MICHIGAN STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
IN COOPERATION WITH THE MICHIGAN POTATO INDUSTRY COMMISSION

2004 Michigan Potato Research Report

Left to Right: Ben Kudwa, MPIC; Caryn Owens, SME; Gary Dannemiller, SME; Dick Crawford, MSU; State Senator Alan Cropsey, Craig Starkweather, Chief of Staff for Senator Cropsey and Dr. Dave Douches, MSU.
See inside cover letter for photo details.

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2004 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 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 13 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 and disease resistance. 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 and early die), 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 material 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 and the Michigan Potato Industry Commission (MPIC)-funded construction of the B.F. (Burt) Cargill Demonstration Storage adjacent to 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 reported in the annual Potato Variety Evaluation Report.

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 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 12 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, lowering glycoalkaloids (*STG*), and drought resistance (*CBF1*). 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 2004 field season, progeny from over 600 crosses were planted and evaluated. Of those, the majority were crosses to select for round whites (chip-processing and tablestock), with the remainder to select for yellow flesh, long/russet types, red-skin, and novelty market classes. 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 2004 harvest, 1055 selections were made from the 40,000 seedlings produced. Following harvest, specific gravity was measured and potential chip-processing selections were chipped out of the field. All potential chip-processing selections will be tested in January or March 2004 directly out of 42°F and 50°F storages. Atlantic (50°F chipper) and Snowden (45°F chipper) are chipped 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, 220 and 90 selections were made, respectively. **Table 1** lists some of the potential lines for grower trials in year 2005.

Chip-Processing

About 60% of the single hill selections have a chip-processing parent in their pedigree. Of those selections chipped out of the field, about 85% have a SFA chip score of 1.5 or less. 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 MSG227-2 (scab resistant 45°F chipper), MSH095-4, MSJ036-A (scab resistant), MSH228-6 (moderate scab resistance), MSJ147-1, MSJ126-9Y (moderate scab resistance), MSJ316-A (moderate scab resistance), MSK061-4 (moderate scab resistance) and late blight resistant chipper MSJ461-1.

Dr. Joe Sowokinos, Univ. of Minnesota, has conducted biochemical analyses of our best chipping lines and has discovered that our lines differ from older varieties in their proteins (UGPase) involved in chipping. Some of these lines are MSJ147-1, MSG227-2 and MSJ126-9Y. Moreover, MSJ147-1 and MSJ126-9Y have the desirable levels of acid invertase to chip process from colder storage. His analysis will also allow us target specific crosses to find improved chip-processing varieties that will allow processing from colder storage temperatures.

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. 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 2004, while others were tested under replicated conditions at the Montcalm Research Farm. Promising tablestock lines include MSE221-1 as a scab resistant tablestock, MSI049-A, a bruise resistant round white with red splashes around the eyes, and N084-11, a round white with a smooth round shape and bright skin. We have a number of tablestock selections with late blight resistance. These are MSK128-A, MSL006-AY, MSL072-C, MSL179-AY, MSM171-A and MSM224-1. MSL211-3 has late blight and scab resistance. In addition, all these clones performed well in the dry land trial at Montcalm Research Farm such as Boulder and Michigan Purple and MSJ461-1. MSE192-8RUS and MSA8254-2BRUS are two russet table selections that have scab resistance, while MSL794-BRUS has late blight resistance. MSI005-20Y and MSJ033-10Y are yellow-fleshed lines with smooth round appearance and high yield potential.

At the Great Lakes Expo the MPIC sponsored a booth where we helped promote the sale of Michigan Purple and Jacqueline Seed to the roadside stand and farm market operations.

Disease and Insect Resistance Breeding

Disease screening for scab has been an on-going process since 1988. Results from the 2004 MSU scab nursery indicate that 53 of 158 lines evaluated demonstrated little to no infection to common scab. In addition, 19 other MSU breeding lines showed moderate scab resistance. The limitation of breeding for scab resistance is the reliance on the scab nursery. The environmental conditions can influence the infection each year, thus multiple year data provides more reliable data. A laboratory-based screening process is currently under development that would use thaxtomin in tissue culture to expedite selection of material with potential scab resistance. In 2004, we expanded the scab nursery with an additional acre of land nearby. For three years we inoculated the field with *Streptomyces scabies* and grew scab susceptible cultivars. After 2003 we determined that the infection level was high enough to use for research. This expansion has allowed us to conduct early generation selection for scab resistance among our breeding material. We hope that this expanded effort will lead to more scab resistant lines advancing through the breeding program.

