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2009 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 2009, we tested 220 varieties and breeding lines in the replicated variety trials. 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 or processing markets. The varieties were compared in groups according to market class, tuber type, skin color, and to the advancement in selection. Each season, total and marketable yields, specific gravity, tuber appearance, incidence of external and internal defects, chip color (from the field, 45°F (7.2°C) and 50°F (10°C) storage), as well as susceptibilities to common scab, late blight (foliar and tuber), and blackspot bruising are determined.

PROCEDURE

Nine field experiments were conducted at the Montcalm Research Farm in Entrican, MI. They were planted as randomized complete block designs with two to four replications. The plots were 23 feet (7 m) long and spacing between plants was 10 inches (25.4 cm). Inter-row spacing was 34 inches (86.4 cm). Supplemental irrigation was applied as needed. The field experiments were conducted on a sandy loam soil that was in corn the previous year and in potatoes 4 years previously.

The most advanced selections in the breeding program were harvested at two dates to evaluate early and late harvest potential (Early Harvest Trial). These same clones also harvested at a later standard harvest date, included in the various other variety trials. The Date of Harvest Early and Late Trials were replaced by the Early Trial entries being included in other trials for the second (Late) harvest. The most advanced selections were tested in the Advanced trial, representing selections at a stage after the Adaptation Trial. The other field trials were the North Central, Russet, Adaptation (chip-processors and tablestock), and Preliminary (chip-processors and tablestock). *Note: We also conducted an early harvest observation trial (92 days), to screen newer lines from the*

breeding program for early performance potential as out of the field chip-processing and tablestock varieties. The early observational trial is discussed in the breeding report.

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

RESULTS

A. Early Trial:

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

There were 18 entries that were evaluated at the early harvest trial. The results are summarized in **Table 1**. Atlantic, Onaway and FL1867 were used as check varieties. The plot yields were average to slightly below average in the early harvest (102 days), and specific gravity values were typical to an average year. Hollow heart was the most prevalent internal defect in the early harvest this year, although only to a limited degree. MSQ176-5 and MSM037-3 showed the highest incidence of hollow heart in the late harvest (30% and 28%, respectively). Interestingly, the hollow heart standard Atlantic, had less incidence of hollow heart (3%) compared to average years. In the early harvest trial, the best yielding lines were Onaway, Michigan Purple Red Sport, MSQ086-3, MSL211-3, MSM037-3, and MSQ176-5. Michigan Purple Red Sport is a red-skinned selection with splashes of purple from a sport of Michigan Purple. MSQ086-3 is a round-white breeding line which chip-processes out of the field, is showing early bulking potential, and has strong foliar late blight resistance. MSL211-3 is an attractive, smooth-skinned, round to oval tablestock line with foliar late blight resistance. MSQ176-5 is a round-white freshmarket potato with good yield, round, uniform tuber shape, strong foliar late blight resistance, and moderate scab resistance.

B. Advanced Trial (Table 2)

A summary of the 25 entries evaluated in the Advanced trial results is given in **Table 2**. Overall, the yields for the Advanced trial (135 days) were average or slightly below average. The check varieties for this trial were Snowden, Pike, FL1879, and FL2137. The highest yielding lines were tightly clustered (and not significantly different) between MSP515-2 (316 cwt/a), Kalkaska, FL1879, MSQ089-1, and Beacon Chipper (265 cwt/a). The next highest yielding group was MSQ070-1, followed by MSR036-5, MSK061-4, and MSH228-6. Hollow heart and vascular discoloration were the predominant internal defects, with Kalkaska, MSR159-02, and FL2137 having the highest levels of hollow heart (30, 30, and 23%, respectively). Specific gravity was average with five lines having specific gravities higher than Snowden (1.086): MSQ070-1 (1.097), MSN191-2Y, MSJ147-1, FL2137, and MSK409-1 (1.087). All entries in the trial had excellent chip-processing quality out of the field, with an SFA score of 1.0. Most of the MSU breeding lines have moderate to strong scab resistance. Kalkaska and Beacon Chipper continue to be consistently high yielding lines with good specific gravity, chip quality, and scab resistance. Two promising chip-processing lines are MSQ070-1 (chip quality, high specific gravity, scab and late blight resistance) and MSR061-1 (chip quality, good specific gravity, scab and PVY resistance, and moderate late blight resistance).

Variety and Advanced Breeding Line Characteristics

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

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

Kalkaska (MSJ036-A) – an MSU chip-processing selection with high yield potential. It also has a high specific gravity and scab resistance. The tuber type of MSJ036-A is round and attractive.

