Potato Breeding Report 2014

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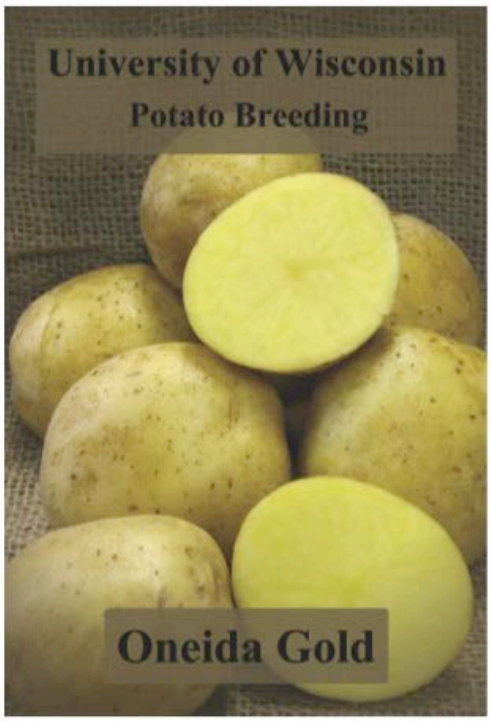
The University of Wisconsin (UW) has been breeding potato varieties for more than 70 years. Central to this effort has been the property now known as the Rhinelander Agricultural Research Station (RARS). The collaboration between scientists in the Department of Horticulture and agriculturalists at RARS produced the mega-varieties Superior (1961) and Snowden (1990). This tradition continues under the leadership of Dr. Jeffrey Endelman, who was hired as the WPVGA Professor of Plant Breeding in 2013. Table 1 lists the certified seed acreage for all named varieties released after 2007 with at least 5 certified acres.

Table 1. Certified seed acreage (Source: PAA).

Release Year	Variety	Market	Acres
2014	Red Endeavor	Fresh market red	18
2014	Oneida Gold	Fresh market yellow	23
2013	Pinnacle	Chip processing	22
2012	Lelah	Chip processing	78
2012	Accumulator	Chip processing	92
2011	Tundra	Chip processing	19
2011	Nicolet	Chip processing	140
2007	Megachip	Chip processing	283

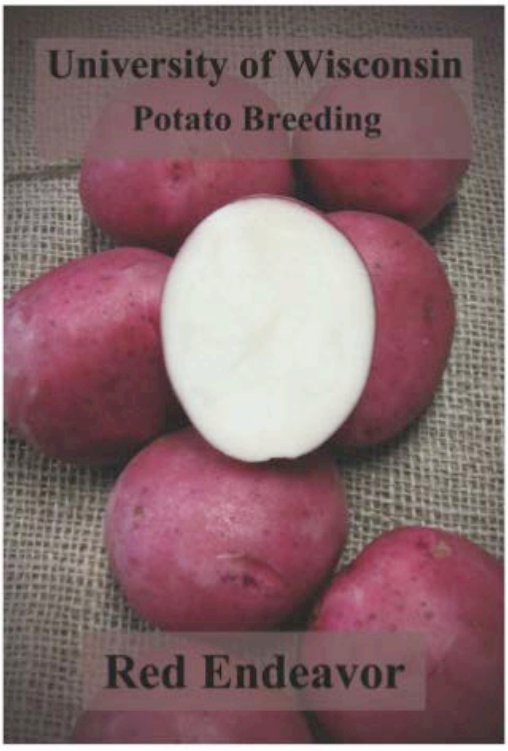
At the top of Table 1 are two new releases from the program: Red Endeavor (formerly W6002-1R) and Oneida Gold (formerly W6703-1Y). Red Endeavor stands out for its uniformly round tubers, bright white flesh, and low incidence of internal defects. A potential weakness is the possibility of skinning due to late maturity. Oneida Gold is the first yellow variety released by the program and stands out for its scab tolerance and low incidence of internal defects. Figure 1 provides additional information about these new varieties.



Oneida Gold (W6703-1Y)

Parentage: Satina x W2257-2Y
Developer: University of Wisconsin - Madison
Plant Variety Protection: Pending

Utilization: Tablestock
Vine Maturity: Full season, later than Yukon Gold.
Yield Potential: Medium-high.
Tuber Set: 10–15 tubers per plant.
Specific Gravity: 1.060–1.075, similar to Yukon Gold.
Disease Profile: Moderate resistance to common scab. Tolerant of *Verticillium wilt*.
Appearance: Skin can develop mild russeting. Eye depth is similar to Yukon Gold. Flesh color is medium yellow.



Red Endeavor (W6002-1R)

Parentage: B1491-5 x W1100R
Developer: University of Wisconsin - Madison
Plant Variety Protection: Pending

Utilization: Tablestock
Vine Maturity: Full season. Canopy develops more slowly than Dark Red Norland and retains vigor longer.
Yield Potential: High yield potential.
Tuber Set: 6–10 tubers per plant.
Specific Gravity: 1.050–1.065, similar to Dark Red Norland.
Disease Profile: Tolerant of *Verticillium wilt*; common scab phenotype is similar to Dark Red Norland.
Storability: Maintains skin quality in storage.
Appearance: Uniform round tubers, with shallow eyes and bright white flesh. Medium-red skin color and very few internal defects.