In the mid-1990's late blight re-emerged as the major fungal disease of potato in the US. Dr. Willie Kirk established foliar late blight testing at the Muck Soils Research Farm, Bath, Michigan. This location 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. The breeding program has been able to identify advanced breeding lines with strong foliar resistance to late blight. In 2001 we released Jacqueline Lee, a yellow-fleshed tablestock potato with late blight resistance. We also have the late blight resistant lines MSI152-A and MSJ317-1, round white tablestock potatoes, and MSJ461-1, a round white chip-processor, being considered for release and commercialization. MSJ461-1, the chip-processing selection, has the same late blight resistance source Jacqueline Lee and was resistant to a US-17 genotype of *Phytophthora infestans* in New York this year. Our other promising late blight resistant lines that have been tested in replicated agronomic trials are MSJ317-1, MSI152-A, MSK136-2, MSL179-AY and MSL211-3 (see Potato Variety Evaluation Report for agronomic data). In each of these lines, the resistance is based on a single resistance source. If we rely on a single source of resistance, the varieties developed from this strategy may be overcome by *P. infestans* at some future date that we cannot predict. Therefore, the most effective breeding strategy is to combine resistance from different pedigrees to build a more durable resistance. Our efforts are now focusing on pyramiding the different resistance sources.

The Muck Soils Research Farm is also used for early generation selection for late blight, genetic studies involving late blight resistance, screening germplasm from other US breeding programs and Dr. Kirk-led fungicide x variety management studies to determine schemes to reduce fungicide usage when late blight resistant cultivars are grown. In 2004 we also screened our *RB*-transgenic potatoes for their foliar resistance to late blight.

With support from GREEEN, we also introduced an early generation Colorado potato beetle screen at the Montcalm Research Farm. In 2004 over 220 breeding lines

from the MSU potato breeding program that had Colorado potato beetle resistant germplasm in their pedigree were evaluated 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. The lines were then sorted into four categories: susceptible, reduced susceptibility, moderately resistant and resistant. The majority of the lines were susceptible, but 32, 32 and 26 lines were classified as reduced susceptibility, moderately resistant and resistant, respectively. The majority of the lines that were moderately resistant or resistant can be attributed to the expression of the *Bt-cry3A* gene or glycoalkaloid/leptine based mechanisms. The most 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. Concurrently, a field cage (no-choice) experiment was conducted to evaluate 6 lines. With two years of data, the glandular trichome-based resistance was not different from the susceptible cultivar. The Bt-based resistance was very effective with complete mortality. The glycoalkaloid-based resistance affected beetle behavior: clipping of the petioles was observed in the cages. Avidin-based insect resistance is being studied in the lab. This resistance may be useful in combination with other host plant resistance factors.

It is a great challenge to achieve host plant resistance 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.

II. Evaluation of Advanced Selections for Extended Storage: MSU Potato Breeding Chip-processing Results From the MPIC Demonstration Commercial Storage (October 2003 - June 2004)

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 5 years we have been conducting a 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. In October 2003, tuber samples from 4 MSU lines plus three Frito Lay lines and Snowden in the Montcalm Research Farm trials were placed in the bin to be cooled to 49°F. Tubers from another 5 lines were placed in the bin that was to be cooled then held at 54°F. The first samples were chip-processed at MSU in October and then, each month until April 2004. Samples were evaluated for chip-processing color and quality.

Table 2 summarizes the chip-processing color of select lines over the 6-month storage season. In the 49°F bin, Snowden was the check variety. From October to April all lines chip-processed acceptably. In the 54°F bin Atlantic was used as check varieties and chip-processed acceptably until April. Liberator, MSH228-6 and MSJ461-1 also chip-processed acceptably. Only MSH112-6 did not chip-process and was dropped from the program. MSG227, UEC, and Liberator were in the 500 cwt storage bins. See Chris Long's storage report for those results and results from the box bins.