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

MSJ147-1 – a full season storage chipper that also has some early sizing. It has excellent chip-processing quality and a high solids content. It has performed well in on-farm trials and has demonstrated an excellent long-term storage chipping profile.

Missaukee (MSJ461-1) – an MSU chip-processing selection with strong foliar resistance to late blight and maturity similar to Snowden. It has excellent chip-processing quality, round shape and above average yield, but an intermediate specific gravity in most years. The chips show few defects. It has good tablestock quality too.

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, but has a short dormancy.

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

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

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

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

MSM171-A – a round-white tablestock line with moderate scab resistance and strong foliar late blight resistance. This line also has an moderately early maturity with a ‘Superior’ type tuber appearance.

MSM246-B – a round-white chip-processing line with good specific gravity and excellent chip quality that has demonstrated potential for good long-term chip quality.

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

MSN170-A – a new round-white chip-processing line with good scab resistance, average specific gravity, and good type. This line produces clean chips with good specific gravity and an early maturity, and has storage potential.

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.

MSP459-5 – another new MSU chip-processing selection with scab resistance, average specific gravity, and a good, round type. This line has excellent chip quality with a low incidence of internal defects and storage potential.

Two varieties were released in 2009: Kalkaska and Missaukee. The breeding line MSJ036-A was released as ‘Kalkaska.’ We have submitted the PVP application to the USDA and the variety release description to the American Journal of Potato Research. Kalkaska is a high yielding, round white potato with an attractive round appearance with shallow eyes. Kalkaska has a strong vine and a full season maturity. This variety has resistance to *Streptomyces scabies* Thaxter (common scab of potato) similar to Pike.

Kalkaska also has industry approved chip-processing storage characteristics (light color and low incidence of defects) and it also has better tolerance to blackspot bruise than Snowden. Specific gravity in Michigan averages 1.083, ranging from 1.075 to 1.096. Kalkaska also has a higher marketable yield than Pike and does not express heat necrosis in the tubers. The name Kalkaska was chosen to acknowledge a town located in the Michigan seed growing region.

MSJ461-1 was released as ‘Missaukee.’ Missaukee is a round white chip processing potato variety resulting from a cross between Tollocan and NY88 and has foliar resistance to potato late blight (*Phytophthora infestans* de Bary). This variety has an attractive round shape and mildly netted, bright skin. Seven years of field testing in Michigan indicate that the yield of total marketable tubers in Missaukee is similar to that of Snowden. However, Missaukee has a lower incidence of internal defects than Snowden. Specific gravity ranged from 1.069 to 1.086 in Michigan trials and out-of-the-field chip scores were similar to those of Snowden. Missaukee showed some resistance to *Verticillium* wilt in 2-years of trials. DNA marker and greenhouse tests indicate that Missaukee is also resistant to the golden cyst nematode (*Globodera rostochiensis* Woll) pathotype Ro1.

In December 2004, 2005, 2007, and 2008, the MPIC sponsored a booth at the Great Lakes Fruit, Vegetable, and Farm Market Expo to market Liberator, Michigan Purple and Jacqueline to the farm market/roadside stand market segment. The breeding program sponsored the booth in 2009 to continue to promote varieties and promising advanced selections that may be of interest to this market segment. There continues to be a strong interest in specialty potato varieties and a growing demand for new, unique potato varieties. We also showcased some of the newer up-and-coming selections from the breeding program to get a sense of the interest from growers who stopped by the booth.

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

The North Central Trial is conducted in a wide range of environments (11 regional locations) to provide adaptability data for the release of new varieties from Michigan, Minnesota, North Dakota, Wisconsin, and Canada. Twenty-one entries were tested in Michigan in 2009. The clones were from three market classes: Red (9 entries), Russet (4 entries), or Round White (8 entries). The results are presented in **Tables 3 and 4**. The MSU lines Missaukee (MSJ461-1), MSN170-A, MSM171-A, and MSL268-D were the Michigan representatives included in the 2009 North Central Trial. The two lines MSM171-A and MSL268-D were trialed in the Russet Trial due to trial size limitations. Missaukee has a good, round type and chip-processing quality combined with strong foliar late blight resistance and continues to perform well in Michigan and other out of state testing locations. MSM171-A a round-white tablestock line with moderate scab resistance, strong foliar late blight resistance, and an early maturity. MSN170-A has exceptional chip-processing quality and typical agronomic performance. MSL268-D has dual-purpose characteristics; good chip-processing quality and an

attractive freshmarket type, combined with late blight resistance, and some early bulking potential.

