Potato Breeding Program Research Update 2007

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Introduction

Potato variety development through the UW Potato Breeding program continues to work on the many levels required to substantiate a comprehensive effort. As presented in this document breeding goals are continuously evaluated in light of both long standing and recent needs of the potato industry. Significant adjustments made in 2006 are the following. 1) Crossing strategies based on improved pedigree analysis, 2) Reduction of years within the selection scheme, 3) Earlier selection exposure to Central WI and 4) Initiation of two new projects are all examples of adjustments made in 2006.
We continue to build collaboration with in state and out of state researchers to achieve the agronomic and disease screening tools. These efforts will confirm if value added characteristics are being captured in advanced selections. Germplasm with key traits are sought as a means of building parents as varieties derived from such parents.
Breeder's Seed multiplication is an ongoing emphasis that has allowed for extensive exposure to various trials and on-farm testing. Our efforts in coordinating systematic testing is improving and beginning to yield a more complete picture of Elite lines promoted from the program. This again is related to the input of many cooperating parties. Finally, SPUDPRO, WARF and the Plant Variety Protection process are each contributing substance to the output of the breeding program.
The following is a summary of our effort in 2006.

Seed Production and Greenhouse Tubers Production and Exchange: One hundred and fifty lines were planted in the greenhouses and the field for crossing and true seed production. Also, 48,000 greenhouse tubers were produced that will be planted in the field as single hills or field year 1 of selection (FY1) in 2007. In a similar experience in 2006, of the 93,004 single hills planted in FY-1, 56,285 corresponded to 398 families coming from WI crosses. The remaining 36,789 single hills were planted with seedling tubers obtained through interchanges with the breeding programs from CO, ME, ID, ND, and Canada. For 2007, the targeted number of single hills (FY-1) is 80,000, 48,000 from WI and the remaining 32,000 will be obtained from CO, ME, ID, ND, NY and Canada. Tuber exchange with out of state sources is important to strengthen selections for Colorado Potato Beatle, viruses (PVY, PVX and others), scab, late, blight, fresh market red and russets, processing ability in russets and round whites (chippers). Enhanced germplasm is currently used to derive varieties of better processing quality (e.g. cold chipping and long storability), disease resistance (scab, late blight, early blight and early dying), and resistance to environmental stresses including cold tolerance and improved tuber quality (enhanced tuber calcium). Germplasm with key traits continues to be sought as a means of building parents as varieties derived from such parents.

Field Year 2 (4 Hills Plots): 2653 lines corresponding to 489 families (crosses) were planted (33% russet, 55% chipping and 12% red) as FY2. Of these 546 lines were selected to be evaluated in FY-3. Early evaluation of processing traits (specific gravity and chipping) will occur thanks to collaboration with the USDA East Grand Forks potato processing facility.

Field Year 3. FY-3 was composed of 756 lines that were planted as unreplicated 8 hills plot at the Hancock, WI A.R.S. and simultaneously, 20 hills plots were planted at the Rhinelander, WI A.R.S for evaluation and seed multiplication. Of 756 lines, the goal is to select 100-120 lines to be included in the replicated trials-1 of 2007. Line performance for early blight, early dying and tuber aspect were recorded. Evaluation of processing traits (specific gravity and chipping) will occur thanks to collaboration with the USDA East Grand Forks potato facility. A special project initiated in Dr. Palta's potato physiology lab included the evaluation of a population of 534 clones from the crosses of Superior to Atlantic and Snowden. An evaluation of these 534 clones was conducted in two unreplicated locations (Hancock and Rhinelander) using 8 hills plots. Preliminary data from this population indicates that important variability for tuber Calcium intake ability. Breeding and genetic studies are proposed for the use and understanding of Calcium intake ability since this may have a significant impact on tuber health and quality. Weights, tuber appearance, specific gravity and frying quality are being evaluated. Tuber appearance indicates a high probability of obtaining competitive lines from these lines. A subset of these lines will be included in the replicated trials-1 of 2007 and 2008.

Field Year 4 and Beyond: Advanced selection trials are conducted at Hancock and Rhinelander, WI. We continue to build collaboration with WI and out of state researchers to achieve the agronomic and disease screening tools. These efforts will confirm if value added characteristics of importance are being captured in advanced selections.

Modifications in Potato Breeding Strategies Implemented in 2006

Important modifications to the breeding scheme were introduced in 2006**.** Basically these modifications consist of the following:

i. A two year reduction within the breeding scheme used to identify Advanced Selections.
ii. Use of the Hancock Agricultural Research Station at earlier stages, targeting adaptation to environment of Central Wisconsin.
iii. Testing at earlier stages for field performance, processing quality (gravity and frying at 45ºF) in collaboration with the USDA facility in East Grand Forks).
iv. Selection at earlier stages for disease resistance (late blight, scab and early dying) through in-State evaluation and collaboration with out of state programs located in OR, MI and ON.
v. A small, but significant component of marker assisted selection in early generations for late blight resistance is carried out in collaboration with Dr. Jiming Jiang's lab at UW-Madison.

The objectives of these modifications, including crossing strategy and early generation selection, are to facilitate a more efficient use of resources. This will be achieved through evaluating a larger number of potential varieties under the environments and stresses of Hancock, which represent the WI Central Sands, our main production region. This will result in a larger number of selectable lines. This approach will increase the opportunities of finding a winner earlier in the selection process. Unless line selection is performed, the genetic make-up of a potato line is not expected to change by year of selection; the earlier their value is known the better for a breeding program. In 2007, implementation of a crossing and early generation strategies similar to 2006 are proposed. The parents to be used will be derived from analysis of 2006 and earlier data, and from recommendations from breeders and potato growers.

Variety Promotion by Name: Besides the SPUDPRO initiative, discussed by Bowen et al. in these proceedings, a complementary effort was initiated in 2006 jointly with WPVGA and Food Insight, Inc. The objective is to stimulate the promotion and development of specialty potatoes for the fresh market. The primary purpose of this project is to consolidate efforts made by UW- researchers, growers and industry to promote existing fresh market potato varieties coming from the Wisconsin Potato Breeding Program as well as develop new variety offers for the fresh market. In the first year, "Villetta Rose" was promoted and marketed using bag locks accompanied with name identification and recipes for use. Chefs from Wisconsin have evaluated 10 Wisconsin varieties for appearance, flavor, and texture for raw, baked, boiled, mashed and fried preparations and have recommended the best preparation methods and provided serving directions. One of the objectives is to use this strategy to include culinary recommendations in the description of new varieties. Results from our red fleshed/red skinned variety W6270-1RR and russet variety Freedom Russet are given in Fig 4 and 5.

Seeds of the Future: Use of Enhanced Germplasm in the Selection of Improved Varieties:

Several potato programs, especially the UW/USDA Germplasm Enhancement Program led by Dr. Shelley Jansky (vice Hanneman) and the US Potato GeneBank (Bamberg) have identified populations and individual lines that have been used as parents to confer characteristics to improve quality and performance of future varieties. Highlights of materials that use enhanced germplasm from these sources which are being evaluated in the breeding program are:

Selection for Resistance to Late Blight: Every year potato growers in Wisconsin spend $4-8 million on fungicide products as an insurance against losses due to potato late blight infections**.** In addition, operational expenses to apply these fungicides are $4 million. The U.S. spends $70-140 in fungicide to control late blight (Stevenson, 2003). Utilization of potato varieties resistant to late blight is the most cost-effective and environmentally sound method to controlling this disease.

Marker Assisted Selection for Resistance to Late Blight: In 2005 six hundred and eighty two clones were screened in Dr. Jiang's laboratory for the presence of late blight RB resistant genes. From these 276 that resulted + for the gene of interest were planted in the field, several tubers of each were harvested to be screened for late blight under field and controlled conditions. Fifteen lines were selected from Year 3 and three were evaluated in the replicated trials (Year 4).

Selection of Progenies for Late Blight Resistance: In 2006, two hundred and forty one progenies of crosses of the MX and LBR sources of resistance were selected in the Year 1 of field selection (Single hills) 46 selected from Year 2 (4 Hills). Late blight tests will be performed in these clones to evaluate resistance.

Oregon (OR) Foliar and Tuber Evaluation of Early Generation Lines*:* 113 lines of different late blight sources of resistance were submitted for unreplicated evaluations (4 hills). The results of this test are given online at www.uwpotatoes.wisc.edu.

Selection for Soft Rot resistance: A group of progenies from lines C297, C31-5-115, C450, and C115 with resistance to tuber and vine rot caused by *Erwinia* spp. were selected from different stages of the breeding program in 2006; these are represented by 88 lines from Year 1, four in Year 2, and nine from Year 3. Resistance to vine and soft rots will enhance the field and storage performance of future WI varieties.

Selection for Early Dying Resistance: A set of 64 lines from the Breeding Enhancement Program were tested in 2006 at the Hancock A.R.S. for resistance to early dying caused by *Verticillium dahliae*. Out of these 23 had better performance and the best for russet, chipping and red types will be considered as parents in the future. These experiments were done in collaboration with Dr. Douglas Rouse from UW-Plant Pathology. Results of this experiment can be found at www.uwpotatoes.wisc.edu.

Cold Chipping: An additional 1900 lines from the Germplasm Enhancement Program are maintained and evaluated for frying and processing characteristics. The best cold chipping lines used in the WI breeding program were derived form *Solanum tarijense*.

Use of Cold Tolerant Germplasm: A set of 48 lines selected for vine and tuber frost tolerance have been developed from crosses and backcrosses made by the US Potato Gene Bank between several species. Some lines can withstand temperatures up to -5°C (23°F after acclimation). These lines can be used to develop frost tolerant varieties.

Use of High Tuber Calcium Intake Ability from Wild Species: The UW breeding program collaborates with the US Potato Gene Bank in the evaluation of calcium content of progenies derived from the crosses of *Solanum tuberosum* and *S. gourlayi* and *S. microdontum.* Some lines can accumulate five times the amount of Ca than regular potato varieties. *High calcium content in tubers has been associated with reduction in blackspot bruise in tubers and general tuber health essential for post-harvest handling operations. In 2007, efforts will be made to move genes from high calcium parents to more adapted materials by traditional sexual multiplication.*

Results of Experiments

The report will cover the 2006 results from ongoing projects carried out by our program staff and a review of the results of experiments collaborated by researchers from WI, the North Central, North East, Oregon and Canada.

1. Elite Line Trials
- **-Agronomic and Diseases Evaluations (See reports by Bussan and Stevenson)**
- **-SpudPro (see Bowen et al. report in these Proceedings)**
- **-North Central Potato Variety Trial (NCPVT)**
- **-Snack Food Association Trial**
- **-North East Regional Trial (NE1014)**

2. Advanced Breeding Lines
- **-Potato Variety and Advanced Selection Evaluation (See Kostichka report)**
- **-Replicated yield and adaptation trials**
- **-On-farm tests and Seed Multiplication**
- **-Scab trial**
- **-Late blight trial**

3. Early Generation Selection

North Central Region Potato Variety Trial (NCPVT): Five lines (three chipping: W2133-1, W2310-3, W2324-1, and two russets: W1879-1rus and W2683-2rus) were included in the NCPVT of 2006 along with advanced selections from MI, MN, ND and Canada. This trial is an opportunity to evaluate in five states the WI materials in relation to potential releases from breeding programs of those states. In WI the NCPVT involved three levels of evaluation: 1) at Hancock as a yield trial, 2) at a second Hancock field for verticillium early dying and 3) at Rhinelander for scab. Apart from the WI location, the NCPVT was conducted in the MI, MN, ND and Canada (AB, MB and ON). In ND, varieties are also tested for sugar end allocation and metribuzin resistance and data will be reported online at www.uwpotatoes.wisc.edu when they become available. The experimental design included three replications. Each experimental plot consisted of single rows of 20 feet per genotype and replication separated 3 ft, and hill to hill separation of 1 ft. The experiment was harvested and graded 120 DAP. Frying and specific gravity samples were taken as described in Table 11. Estimates for the yields, specific gravity, tuber internal defects (brown center, hollow heart, HH, internal brown spot, IBS, vascular discoloration,VD), maturity, diseases (early dying, early blight and common scab) were obtained using procedures described in Table 11. The results from the 2006 NCPVT trial are given in Table 1, Table 2 and Fig 1). In general, specific gravity was low this year for the NCPVT. The highlights of the line performance are as follows:

Wisconsin Lines

W2324-1: a very high marketable yield potential and specific gravity was observed in 2006 that is consistent with observations from previous years. The chip color from the December fry was statistically similar to Snowden and Norvalley. Significantly lower early dying and early blight than the average of the round white lines. Scab severity is the limiting factor to the promotion of this line as a variety for wide adaptation.

