pythium leak), macroconidia of *F. sambucinum* (dry rot) and bacterial cells of *E. carotovora* (soft rot) were prepared from cultures of the pathogens previously isolated from potato tubers in Michigan. All pathogens were grown on PDA for 10 days prior to preparation of inoculum solutions. Two non-treated controls, either inoculated with one of the pathogens or non-inoculated were included in the trial. Damaged tubers, (10/replicate/treatment; total 40 tubers/treatment) were sprayed with 10 ml of pathogen suspension, for a final dosage of about 0.25 ml per tuber. Tubers were stored for 24 h after inoculation at 20°C before treatment. Fungicides were applied as liquid treatments in a water suspension with a single R&D XR11003VS spray nozzle at a rate of 1L/ton at 50 psi onto the tuber surfaces, with an entire seed surface being coated in the seed treater. After inoculation, tubers were incubated in the dark in plastic boxes at 12°C for 60 days. Tubers were cut open and the number of tubers with symptoms or signs of the individual pathogens were counted to determine incidence of disease. Disease severity was assessed using a disease severity index. Disease severity classes were determined as class 0 = 0%; 1 = 1 - 10%; 2 = 11 - 20%; 3 = 21 - 50; 4 > 51 – 100% internal area of tuber tissue with disease. The disease severity index was then calculated as the number in each class multiplied by the class number and summed. The sum was then multiplied by a constant to express severity on a 0 – 100 scale. Data were analyzed using analysis of variance and the Tukey's LSD test in JMP (SAS Institute, NC).

Results and Conclusions

In the late blight studies (Table 1) all of the treatments had a significantly lower incidence of disease and mean disease severity index than the inoculated/not-treated check. There was no significant difference among any of the treatments and the untreated/not-inoculated check (Table 1). No disease was observed in any of the not-inoculated treatments. Overall, disease incidence and severity was low even in the inoculated check (Table 1). In the Pythium leak experiment (Table 2), all of the not-inoculated treatments were not significantly different from then inoculated check. Inoculated treatments treated with Oxidate or Quadris were significantly different from the inoculated/not-treated check and not significantly different from the untreated check. Phostrol, Serenade (high and low) and Sonata all had disease incidences and a mean disease index that was not significantly different from the inoculated/not-treated check, with the highest disease incidence occurring in the low rate Serenade treatment. Quadris provided the best disease control. In the Fusarium dry rot experiments (Table 3), all of the treatments had a significantly lower disease index than the inoculated check and were not significantly different to the untreated check. However, mean disease incidence in the inoculated biofungicide treatments Sonata, and Serenade (high rate), were not significantly different to the inoculated/not-treated check. Phostrol and Oxidate provided the best disease control followed closely by Quadris. In the pink rot experiments (Table 4), no disease was found in any of the not-inoculated treatments and the untreated/not-inoculated check. Disease incidence and severity in the inoculated/not-treated check was relatively low. The inoculated Sonata and Serenade (low) treatments were not significantly different from the inoculated/not-treated check. Disease incidence in all other inoculated treatments was close to zero and not significantly different from the untreated/not-inoculated check. Overall in this study, Serenade and Sonata provided limited control of potato storage diseases, while treatment with Oxidate, Phostrol and Quadris provided effective disease control.

Funding: MPIC and NPC

Table 1. Percentage of tubers in each disease severity class, the mean potato late blight severity indices and disease incidences 120 days after treatment with fungicides/biofungicides.

Treatment (rate/cwt)[1]	Inoculation[2]	Percentage of tubers in each disease severity class[3] Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Mean Severity Index[4]	Mean disease incidence
Untreated check	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0 c[5]	0.0 b
Inoculated check	+	77.5	0.0	5.0	8.8	3.8	5.0	15.3 a	22.5 a
Sonata (0.32)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0 c	0.0 b
	+	93.8	0.0	0.0	1.3	0.0	5.0	5.8 b	6.3 b
Serenade High (0.32)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0 c	0.0 b
	+	95.0	0.0	0.0	2.5	0.0	2.5	4.0 bc	5.0 b
Serenade Low (0.16)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0 c	0.0 b
	+	97.5	0.0	0.0	2.5	0.0	0.0	1.5 bc	2.5 b
Phostrol (2.56)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0 c	0.0 b
	+	96.3	0.0	0.0	1.3	0.0	2.5	3.3 bc	3.8 b
Oxidate (0.125)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0 c	0.0 b
	+	97.5	0.0	0.0	2.5	0.0	0.0	1.5 bc	2.5 b
Quadris (0.125)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0 c	0.0 b
	+	100.0	0.0	0.0	0.0	0.0	0.0	0.0 c	0.0 b

