You Breed Potatoes?! Exactly "How" and "Why" Would You Do Such a Thing?

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When explaining to new acquaintances that you are a "potato breeder", there oftentimes are some interesting responses from silence and incredulous looks, to active interest in knowing more about the process. It's definitely an interesting career!

This presentation was designed to present information regarding potato breeding, the protocols involved, and the timeline required for the development of a new variety. The development of new potato varieties with enhanced pathogen and pest resistances and nutritional qualities are primary objectives of the Aberdeen potato breeding program, as well as efforts in developing varieties with reduced requirements for production inputs such as water and nitrogen. Information on new and upcoming varieties from the Aberdeen program is also presented in this report.

Potato Breeding

A potato producer is very aware that potato "seed" actually represents pieces of a tuber with an "eye" present. Sprouts that emerge from the seed pieces are genetically identical (with the exception of the occasional mutant—such as giant hills) resulting in a very homogenous crop. The obvious benefit of this form of reproduction is uniform plant growth, maturation, and senescence during the growing season thereby facilitating harvest. The question arises, however, **how does one genetically enhance a potato variety that is clonally propagated?**

Fortunately, the clonally-propagated potato has not lost its ability to reproduce sexually as well. The flowers produced on a potato plant contain both male and female sexual organs. Pollen (analogous to sperm) produced by anthers are transmitted via pollinators such as bumblebees to fertilize the female organs resulting in the production of green berries. If the berries are cut, true potato seed (TPS), looking much like tomato seed, is present inside. If planted, TPS will germinate into potato seedlings, each of which is genetically dissimilar from its siblings and its parents.

Potato breeders use sexual reproduction in potato for the genetic enhancement of the crop. Every year, parent plants are selected by breeders and grown in the greenhouse. Once plants start flowering, crosses or hybridizations are designed and conducted to augment the weakness of one parent with the strengths of another, or to build upon shared strengths of both parents. If the sexual hybridization is successful, TPS is produced. When the TPS is planted and germinated, a percentage of the seedlings that grow into potato plants and tuberize will combine the strengths of both parents without their associated weaknesses, or will produce progeny that are superior to either parent for a unique trait shared in common by both parents. Approximately 12-15 years after a seedling is germinated in the greenhouse, it may be released as a new potato variety.

Why the long duration in the development of a new potato variety? Several factors contribute to this timeframe. The germinated seedling initially produces very small and few tubers in the greenhouse. These seedling tubers represent the transition to asexual propagation—the genetic constitutions of germinated seedlings are now "fixed" via subsequent asexual propagation by tubers. Subsequently, the seedling tubers are planted in the field for evaluation and final selection of promising clones. Once selected, the seed of breeding clones are maintained and also increased over years to allow evaluations in replicated trials over years and locations. Data is collected on yield, disease reactions, and processing and sensory attributes and compared to the performance of varieties also included in the same trials. If a major weakness is identified relative to industry-standard cultivars, then the clone is no longer evaluated for its cultivar potential, and is discarded from the breeding program.

Promising breeding clones that have advanced in the program may be requested and subsequently evaluated by commercial cooperators prior to release. Research and commercial evaluations take time to ensure that a breeding clone has the potential to be released as a cultivar. Prior to release as a variety, further trials of a promising breeding clone at varied fertilizer and water regimes, and storage conditions are conducted. This information allows the development of management profiles specific for the new variety, thereby optimizing its production and facilitating its acceptance by the potato industry.

New Varieties

BLAZER RUSSET (A7816-14 x NorKing Russet)

Released in 2005, Blazer Russet is an early-maturing, dual-purpose variety that has found a niche with the processing industry as a replacement for Shepody. Blazer Russet is resistant to tuber external defects, sugar ends, common and powdery scab, and PVX. It is moderately resistant to blackspot bruise, tuber late blight, and net necrosis. Blazer Russet has moderate susceptibility to hollow heart.

A9045-7: TO BE GROWN UNDER THE TRADMARKED NAME 'HIGHLAND RUSSET' (Ranger Russet x Russet Legend)

Released in 2006, this lightly-russeted variety is used by the processing industry. Strengths of Highland Russet include a high yield of tubers with an excellent size profile and uniformity, and few external or internal defects. Fry recovery from the field and storage has been high and it shows good potential for the processing market. Highland Russet has good resistance to Verticillium wilt and PVX and is moderately resistant to PVY^o, common scab, and early and tuber late blight. A weakness is a greater susceptibility to powdery scab infections of the tuber relative to Russet Burbank and a relatively light skin, which may limit its use for fresh pack.

A93157-6LS: TO BE GROWN UNDER THE TRADEMARDED NAME 'PREMIER RUSSET' (A87149-4 x A88108-7)

Released in 2006, this dual-purpose variety is most notable for its resistance to the accumulation of reducing sugars following long-term storage at temperatures as low as 42 F. Premier Russet is high yielding and has tubers with high specific gravity and few external defects. It is resistant to PVY^o , common and powdery scab, early dying, and is tolerant of water stress. Premier is moderately resistant to tuber early blight and soft rot. Weaknesses include susceptibility to blackspot bruise, Fusarium dry rot, and early season hollow heart. Premier also has short tuber dormancy, but its ability to store at 42 F can help to prolong dormancy.

NDA5507-3Y: TO BE GROWN UNDER THE TRADEMARKED NAME 'YUKON GEM' (BRODICK X YUKON GOLD)

Released in 2006, this round-oblong, yellow-fleshed variety is very similar to its parent, Yukon Gold. However, Yukon Gem is higher-yielding (12% higher in Idaho) than Yukon Gold and is resistant to PVY^o, common scab, tuber blight (early and late), net necrosis, blackspot and shatter bruise. It is moderately resistant to dry rot and foliar late blight. Its resistances make Yukon Gem a good candidate for organic production. It also chips acceptably, but its lower specific gravity may limit its use for this purpose.

Promising Breeding Clones

A95109-1 (Blazer Russet x Summit Russet)

An advanced breeding clone, A95109-1 has had high fresh merit in Tri-State and Western Regional Potato Variety Trials. A95109-1 is an early-maturing, russeted clone that produces a high percentage of U.S. No. 1 tubers. Its attractive tubers make it very suitable for use by the fresh-pack industry. It could also be used as an early processor. It is resistant to external and internal tuber defects and is resistant to common scab. A95109-1 also has moderate resistance to dry rot. Some shatter bruise was noted in this breeding clone in the 2005 and 2006 Western Regional Potato Variety Trial. A decision to release A95109-1 as a variety will be made in 2007.

A91814-5 (NDA2031-2 x Ivory Crisp)

A breeding clone bred for use by the chipping industry, A91814-5 completed three years of evaluations in the Western Regional Chip Trial in 2005. It completed two years of testing in the USPB/SFA trials. This breeding clone is notable for its very high yields and specific gravity. Tubers are cold-sweetening resistant and display little or no hollow heart. A91814-5 also has moderate resistance to early dying and corky ringspot. Weaknesses of A91814-5 include susceptibility to PVY^{o}, common scab and tuber late blight infection. A decision to release A91814-5 as a variety will be made in 2008.