W2133-1: high marketable yield and chip color similar to Snowden in the December fry. The tubers were of medium size and adequate internal quality. Early blight performance similar to Snowden.

W2310-3: best chip color coming from storage at 47°F (8.3°C) and 42°F (5.5°C) of all lines tested. This line exhibited the lowest yield among the three WI lines.

W2683-2rus: Very good yield, significantly higher than Russet Burbank and Russet Norkotah. High resistance to common scab as demonstrated in scab evaluation under high pressure. The chip color was lighter compared with Russet Burbank.

W1879-1rus: Uniform medium size tubers. Marketable yield was similar to Russet Burbank and Russet Norkotah. Internal quality superior to the average of the russet lines evaluated. Early maturity.

Alberta, CN lines: The most outstanding line from the AB breeding program was the russet line CV97006-1rus. AND98324rus presented a high percentage of hollow heart (28.4%) and common scab (29.1%). WV3667rus presented a high percentage of tubers with internal brown spot.

Michigan lines: MSI-005-20Y was a round white line with very high yield, 24% higher than Atlantic, good common scab performance in an overall low severity field. MSJ461-1 (a round white) also was high yielding at Hancock but had significant internal brown spot (IBS) problems (see Table 1). Among Michigan russets, MSA8254-3Brus had yields similar to Russet Burbank but higher hollow heart problems compared to the rest f the russets.

Minnesota Lines: Among the Minnesota lines, MN18710rus, was the one with better yield and overall performance. Fry color was worse than the average of the russet lines.

North Dakota lines: Several ND selections had high yields at Hancock. Among the round white, ND5775-3 had the highest yield potential, 31% higher than Atlantic; however, it also had higher hollow heart problems higher than Atlantic and the average of the round white lines. The specific gravity of this line was similar to Atlantic in our Hancock test. The red line ND5002-3 had higher yield than Dark Red Norland and did not have any important negative aspect in our study.

Table 1. Performance of lines evaluated in the North Central Potato Variety Trial, Hancock WI ARS, 2006

Clone	TotalYield	#1Yield	#1Yield	Bsize	Culls	Specific	Fry	Fry	HH	IBS	VD	BC	No Internal	Early Dying	Scab%	Scab	Early Blight	Maturity
	(cwt/A)	(cwt/A)	% of std	(cwt/A)	(cwt/A)	Gravity	47F 3 mo	42F 3 mo	%	%	%	%	Defects	Severity	Cover	Sever	Sever	1 to 5
Round white																		
All	509	471	100	9.8	30.6	1.079	4.8	7.1	3.0	5.5	1.7	1.4	88.5	2.5	8.1	1.6	2.6	2.2
Atlantic (std)	505	469	100	5.3	29.5	1.076	5.2	6.7	9.8	12.5	3.0	2.2	69.7	2.8	5.7	1.9	**2.1**	2.2
CV97065-1	428	394	84	5.8	30.1	1.076	4.4	7.0	0.4	2.0	1.1	0.7	97.3	3.8	10.9	1.7	3.4	**1.2**
MN00307-1	273	250	53	11.4	11.8	1.080	6.4	8.9	0.9	3.7	0.7	2.3	92.4	2.5	5.7	1.4	2.8	**1.8**
MSI005-20Y	**597**	**584**	124	2.4	7.5	1.070	8.3	9.8	0.3	2.0	0.7	1.1	97.3	2.7	1.8	**1.1**	2.5	2.6
MSJ461-1	**595**	**560**	119	9.2	23.2	1.078	5.0	8.2	0.3	12.9	0.7	0.8	83.7	**1.8**	12.2	2.2	2.4	3.3
ND5775-3	**653**	**613**	131	4.8	31.4	1.082	4.3	6.2	11.0	2.9	2.6	3.2	80.0	**1.5**	3.1	1.2	**1.7**	3.8
ND7818-1	522	470	100	6.4	46.0	1.079	3.9	6.8	0.4	3.3	1.1	0.7	95.7	3.7	8.3	1.8	3.9	**1.4**
NorValley	475	433	92	12.6	28.4	1.076	**3.7**	**5.9**	2.1	2.0	0.7	1.1	95.7	2.8	3.1	1.2	2.9	**1.5**
Snowden	489	470	100	8.1	8.8	**1.085**	4.0	6.8	0.3	2.9	4.2	1.6	90.3	**1.6**	10.9	1.7	2.9	2.5
W2133-1	531	501	107	5.8	24.0	1.079	4.3	7.2	0.4	5.8	0.7	0.7	93.0	2.6	10.9	1.9	2.8	2.2
W2310-3	433	406	87	8.8	17.4	1.076	**3.3**	**4.2**	0.3	2.0	1.5	1.1	96.2	2.5	9.6	1.8	2.5	2.5
W2324-1	**591**	**562**	120	6.3	18.9	**1.087**	**3.8**	6.4	3.3	8.7	3.0	0.8	83.2	**1.6**	16.1	2.5	**1.8**	3.3
Reds																		
All	487	455	114	12.9	31.3	1.067			3.3	5.5	1.7	1.4	88.7	2.5	8.1	1.6	2.6	2.2
CV97050-3	380	328	82	7.2	48.7	1.070			1.5	3.3	1.5	1.6	92.5	2.8	5.7	1.7	2.5	2.9
MN00177-6	394	310	78	62.7	23.5	1.070			0.4	9.1	0.7	0.8	88.7	2.2	3.1	**1.1**	2.4	**1.7**
MN99460-14	407	385	97	7.8	17.2	1.073			11.7	4.5	0.7	2.8	80.5	2.9	12.2	1.8	2.8	**1.5**
ND4659-5	472	448	112	8.2	18.6	1.068			0.4	3.3	0.7	1.9	94.1	3.7	1.8	**1.1**	2.8	**1.5**
ND5002-3	502	484	121	10.9	9.4	1.064			0.4	2.0	0.7	0.8	97.9	1.9	1.8	**1.1**	2.2	1.8
Red Norland(std)	437	399	100	3.4	38.5	1.060			1.0	2.0	1.9	0.8	95.7	3.1	4.4	1.4	4.0	2.8
Red Pontiac	**642**	**591**	148	6.9	44.9	1.064			2.1	5.8	3.0	1.9	86.0	**1.6**	19.2	2.8	2.8	2.8
Russets																		
All	536	478	108	12.7	32.5	1.073	7.1	8.6	8.7	5.5	1.7	1.4	82.5	2.5	8.1	1.6	2.6	2.2
AND98324	538	493	112	6.7	38.4	1.082	**5.5**	**7.3**	28.4	11.1	1.3	1.6	57.6	**1.8**	29.1	2.8	**2.1**	3.0
CV97006-1rus	**613**	**601**	136	5.8	5.3	1.070	**5.9**	**6.9**	4.5	3.7	0.7	1.1	90.8	2.4	1.8	**1.1**	2.8	2.8
MN18710rus	551	511	116	10.4	29.8	1.075	8.6	9.7	3.9	2.5	2.6	0.8	90.8	**1.3**	4.4	1.2	**1.7**	2.6
MSA8254-3Brus	511	426	96	22.6	62.9	1.070	8.5	9.9	25.9	4.1	0.7	1.9	69.1	**1.8**	1.8	**1.1**	3.1	2.6
ND7882b-7rus	412	382	86	10.4	22.1	1.071	8.0	9.7	**0.9**	3.3	1.1	0.8	**94.6**	4.0	1.8	**1.1**	3.5	**1.7**
R. Burbank (std)	**656**	442	100	22.0	194.1	1.068	7.5	9.0	12.8	8.7	3.8	2.5	69.6	**1.8**	5.7	1.4	**1.5**	**1.7**
Russet Norkotah	517	497	112	12.1	**7.9**	1.068	7.6	9.8	5.7	2.5	3.0	1.1	88.1	4.0	4.4	1.5	3.2	**1.1**
W1879-1rus	523	496	112	19.4	**7.5**	1.070	6.8	8.4	3.3	2.5	0.7	0.8	**94.0**	3.1	17.6	1.4	2.5	**1.4**
W2683-2rus	**610**	**568**	128	15.2	26.5	1.073	6.7	7.7	3.9	3.7	1.5	1.1	90.2	2.2	1.8	**1.1**	2.5	2.5
WV3667-1	**609**	553	125	16.1	39.5	1.079	6.8	8.5	9.9	25.4	3.8	1.4	52.8	3.1	20.0	2.7	**1.9**	**1.2**

Note: Underlined means are statistically lower than the average of the group where they belong

Highlited means are statistically better than the average of their group

Normal font type depicts performance that is similar to the mean performance of the group (round white, red, chip)

Table 2. Category No.1 yield of lines evaluated in Alberta, Manitoba, Nebraska and WI, comments from the WI yield trial.

Clone	ALB	MB	NE	WI	Comments from WI experiments
RED	**No. 1 Yield (cwt/A)**				
CV97050-3	353	231	176	328	Lower yield, higher gravities than Red Pontiac and Dark Red Norland, nice looking at harvest, mid season to late, watch skinning & growth cracks.
MN 00177-6			62	310	Lower yield, higher gravities than Red Pontiac and DR Norland, pear shape, very pale color, small elongated red, early, no tuber dormancy. Watch sprouting!
MN 99460-14			164	385	Yield similar to Dark Red Norland, higher gravity, nice looking, but susceptible to hollow heart, early
ND4659-5R	332	293	148	448	Good yield, gravity higher than Dark Red Norland, nice red color, uniform mid size tubers, may be susceptible to early dying.
ND5002-3R	192	274	137	484	Good yield in WI, very nice looking at harvest but its good look collapsed after 3 mo in storage (WI).
Dark Red Norland	491	368	295	399	
Red Pontiac	639	540	376	591	
RUSSET / LONG					
AND98324-1Russ	519	377	236	493	Good yield, similar to Russet Norkotah, but more hollow hearts than Russet Burbank, better frying ability than Burbank at 3 mo. in storage, scab susceptible
CV97006-1	409	387	205	601	Very high yield, higher than Russet Norkotah, in WI, mid to late season, nice skin, blocky, better frying ability than Burbank at 3 mo. in storage, some pointed ends
MN 18710			261	511	Yield similar to Russet Norkotah, big size, good looking, good performance for early dying and early blight.
MSA8254-2BRUS	375	369	159	426	No. 1 yield = Burbank, some knobs, more hollow heart than Burbank, good early dying tolerance
ND7882b-7Russ	494	290	120	382	Low yield, nice color. It may be susceptible to early blight and early dying,
W1879-1Rus	201	183	61	496	Uniform medium size tubers. Marketable yield similar to Russet Burbank and Russet Norkotah. Internal quality superior to the average of the russet lines evaluated. Early maturity.
W2683-2Rus	323	276	134	568	Yield significantly higher than the mean of the russet tested, scab tolerant.
W3140-3Rus	364	381	216		
WV3667-1	400	257	27	553	High yield and maybe high gravity, pale russeting, high internal brown spot, scab susceptible, maybe early blight tolerant.
R. Burbank	421	252	133	442	
R. Norkotah	412	301	91	497	

Table 2. Category No.1 yield of lines evaluated in Alberta, Manitoba, Nebraska and WI, comments from the WI yield trial (cont'd).