Figure 1. Variety releases from 2014.

The structure of the early generation propagation and selection activities was similar to previous years (see Table 2). Seedlings from over 200 different crosses were planted in the greenhouses at RARS, with a target of producing 40,000 genetically distinct minitubers. Nearly 50,000 breeding lines were evaluated as single hills in the Year 1 trial in 2014. Of the more than 80,000 single hills evaluated in 2013, just over 1000 were selected and tested as 8-hill plots at RARS in 2014. At present, Year 3 is the first time that breeding lines are evaluated outside of RARS, using an 8-hill plot. In 2014 we screened just over 500 Year 3 breeding lines at the Hancock (chip, russet) or Langlade (red, yellow, specialty) Research Stations.

Table 2. 2014 early generation stages.

Year	Activity	No.
0	Seedlings in greenhouse	204 families
1	Single-hill (1H) plots at RARS	49,016
2	8H at RARS	1039
3	8H at HARS/Antigo (20H at RARS)	505

The structure of the trials for mid- to late-generation breeding lines (Year 4+) was modified compared to previous years. Rather than test the Year 4 and Year 5 groups separately, the trials were organized by market category and contained multiple cohorts (Table 3). This organization allowed us to make more direct comparisons between breeding lines and standard varieties within a market category. Each market-category trial also contained the out-of-state entries we test as part of the National Chip and Fry Processing Trials (NCPT, NFPT). The biggest trial was our chip trial at Hancock with 229 entries and 401 plots, followed by the fry processing trial containing 100 entries and 221 plots (also at Hancock).

Table 3. 2014 replicated trials (Year 4+).

Category	Location	# Entries	# Plots
Chip	Hancock	229	401
Processing Russet	Hancock	100	221
Fresh Market Russet	Hancock	40	101
Fresh Market Yellow & White	Hancock	20	53
Fresh Market Red & Specialty	Antigo	48	124

Our fresh market trials were subdivided into russet, yellow, and red categories (Table 3), and portions of these trials were replicated on commercial farms in cooperation with Mike Drilias and Mike Copas. A graduate student (Lance Snodgrass) will be comparing the performance of breeding lines across the research and commercial sites, which should allow us to gauge the quality of our public research stations as selection environments. Advanced fresh market lines were put on public display at the UW Hancock Storage Research Facility during the annual Potato Variety Expo, held October 29–30 this year (Figure 2). A new attraction in 2014 was that samples of boiled potatoes were available for tasting, which stimulated discussion about the role of flavor, texture, and flesh color in variety development.