III. Germplasm Enhancement

In 2004, about 3% of the populations evaluated as single hills were diploid. From this breeding cycle, we plan to screen the selections chip-processing from storage. In addition, selections were made from over 4,000 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. About 50 selections were made among the diploid material in 2004. 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 at the Michigan State University Horticulture Farm in 2005. In 2004 we made crosses with late blight resistant diploid lines derived from *Solanum microdontum* to our tetraploid lines. These progeny are being grown in the greenhouse and will be evaluated in 2005 for these late blight resistant and other agronomic characteristics.

IV. Integration of Genetic Engineering with Potato Breeding

Assessment of Natural (Glandular Trichomes and Glycoalkaloid-Based) and Engineered (*Bt-cry3A*) Potato Host Plant Resistance Mechanisms for Control of Colorado potato beetle: Caged no-choice studies.

The Colorado potato beetle, *Leptinotarsa decemlineata*, is the leading insect pest of potato (*S. tuberosum* L.) in northern latitudes. Host plant resistance is an important tool in an integrated pest management program for controlling insect pests. A field study was conducted in 2003 and 2004 to compare natural (glandular trichomes (NYL235-4) and glycoalkaloid-based (ND5822C-7)), engineered (*Bt-cry3A*: NO8.8, Atlantic NewLeaf, *Bt-cry1Ia1*: Spunta G2) host plant resistance mechanisms of potato for control of Colorado potato beetle. Six different potato lines representing 5 different host plant resistance lines were evaluated in caged studies (no-choice) at the MSU campus farms. Each cage with 10 plants represented one plot. The cages were arranged in a randomized complete block design consisting of three replications. Twenty egg masses were placed on the plants in each cage. Observations were recorded weekly for a visual estimation of percent defoliation by Colorado potato beetles, and the number of egg masses, larvae, and adults. The *Bt-cry3A* transgenic line and the combined resistance line were effective in controlling feeding by Colorado potato beetle adults and larvae. The high glycoalkaloid line had less feeding, but the beetles clipped the petioles, which led to greater defoliation in the first few weeks. Foliage re-growth occurred by the end of the season. The glandular trichome line suffered less feeding than the susceptible control. Spunta G2 was effective in limiting defoliation, but larval mortality was not as high as in the *Bt-cry3a* lines. Based on these results, the *Bt-cry3A* gene in combination with glandular trichome mechanism is an effective strategy that could be used to develop potato varieties for use in a resistance management program for control of Colorado potato beetle. The *Bt-cry1Ia1* all is effective against Colorado potato beetle. **Figure 1** shows the combined results of caged trial in 2003 and 2004.

Combining engineered and natural host plant resistance to *Phytophthora infestans* in cultivated potato

General susceptibility of potato cultivars to *Phytophthora infestans* (Mont.) de Bary is a major concern for potato production. The major resistance gene *RB* was cloned from *Solanum bulbocastanum* Dun. a diploid (2n=2x=24) Mexican species that is highly resistant to all known races of *P. infestans*. The objective of this work is to combine conventionally bred sources of resistance with the *RB* gene via *Agrobacterium* transformation. Our hypothesis is that by pyramiding engineered resistance with natural plant resistance we expect to obtain stronger and more durable resistance to potato late blight. Therefore, this study was undertaken to test the effectiveness of the *RB* gene on its own by transforming late blight-susceptible clones (Atlantic, and the breeding line MSE149-5Y), and to test the effectiveness of the gene in combination with natural late blight resistance by transforming resistant clones (Stirling, and the advanced breeding line MSJ461-1). The RB-transgenic potato lines were tested at the Muck Soils Research Farm and we identified 3 lines to be expressing the RB gene and have foliar late blight resistance.

