

**Progress Report to the Maine Potato Board Research Subcommittee
January 25, 2015**

Project Title:

Breeding New Varieties to Provide Marketing Opportunities and Improved Pest Resistance (2014 Growing Season)

Investigators:

Gregory A. Porter, Paul Ocaya, and Tammy Mills; School of Food & Agriculture, University of Maine, Orono.

Executive Summary:

The University of Maine Potato Breeding Program uses traditional plant breeding to create, select, and develop new potato varieties for Maine and elsewhere. The objective of this research is to develop and select new potato varieties which will provide marketing opportunities to the Maine Potato Industry and/or solve disease management problems. During 2014, our research effort by market category was as follows: 50% russets and long-whites for processing and/or fresh market; 40% whites for chipping and/or fresh market; and 10% reds and specialty varieties. The Maine breeding program is the only eastern U.S. program with an emphasis on russets and long-whites with processing and fresh market potential. This report provides a summary of the 2014 activities.

Sebec (AF0338-17) and Easton (AF3001-6) were named and released during 2013/2014. Plant variety protection (PVP) applications have been submitted and both varieties were licensed from the University by the Maine Potato Board. Sebec is primarily seen as an alternative to Atlantic for chipping out of the field in the mid-Atlantic and S.E. states. It combines high yields, good out-of-field chip quality, verticillium resistance, and much less internal heat necrosis and hollow heart than Atlantic. It is being FAST-TRACKED by the US Potato Board. Sebec can also be used for fresh market, though it greens quickly under fluorescent lights and is moderately susceptible to scab. Easton, a long-tuber-type clone with netted to lightly russet skin, has outstanding fry color and yields, good tuber type, relatively little hollow heart, and very good verticillium wilt resistance. It is primarily seen as a fry processing variety, though it has good boiled and baked quality. It has been a top performer in the National Fry Processing Trials (NFPT). Easton has potential weaknesses with rot, skinning, and bruise susceptibility that will require special management attention. It requires less N fertilizer than Russet Burbank.

We many more promising close in the development pipeline. Examples include: AF3362-1(a dual-purpose russet with outstanding yields, bruise resistance, relatively low hollow heart incidence, moderate scab resistance and reasonably good appearance for fresh market); AF4296-3 (a promising russet for fry processing); AF4157-6 (an early-maturing chipping clone); AF4648-2 (a mid-season chipper with scab, PVY, and golden nematode resistance); AF4138-8 (a promising fresh market white with excellent boiled quality, blackspot bruise resistance, moderate scab resistance, medium-early maturity, and relatively little hollow heart); AF4985-1 (a pretty red with good market quality and moderate scab resistance); AF4659-12 (a yellow-fleshed “pinto-type”, fingerling/roaster, specialty variety with an interesting red and yellow skin

pattern and excellent cooking quality) and AF4550-2 (an early, purple-skinned, white-fleshed clone).

Priorities in the area of disease resistance were: late blight, scab, and PVY. Because of increasing concerns about PVY in the U.S. potato industry, we have dramatically increased our crossing and selection program for PVY resistance since 2011. Although these diseases were our top priorities, our work on disease and pest resistance also included efforts to develop varieties with resistance to: PLRV, verticillium wilt, fusarium dry rot, pink rot, nematodes, bruising, internal defects, insects, etc. Funding provided by the ME Potato Board and USDA-ARS has allowed us to incorporate marker-assisted selection for potato virus Y (PVY) resistance and golden nematode. We are now developing marker-assisted selection procedures for late blight resistance. Advanced clones in our program typically have resistance to several important potato pests. As an example, AF4648-2, a promising dual-purpose chipping and fresh market white, combines excellent scab resistance with golden nematode and PVY resistance. It also has moderate late blight and pink rot resistance. Progress in breeding for late blight resistance has been dramatic. We currently have 94 late blight resistant, third-year clones and 21 more advanced late blight resistant clones moving through the program and more coming behind them. The clones will be moved forward based on field performance and either developed for commercial release or used as breeding material to produce future commercially valuable cultivars with good field resistance to late blight.

Project Objectives:

1. To breed, select, and develop new potato varieties for Maine which provide marketing opportunities and/or improved pest/disease resistance.