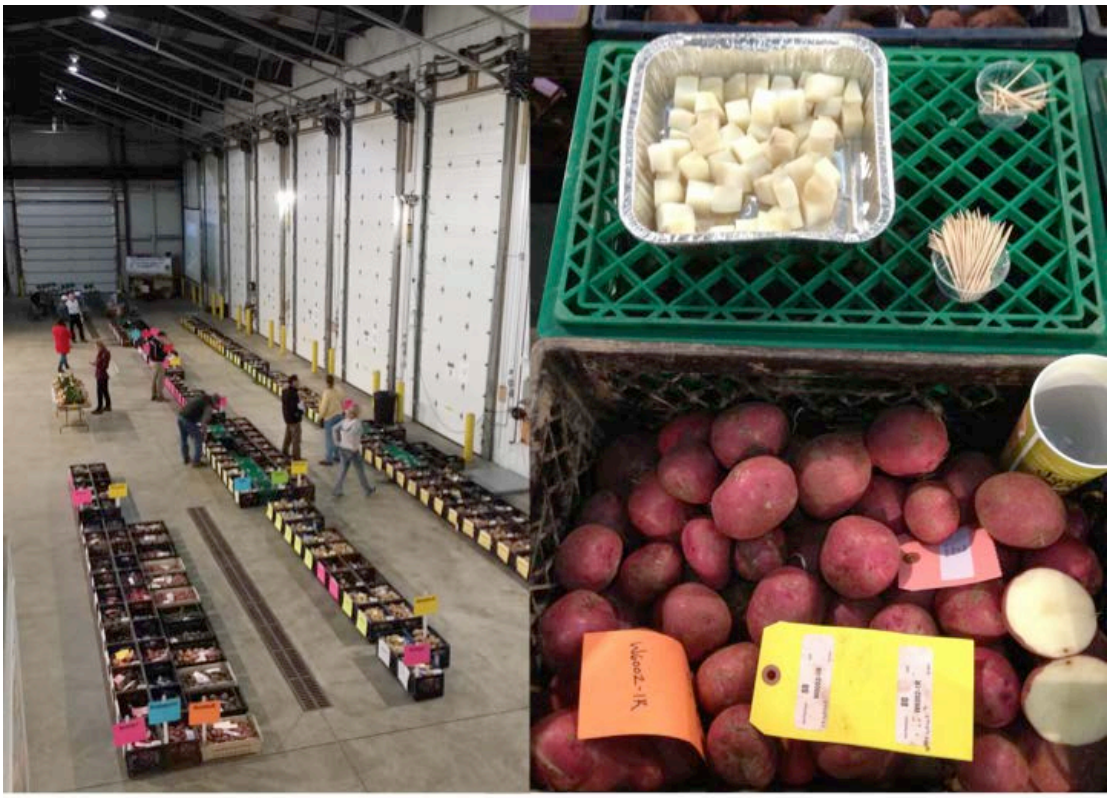


Figure 2. The 2014 Potato Variety Expo at the Hancock Research Station. (Left photo credit: Troy Fishler. Right photo credit: Jeff Endelman)

One of the highlights from 2014 was the success of our crossing program. The crossing activity was moved into one of the older, larger greenhouses at RARS that was renovated for this purpose (Greenhouse #6, Figure 3 at left). More than 500 cross-combinations were made, with a focus on crosses within our elite germplasm. This strategy maximizes the probability of finding progeny with the potential to be commercial successes. We also emphasized enriching our breeding populations for PVY resistance by "backcrossing" PVY-resistant chip and russet breeding lines to elite types. This pseudo-backcrossing strategy was also used to introgress resistance to cold-induced sweetening from our elite chip lines into our russet germplasm.

Figure 3. Crossing block at RARS

Another milestone for 2014 was the launch of our genetic marker-based screening effort for resistance to potato virus Y (PVY). Two different sources of extreme resistance to PVY are widely used in North America. One gene, designated Ry_{adg}, was introduced to cultivated potato (*S. tuberosum* ssp. *tuberosum*) from *S. tuberosum* ssp. *andigena,* and the other gene, Ry_{sto}, was introduced from the wild species *S. stoloniferum*. The markers for both genes (known as YES3-3B and RYSC3, respectively) can be assayed using PCR and gel electrophoresis. Figure 4 shows the result for YES3-3B, which produces a 284 bp fragment that is visible as a third band on the left side. To ensure the assay was working, we included W8946-1rus as a positive control, which is known to have inherited Ry_{sto} from the USDA-ARS breeding line PA98V1-2. For a negative control we used the PVY-susceptible line W6234-1rus. Of the four new breeding lines tested in this gel, only AW08417-6rus showed a banding pattern indicating the presence of Ry_{sto}. The other three did not inherit the resistance gene.

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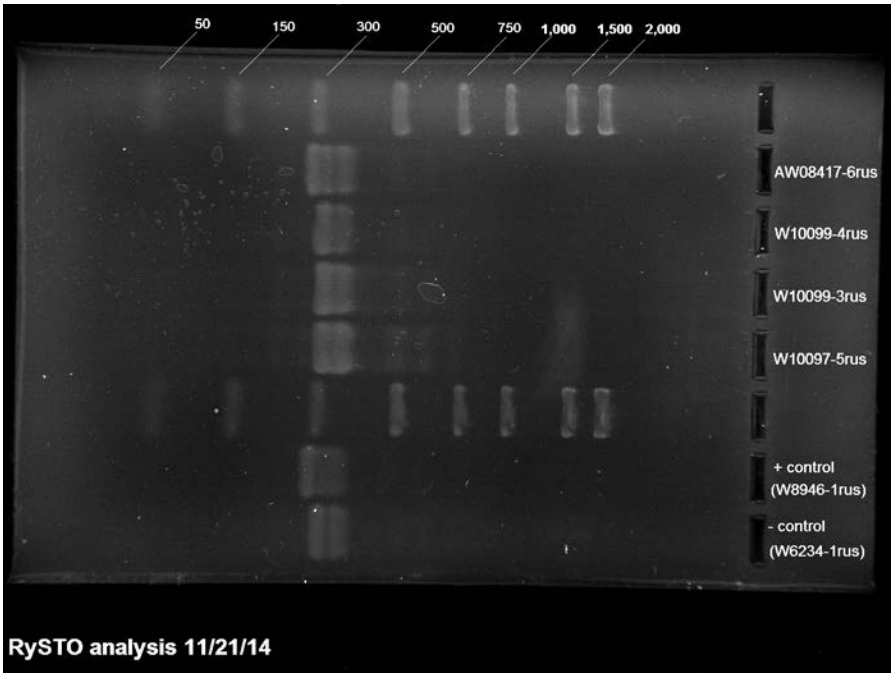

Figure 3. Marker-based screening for extreme resistance to PVY (YES3-3B marker for Ry_{sto}).

We thank the Wisconsin Certified Seed Potato Program and the WPVGA SPUDPRO committee for partnering with us to release new varieties. More information about the UW potato breeding program is available at http://potatobreeding.cals.wisc.edu or by contacting Jeff Endelman (endelman@wisc.edu).