Insecticidal activity of avidin against Colorado potato beetle larvae, *Leptinotarsa decemlineata* (Say)

The Colorado potato beetle, *Leptinotarsa decemlineata* (Say), is the most destructive insect pest of potato, *Solanum tuberosum* (L.) in eastern North America. The insect has adapted to every insecticide used to manage it. Avidin is a protein found in chicken egg whites that has demonstrated insecticidal properties against a number of Lepidopteran and Coleopteran pests. This protein protects the chicken embryo by sequestering biotin from disease causing organisms. Biotin is an essential co-enzyme required for all organisms, including insects. Biotin is a cofactor of a carboxylase which is required for many important processes like lipogenesis, gluconeogensis, fatty acid and amino acid catabolism. Without this co-enzyme, an insect's growth is severely stunted, eventually leading to death. The gene for avidin production has been cloned and inserted into a few crops, including maize, tobacco and potato and has demonstrated resistance to a wide spectrum of insect pests. We have expressed avidin in two potato lines: MSE149-5Y, a susceptible potato line, and ND5873-15, a high glycolakaloid line. Detached leaf bioassays were performed on transgenic and non-transgenic clones of MSE149-5Y and ND5873-15 using Colorado potato beetle neonates and third instars. Survivorship and consumption were measured every 2d over a 12d period for neonates and avidin was effective in reducing growth and increasing larval morality.

USAID-funded International project to Develop Potato Tuber Moth Resistant Potatoes

Potato tuber moth, *Phthorimaea operculella* (Zeller), is the most serious insect pest of potatoes worldwide. The introduction of the *Bacillus thuringiensis* (Bt) toxin gene via genetic engineering offers host plant resistance for the management of potato tuber moth. The primary insect pest in Egyptian potato production, like many other

countries in the Middle East, is the potato tuber moth. Recently it has emerged as a pest in Washington State and has also been a serious problem in Mexico.

Two transgenic 'Spunta' clones, G2 and G3, have been identified that produced high control levels of mortality in first instars of potato tuber moth in laboratory tuber tests (100% mortality), and field trials in Egypt (99-100% undamaged tubers). Reduced feeding by Colorado potato beetle first instars was also observed in detached-leaf bioassays (80-90% reduction). Field trials in the U.S. demonstrated that the agronomic performance of the two transgenic lines was comparable to 'Spunta'. In 2004 the Spunta lines were resistant to the potato tuber moth and the Colorado potato beetle in Washington State. We are currently working with USAID, Syngenta and South Africa to commercialize the Spunta-G2 and Spunta-G3 lines. We have also transformed Atlantic, Lady Rosetta and Jacqueline Lee with the *Bt-cry1Ia1 (*formally *cryV* gene).

V. Variety Release

We will be naming, releasing and protecting UEC in 2005. MSG227-2 (scab resistant chipper) and MSJ461-1 (late blight resistant chipper/tablestock) also show commercial potential. **Table 3** summarizes the commercial seed production of MSU lines in 2004.

VI. Development of a DNA-based Fingerprint System for Potato Varieties

The ability to quickly and accurately identify potato clones is important to potato breeding programs and to the potato seed industry and commercial growers. Since 1990, the Michigan State University Potato Breeding and Genetics Program has used an isozyme-based fingerprint system to identify potato cultivars. Isozyme analysis has been an economical and effective means of discriminating potato clones; however, they require fresh, healthy tuber or leaf tissue. DNA-based fingerprinting using simple sequence repeats (SSRs or microsatellites) has been shown to discriminate between potato clones. DNA can be extracted from freeze-dried tissue. The SSR fingerprinting system developed in our lab can be used as a practical fingerprint system for cultivated potato. This research was published in the American Journal of Potato Research in 2004.