Grant Received:

\$34,000

Accomplishments to Date:

The University of Maine Potato Breeding Program uses traditional plant breeding to create, select, and develop new potato varieties for Maine and elsewhere. The objective of this research is to develop and select new potato varieties which will provide marketing opportunities to the Maine Potato Industry and/or solve disease management problems. Funding provided by the ME Potato Board and USDA-ARS has allowed us to incorporate marker-assisted selection for potato virus Y (PVY) resistance and golden nematode. We are now developing marker-assisted selection procedures for late blight resistance. During 2014, our research effort by market category was as follows: 50% russets and long-whites for processing and/or fresh market; 40% whites for chipping and/or fresh market; and 10% reds and specialty varieties. The Maine breeding program is the only eastern U.S. program with an emphasis on russets and long-whites with processing and fresh market potential. Priorities in the area of disease resistance were: late blight, scab, and PVY. Because of increasing concerns about PVY in the U.S. potato industry, we have dramatically increased our crossing and selection program for PVY resistance since 2011. Although these diseases were our top priorities, our work on disease and pest resistance also included efforts to develop varieties with resistance to: PLRV, verticillium wilt, fusarium

dry rot, pink rot, nematodes, bruising, internal defects, insects, etc. This report provides a summary of the 2014 activities.

Progress on Russets/Long Whites: We named and released Easton (AF3001-6) during 2013/2014. A plant variety protection (PVP) application has been submitted and Easton has been licensed from the University by the Maine Potato Board. Easton, a long-tuber-type clone with netted to lightly russet skin, has outstanding fry color and yields, good tuber type, relatively little hollow heart, and very good verticillium wilt resistance. It is primarily seen as a fry processing varieties, though it has good boiled and baked quality. It has been a top performer in the National Fry Processing Trials (NFPT). Easton has potential weaknesses with rot, skinning, and bruise susceptibility that will require special management attention. It requires less N fertilizer than Russet Burbank.

AF3362-1, a dual-purpose russet, continues to look very good in trials in northern areas. It has outstanding yields, bruise resistance, relatively low hollow heart incidence, moderate scab resistance and reasonably good appearance for fresh market. Baked quality has been good. It may also be a suitable alternative to Shepody for out-of-field and short-term storage fry processing. PVY susceptibility has slowed building of seed stocks for commercial trials. It is susceptible to internal heat necrosis in southern areas. We currently have many other advanced russet/long-white clones in field and processing trials with McCain Foods. The most advanced and promising are Easton (AF3001-6), AF3362-1, AF4296-3, AF4040-2, AF4113-2, AF4124-7, AF4172-2, AF4609-1, AF4872-2, AF4950-2, and AF4953-6). Yield, tuber type, size profile, internal quality, bruise resistance, and fry processing characteristics are key selection criteria. We are actively participating in national U.S. Potato Board and USDA-NIFA SCRI projects designed to improve the quality of processed potato products (NFPT and SCRI). Easton (AF3001-6), AF4296-3, and AF4342-3 have been among the top performers for yields and fry quality in the NFPT trials. AF4296-3 has been chosen for FAST-TRACK seed production from the NFPT/SCRI project. As a result 27,000 NFT minitubers of this clone were produced in 2013 for 2014 seed increases in ME and WI. AF3362-1, AF4040-2, AF4124-7, AF4609-1, AF4872-2, AF4950-2, and AF4953-6 have also done well in these national processing trials.

Progress on Whites and Chippers: We named and released Sebec (AF0338-17) during 2013/2014. A plant variety protection (PVP) application has been submitted and Sebec was licensed from the University by the Maine Potato Board. Sebec is primarily seen as an alternative to Atlantic for chipping out of the field in the mid-Atlantic and S.E. states. It combines high yields, good out-of-field chip quality, verticillium resistance, and much less internal heat necrosis and hollow heart than Atlantic. It is being FAST-TRACKED by the US Potato Board. Sebec can also be used for fresh market, though it greens quickly under fluorescent lights and is moderately susceptible to scab.