[1] The rate of product in fl. oz. (oz. for Quadris) per hundredweight seed tubers applied in mixture with water at 2 L/ton.
[2] "+" tubers were inoculated; "–" tubers were not inoculated immediately after wounding.
[3] Severity classes were determined as class 0 = 0%; 1 = 1 - 10%; 2 = 11 - 20%; 3 = 21 - 50%; 4 > 51 – 100% internal area of tuber tissue with disease.
[4] The severity index is the number in each class multiplied by the class number and summed. The sum is then multiplied by a constant to express severity on a 0 – 100 scale.
[5] Mean values of diseased tubers within a column followed by the same letter are not significantly different at *p* = 0.05 (Tukey test).

Table 2. Percentage of tubers in each disease severity class, the mean Pythium leak severity indices and disease incidences 120 days after treatment with fungicides/biofungicides.

Treatment (rate/cwt)[1]	Inoculation[2]	Percentage of tubers in each disease severity class[3] Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Mean Severity Index[4]	Mean disease incidence
Untreated check	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0 d[5]	0.0 e
Inoculated check	+	65.0	1.3	2.5	2.5	11.3	17.5	29.3 ab	35.0 a
Sonata (0.32)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0 d	0.0 e
	+	63.8	0.0	0.0	0.0	13.8	22.5	33.5 a	36.3 a
Serenade High (0.32)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0 d	0.0 e
	+	72.5	0.0	0.0	0.0	5.0	22.5	26.5 ab	27.5 ab
Serenade Low (0.16)	–	98.8	0.0	0.0	0.0	0.0	1.3	1.3 d	1.3 de
	+	60.0	0.0	0.0	3.8	8.8	27.5	36.8 a	40.0 a
Phostrol (2.56)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0 d	0.0 e
	+	78.8	0.0	0.0	1.3	6.3	13.8	19.5 bc	21.3 bc
Oxidate (0.125)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0 d	0.0 e
	+	86.3	1.3	0.0	1.3	3.8	7.5	11.5 cd	13.8 cd
Quadris (0.125)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0 d	0.0 e
	+	95.0	0.0	0.0	0.0	0.0	5.0	5.0 d	5.0 de

[1] The rate of product in fl. oz. (oz. for Quadris) per hundredweight seed tubers applied in mixture with water at 2 L/ton.
[2] "+" tubers were inoculated; "–" tubers were not inoculated immediately after wounding.
[3] Severity classes were determined as class 0 = 0%; 1 = 1 - 10%; 2 = 11 - 20%; 3 = 21 - 50%; 4 > 51 – 100% internal area of tuber tissue with disease.
[4] The severity index is the number in each class multiplied by the class number and summed. The sum is then multiplied by a constant to express severity on a 0 – 100 scale.
[5] Mean values of diseased tubers within a column followed by the same letter are not significantly different at *p* = 0.05 (Tukey test).

Table 3. Percentage of tubers in each disease severity class, the mean Fusarium dry rot severity indices and disease incidences 120 days after treatment with fungicides/biofungicides.