ROUND WHITE	No. 1 Yield (cwt/A)				Comments from WI experiments
	ALB	MB	NE	WI	
CV97065-1	364	172	117	394	Low yield, gravity as Atlantic, internal defects (IBS,HH), good tolerance to foliar early blight. Good chips from 47°F at 3mo in storage.
MN 00307-1			166	250	Lowest yield, early, variable size, poor frying ability from 47°F at 3mo in storage.
MSI005-20Y	502	463	225	584	Very high yield, higher than Atlantic, smooth, good looking tubers, gravity may be lower than Atlantic scab tolerance (low stress). Poor chipping ability from 47°F at 3mo in storage.
MSJ461-1	346	415	282	560	Very high yield, higher than Atlantic, smooth, frying ability as Atlantic, from 47°F at 3mo in storage, watch tuber internal defects (IBS) = Atlantic, good tolerance to early dying, late.
ND5775-3	566	633	367	613	Highest yield, watch hollow heart = Atlantic, very good frying ability at 3 mo of storage, good tolerance to early dying and early blight, late
ND7818-1Y	535	327	174	470	Yield similar to Atlantic, frying ability at 3mo similar to Snowden, some pear shape, susceptible to early dying & early blight, early
W2133-1	388	320	207	501	High marketable yield and chip color similar to Snowden in the December fry. Medium size tuber of adequate internal quality. Early blight performance similar to Snowden. 20% hollow heart at a single location in MI.
W2324-1	377	488	373	562	Very high yield, good frying ability, specific gravity similar or higher than Snowden, frying ability at 3 mo similar to Snowden, susceptible to scab, tolerant to early blight, late
Atlantic	491	373	309	469	
NorValley	412	245	279	433	
Snowden	466	293	267	470	

Fig. 1 Graphic depicting yield of line W2324-1 evaluated in four locations of the North Central Region Potato Variety Trial.

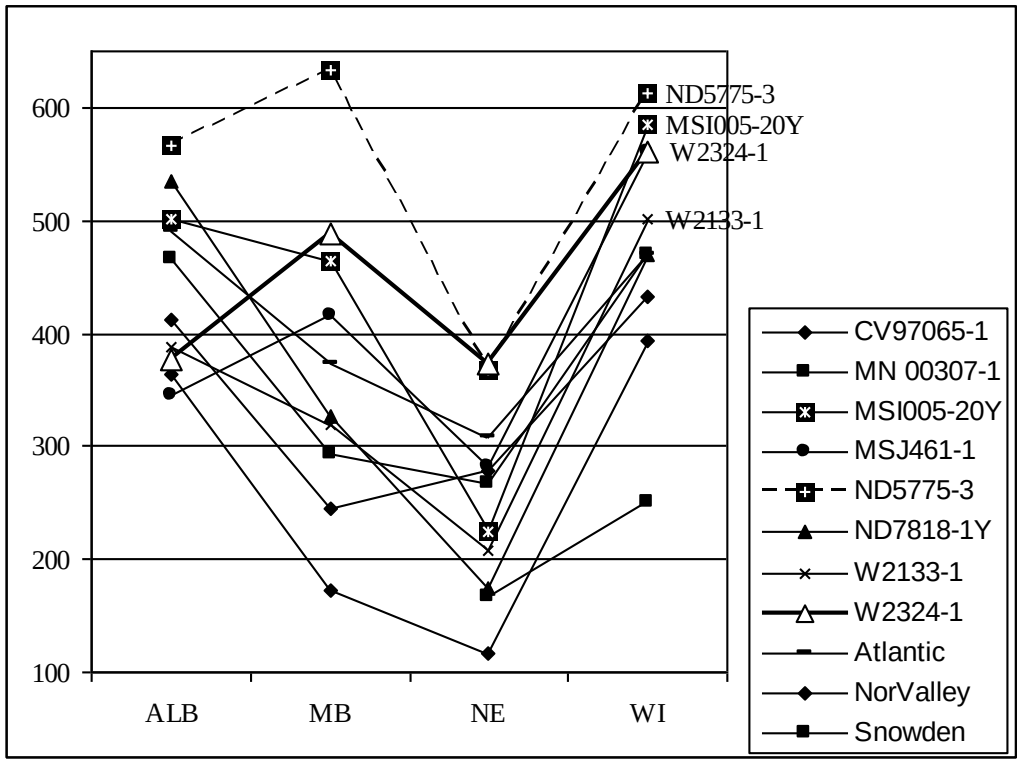
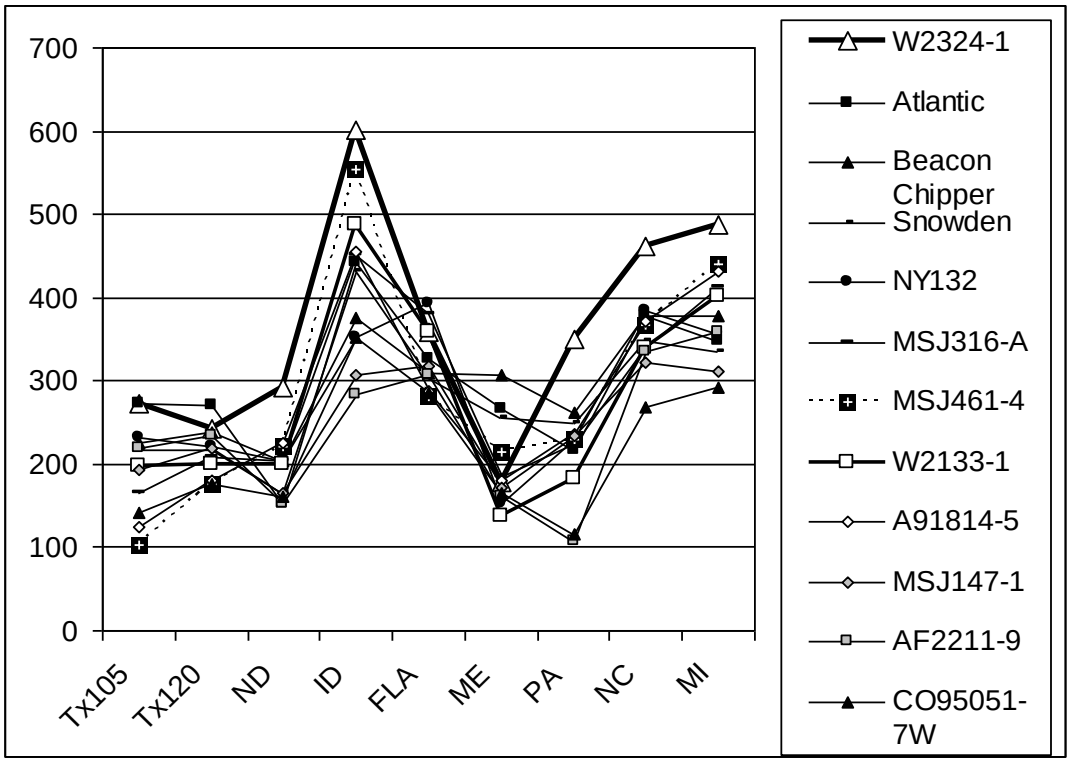


Fig. 2 Graphic depicting yield (cwt/A) of line W2324-1 tested in eight locations of the National Snack Food Association Trial



Snack Food Association (SFA) Trial: W2133-1 and W2324-1 were submitted to be trialed in 9 locations in the states of ID, FL, ME, MI, MN, NC, PA, TX and WI. This trial was coordinated by Dr. Donald Haselth, Cornell University. A summary of the yield and specific gravity data is provided in Tables 3 and 4, and Fig 2 and 3. The following comments were made by the collaborators of the SFA trial:

W2133-1: Herr Foods (MI) rated this line with the best chip quality from storage (48ºF and 55ºF chipped on January 27th and March 24th, 2006. Very light scab and nice appearance were observed. Tx: Below average yield and high proportion of B size tubers in early and late tests. NC: chip color was excellent in the chipping tests. No significant internal defects were recorded. External defects included soft rot, sunscald, misshapes, tight stolon attachment and growth cracks.
W2324-1: raw internal quality was good in the tubers. Out of the field chip processing results from Herr Foods ranked this variety in the top four in the Michigan trial. A minimal amount of black spot bruise was recorded in the bruise test. The only concern noted is the common scab susceptibility of this variety. In Tx soft rot was reported as having some impact in its yield. NC: Marketable yield was 124% Atlantic, gravity was 1.082, and chip scores were excellent for the 24 to 48 hr test and good for the 5 to 7 day test. External defects included misshape, growth cracks, and tight stolon attachment.
CO95051-7W: Chip color was exceptional. External defects included sunscald, growth cracks, misshapes, enlarged lenticels, and high levels of skin blemishes due to Rhizoctonia.
ND5822C-7 exhibited the best Agtron score as well as the least number of chip defects in the group, but exhibited a very high level of hollow heart (36-40%) in this evaluation.
MSJ461-1: 30% pitted surface scab in MI. In NC, no significant internal defects were recorded, external defects included scab, secondary growth, misshape, growth cracks, sunscald, and high levels of skin blemishes due to Rhizoctonia.
Snowden: 40% deep pitted scab (MI),
A91814-5: Over 50% had deep pitted scab (MI). Chip color was excellent in NC, but 14% soft rot was noted, other defects included high levels of sunscald and, as well as some soft rot, and growth cracks (NC).
Atlantic: 25% deep pitted scab in MI.
NY132: less than 5% scab. Significant hollow heart observed in ID. In NC, no significant internal defects were recorded. Chip color was excellent in both the 24 to 48 hr and 5 to 7 day chip tests. No significant internal defects were recorded. External defects were mishapes, growth cracks, sunscald, and skin blemishes due to Rhizoctonia.
AF2211-9: Chip color was exceptional is the 24 to 48 hour chip test and excellent in the 5 to 7 day chipping. Internally 14% brown center was noted, external defects included sunscald, misshapes, and high numbers of growth cracks.
Beacon Chipper: Chip color was excellent at the 24 to 48 hour chipping and good at the 5 to 7 day test. Twenty-two percent soft rot was observed internally, external defects included misshapes, sunscald, soft rot, growth cracks, and skin blemishes due to Rhizoctonia.
MSJ147-1: Chip color was exceptional. External defects included secondary growth, misshapes, growth cracks, deep apical ends, common scab, and skin blemishes due to Rhizoctonia (NC).

MegaChip: light scab, good consistent size and appearance.
MSJ316-A: no scab, good average size. Chip color was excellent in the 24 to 48 hr test and good in the 5 to 7 day chip test. External defects observed included growth cracks, sunscald, tight stolon attachment, secondary growth, misshape, and skin blemishes due to Rhizoctonia.

Late blight occurrence in Exeter, ME reported by J. Doorman: A late blight spore shower infected the trial area in early August and considerable differences were observed in foliage tolerance to the disease and led to late blight tuber rot occurring on some of the selections. A late blight tolerance rating was made on August 18th: Atlantic, MSJ461-1, MSJ147-1, Beacon Chipper, CO95051-7W, W2324-1 and W2133-1 appear to have strong tolerance to foliar infection from Late Blight. These cultivars had limited foliage lesions from the disease at the mid-August evaluation. Snowden, AF2211-9, MSJ316-A and NY132 appear to have little tolerance to foliar late blight invasion. Late blight tuber rot and deep pitted scab significantly reduced the yield potential of W2324-1, NY132, and W2113-1.

Sprouting studies from PA: results suggest that Snowden, Atlantic and MSJ461-1 may have similar storage sprouting performance. W2133-1, NY132, AF2211-9, MSJ316A, and A91814-5 were most similar to MegaChip and ND5822C-7 appeared to have the longest tuber dormancy (Fig.3).