In addition to Sebec (AF0338-17), AF4157-6 is a promising chipping clone that combines early maturity and good out-of-field chipping in the southern states with excellent storage chip color, including low sugars and the ability to chip from cool storage. It has relatively small tuber size and is scab susceptible, but our next chipper in line (AF4648-2) has larger tuber size and good scab resistance. AF4648-2 combines excellent scab resistance, PVY and golden nematode resistance with good yields, specific gravity, internal quality, bruise resistance, and chip quality. It also appears to have moderate late blight and pink rot resistance. AF4157-6 and

AF4648-2 have been FAST-TRACKED by the US Potato Board due their outstanding promise for chip potato production. AF5040-8 was a top performer in the 2014 national chip trials (NCPT) due to its high yields, high specific gravity, and good internal quality. It was selected for future FAST-TRACK seed production once virus removal is completed and tissue culture plants are available.

AF4648-2 (described above) is a promising candidate for both chipping and fresh market use. AF4138-8 is also a promising fresh market white. It has bright, attractive tubers, low specific gravity, excellent boiled quality, blackspot bruise resistance, moderate scab resistance, medium-early maturity, and relatively little hollow heart. Yields have been greater than Superior and Katahdin in Maine trials and it has done well in most SE and Mid-Atlantic trials. Several more attractive whites with scab resistance, high yields, and good internal quality are advancing through the program and will enter expanded trials and seed production if 2015 results remain favorable.

Progress on Reds and Specialty Types. Growers have expressed a strong interest in new red varieties that have smooth skin, attractive appearance when grown on our soils, and ability to hold their color in storage. Reds are a critical component of the seed potato market and new, well-adapted reds will provide opportunities for our seed growers, especially in VA, NC, FL, and other southern states. This is a new component of the program which was established based on grower input. Red seedling tubers brought in from WI, ND, CO, and ID have been screened in ME since 2008 and entered testing in FL, NC, NY, and ME trials since 2010. Several are showing good potential though it has been difficult to find the ideal combination of skin quality, yields, and bruise/skinning resistance. AF4985-1, fits many of these criteria (good appearance, moderate scab resistance and favorable yield, size profile, and internal quality); however, it has had significant growth crack problems in several trials. Seed stocks of AF4985-1 and several other promising reds are being expanded for larger-scale testing in 2015 and beyond.

We currently have three promising specialty clones that should be of interest to small-scale growers. AF4659-12, a yellow-fleshed “pinto-type” specialty variety with a interesting red and yellow skin pattern. It produces small, fingerling-type tubers that are excellent roasted, boiled, or fried. AF4550-2 is an early, purple-skinned, white-fleshed clone with moderate yields and good boiled quality. It has much better purple skin color than Caribe, Purple Viking, and other standard purples, but it is susceptible to scab. AF5245-1 is also purple skinned with white flesh. It is very attractive and has good yields, tuber size, and internal quality.

Progress of Disease Resistance: Advanced clones in our program typically have resistance to several important potato pests. As examples, four of the advanced clones in McCain Foods trials had important disease resistance traits: AF3362-1 has resistance to scab as well as excellent bruise resistance; Easton and AF4296-3 have good verticillium resistance, while AF3317-15 has very good resistance to late blight, scab, and pink rot. AF4648-2, a promising chipper, combines excellent scab resistance with GN and PVY resistance. It also appears to have moderate late blight and pink rot resistance. Progress in breeding for late blight resistance has been dramatic. We currently have 94 late blight resistant, third-year clones and 21 more advanced late blight resistant clones moving through the program and more coming behind them. The clones will be moved forward based on field performance and either developed for commercial release or used as breeding material to produce future commercially valuable

cultivars with good field resistance to late blight. These cultivars would reduce the vulnerability of the crop to losses from late blight and would potentially allow growers to reduce their fungicide costs. PVY has been very difficult to manage in recent years. We have greatly increased crossing and selection efforts for PVY resistance, including the use of marker –assisted selection for PVY resistance. AF4648-2 and several other advanced selections in our program appear to be immune to PVY.

Breeding and Selection Approach: Crossing takes place at Aroostook Research Farm using parents from our program, Cornell University, Michigan State, North Dakota State University, University Wisconsin, and the USDA-ARS, as well as named varieties from North and South American as well as Europe. We generate true potato seed from the crosses and use these seeds to produce greenhouse seedling tubers. Excess greenhouse tubers are exchanged with the USDA-ARS Idaho, Michigan, Colorado, North Dakota, and Wisconsin breeding programs to gain access to russets, reds, and chippers that will strengthen our program’s ability to provide new varieties for the Maine industry.