Table 1. Potential Lines for 2005 On-Farm Grower Trials

Line	Pedigree		Comments
	Female	Male	
Processing			
MSG227-2	Prestile	MSC127-3	Scab resistant
MSH228-6	MSC127-3	OP	Scab tolerant
MSJ036-A	A7961-1	Zarevo	Scab tolerant chipper
MSJ080-1	MSC148-A	S440	High yield
MSJ147-1	Norvalley	S440	cold chipper
MSJ316-A	B0718-3	Pike	Scab tolerant chipper
MSJ461-1	Tollocan	NY88	Late blight resistant
MSK061-4	MSC148-A	ND2676-10	Scab tolerant chipper
MSK136-2	Greta	B0718-3	Late blight resistant
MSK498-1Y	Saginaw Gold	Brodick	Scab tolerant chipper
Tablestock			
BOULDER (MSF373-8)	MS702-80	NY88	Dryland production, large tubers
LIBERATOR (MSA091-1)	MS702-80	Norchip	Scab resistant, bright skin
MICHIGAN PURPLE	W870	Maris Piper	Bright purple skin, white flesh
MSA8254-2BRUS			Scab tolerant
MSE192-8RUS	A8163-8	Russet Norkotah	Scab resistant russet (Norkotah replacement)
MSE221-1	Superior	MS700-83	Scab tolerant, Superior-type
MSI005-20Y	MSA097-1Y	Penta	Yukon appearance
MSI049-A	Brodick	MSC121-7	Blackspot bruise resistant, red splashes
MSI152-A	Mainestay	B0718-3	Late blight resistant, round white
MSJ033-10Y	MSA097-1	Penta	Yellow, Scab resistant

Table 2.

2003-2004 Demonstration Storage Chip Results
Michigan State University Potato Breeding and Genetics
Montcalm Research Farm
Chip Scores: SFA Scale[†]

		Sample Dates:					
	Date:	11/4/2003	12/2/2003	1/6/2004	2/12/2004	3/11/2004	4/7/2004
Line	**Temp:**	55 °F	54 °F	50 °F	50 °F	49 °F	51 °F
FL1833		1.5	1.0	1.5	1.5	ND	ND
FL1867		1.0	1.0	1.0	1.0	1.5	1.0
FL1922		1.0	1.0	1.0	1.0	1.0	1.0
MSG227-2		1.0	1.5	1.5	1.0	1.0	1.0
MSJ080-1		1.0	1.5	1.5	1.5	1.5	1.5
MSJ147-1		1.0	1.0	1.5	1.0	1.0	1.5
SNOWDEN		**ND**	**1.0**	**1.0**	**1.0**	**1.0**	**1.5**
UEC		1.0	1.0	1.0	1.0	1.0	1.5
	Temp:	55 °F	54 °F	54 °F	54 °F	54 °F	51 °F
ATLANTIC		**1.5**	**1.0**	**1.5**	**1.5**	**1.5**	**1.5**
LIBERATOR		1.5	1.0	1.0	1.0	1.0	1.0
MSH112-6		2.0	2.5	2.0	2.0	2.0	1.0
MSH228-6		1.0	1.0	1.5	1.0	1.5	1.5
MSJ461-1		1.5	2.0	1.5	1.0	1.5	1.5

[†]Snack Food Association Chip Score

Ratings: 1 - 5
1: Excellent
5: Poor
ND: No Data
Chip scores were from two-slice samples from five tubers of each line collected at each sample date.

Table 3. Potato Seed Inventory 2004
MSU Potato Breeding Program Introductions
Availability of Michigan Certified Seed
A Cumulative Inventory

LINE	MINI-TUBERS (UNITS)	FY1 (CWT)	FY2 (CWT)	FY3 (CWT)	FY4 (CWT)
Jacqueline Lee (MSG274-3)	7901	3	-	100	-
Liberator (MSA091-1)	5153	27	748	4150	-
Michigan Purple	4986	106	1422	-	1080
MSE192-8RUS	3247	-	-	-	-
MSE202-3RUS	635	-	-	-	-
MSF099-3	-	-	-	67	-
MSG227-2	388	-	-	1950	-
MSH067-3	573	-	-	-	-
MSH095-4	617	-	-	-	-
MSI152-A	2280	5	-	-	-
MSJ461-1	7274	4	88	-	-

Information listed above is a cumulative count from Golden Seed Farms, Haindl & Hanson Farms, Iott Seed Farms Inc., Krueger Seed Farm, Marker Farms, Makarewicz Seed Farm, Sklarczyk Seed Farm, and Skogman Seed.
Table courtesy of Chris Long.

Fig. 1

Colorado Potato Beetle Field Cage Trial Relative Area Under the Defoliation Curve (RAUDC) of HPR Potato Lines