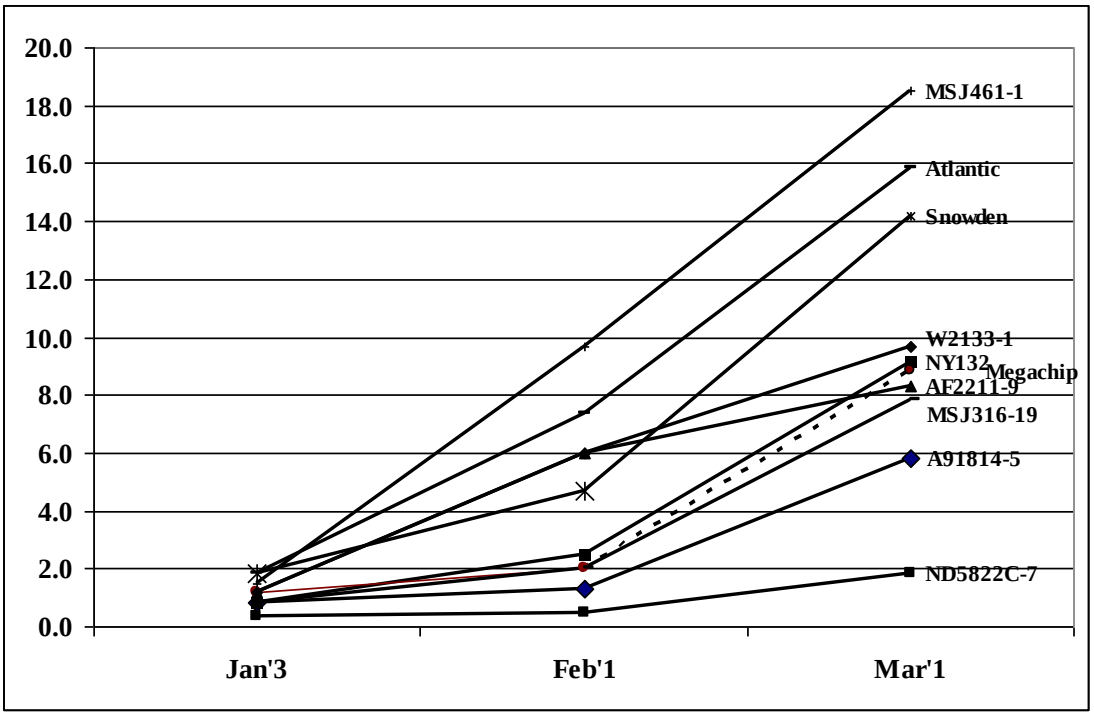
Table 3. Tuber yield (cwt/A) of lines evaluated at eight locations of the National Snack Food Association Trial.

Varieties	105DAP	122DAP								Mean
	Tx105	Tx120	ND	ID	FLA	ME	PA	NC	MI	Variety
W2324-1	**272**	**242**	**292**	**601**	**359**	**178**	**351**	**461**	**488**	**360**
Atlantic	272	270	152	442	327	266	217	377	347	297
Beacon Chipper	226	239	203	376	310	308	262	378	378	298
Snowden	216	217	165	432	303	256	249	348	335	280
NY132	231	221	203	352	394	153	230	384	357	281
MSJ316-A	166	208	205	450	381	184	223	339	411	285
MSJ461-1	102	177	222	555	281	215	230	367	441	288
W2133-1	**197**	**199**	**199**	**488**	**358**	**137**	**183**	**340**	**401**	**278**
A91814-5	124	181	225	456	287	181	237	372	431	277
MSJ147-1	193	220	165	306	317	172	233	322	311	249
AF2211-9	220	233	153	284	306	161	107	336	358	240
CO95051-7W	142	176	160	352	286	166	115	269	292	218
Mean/Location	202	219	224	424	326	198	220	358	379	283
$LSD_{5\% Error}$	55*	53*	n/a	74	n/a	n/a	39	55.6		

Table 4. Tuber specific gravity of lines evaluated at eight locations of the National Snack Food Association Trial.

Varieties	105DAP	122DAP							Mean
	Tx	Tx	ID	FLA	ME	PA	NC	MI	Variety
Atlantic	1.081	1.091	1.097	1.09	1.08	1.097	1.082	1.087	1.088
NY132	1.079	1.083	1.098	1.088	1.079	1.098	1.072	1.091	1.086
AF2211-9	1.082	1.09	1.096	1.09	1.073	1.084	1.081	1.081	1.085
CO95051-7W	1.075	1.078	1.105	1.082	1.077	1.089	1.078	1.081	1.083
W2324-1	**1.078**	**1.083**	**1.095**	**1.081**	**1.072**	**1.093**	**1.082**	**1.083**	1.083
A91814-5	1.072	1.077	1.096	1.082	1.075	1.099	1.082	1.085	1.084
Snowden	1.077	1.079	1.09	1.082	1.075	1.094	1.08	1.081	1.082
W2133-1	**1.073**	**1.08**	**1.095**	**1.082**	**1.081**	**1.089**	**1.072**	**1.084**	1.082
MSJ147-1	1.082	1.078	1.095	1.09	1.071	1.077	1.078	1.084	1.082
Beacon Chipper	1.076	1.083	1.087	1.088	1.073	1.081	1.079	1.083	1.081
MSJ316-A	1.068	1.076	1.089	1.075	1.071	1.084	1.076	1.083	1.078
MSJ461-4	1.068	1.076	1.09	1.078	1.073	1.08	1.072	1.077	1.077
Mean Location	1.076	1.081	1.094	1.084	1.075	1.089	1.078	1.083	1.083
$LSD_{5\% \text{ Error}}$	0.003*	0.003*	0.004	n/a	n/a	n/a	n/a		

Fig 3. Snack Food Trial 2005: Pennsylvania Average Sprout Length in Storage (inches)



US North East (Maine) Regional Trials Results:
Excerpts from G.A. Porter, P.C. Ocaya, B. MacFarline and B. Plummer 2006 Maine Potato Variety Trials report.

Potato variety trials were conducted at three locations in ME (Aroostook Research Farm in Presque Isle, Exeter (Central Maine) and St. Agatha (northern Maine). These trials were as a part of the collaborative NE1014 Regional Project. Since 1998 the WI breeding program contributes elite lines to this trial. Single rows plots, 25 feel long were evaluated per replication. An excerpt of the results relevant to the WI lines evaluated is given in Tables 5-7.

Table 5. Performance of WI breeding lines included in the Mid Season Test (Vine kill 103-104 DAP), Maine 2006 (NE1014 Regional Potato Variety Trial).

	Presque Isle, ME (103 DAP)				St. Agatha, ME (104 DAP)				
Variety	Total Yld	Yield	>1 7/8"	Spec	Total Yld	Yield	>1 7/8"	Spec	
	(cwt/A)	>1 7/8"	% of Std	Gravity	(cwt/A)	>1 7/8"	% of Std	Gravity	%Scab
Snowden	377	332	96	1.106	469	383	98	1.104	0.2
Atlantic (std)	395	345	100	1.102	497	429	100	1.101	1.1
Beacon Chipper	386	354	103	1.094	-	-	-	-	-
Dakota Diamond	395	317	92	1.101	-	-	-	-	-
W2978-3	363	319	92	1.092	387	305	71	1.084	9.9
W4132LB	-	-	-	-	400	192	45	1.087	36.2

Table 6 Comparison of W4132LB with standard varieties and breeding lines evaluated in the Late Season Test (Vine kill 109 DAP), Presque Isle, ME 2006

Variety	Total Yld	Yield	>1 7/8"	Yield	Specific
	(cwt/A)	>1 7/8"	%of Std	>2 1/4"	Gravity
Katahdin (std)	367	314	100	273	1.081
Yukon Gold	431	377	120	352	1.091
AF2376-5	360	329	105	279	1.090
AF2916-1	405	334	106	228	1.085
B1806-8	380	341	109	252	1.084
B1870-3	317	286	91	204	1.066
NY137	281	238	76	190	1.070
NYY73-49	428	373	119	335	1.091
W4132LB	459	401	128	290	1.093
W-D test (k=100)	67	70	-	71	0.005

Comments on Wisconsin breeding lines from the NE Regional Trial

Results from the 2005-2006 storage season indicated the following:
W2265-25: chip color (Agtron readings) similar to Atlantic in February 10, 2006 tests coming from 50°F, 45°F and 38°F, but darker than Snowden at 45°F and 38°F; less percentage of growth cracks and more black spot bruising potential than Atlantic from simulated tests. The number of days to sprout was similar to Atlantic and 7 days later than Snowden under 45°F and 85% RH.

Freedom Russet (W1836-3rus): chip color (Agtron readings) lighter than Burbank but darker than Gemstar Russet in February 10, 2006 tests coming from 50°F, 45°F and 38°F. Shatter and black spot bruise potential similar to Russet Burbank in tubers grown at Presque Isle, ME. Black spot bruising potential was higher than Burbank in tubers grown at St. Agatha. The number of days to sprout initiation was 153, thirty five days earlier than Burbank. Sprouts reached 0.5" at 188 days in storage, 21 days earlier than Burbank. **W2249-4rus**: chip color (Agtron readings) similar to Gemstar Russet and lighter than Burbank and Russet Norkotah in February 10, 2006 tests coming from 50°F, 45°F and 38°F. Shatter and black spot bruise potential similar to Russet Burbank. The number of days to sprout initiation was 160, twenty eight days earlier than Burbank. Sprouts reached 0.5" at 188 days in storage, 21 days earlier than Burbank.

Table 7. Performance of WI russet breeding lines included in the Late and Mid Season Test (Vine kill 109 and 104 DAP), Maine 2006 (NE1014 Regional Potato Variety Trial).

	Presque Isle, ME (109 DAP)							St. Agatha, Maine (104 DAP)				
Variety	Total	Yield	Yield				Chip	Total	Yield	Yield		
	Yield	>1 7/8"	>1 7/8"	Spec	Mis-	HH	Color	Yield	>1 7/8"	>1 7/8"	Spec	Mis-
	(cwt/A)	(cwt/A)	%Std	Grav	shapen	%		(cwt/A)	(cwt/A)	%Std	Grav	shapen
R. Burbank	409	287	100	1.088	22.0	7.5	50.0	450	347	100	1.092	18.0
Blazer Russet	329	271	94	1.087	14.0	5.0	58.0	451	405	117	1.093	9.9
Gemstar Russet	388	336	117	1.081	8.6	2.5	58.0	450	385	111	1.086	9.7
R. Norkotah	310	284	99	1.079	5.6	0.0	48.0	416	400	115	1.085	3.0
Shepody	371	204	71	1.090	11.6	2.5	58.0	462	233	67	1.091	15.5
W2466-5rus	374	308	107	1.080	7.8	0.0	64.0	409	356	103	1.09	10.7
W2683-2rus	408	303	106	1.081	18.6	0.0	60.0	371	316	91	1.084	12.5
W-D test (k=100)	57	54		0.004	-	-	-	69	92	-	0.006	-

Advanced Breeding Lines:

Replicated Yield and Adaptation Trials (RT): Two selection experiments that included advanced breeding lines were conducted at the Rhinelander and Hancock A.R.S. locations. The replicated trial 1 (RT_1) was composed of 112 lines, including 64, 30 and 18 chipping, russets and reds respectively. The RT_2 was composed by 50 lines, including the best performing 17, 15 and 4 chipping, russets and reds lines from the 2005 RT_1 trial. The amount of lines evaluated in these trials increased from 80 to 148 in relation to 2005 as a part of the modifications in the breeding scheme in 2006. Evaluations emphasized vigor, maturity, early blight, yield, grade, specific gravity, tuber external and internal defects. Results of these experiments are given in Tables 8 and 9. Frying evaluations will be performed directly from 42 and 47°F storages at 3, 5 and 9 months after harvest. Selections from RT_1 and RT_2 will yield the lines to be evaluated in 2007 (first year Breeder's Seed Multiplication for future on-farm grower exposure, as well as other WI and out of state trials).

Table 8. Results of the Second Year (RT2) 2006 Replicated Yield and Adaptation Trial 2006, Hancock and Rhinelander WI Agriculture Research Stations.