Field selection initially takes place in Northern Maine; however, third- through fourth-year material is quickly advanced to multi-site field testing in ME, NY, PA, OH, VA, NC, FL, and beyond to determine the range of adaptation and assure relatively consistent performance over production environments. We are actively participating in coordinated national projects to improve chipping (NCPT) and fry (NFPT) varieties. We work with growers and processors to commercially test the most promising clones and determine which merit commercial release.

Crosses conducted in the Aroostook Research Farm greenhouse and at Orono during spring 2014 resulted in 449 families and 225,000 true potato seed (TPS). The top priorities represented in the 2014 crosses were improved russet, processing, and chipping clones, especially with late blight, scab, and/or virus resistance. Seedling tubers (56,935) from prior ME crosses and from germplasm exchanges with other breeding programs (WI, MI, CO, USDA-ARS, and ND) were planted in the field and selected for performance under ME growing conditions. We selected 1136 (2.0%) for continued evaluation in 2015. By category the selections were as follows: 492 (43%) round to oblong white-skinned potatoes for fresh and/or chipping markets; 61 (5%) red- or purple-skinned potatoes for fresh market or processing; and 583 (52%) long-tuber-type whites and russets for fresh and/or processing markets. The selection of red- or purple-skinned potatoes (11% and 5% in 2013 and 2014, respectively) is a marked change for the program and reflects grower interest in developing red-skinned varieties with excellent appearance under ME conditions.

A total of 338 second-year clones were selected during 2014 (338 out of 1302, 26.0%). Of these selections, 154 (46%) were russets or long whites. There were 145 round-white or yellow-fleshed selections (43%) and 39 (12%) were red-skinned or specialty clones. Many of these clones were derived from parents with late blight, PVY, and/or other key disease resistance traits. The 338 selected second-year clones will be advanced to 3rd year testing during 2015 in ME, FL and NC.

Twenty-five of 48 (52%) advanced selections (6th year or older clones) were retained for further evaluation in ME and elsewhere during 2015. The advanced clones that have been selected to date are distributed as follows: 15 russets and long whites (60%), 5 chippers or dual-purpose whites (20%), 1 round-white fresh market (4%), and 4 reds, purples, and specialty types (16%).

Twenty-five of 60 (42%) intermediate selections (5th year clones) were retained for further evaluation during 2015. These were distributed as follows: 13 russets and long whites (52%), 9 round-whites (36%), and 3 red-skinned or specialty clones (12%).

Fifty of 106 (47%) 4th year clones were retained for further evaluation during 2015. These were distributed as follows: 20 russets and long whites (40%), 22 round-whites (44%), and 8 colored skin or specialty clones (16%).

One hundred twelve of 305 (37%) 3rd year clones were retained for further evaluation during 2015. These were distributed as follows: 60 russets and long whites (54%), 42 round-whites (38%), and 10 colored skin, yellow-fleshed, or specialty clones (9%).

Minitubers, N1, or N2 seed of the following advanced clones are available from the Maine Seed Potato Board or will become available after the 2015 harvest: Sebec (AF0338-17), Easton (AF3001-6), AF3362-1, AF4138-8, AF4157-6, AF4172-2, AF4296-3, AF4648-2, and AF4659-12. Sebec, AF4157-6, AF4296-3, AF4648-2 are part of the Fast-Track seed production program of the US Potato Board and/or the US Potato Board/SCRI acrylamide project. This program produces minitubers and start-up seed production for processing trials.

Licensing/Royalties/Commercialization. Most releases to date have been Public Releases (the exception was Reeves Kingpin, licensed initially to McCain Foods). Policies of U.S. Breeding Programs have changed dramatically with Plant Variety Protection and most are now protected and require licensing and royalties. Most future releases from the Maine Breeding Program are likely to be via licensing with favorable terms for Maine growers and/or companies. The Maine Potato Board, University, and stakeholders have worked together to develop a release plan for our varieties. We named and released Sebec (AF0338-17) and Easton (AF3001-6) during late 2013 and early 2014. Plant variety protection (PVP) applications have been submitted and both varieties were licensed from the University by the Maine Potato Board. I would like to see AF3362-1 and possibly several other varieties released during 2015 or 2016.