D. Russet Trial (Table 4)

We continue to increase our russet breeding efforts to reflect the growing interest in russet types in Michigan. In 2009, 18 lines evaluated after 128 days. The results are summarized in **Table 4**. Russet Norkotah was the reference variety used in the trial. Overall, the internal quality in the russet trial was above average; however, hollow heart and vascular discoloration continue to be the most prevalent internal defects. The highest hollow heart level was observed in AC99375-1Rus (50%), Classic Russet (A95109-1Rus) (40%), and MN02467RUS (15%). Classic Russet also had a significant amount of vascular discoloration (30%). Specific gravity measurements were average with Russet Norkotah at 1.074. The yield of the overall trial was average to below average for 2009. Off type and cull tubers were found in nearly all lines tested, but ranged only from a high of 7% down to 1%. The highest yielding entry was AC99375-1Rus with 367 cwt/a US#1 yield, followed by A02062-TE and A01025-4.

E. Adaptation Trial (Tables 5 and 6)

The Adaptation Trial is conducted as two separate trials based on market class: chip-processing and tablestock trials. The majority of the lines evaluated in the Adaptation Trial were tested in the Preliminary Trial the previous year. Four reference cultivars (Atlantic, Snowden, Pike, and FL1879), and 15 advanced breeding lines are reported in the chip-processing trial. The trial was harvested after 135 days and the results are summarized in **Table 5**. All entries had good out-of-the-field chip scores (1.0 SFA scale). Specific gravity values were average for the Montcalm Research Farm (Atlantic was 1.090 and Snowden was 1.085). The highest specific gravity was MSR102-3 at 1.095. The overall plot yields for this trial were lower than average in 2009. Boulder was the highest yielding line in 2008 and 2009 (133 cwt/a greater than Atlantic). Multiple new breeding lines combine scab resistance and chip-processing: MSR102-3, MSR058-1, MSR127-2, MSR161-2, and MSR169-8Y. MSR102-3 also combines late blight resistance, scab resistance, and chip-processing with a high specific gravity. MSR058-1 and MSR157-1Y are also late blight resistant and have moderate scab resistance. MSQ461-2PP is a purple-skinned purple flesh line with good specific gravity and scab resistance that can be used to make chips for the specialty market.

In the tablestock trial, 22 advanced breeding lines were evaluated with Onaway and Yukon Gold check varieties. The trial was harvested after 128 days and the results are summarized in **Table 6**. In general, the yield was average in this trial and internal defects were low. The greatest amount of hollow heart was seen in Yukon Gold (15%), followed by Reba (13%) and MSQ176-5 (10%). There were a significant number of oversize potatoes in MSQ176-5 and MSQ279-1. The highest yielding line was MSI005-20Y (yellow flesh) at 330 cwt/a, followed by MSQ279-1, MSS176-1, and MSQ086-3.

Eight of the 20 lines have late blight resistance and eight lines have moderate to strong scab resistance. Seven of the 20 lines also had early maturity, similar to Yukon Gold. Promising lines with attractive type for the tablestock market and strong foliar late blight resistance include MSM182-1, MSS176-1, MSQ086-3, MSQ176-5, and MSS737-1Y. MSM182-1 also has PVY resistance. MSQ086-3 is a round-white breeding line which chip-processes out of the field, is showing early bulking potential, and has strong foliar late blight resistance. 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.

F. Preliminary Trial (Tables 7 and 8)

The Preliminary trial is the first replicated trial for evaluating new advanced selections from the MSU potato breeding program. The division of the trials was based upon pedigree assessment for chip-processing and tablestock utilization. The chip-processing Preliminary Trial had 34 advanced selections and two check varieties (Atlantic and Snowden). The chip-processing trial was harvested after 133 days and is summarized in **Table 7**. Most lines chip-processed well from the field (SFA chip score 1.0 – 1.5). Specific gravity values were average for the trial (Atlantic: 1.086). The yields were slightly below average with Atlantic at 291 cwt/a and Snowden at 250 cwt/a. Twelve of the lines (35%) were classified to be resistant or moderately resistant to scab (≤ 1.5 scab disease rating). Seven lines have demonstrated foliar late blight resistance. MSQ029-1 has good agronomic performance with yield potential, solid specific gravity, late blight and PVY resistance.