	1-5	A-size		B-size			Simulated				December	
	Early	Yield	Yield A	Yield	Culls	Specgrav	Blackspot Bruise		IBS	HH	Chip Color	
Round White	Blight	cwt/A	% of std	cwt/A	cwt/A	Hancock	%	1 to 5	%	%	47°F	42°F
(All)		391		16.1	17.8	1.074	32.4	2.3	19.6	1.7	4.3	6.2
W1201	**2.0**	425	99	13.2	20.7	**1.082**	26.3	2.3	16.9	2.0	4.8	6.9
W3157-2	**1.4**	331	77	15.2	24.6	1.077	19.5	2.2	14.7	3.7	4.5	6.6
W3186-2	2.7	422	99	12.6	10.4	**1.080**	53.1	2.8	25.8	0.3	4.4	5.6
W3722-2	3.1	415	97	15.0	19.0	1.075	56.0	3.1	27.6	1.5	4.1	5.6
W3747-1	3.2	384	90	23.1	14.3	1.067	40.3	2.0	21.0	0.3	**3.1**	**5.3**
W3747-7	**2.3**	**465**	109	13.2	13.4	1.076	64.3	3.4	33.9	0.3	4.3	6.3
W3750-3	2.9	425	99	15.2	10.0	1.074	59.5	3.4	33.5	1.2	4.3	7.1
W3846-4Y	3.1	385	90	18.2	17.1	1.076	39.3	2.5	22.1	0.3	4.7	6.7
W3852-4Y	2.5	417	97	13.7	17.5	1.076	19.2	2.3	18.0	0.7	4.3	7.2
W3911-1	3.1	414	97	18.2	27.5	**1.079**	**8.6**	**1.6**	**8.8**	1.6	4.1	5.9
W4013-1	3.8	265	62	26.8	10.3	1.072	30.7	2.6	18.8	0.3	**3.0**	**4.9**
W4016-4	2.8	**453**	106	12.8	11.2	1.073	**17.3**	**1.7**	13.6	2.4	3.7	**5.2**
W4113-5	3.3	331	77	15.2	27.6	1.063	**9.0**	**1.1**	**6.6**	5.0	3.9	**5.0**
W4132-1	2.9	383	89	13.7	15.4	1.073	52.8	3.4	31.7	0.3	7.4	9.1
W5786-1	3.0	349	82	9.3	18.9	1.065	**17.3**	**1.3**	13.2	7.6	4.0	6.7
Dakota Pearl	3.2	341	80	20.1	20.7	1.065	**7.7**	**1.4**	10.2	2.0	**3.5**	**5.0**
Snowden	3.0	386	90	15.0	8.3	1.077	40.6	2.9	28.7	0.3	3.7	6.1
Snowden Chip co	-	-	-	-	-	-	-	-	-	-	2.8-4.6	5.2-6.9
Atlantic (std)	2.6	428	100	11.1	23.1	**1.083**	41.2	2.8	21.7	6.7	4.6	5.4
95% Interval*		377-478		2-20	12-34.3	1.079-1.087	25-57	2.3-3.3	10.3-33	-	-	-
Red (all)		431		24.8	17.7	1.060	16.3	2.0	10.7	-	-	-
W3957-6R	3.5	389	99	32.5	12.0	1.054	4.9	**1.1**	3.9	0.7	-	-
W5767-1R	**2.2**	**520**	133	21.6	18.6	1.065	5.8	2.0	12.1	1.5	-	-
W6270-1RR	2.7	**516**	132	27.7	11.2	1.059	15.4	2.1	10.6	0.3	-	-
D.R.Norland	4.0	392	100	19.2	19.3	1.053	9.6	**1.2**	3.9	0.3	-	-
95% Interval		330-455		8.9-29	7.6-31.0	1.046-1.060	0-29.0	0-1.9	-	-	-	-
Russets/Long		373		28.8	21.6	1.067	29.3	2.1	14.1	1.7	6.4	9.1
W3730-4rus	2.8	394	110	32.4	22.5	**1.088**	33.6	2.6	20.7	1.6	5.6	**7.4**
W3740-4rus	2.2	**469**	131	28.6	33.9	1.065	41.3	2.9	22.8	0.6	7.9	9.8
W3743-5rus	**1.9**	**466**	130	**19.2**	33.2	1.064	34.6	2.5	18.4	1.1	7.8	9.8
W3952-3rus	2.6	371	104	36.4	22.9	1.063	23.1	1.7	7.3	1.1	7.2	9.6
W4143-3rus	2.7	263	74	39.3	26.6	1.068	50.9	2.8	23.6	2.3	**5.7**	8.6
W4146-1rus	2.6	295	82	35.1	11.6	1.069	**9.6**	**1.4**	5.5	1.1	7.6	9.8
W4184-3rus	2.5	364	102	**19.8**	13.5	1.062	24.0	1.7	8.8	2.3	**5.6**	9.0
W5716-1rus	**2.0**	364	102	29.0	12.8	**1.076**	53.8	2.5	19.1	0.6	6.0	8.6
W5785-2rus	2.5	347	97	54.6	14.7	**1.074**	17.3	2.0	10.6	0.6	5.8	9.0
W5785-4rus	3.7	383	107	**16.9**	20.1	1.058	19.2	**1.6**	5.8	0.6	6.4	9.8
W6153-21Yrus	2.5	330	92	29.3	28.7	1.065	28.7	2.5	19.1	9.7	6.2	8.7
W6153-6Yrus	3.6	397	111	26.8	20.2	1.064	**8.6**	**1.1**	5.8	0.3	6.2	8.3
Goldrush	3.7	345	96	**16.8**	17.4	1.060	18.3	1.7	6.2	0.6	6.5	9.8
R. Burbank	**2.4**	358	100	26.4	43.5	1.069	57.6	2.8	21.4	0.6	6.3	9.5
95% Interval		306-410		17-34	32-54	1.065-1.074	.5-73.7	2.2-3.3	9-32.8	-	5.5-7.0	8.6-10

Note: *95% confidence interval defines boundaries within the standard variety spreads 95% of the time. Means of other lines that fall within that interval are considered statistically similar to the standard.

Table 9. Results of the First Year (RT1) Replicated Yield and Adaptation Trial 2006, Hancock and Rhinelander, WI, 2006.

	A-size	A-size	B-size		Simulated		Hancock	Hancock	Hancock	Hancock
	Yield	Yield	Yield	Culls	Blackspot Bruise		HH%	IBS%	VD%	Specgrav
	cwt/A	% of std	cwt/A	cwt/A	%	1-5				
Round White										
All	386		24.2	26.3	33.0	2.6	2.9	39.5	1.4	1.074
W4281-6	**439**	**109**	**10.9**	37.7	29.2	2.4	2.2	32.6	5.5	1.070
W4282-2	377	94	29.9	22.9	37.3	2.5	0.5	50.3	0.3	1.071
W4282-3	373	92	21.2	25.9	33.7	2.7	8.2	47.9	0.3	1.076
W4387-7	364	90	***8.0***	24.9	**14.8**	***1.5***	20.2	**10.9**	0.3	1.067
W4565-8	388	96	**11.7**	26.9	37.3	3.1	0.5	57.6	0.3	1.066
W4565-9	***477***	**118**	16.9	49.5	31.0	2.5	0.5	47.1	0.3	**1.079**
W4566-1	343	85	**10.8**	20.0	**15.7**	***1.8***	2.2	**19.8**	0.3	1.068
W4566-3	331	82	31.8	27.9	30.1	2.9	0.5	45.5	0.3	1.076
W4645-1	**439**	109	24.1	19.8	*62.5*	3.2	2.2	60.0	0.3	***1.094***
W4710-4	347	86	**9.2**	23.8	19.3	2.5	0.5	38.2	1.0	1.072
W4734-2	405	100	38.1	17.5	**16.6**	2.7	3.9	60.0	0.3	1.075
W4736-8	385	95	38.4	17.1	31.9	2.7	0.5	31.0	1.8	1.077
W6237-6	359	89	22.0	41.7	48.1	2.7	0.5	33.4	1.0	1.076
W4980-1	374	93	24.9	19.5	39.6	3.1	0.7	50.3	1.0	1.075
W5015-12	***470***	**117**	23.1	18.5	41.4	2.9	0.7	55.9	2.5	1.075
W5015-19	344	85	13.3	26.6	21.6	**2.0**	1.6	21.3	0.3	1.071
W5015-2	408	101	20.4	23.6	34.2	2.8	*10.2*	48.7	0.3	1.073
W5015-3	376	93	14.3	33.4	34.2	2.9	1.6	25.4	1.0	**1.080**
W5015-5	415	103	13.0	22.2	*60.3*	*3.5*	9.4	56.0	0.3	1.077
W5015-7	405	100	18.2	26.4	*63.9*	*3.5*	0.7	*72.8*	4.0	1.072
W5021-4	402	100	20.2	34.0	41.4	3.1	1.6	49.5	0.3	**1.080**
W5075-3	349	87	**9.5**	*57.9*	20.7	***2.0***	1.6	23.0	0.3	1.068
W5115-7	395	98	14.3	21.9	31.5	2.9	2.4	28.6	4.0	1.076
W5212-2	380	94	**12.5**	24.1	27.9	2.1	0.7	24.6	3.2	1.076
W5216-3	393	98	20.0	32.4	**18.0**	2.1	2.5	23.8	0.3	1.074
W6238-1	423	105	*53.3*	19.0	23.4	**2.0**	0.7	**14.9**	0.3	1.074
W5267-1	370	92	32.6	17.1	46.9	3.1	0.8	51.1	0.3	1.075
W5267-3	354	88	22.8	26.6	32.5	2.5	2.5	42.3	1.8	1.075
W5267-4	359	89	38.4	25.0	29.8	***2.0***	0.8	**14.9**	3.3	1.072
W5268-1	424	105	17.2	24.5	45.1	2.9	0.8	47.9	0.3	1.074
W5285-9	356	88	14.0	40.3	28.0	2.9	3.4	55.2	1.0	1.078
W5287-3	372	92	**12.7**	17.1	*65.8*	*3.6*	0.8	*73.6*	0.3	***1.082***
W5287-4	350	87	13.6	21.6	37.9	2.5	0.8	36.6	0.3	1.078
W7063-1	*286*	71	*76.3*	*60.1*	***11.8***	***1.3***	1.7	18.9	0.4	1.072
W7077-2	434	108	24.7	45.1	28.0	2.8	0.8	47.9	0.3	1.074
W7080-2	392	97	21.8	22.4	***10.0***	***1.5***	1.7	**14.9**	1.0	1.072
W7082-2	327	81	36.4	26.3	19.0	***1.8***	0.8	**18.1**	1.8	1.070
W7088-5	415	103	16.9	22.8	*60.4*	*3.8*	9.4	54.3	1.8	1.066
W7104-1	385	96	15.1	35.8	25.3	2.5	1.7	43.1	0.3	1.066
Dakota Pearl	367	91	22.3	22.8	**14.7**	***1.7***	3.4	22.7	5.2	1.071
MegaChip	410	102	***9.6***	22.4	32.2	2.8	1.6	34.2	0.3	1.076
W5840-7	412	102	15.0	25.4	*56.5*	*3.5*	5.0	*69.6*	0.3	**1.079**

Table 9. Results of the First Year (RT1) Replicated Yield and Adaptation Trial 2006, Hancock and Rhinelander, WI, 2006 (cont'd).