Treatment (rate/cwt)[1]	Inoculation[2]	Percentage of tubers in each disease severity class[3] Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Mean Severity Index[4]		Mean disease incidence	
Untreated check	–	91.3	0.0	3.8	0.0	2.5	2.5	6.0	bcd[5]	8.8	cd
Inoculated check	+	43.8	6.3	27.5	0.0	17.5	5.0	31.3	a	56.3	a
Sonata (0.32)	–	81.3	7.5	10.0	1.3	0.0	0.0	6.3	bcd	18.8	bcd
	+	65.0	10.0	25.0	0.0	0.0	0.0	12.0	bc	35.0	ab
Serenade High (0.32)	–	80.0	11.3	8.8	0.0	0.0	0.0	5.8	bcd	20.0	bcd
	+	67.5	8.8	16.3	5.0	2.5	0.0	13.3	b	32.5	abc
Serenade Low (0.16)	–	88.8	8.8	2.5	0.0	0.0	0.0	2.8	cd	11.3	bcd
	+	68.8	8.8	15.0	6.3	0.0	1.3	12.8	b	31.3	bc
Phostrol (2.56)	–	96.3	2.5	1.3	0.0	0.0	0.0	1.0	d	3.8	d
	+	90.0	1.3	6.3	2.5	0.0	0.0	4.3	bcd	10.0	cd
Oxidate (0.125)	–	95.0	1.3	3.8	0.0	0.0	0.0	1.8	d	5.0	d
	+	87.5	1.3	10.0	1.3	0.0	0.0	5.0	bcd	12.5	bcd
Quadris (0.125)	–	97.5	2.5	0.0	0.0	0.0	0.0	0.5	d	2.5	d
	+	78.8	0.0	17.5	3.8	0.0	0.0	9.3	bcd	21.3	bcd

[1] The rate of product in fl. oz. (oz. for Quadris) per hundredweight seed tubers applied in mixture with water at 2 L/ton.
[2] "+" tubers were inoculated; "–" tubers were not inoculated immediately after wounding.
[3] Severity classes were determined as class 0 = 0%; 1 = 1 - 10%; 2 = 11 - 20%; 3 = 21 - 50%; 4 > 51 – 100% internal area of tuber tissue with disease.
[4] The severity index is the number in each class multiplied by the class number and summed. The sum is then multiplied by a constant to express severity on a 0 – 100 scale.
[5] Mean values of diseased tubers within a column followed by the same letter are not significantly different at $p = 0.05$ (Tukey test).

Table 4. Percentage of tubers in each disease severity class, the mean pink rot severity indices and disease incidences 120 days after treatment with fungicides/biofungicides.

Treatment (rate/cwt)[1]	Inoculation[2]	Percentage of tubers in each disease severity class[3] Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Mean Severity Index[4]		Mean disease incidence	
Untreated check	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0	c	0.0	d
Inoculated check	+	81.3	1.3	13.8	3.8	0.0	0.0	8.0	a	18.8	a
Sonata (0.32)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0	c	0.0	d
	+	87.5	0.0	10.0	2.5	0.0	0.0	5.5	a	12.5	ab
Serenade High (0.32)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0	c	0.0	d
	+	90.0	0.0	6.3	3.8	0.0	0.0	4.8	ab	10.0	bc
Serenade Low (0.16)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0	c	0.0	d
	+	80.0	3.8	12.5	3.8	0.0	0.0	8.0	a	20.0	a
Phostrol (2.56)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0	c	0.0	d
	+	96.3	0.0	3.8	0.0	0.0	0.0	1.5	bc	3.8	cd
Oxidate (0.125)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0	c	0.0	d
	+	96.3	0.0	3.8	0.0	0.0	0.0	1.5	bc	3.8	cd
Quadris (0.125)	–	100.0	0.0	0.0	0.0	0.0	0.0	0.0	c	0.0	d
	+	98.8	0.0	1.3	0.0	0.0	0.0	0.5	c	1.3	d

[1] The rate of product in fl. oz. (oz. for Quadris) per hundredweight seed tubers applied in mixture with water at 2 L/ton.
[2] "+" tubers were inoculated; "–" tubers were not inoculated immediately after wounding.
[3] Severity classes were determined as class 0 = 0%; 1 = 1 - 10%; 2 = 11 - 20%; 3 = 21 - 50%; 4 > 51 – 100% internal area of tuber tissue with disease.
[4] The severity index is the number in each class multiplied by the class number and summed. The sum is then multiplied by a constant to express severity on a 0 – 100 scale.
[5] Mean values of diseased tubers within a column followed by the same letter are not significantly different at $p = 0.05$ (Tukey test).