Current Advanced Prospects for Commercialization. Seed of these clones is currently available from the Maine Seed Potato Board, Maine seed growers, and/or Aroostook Research Farm. Additional clones in each marketing class will become available over the coming years. For more information on these clones, seed availability, or research results please contact Greg Porter; 5722 Deering Hall, Room 415; University of Maine, Orono, ME 04469-5722; (207)581-2943; porter@maine.edu

- **Sebec, AF0338-17** (AF303-5 x SA8211-6), a widely-adapted, mid-season, high yielding, round white for out-of-field chipping and fresh market. It has performed well in the S.E. and mid-Atlantic states with yields averaging at or above those of Atlantic (US#1 yields 107% of Atlantic in 25 ME trials). Specific gravity has averaged 4 points lower than Atlantic in SE and Mid-Atlantic trials, but 8 points below Atlantic in ME trials. AF0338-17 has chipped well from the field and has had much lower incidence of internal defects than Atlantic. It is moderately susceptible to scab, but has moderate verticillium resistance. The Maine Potato Board has licensed this variety and an application for Plant Variety Protection has been submitted. **Seed Availability:** Maine certified seed (see ME

seed book); Maine Seed Potato Board seed and disease-free culture tubes or minitubers; University of Maine seed. It is also in US Potato Board Fast-track seed potato production.

- **Easton, AF3001-6** (Silverton Russet x AF1668-60), a widely adapted, late maturing, long-white with netted skin, very good fry color, and high yields. Easton is very good baked, boiled, and mashed. U.S. #1 yields have averaged ~131% of standard russeted varieties (usually Russet Burbank) in Maine trials. Specific gravity is moderate (average of 1.081 in ME trials, -0.001 vs RB) and fry color from storage has been excellent. It has been an outstanding performer in the national fry processing trials (NFPT). It is moderately susceptible to scab, but has good verticillium resistance. Susceptibility to tuber decay (tuber blight in 2011, softrot in several research trials, fusarium in a 2013 commercial trial) has been a concern so far for this variety. Careful disease management and seed handling will be required. Easton requires less N fertilizer than Russet Burbank. Lower N rates, additional vinekilling time, and careful harvest management will be needed to assure good quality and storability. The Maine Potato Board has licensed this variety and an application for Plant Variety Protection has been submitted. Seed Availability: Maine certified seed (see ME seed book); Maine Seed Potato Board seed, disease-free culture tubes, or minitubers; University of Maine seed.
- **AF3362-1** (Reeves Kingpin x Silverton Russet), a mid-season, long russet with good yields, processing potential, and fair to good appearance. AF3362-1 is very good baked and mashed. U.S.#1 yields have averaged ~130% of standard russeted varieties (usually Russet Burbank) in Maine trials. Specific gravity is moderate (average of 1.083 in ME trials, +0.001 vs RB) and fry color from storage has been mostly good. It may be a good alternative to Shepody for out-of-field and short-term storage processing use as well as useful for russet fresh market. It has moderate scab resistance and good bruise resistance. AF3362-1 is susceptible to internal heat necrosis and should not be grown in the S.E. states or other areas where this defect is frequently observed. PVY susceptibility has slowed building of seed stocks for commercial trials. Seed Availability: Certified Maine Seed (see ME seed book); Maine Seed Potato Board seed, disease-free culture tubes, or minitubers; University of Maine seed.
- **AF4124-7** (A8469-5 x SC9512-4), a medium-late maturing, russet with good fry quality, fair tuber appearance, and high yields. US#1 yields have averaged ~114% of standard russeted varieties (usually Russet Burbank) in Maine trials. Specific gravity is moderate to high (average of 1.085 in ME trials, +0.006 vs RB) and fry color from storage has been good. It has been a good performer in the national fry processing trials (NFPT). It is moderately resistant to scab and is blackspot bruise resistant. Seed Availability: University of Maine seed plus tissue culture tubes from Porter Farm, ME Seed Potato Board.
- **AF4138-8** (SA9707-6 x AF1953-4), a fresh market, early to mid-season, round to oblong white with bright skin. It has good yields, attractive tubers, low specific gravity, blackspot bruise tolerance, low hollow heart incidence, and good boiled quality. It is moderately resistant to scab. U.S.#1 yields have averaged 106% of Atlantic and 109% of Superior in Maine trials. Specific gravity has averaged of 1.068 in ME trials, -0.022 vs

Atlantic and -0.0011 vs Superior. Seed Availability: University of Maine seed, tissue culture tubes from Porter Farm, Maine Seed Potato Board.