	A-size	A-size	B-size		Simulated		Hancock	Hancock	Hancock	Hancock
	Yield	Yield	Yield	Culls	Blackspot Bruise		HH%	IBS%	VD%	Specgrav
	cwt/A	% of std	cwt/A	cwt/A	%	1-5				
W5948-2	382	95	27.8	15.3	22.3	2.4	2.5	35.0	0.3	1.078
W5985-2	433	107	18.3	18.0	42.1	*3.6*	0.7	58.4	0.3	1.073
W6009-8	418	104	**12.6**	24.5	37.6	3.1	5.9	62.4	0.3	1.075
W6036-3	379	94	14.8	21.6	39.4	2.7	3.3	34.2	2.5	1.078
W7123-3	378	94	14.8	24.4	32.2	2.5	0.7	**19.0**	1.8	1.074
W7124-2	369	91	13.1	23.4	42.1	2.9	4.2	44.7	1.8	1.072
W7124-3	392	97	22.5	26.0	*64.6*	*3.5*	5.0	*72.0*	1.8	1.078
W7124-7	368	91	36.6	17.5	37.7	2.9	0.7	51.1	0.3	1.069
W7124-9	366	91	30.7	22.4	***10.7***	***1.5***	0.7	**19.7**	0.3	1.072
W7126-1	340	84	38.1	26.3	*64.6*	*3.2*	0.7	60.0	0.3	1.076
W7134-7	344	85	16.6	23.4	**17.9**	***1.7***	0.7	47.9	0.3	**1.079**
W7135-1	422	105	17.0	27.1	21.5	**2.0**	4.2	21.4	0.3	1.069
W6040-1	**440**	**109**	25.4	20.8	**15.7**	***1.7***	1.4	**14.1**	0.1	1.069
W6102-1RB	404	100	15.4	26.8	**15.7**	2.1	*11.7*	20.6	0.1	1.069
W6102-2RB	357	89	25.7	23.0	30.1	2.7	0.5	48.7	0.1	1.074
W6106-1RB	378	94	90.3	15.2	26.5	2.9	0.5	34.2	*30.7*	1.067
W6106-2RB	*288*	71	24.3	21.9	50.8	*3.3*	5.7	*71.2*	1.6	1.073
W7263-2	387	96	**12.6**	26.9	25.6	2.4	*13.5*	45.5	1.6	1.063
W7263-3	378	94	15.8	25.4	**17.5**	**2.0**	0.5	21.3	0.1	1.072
W7279-1	***487***	***121***	*41.5*	19.9	**15.7**	***1.8***	0.5	23.8	0.8	1.072
Atlantic (std)	403	100	13.3	23.4	29.2	2.5	7.4	35.8	0.3	***1.082***
95% C.I.	351-455		1.4-25.2	4.2-41.5	13.7-45	2.0-3.0	2.4-12.4	15.7-56.0	0.0-4.7	.077-1.087
Snowden	386	96	19.2	25.7	53.1	3.2	0.7	32.6	0.3	1.076
95% C.I.	335-438		7.4-31.1	7.8-43	38-69	2.7-3.7	0.0-5.7	12.5-52.8	0.0-4.7	.071-1.080
Red Skin Lines										
All	386		24.3	25.6	8.2	1.3	1.3	8.1	1.2	1.058
W4472-2R	387	104	14.2	20.8	4.7	1.1	0.2	3.0	1.0	1.056
W5101-2R	***493***	***133***	21.7	39.4	4.7	1.1	1.1	2.2	0.3	1.056
W5162R-1R	332	89	90.8	14.2	7.4	1.3	0.2	7.9	1.0	***1.068***
W5249-2R	410	110	17.1	29.3	3.8	1.2	0.2	4.7	2.5	1.061
W5260-2R	***487***	***131***	21.7	18.9	6.5	1.2	0.2	3.8	1.0	1.054
W6147-2R	328	88	11.6	30.2	11.0	1.5	0.2	10.3	1.0	1.059
W5261-1R	***461***	***124***	54.0	32.8	3.7	1.3	0.4	5.5	1.2	1.060
W5261-2R	362	98	48.3	26.3	15.4	1.6	0.4	15.9	0.5	1.057
W5423-5R	369	99	18.6	21.8	9.1	1.6	0.4	21.6	1.2	1.060
W5538-1R	328	88	20.4	20.3	1.9	1.1	0.4	3.0	0.5	1.056
W5841-1R	426	115	19.5	21.6	11.8	1.3	0.4	7.9	0.5	1.058
W5841-3R	**436**	***118***	31.9	21.8	2.8	1.1	0.4	3.0	0.5	1.054
W6001-1R	415	112	**11.8**	16.4	4.6	1.3	0.4	5.5	0.5	1.063
W6954-2R	364	98	25.5	27.8	28.9	2.2	0.4	16.7	1.9	1.056
W7299-2R	**432**	***116***	18.6	27.4	1.9	1.1	0.4	3.9	0.5	*1.047*
W7300-1R	310	84	40.7	17.1	1.9	1.1	0.4	2.2	0.5	1.052
W7343-1R	387	104	35.3	31.3	2.8	1.2	3.0	4.7	1.2	1.062
Dark Red No	371	100	12.4	26.8	3.7	1.1	1.3	2.2	0.5	1.055
95% C.I.	316-426		0-25.1	7.9-45.7	0-20.1	1.0-1.6	0-6.4	0-23.3	0.0-4.6	.049-1.061

Note: *95% confidence interval defines boundaries within the standard variety spreads 95% of the time. Means of other lines that fall within that interval are considered statistically similar to the standard.

Table 9. Results of the First Year (RT1) Replicated Yield and Adaptation Trial 2006, Hancock and Rhinelander, WI, 2006 (cont'd).

	A-size	A-size	B-size		Simulated		Hancock	Hancock	Hancock	Hancock
	Yield	%Yield	Yield	Culls	Blackspot Bruise		HH%	IBS%	VD%	Specgrav
	cwt/A	of std	cwt/A	cwt/A	%	1-5				
Russet/Long										
All	386		24.3	34.3	35.1	2.3	4.0	25.2	1.1	1.070
W3666-2rus	383	110	18.7	26.3	38.5	2.5	1.0	20.6	0.5	1.066
W4219-2rus	358	102	13.4	47.7	22.3	2.1	7.9	16.6	2.7	1.068
W4239-2rus	352	101	16.5	*60.3*	46.5	*3.2*	3.8	40.7	3.5	1.069
W4256-1rus	**447**	**128**	27.8	38.9	52.8	3.0	*15.0*	19.0	0.5	1.069
W4292-1rus	348	100	25.3	*70.7*	20.4	2.1	1.3	7.7	0.5	1.065
W4315-5rus	357	102	22.8	26.7	*69.0*	2.8	1.3	*53.6*	0.5	1.069
W4619-1rus	281	80	**8.8**	17.3	25.8	2.1	2.1	17.4	0.5	1.067
W4619-3rus	420	120	**9.1**	38.7	**15.9**	**1.8**	0.4	11.8	0.5	1.069
W4676-2rus	421	121	14.2	26.8	42.0	3.0	*34.0*	39.1	0.5	1.066
W4697-2rus	338	97	22.2	28.3	*57.3*	*3.2*	7.3	*54.4*	0.5	***1.082***
W4973-1rus	354	101	64.6	35.5	33.0	2.2	0.4	13.4	0.5	1.073
W5001-3rus	381	109	20.6	26.9	***15.0***	**1.8**	2.1	6.9	1.3	1.064
W6155-2rus	***528***	***151***	36.4	50.0	41.1	*3.2*	0.4	*60.0*	0.5	1.064
W6197-2rus	215	62	20.1	**15.1**	33.9	2.5	6.4	25.5	0.5	***1.078***
W6234-4rus	**449**	**128**	22.0	33.1	32.1	2.5	9.0	8.5	0.5	1.073
W5257-2rus	404	115	22.6	29.6	28.6	2.3	4.6	24.6	0.5	1.069
W5303-1rus	351	100	19.1	36.8	*66.4*	*3.4*	1.2	45.6	0.5	1.073
W5818-2rus	320	92	39.6	19.1	24.1	2.2	5.5	22.2	0.5	***1.084***
W5827-1rus	**444**	**127**	18.0	31.5	*54.6*	2.8	1.2	24.6	1.3	1.069
W5856-1rus	***472***	***135***	34.8	27.9	***10.6***	***1.5***	1.2	12.6	0.5	1.073
W6968-2rus	429	123	**11.7**	24.9	25.0	1.9	1.2	23.8	0.5	1.067
W7012-1rus	399	114	19.4	34.6	21.4	**1.8**	1.2	11.0	1.3	1.069
W7051-1rus	424	121	29.4	32.3	43.9	2.5	1.2	23.0	0.5	1.067
W7051-2rus	375	107	38.6	37.5	***8.8***	***1.2***	1.2	6.9	0.5	1.073
W7070-2rus	401	115	20.1	53.9	51.1	2.6	1.2	17.4	0.5	1.070
W7098-2rus	433	124	**12.8**	37.8	***13.3***	**1.8**	3.8	8.6	0.5	1.065
W7121-1rus	344	98	20.3	50.9	28.6	2.1	2.1	17.4	0.5	**1.075**
W7144-3rus	349	100	53.0	19.1	*85.2*	*3.9*	*12.4*	*79.3*	0.5	1.073
Goldrush	406	116	**12.6**	34.1	***12.4***	***1.5***	2.1	7.7	2.0	1.064
R. Burbank	350	100	38.1	49.4	45.6	***1.5***	0.4	35.9	1.3	1.069
95% C.I.	298-401	n/a	26-50	31-67	30-61.5	1.0-2.1	0.0-5.5	15.3-56.5	0.0-5.4	1.064-1.074

Note: *95% confidence interval defines boundaries within the standard variety spreads 95% of the time. Means of other lines that fall within that interval are considered statistically similar to the standard.

On-Farm Evaluation of WI Breeding Lines by WI Growers and Seed Increase

In 2006, thirteen commercial growers tested 16 lines and 3 seed growers tested 3 lines. Some growers received multiple lines totaling 36 variety x location test. The total seed distributed to growers was 307 cwt. In 2006, a selected group of lines were multiplied in Rhinelander for the 2007 on-farm tests. These seed lots were evaluated for virus expression in the summer and tested in FL in the winter by the WI Seed Certification Program. Table 10 represents the varieties included in the 2006 seed multiplication lots.

Table 10. Lines in seed multiplication stage, 2006

06 Stage	05 stage	W#	Type	2006 Seed (cwt)
Year 1 Entries				
cp3	RT1	3186-2	chip	2
cp3	RT1	3852-4Y	chip/Y-spec	4
cp3	RT1	3846-4Y	chip/Y-spec	2
cp3	RT1	3957-6R	red	1.5
cp3	RT1	5767-1R	red	2
cp3	RT2	6270-1R	red-spec	3
cp3	RT1	3743-5rus	rus-fresh	3.5
cp3	RT2	3754-3	chip	
cp3	RT1	6153-21Yrus	rus/Y	2.5
cp3	RT1	6153-6Yrus	rus/Y	1.5
cp3	RT1	5716-1rus	rus-dual	12
cp3	RT2	3132-1rus	rus-fresh	1.5
cp3	BM	3666-2rus	rus-fresh	9
cp3	RT1	3740-4rus	rus-fresh	9
cp3	RT1	3952-3rus	rus-fresh	3.5
cp3	RT1	3730-4rus	rus-proc	2
tt	cp3	2301-3P	fresh	2
Year 2 Entries				
BK1	cp3	2133-1	chip	14
BK1	cp3	2309-7	chip	12
BK1	cp3	2564-2	chip	21
BK1	cp3	2841-1	chip	
BK1	cp3	2609-1R	red-fresh	12
BK1	cp3	3882-1R	red-fresh	10
BK1	cp3	3160-5LBrus	rus-dual	7
BK1	cp3	3162-3LBrus	rus-dual	8
BK1	cp3	2683-2rus	rus-fresh	80
BK1	cp3	3140-3rus	rus-fresh	7
Year 3 and 4 entries				
BK2	BK1	2324-1	chip	49
BK2	BK1	2438-3Y	chip	40
BK2	BK1	2717-5	chip	
BK2	BK1	2978-3	chip	25
BK2	BK1	2982-1	chip	2
BK2	BK1	4013-1	chip	5
BK2	BK1	4016-4	chip	5
BK2	BK1	4132-1	chip	4
BK2	BK1	3565-5R	red-fresh	8
BK2	BK1	1879-1rus	rus-dual	14
BK2	BK1	3328-1rus	rus-dual	21

Late Blight Evaluation of Advanced Lines:

In the summer of 2006, forty varieties including 35 advanced lines and five cultivars (Russet Burbank, Ranger Russet, Russet Norkotah, Shepody and Snowden) were evaluated in Corvallis, OR, in collaboration with Isabel Vales and Yilma Solomon. A randomized complete block design was used with two replicates. The planting date was June 15; each experimental plot consisted of one row of 12 hills separated 0.23 m between them and 0.864 m between rows. Russet Burbank was used as a late blight spreader rows. *Phytophthora infestans* spores of the US-8 strain were inoculated 3 times on a 3.05 x 3.05 m grid in late August 21 & 29 and early September. Spores were applied as a water suspension using a hand-held pump-up sprayer. Late Blight infection rate was recorded on September 20 & 29 and the last in October 6 & the area under the disease progress curve (AUDPC) were calculated using the midpoint rule method (Campbell and Madden, 1990), as AUDPC = $\Sigma_{i=1}^{n-1} [(t_{i+1} - t_i)(y_i + y_{i+1})/2]$, where "t" is time in days of each reading "i", "y" is the percentage of affected foliage at each reading and "n" is the number of readings. Tubers were harvested and examined for tuber infection and decay based on a sample of 10 random tubers from each plot that were stored for two weeks and scored for infection rate and the data was expressed in percentage. Except for weed control, all pesticides were omitted in blight trials. Additional irrigation was applied in late August to stimulate disease development.