Funding: MPIC

Summary Report for the 2006-2007 Dr. B. F. (Burt) Cargill Potato Demonstration Storage

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Introduction

This is a summary report of the 2006-2007 Dr. B.F. (Burt) Cargill Potato Demonstration Storage Annual Report Volume 6. This report is designed to provide a short summary of the 2006-2007 storage committee activities. To obtain a copy of the full 2006-2007 Demonstration Storage Report please contact the Michigan Potato Industry Commission office (517-669-8377) or Chris Long at Michigan State University (517-355-0271 ext.#193). The full report will be provided to you free of charge.

Goals and Objectives

The 2006 growing season resulted in above average specific gravity with strong overall yields. The early part of the growing season was cool and wet with a warm and humid summer. The harvest season was generally cold and wet causing severe breakdown in storage resulting in above average losses.

The goal of the MPIC Storage and Handling Committee for the 2006-2007 bulk bin storage season was to develop more in-depth storage profiles on three commercially available varieties. They were MegaChip, Monticello and Beacon Chipper. MegaChip has shown susceptibility to above average levels of external defects. These defects result in detrimental sugar accumulation which intern results in defects in the finished chips. Because of this, our objectives were to manage the accumulation of internal sugars around these external defects through the utilization of pile temperature and fresh air volume. Our second variety of interest was Monticello. The objective for this variety during this storage season was to precondition one bulk bin and recondition the other bin prior to shipping in late May or early June. Two bulk bins of Beacon Chipper were stored in 2006. One bin from Sandyland Farms and the other from Sackett Acres. The variety has performed well in the storage facility for three consecutive years. The storage committee was interested in comparing grower practices and observing if grower specific practices appeared to affect the storage quality of this variety. All bins were treated with CIPC on October 24th and December 20th, 2006.

Results for the 500 cwt. Bulk Bins:

MegaChip Bulk Bin 2. These potatoes were planted on April 22, 2006 and harvested on September 18, 2006 at 67.0 ºF pulp temperature. The potatoes were grown at Crooks Farms and were received with an 84% bruise free rating. The sucrose rating rose from 0.529 at harvest to 0.694 in early November, at which point a steady decline was recorded until the first of January, 2007. The sucrose rating rose from 0.421 in January to 0.651 in mid February, at which point the potatoes were processed at Utz Quality Foods in Hanover, PA. From October 2006 until shipment in 2007 the percent glucose remained steady at 0.002. The variety averaged over 10 percent total chip defects during storage evaluation. The load, when processed at Utz, scored 1 percent external and 3 percent internal defects in the finished product with an AGTRON score of 61.6. The storage temperature of this bin in late September was 58.2 ºF and trended downward to 54.8 ºF in mid February when the bin was sold. MegaChip has many positive agronomic traits; yield, scab tolerance, vine vigor and high specific gravity. Given this varieties slower respiration rate and high specific gravity, it was a challenge to precondition and store with confidence. There was a great concern with the amount of internal and external defects present as to whether this bin would process acceptably. The bin did process acceptably, but much reservation was had about the storability of this variety. We will continue to attempt to expand our confidence in this variety in the future.

Monticello Bulk Bin 3. The results of this preconditioning and reconditioning study were mixed. The potatoes in bulk bins #3 and #4 were from Sackett Potatoes and were planted May 3, 2006. They were harvested October 6th and loaded into the storage bins the following day at 55 ºF. Bins 3 and 4 were 79 and 74 percent black spot bruise free, respectively. The Monticello in bulk bin 3 had a sucrose rating of 0.705 in late October, 2006 which declined steadily to 0.462 in mid February, 2007. The percent glucose was high during the first three months in storage and then declined to 0.003 percent glucose on the 12th of February. The pile temperature was kept warm at 55 ºF to precondition the potatoes, but in doing so, multiple spots of potato soft rot advanced to the point that the bin needed to be moved before the bin was lost. Total chip defects declined from over 30 percent in late October, 2006 to 6.1 percent on the day of shipping in February, 2007. The variety was able to be preconditioned, but due to carryover of field vine rot and the tubers being stored at warmer temperatures, the soft rot in the bin resulted in premature marketing. This bin was processed at Utz on February 14, 2007 with a total of 5 percent defects and an AGTRON score of 63.5.