- **AF4157-6** (Yankee Chipper x Dakota Pearl), an early to mid-season, round to oblong white with good yields for an early variety, moderately-high gravity, very good chip color, and fair to good appearance. U.S.#1 yields have averaged 96% of Atlantic and 103% of Snowden in Maine trials. Specific gravity is moderate to high (average of 1.085 in ME trials, -0.004 vs Atlantic in ME trials) and chip color from storage has been very good. It typically has a small tuber size profile. It has low sugars even from cool temperature storage. It is susceptible to scab, but has resistance to blackspot bruise and moderate pink rot resistance. AF4157-6 has potential as a chipper in southern states and in northern states on fields where scab is not a concern. Seed Availability: University of Maine seed; Maine Seed Potato Board seed, disease-free culture tubes, or minitubers; US Potato Board Fast-Track program field-grown seed (Zeloski, WI).
- **AF4172-2** (A95523-12 x A92158-3), a medium maturing, russet with good fry quality, fair to good tuber appearance, and high yields. US#1 yields have averaged ~115% of standard russeted varieties (usually Russet Burbank) in Maine trials. Specific gravity is moderate (average of 1.083 in ME trials, +0.003 vs RB) and fry color from storage has been very good. It has been a good performer in the national fry processing trials (NFPT). It is susceptible to scab, but has good bruise resistance and moderate pink rot resistance. Tuber size tends toward the smaller size classes. Baked quality scores have been very good. Seed Availability: University of Maine seed plus tissue culture tubes from Porter Farm, Maine Seed Potato Board.
- **AF4296-3** (A0508-4 x A99081-8), a widely adapted, late maturing, russet with good fry quality, fair tuber appearance, and high yields. US#1 yields have averaged 113% of standard russeted varieties (usually Russet Burbank) in Maine trials. Specific gravity is moderate (average of 1.079 in ME trials, -0.001 vs RB) and fry color from storage has been good. It has been an outstanding performer in the national fry processing trials (NFPT). It is moderately susceptible to scab, but has moderate verticillium resistance and good bruise resistance. Seed Availability: Maine and Wisconsin early generation seed (SCRI Fast-Track seed production); University of Maine seed; Porter Farm, ME Seed Potato Board seed and tissue culture.
- **AF4550-2** (W2301-3 x W1101R), an early, purple-skinned, white-fleshed clone with moderate yields and good boiled quality. It has much better purple skin color than Caribe, Purple Viking, and other standard purples, but it is susceptible to scab. Seed Availability: University of Maine seed plus it is in virus clean up for tissue culture.
- **AF4648-2** (NY132 x Liberator), a mid-season, round to oblong white with good yields, high gravity, bruise resistance, good chip color, and good appearance. It could go for chipping or fresh market. It has good scab resistance and is resistant to golden nematode and PVY. It has moderate late blight and pink rot resistance. U.S.#1 yields have averaged 94% of Atlantic and 101% of Snowden in 7 ME trials. Specific gravity has averaged of 1.086 in ME trials (+0.001 vs Atlantic). Seed Availability: University of

Maine seed; Porter Farm (ME Seed Potato Board) seed and tissue culture; USPB Fast-Track program field-grown seed (Zeloski, WI).

- **AF4659-12** (A99331-2 x US147-96RY), a yellow-fleshed “pinto-type” specialty variety with an interesting red and yellow skin pattern. It produces small, fingerling-type tubers that are excellent roasted, boiled, or fried. Seed Availability: University of Maine seed plus tissue culture tubes from Porter Farm (Maine Seed Potato Board).
- **AF4985-1**(ND8555-8 x ND4756-1), a red-skinned, white-fleshed clone with good appearance, yield, internal quality, and cooking quality. It has moderate scab resistance, but has been prone to growth cracking in some trials. Seed Availability: University of Maine seed; it will be submitted to Porter Farm (Maine Seed Potato Board) for virus removal and tissue culture.