Ranger Russet, Russet Norkotah, Shepody and Snowden were all similar to Russet Burbank in the foliar reaction to late blight. The AUDPC was 988 units for Russet Burbank, and the LSD at a 5% type I error was 383 units as depicted in Fig 4a. The most advanced lines Freedom Russet (W1836-3rus), MegaChip and Villetta Rose (W2275-3R) were all statistically similar to Russet Burbank. Several advanced lines had AUDPC significantly lower to Russet Burbank and all control cultivars. These include W3162-5rus, W4132-LB, W3160-5LB, W3852-4Y, W5129-1 and W5132-7 (Fig.4a). Extremely low to zero foliar late blight incidence was observed in the lines W5133-1, W5133-5, W5126-4, W4714-1, WTS1216-3, WTS1216-4 and WTS1217-1 (Fig.4a).

Results from the late blight evaluation on tubers indicated that some lines with better foliar AUDPC than Russet Burbank may be equally or more susceptible to tuber infestation than Russet Burbank; these include WTS1216-4, W5132-7, W4132-LB and WTS1216-3 (Fig. 4b). If these results hold, the best overall resistance from these tests was found in the lines W5133-1, W5133-5, W5126-4, W4714-1, and WTS1217-1. Tuber quality of these lines and agronomic performance should be studied in replicated trials to assess their value as cultivar or parent. The parental lines of W5133 are J101K6A21 x MN18710rus; the parents of W5126-4 are J101K6 x Ranger Russet and the parents of W4714-1 are J101K6A21 x W1355-1. All of these selected lines derived their resistance from the *Solanum bulbocastanum* through the common J101 parent.

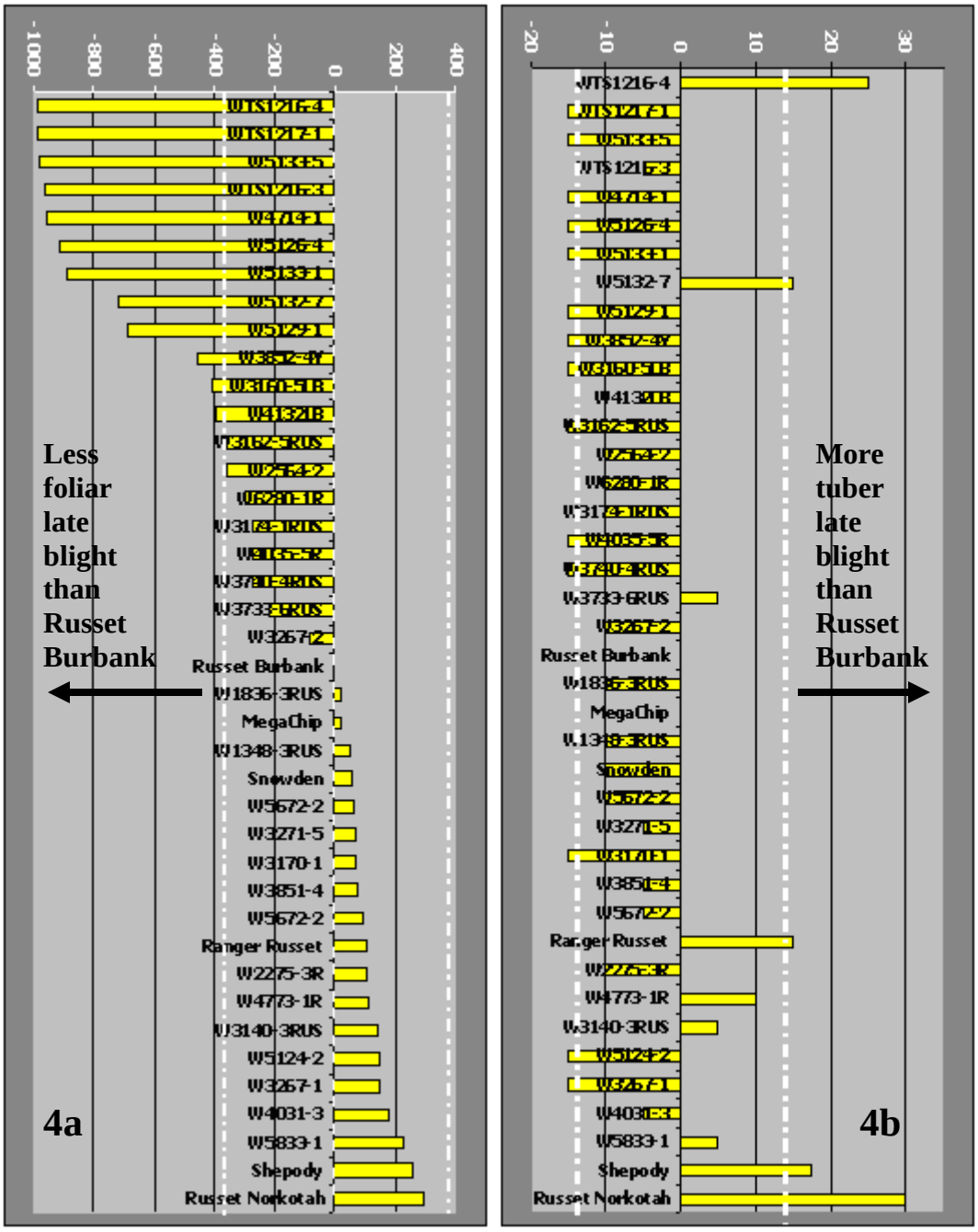
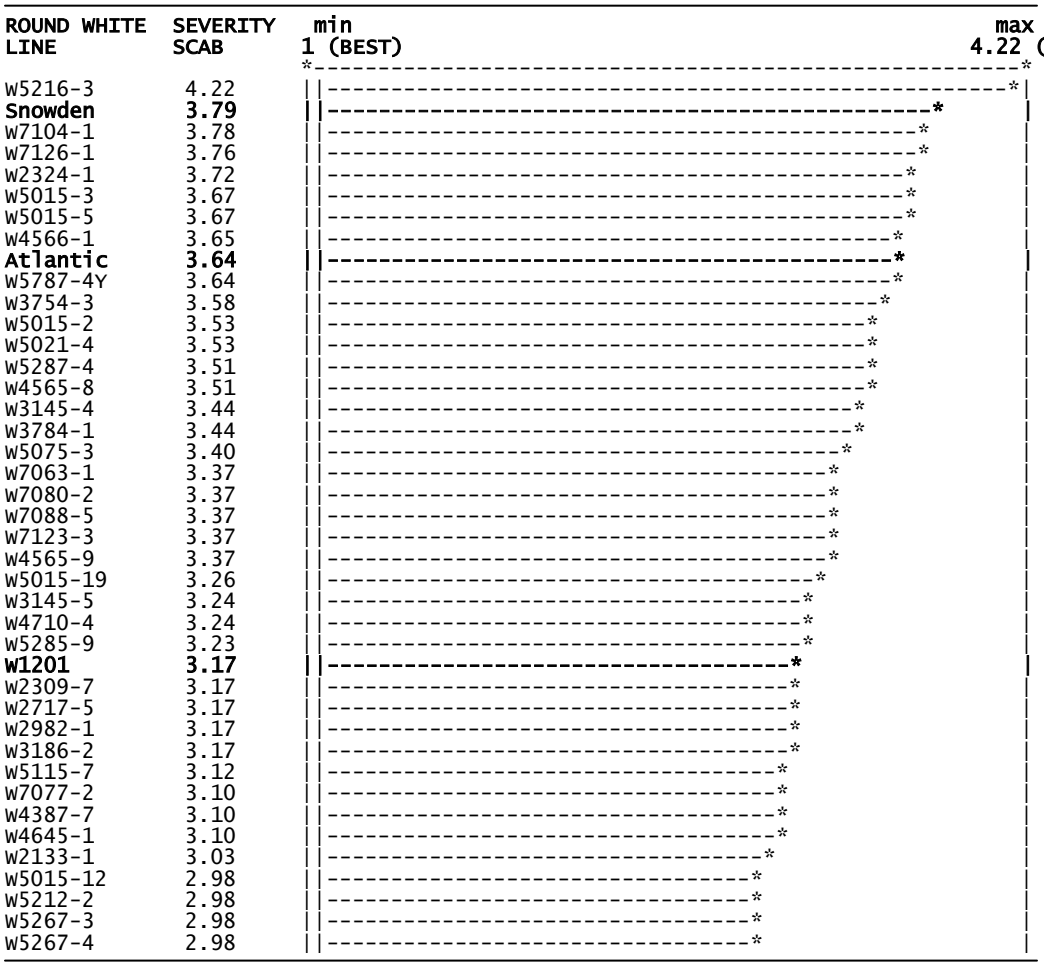


Fig 4a and b. Area under the disease curve values of Wisconsin advanced breeding lines compared to Russet Burbank (AUDPC=988), Corvallis, OR, 2006. Varieties whose bars extend to the left of the broken line exhibited lower foliar or tuber late blight symptoms than Burbank as depicted in Fig 4a and 4b.

Selection for Resistance to Common Scab

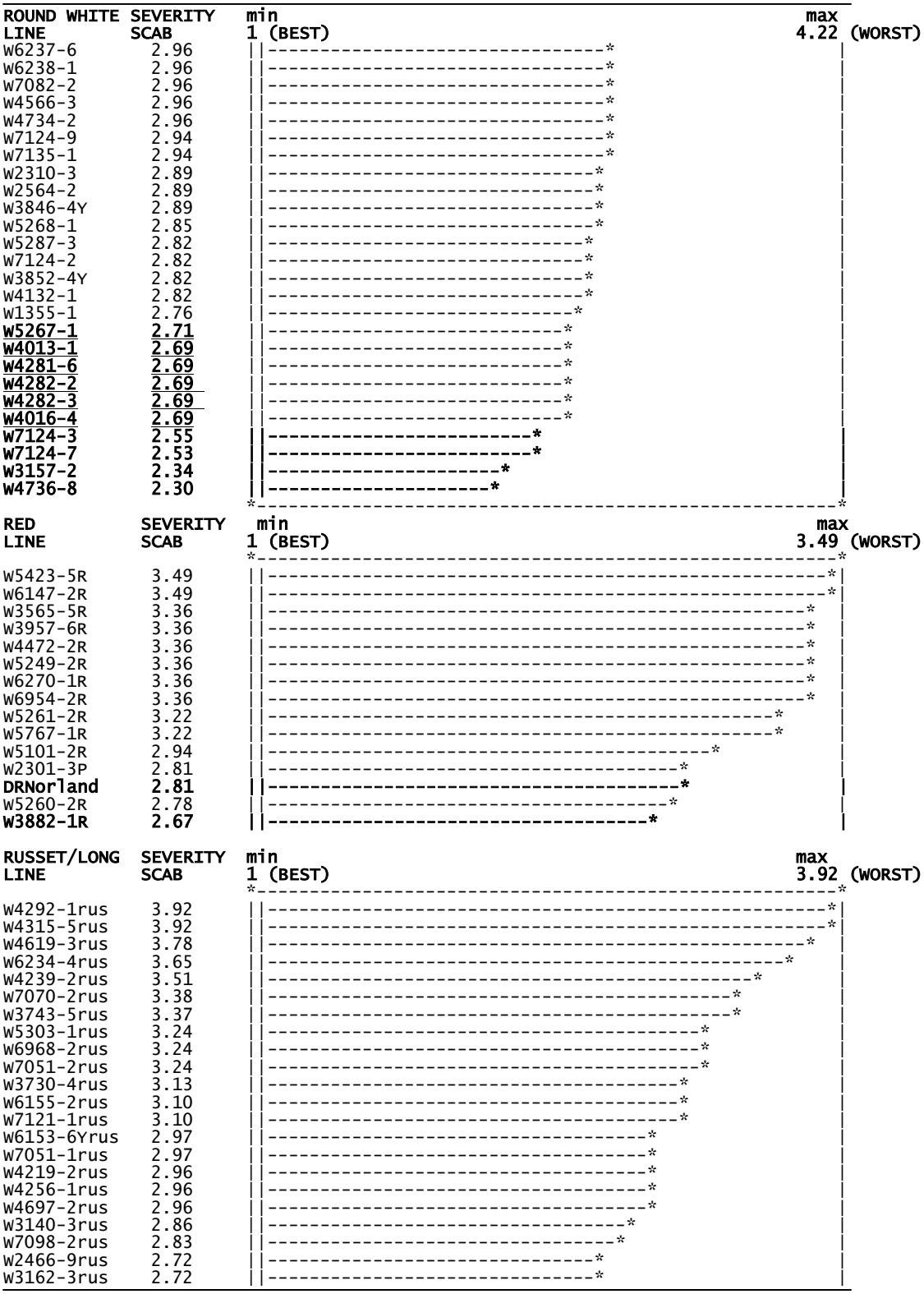
Experiments including 128 advanced lines (68, 45 and 15 chipping, russets and red respectively) were planted under heavy disease pressure at Alliston, ON and Rhinelander WI. Lines of advanced generation represented in RT_1 and RT_2 were evaluated in these trials. The Alliston experiment was carried out in collaboration with Dr. Eugenia Banks. Additional scab data was also available from the Verticillium experiment from Hancock and the replicated trials. Eleven russet lines including Freedom russet (W1836-3rus), W6197-2rus, W5257-2rus, W4676-2rus, W3160-5rus, W2683-2rus, W1879-1rus, W3666-2rus, W3132-1rus, W5716-1rus and W3952-3rus showed equal or better scab resistance than Russet Burbank and Goldrush. Among the chipping lines, the best performing lines were W4736-8, W3157-2, W7124-7 and W7124-3. A second group with good performance were W4016-4, W4282-3, W4282-2, , W4281-6, W4013-1 and W5267-1. Both groups performed better than White Pearl (W1355-1), MegaChip (W1201), Snowden and Atlantic. Among the reds, W3882-1R, W5260-2R, W2301-3P (purple skin) and W5101-2R showed similar scab tolerance as Dark Red Norland. Fig. 5 presents the results of the Alliston evaluation.