Monticello Bulk Bin 4. The potatoes in this bin were identical to those in bin #3. Our desire was to cool the tubers as soon as possible to extend storage life and then recondition in the Spring prior to shipping, similar to commercial practices for the Snowden variety. After two months in storage at 55 ºF this variety was cooled to 50 ºF over a four week period. The ending storage temperature was 50.0 ºF on the 26th of February when this bin was shipped to Utz Quality Foods. The sucrose rating and percent glucose were sporadic through the cooling period and appeared to be unstable most of the season. At the date of shipping, the sucrose rating and percent glucose were 0.396 and 0.002 respectively, which appeared to be more representative of a typical storage variety at this point in the season. Total chip defect levels were 5 percent on the 26th of February, 2007. The variety appeared to cleanup just prior to shipping. The Monticello's in this bin began exhibiting areas of wet break down and were sold prematurely also. They were processed at Utz on February 28th with 8 percent total defects and an AGTRON score of 64.2.

Beacon Chipper (Sandyland) Bulk Bin 5. The Beacon Chipper's that were in bulk bin #5 were grown by Sandyland Farms, LLC. They were planted April 28, 2006, harvested September 17, 2006 and loaded into storage the following day at 61.0 ºF. These potatoes were 86 percent black spot bruise free at the time of bin loading. From past storage profiling we knew that Beacon Chipper would maintain good storage quality until late February. The sucrose rating at harvest was 0.731 with a 0.002 percent glucose value. The sucrose rating declined to a low of 0.381 in early December of 2007 with a 0.002

percent glucose value. The pile temperature was cooled from 58.0 ºF in late September to 50 ºF by early January, 2007. The pile temperature remained at 50.0 ºF until shipping on February 14th, 2007. This bin averaged around 10 percent chip defects during the storage season. The bin was processed at Herr's Foods, Knottingham, PA on February 15, 2007 with a total of 17 percent chip defects recorded at the plant. Most of the defects were a result of pressure bruise and internal shading. The bin recorded a 62.1 AGTRON score with a 1.074 specific gravity and a 2.0 SFA score. Overall, the bin stored and processed well. This variety appears to works well in the late "out of the field" or early storage market window.

<u>Beacon Chipper (Sackett Acres) Bulk Bin 6.</u> The potatoes in bin 6 were grown at Sackett Acres, Inc. They were planted April 27th, 2006, harvested September 21st, 2006 and loaded into storage the following day at 61.0 ºF. The potatoes were received with an 88 percent black spot bruise free rating. The potatoes were received with a moderate amount of surface scab. The sucrose rating at harvest was 0.882 with a 0.002 percent glucose value. The sucrose level declined to 0.554 in mid November with the percent glucose value remaining flat at 0.002. The pile temperature at this time was 53.9 ºF. As the pile temperature was cooled to 49.0 ºF in mid January, sucrose levels rose to a high of 0.654. After five weeks at 49.0 ºF the sucrose rating declined to 0.443 with a percent glucose value of 0.001 at the time of shipping. Total chip defect at the time of shipping was 0.0 from our storage testing. Herr's reported a 60.9 AGTRON score and a 2.0 SFA score with a 1.074 specific gravity. Herr's defects were much higher than reported at the storage due to the amount of surface scab observed at the plant. Overall, bulk bin 5 and 6 processed similarly even though they were grown under different production practices.

<u>Promising Varieties In the Box Bin Trial</u>:

Varieties that looked promising in the Box Bin trial (Bin 1) in 2006 for long term storage were Monticello, CO95051-7W, MSJ126-9Y, MSJ147-1 and MSJ316-A. These varieties will be considered for larger scale evaluations in the 2007-2008 storage season.