Table 8 summarizes the 32 tablestock lines evaluated in the Preliminary Trial (Onaway was the check variety). This tablestock trial was harvested and evaluated after 128 days. Ten of the 32 lines were late blight resistant, two have moderate late blight resistance, and seven were scab resistant or moderately resistant (≤ 1.5 scab disease rating). MST500-1, Stirling, MSR601-22, MSS070-B, MST384-1PP, MSS206-2 were the highest yielding lines. In general, there was a low incidence of internal defects, except for some hollow heart: Stirling (95%), MST377-2P (30%), MSS487-2 (25%). Four of the top yielding lines have late blight resistance and marketable maturities (MST500-1, MSS070-B, MSS206-2, and MSS483-1). In addition to traditional round white, red-skinned, and yellow flesh freshmarket categories, there are some unique specialty lines. A few of the lines in this trial were considered for their unique color attributes for the specialty potato market: MST377-2P (purple skin, white flesh), MST123-1RY (red skin, yellow flesh), MST235-2SPL (splash), MST384-1PP, MSS514-1PP (purple skin, purple flesh).

G. Potato Scab Evaluation (Table 9)

Each year, a replicated field trial at the MSU Soils Farm (E. Lansing, MI) is conducted to assess resistance to common scab. We are using a 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 9** categorizes many of the varieties and advanced selections tested in 2009 at the MSU Soils Farm Scab Nursery over a three-year period. The varieties and breeding lines are placed into six categories based upon scab infection level and lesion severity. A rating of 0 indicates zero scab infection. A score of 1.0 indicates a trace amount of infection. A moderate resistance (1.2 – 1.8) correlates with <10% infection. Scores of 4.0 or greater are found on lines with >50% infection and severe pitted lesions.

The check varieties Russet Norkotah, Yukon Gold, Onaway, Pike, Atlantic and Snowden can be used as references (bolded in **Table 9**). The table is sorted in ascending order by 2009 rating. 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 69 lines, of the 157 tested, had a scab rating of 1.5 (better than or equivalent to Pike) or lower in 2009. Most notable scab resistant MSU lines are MSH228-6, Kalkaska (MSJ036-A), MSJ126-9Y, MSK061-4, MSL007-B, MSN230-1RY, MSQ070-1, MSQ289-5, MSQ440-2, MSR036-5, MSR061-1, MSR102-3; as well as some earlier generation lines MSS176-1, MSS544-1R, S737-1Y, and MST306-01. The greater number of MSU lines in the resistant and moderately resistant categories indicates we are making progress in breeding more scab resistant lines for the chip-processing and tablestock markets. There are also an increasing number of scab resistant lines that also have late blight resistance and PVY resistance. We also continue to conduct early generation scab screening on selections in the breeding program beginning after one year. Of the 327 early generation selections that were evaluated, 128 were resistant (scab rating of ≤ 1.0). Scab results from the disease nursery are also found in the Trial Summaries (**Tables 2-8**).

H. Late Blight Trial

In 2009, a late blight trial was planted at the Muck Soils Research Farm. As in previous years, 256 entries were planted in replication for evaluation in replicated plots. These include lines tested in the agronomic variety trial and entries in the National Late Blight Variety Trial. Block planting full rows of advanced selections provide a better assessment of the late blight resistance of these lines. We also planted 171 early generation breeding lines that have a late blight resistant pedigree. The field was planted on June 4. Two weeks following planting, almost six inches of rain fell at the farm over 12 days. The flooding from these and subsequent rains damaged the plots beyond recovery. Unfortunately, all plots were destroyed and no data were taken. We were able to do a late planting for a trial to test 90 *Solanum microdontum* accessions. The late blight trials will be conducted at a new location next year at the MSU Clarksville Horticultural Experiment Station. We will try again for a successful late blight disease field test in 2010.

I. Blackspot Bruise Susceptibility (Table 10)

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

In 2009, the bruise levels were comparable to previous years. The most bruise resistant MSU breeding lines this year from the Advanced trial were MSQ289-5, MSP459-5, MSQ131-A, MSQ130-4, MSL292-A, Pike, MSQ089-1, MSR061-1, MSJ126-9Y, and MSK061-4. The most susceptible lines from the Advanced trial were Kalkaska, FL2137, MSN191-2Y, MSL007-B, MSK409-1, and FL1879. Of the earlier generation breeding lines (Preliminary Trial), the most bruise resistant were MSS927-1, MST096-2Y, MST169-07, MSS199-A, MSS514-1PP, and MST065-2. The most bruise resistant russet entries were A02062-1TE, AOTX95265-4Rus, CO99053-4Rus, and CO99100-1Rus; the most susceptible were PA03NM5-1, Canela Russet, and AC99375-1Rus. The most bruise resistant entries in the US Potato Board/Snack Food Association Trial were NY138, CO96141-4W, and Kalkaska. Snowden, AF2291-10, CO97043-14W, and Atlantic were the most bruise susceptible in this trial.