Fig. 5. Severity of scab on chipping, red and russet lines from WI. Alliston, ON, 2006.



Note: Lines with lowest scab severity and checks are highlighted, Alliston, ON.
Underlined lines are significantly better with <10% type I error.

Fig.5. Severity of scab on chipping, red and russet lines from WI. Alliston, ON, 2006 (cont'd)



ROUND WHITE LINE	SEVERITY SCAB
W6237-6	2.96
W6238-1	2.96
W7082-2	2.96
W4566-3	2.96
W4734-2	2.96
W7124-9	2.94
W7135-1	2.94
W2310-3	2.89
W2564-2	2.89
W3846-4Y	2.89
W5268-1	2.85
W5287-3	2.82
W7124-2	2.82
W3852-4Y	2.82
W4132-1	2.82
W1355-1	2.76
W5267-1	**2.71**
W4013-1	**2.69**
W4281-6	**2.69**
W4282-2	**2.69**
W4282-3	**2.69**
W4016-4	**2.69**
W7124-3	**2.55**
W7124-7	**2.53**
W3157-2	**2.34**
W4736-8	**2.30**

min 1 (BEST) — max 4.22 (WORST)

RED LINE	SEVERITY SCAB
W5423-5R	3.49
W6147-2R	3.49
W3565-5R	3.36
W3957-6R	3.36
W4472-2R	3.36
W5249-2R	3.36
W6270-1R	3.36
W6954-2R	3.36
W5261-2R	3.22
W5767-1R	3.22
W5101-2R	2.94
W2301-3P	2.81
DRNorland	**2.81**
W5260-2R	2.78
W3882-1R	**2.67**

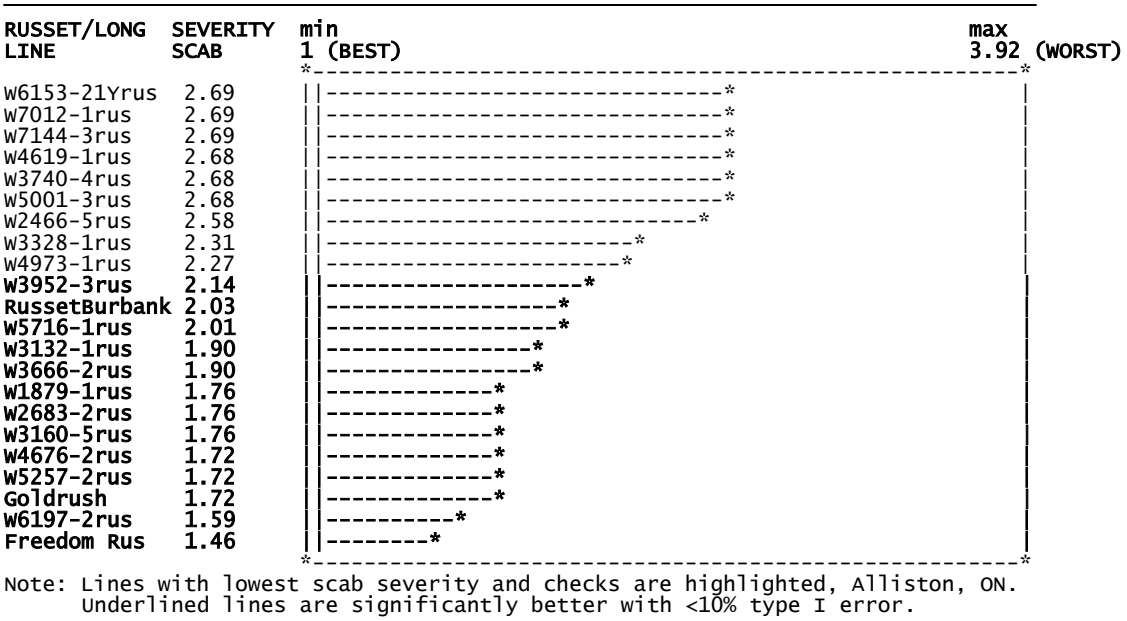
min 1 (BEST) — max 3.49 (WORST)

RUSSET/LONG LINE	SEVERITY SCAB
W4292-1rus	3.92
W4315-5rus	3.92
W4619-3rus	3.78
W6234-4rus	3.65
W4239-2rus	3.51
W7070-2rus	3.38
W3743-5rus	3.37
W5303-1rus	3.24
W6968-2rus	3.24
W7051-2rus	3.24
W3730-4rus	3.13
W6155-2rus	3.10
W7121-1rus	3.10
W6153-6Yrus	2.97
W7051-1rus	2.97
W4219-2rus	2.96
W4256-1rus	2.96
W4697-2rus	2.96
W3140-3rus	2.86
W7098-2rus	2.83
W2466-9rus	2.72
W3162-3rus	2.72

min 1 (BEST) — max 3.92 (WORST)

Note: Lines with lowest scab severity and checks are highlighted, Alliston, ON.
Underlined lines are significantly better with <10% type I error.

Fig. 5. Severity of scab on chipping, red and russet lines from WI. Alliston, ON, 2006 (cont'd)



Note: Lines with lowest scab severity and checks are highlighted, Alliston, ON.
Underlined lines are significantly better with <10% type I error.

Late Blight Evaluation of Early Generation Lines:

Lines of early generations were tested in the same field in Corvallis, OR, in collaboration with Isabel Vales and Yilma Solomon using unreplicated 4 hills plots, otherwise the evaluations followed the same procedures described for the advanced generation lines described above. A number of early generation lines are performing as well as the WTS lines that represent crosses to wild species with resistant background. Among the lines with the lowest AUDPC are W6360-1, W6896-3, W5986-1, W6905-4, W6929-2, W6776-1, W6893-1, W6922-1 and W6925-1. All of these lines had AUDPC scores under W4714-1 (Fig. 2), which had extremely low AUDPC in the replicated trial. Of these lines W6360-1, W6896-3, W6776-1, W6893-1, W6922-1 and W4714-1 did not show late blight tuber symptoms, and may be the best candidates to evaluate in 2007 in replicated trials to assess resistance. These six selected lines represent three different sources of late resistant genes. Details about the results of the late blight evaluation of early generation lines can be found at the potato breeding website www.uwpotatoes.wisc.edu.

Experimental Procedures and Statistical Analyses

Table 11. Methods of Evaluation Applied in WI trials and Statistical Methods of Analyses

Specific gravity: Determined by weight in air/water method on samples of approximately 10 lbs.
Internal Defects: Hollow heart (HH), internal brown spot (IBS), vascular discoloration (VD), and brown center (BC): percentage determined from 30 randomly selected potatoes/replication = 90 potatoes/line.
Simulated Impact Bruise: The potential for black spot bruise was evaluated by placing 30 tuber sample/ replication that were held in storage at 50°F for two weeks 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 two weeks after bruised and individual tubers were assessed for the percentage tubers that had blackspot bruises on each potato (incidence) and a 1-5 scale to estimate severity; 1 = no bruises and 5 extensive bruise damage.
Chip color evaluation: WI tests (RT1, RT2 and NCPVT) included the evaluation of five randomly selected potatoes that were fried from samples of each plots stored at 42 and 47°C. These samples were stored in September 8 for the Hancock experiments (NCPVT was only planted at Hancock), and September 22 for the Rhinelander experiments. Initial storage condition was 55°C. In mid October, the tubers were sprout inhibited and transferred directly to the 42 and 47°C temperatures in Nov 2. Frying occurred between Nov 30 and Dec5 for RT2 and NCPVT, and Dec 5 and Dec 14 for RT2. Potatoes were chipped directly out of the storage. Chips were fried at 350°C for three minutes using a Hotpoint™ HK3 model (General Electric, Chicago Heights, IL). Chip color scores were estimate using a visual 1-10 scoring scale was used where 1=very light chip color and 10=very dark chip color. Chip colors for Maine reports and other out of state collaborators were given in Agtron units. These were evaluated using Agstron Process Analyzer calibrated with a black disk "0" = 0, and white disk "90" = 90). Each chips sample was crushed was read three times and was thoroughly mixed between readings. Larger values equal lighter chips.
Early Dying Severity: Measured 85 days after planting (DAP), in a 1-5 scale, where 1 indicates no symptoms and 5 indicates early senescence of plants, especially reflected as a differential senescence of leaflets at both sides of the same petiole.
Early Blight Severity: Measured 85 days after planting (DAP), in a 1-5 scale, where 1 indicates no symptoms and 5 indicates severe symptoms.
Common Scab: Scab coverage was evaluated as a measure of incidence as the percentage of tubers affected. Scab severity was evaluated using a 1 to 5 scale, where 1=no scab and 5 = indicates that 60-100 of tubers in a plot covered with pitted scab.
Tuber Grading and Yield: Undersize (B) for russet potatoes defined as the combined yield of tubers < 1 and 7/8'' diameter or < 4oz. For round white and red potatoes defines as the yield of tubers < 1 and 7/8'' diameter. **Culls:** defined as the weight of tubers with external defects, mostly growth cracks, rot, misshape, green, etc. **Size A or US#1**: remaining plot weight after undersize and culls have been removed. All yield data was reported in cwt/A.
Maturity: estimated in a 1-5 scale where 1 is very early and 5 is very late.

Analyses of variance and mean comparison: for the cultivars were calculated by SAS proc mixed. Estimates of the effects of market type and variety within market type were computed. A confidence interval for standard variety within each market type was given in experiments conducted in WI to facilitate the comparison of advanced and elite lines with the performance its corresponding standard variety (e.g. Dark Red Norland for reds). Lines whose mean is outside the confidence interval for its corresponding standard are considered statistically different than the standard variety. One objective of the breeding program is to select varieties that are statistically different in a set of traits that may determine their potential as cultivars.