The US Potato Genebank (USPG)

History and support of the genebank

Before 1950 and the US national plant germplasm system was started, potato breeding stocks were imported *ad hoc* by various scientists and breeders. So they were not available to the whole community, and got infected with viruses or otherwise lost. Potato scientists organized to lobby for a centralized program to import, classify, preserve, evaluate, and distribute potato germplasm. Since Wisconsin particularly pushed for a genebank, the responsibility was put on us. It seemed a good idea to have it a bit removed from the production area of the state, and the UW research farm (Peninsular Agricultural Research Station, PARS) at Sturgeon Bay was chosen as the USPG home in 1948. It was the first inter-regional project (all US Ag Experiment Stations contributing) so was long recognized as "IR-1". We are still funded inter-regionally, but now major funding is contributed by USDA Agricultural Research Service, and UW also provides substantial infrastructure and administrative support.

Significance of location of the genebank

Wisconsin was selected because its scientists were most vocal in requesting a genebank, which was the case in part because of the importance of potato in Wisconsin's university research and breeding programs and farms. When the genebank was envisioned, a lot of tuber multiplication of germplasm in the field was expected, so a site less prone to virus infection from aphids was sought. It was also expected that the genebank would need to do a lot of crosses, so a cooler site near Lake Michigan would be advantageous. Eventually, neither of these became so important, since the clonal collection is now kept completely *in vitro*, and most of the crossing for botanical seed increases is done in the greenhouse in the winter.

Genebank facilities

We have a complete tissue culture lab and growth chamber facility to support a clonal collection of about 1000 items. In addition, there are 10 greenhouse compartments in which plants are grown to generate seeds and tubers for distribution to customers, as well as for cooperative and in-house research. We have four large screenhouses for similar work in the summer. A seed lab is used to extract, dry and package the seeds. Freezers hold the seed collection, and a walk-in refrigerated storage holds research tubers. We need to have most of our own supporting facilities, since there are no other permanent programs doing similar things on-site or nearby. As per the mission of UW research farms, PARS supports our field plot program and provides a tool shop and utilities. For research pertinent to cultivar production, we also do substantial plot work every year at Hancock Agricultural Research Station, in the central production area of the state, about 150 miles away. Since we are a bank for genes, a basic area of research is to monitor genetic diversity—where it is in the collection and in the wild, and what germplasm-handling steps make genes vulnerable to being lost. So we also have a DNA marker lab in the UW Horticulture department on campus in Madison about 200 miles away.

Staff

Full time staff are four federal and two UW employees. Bamberg is full time project leader and USDA geneticist. Two other federal scientists have part-time appointments to the project—taxonomist Dr. David Spooner, and germplasm enhancer Dr. Shelley Jansky, both stationed in Madison. Three other USDA employees on site are horticulturist Tim Kazmeirczak, IT specialist Jesse Schartner, and seed specialist Sheila Stoneman. UW program manager Max Martin who runs the clonal collection is also on site, and UW staff scientist Dr. Alfonso del Rio runs the DNA marker lab in Madison. Several more students and part-time UW employees contribute to the service and research efforts both at Sturgeon Bay and Madison. Then too, the common model for us is to form specific partnerships with many specialists around the country. For example, they might contribute expertise in entomology, to which we would contribute expertise in germplasm screening and manipulation in a collaboration to study resistance to a particular insect pest.

Purpose of the genebank

The purpose of USPG, like any genebank is to acquire, classify, preserve, evaluate and distribute germplasm, information and technology pursuant to improving the crop. We are the only facility in the US with that mission for potato, but we also support potato improvement around the world. A good analogy is found in a tool store. To most effectively serve its customers, it has to offer (*acquire*) the broadest possible array of tools. Those tools have to be well organized on the shelves (*classified*) so the customers can easily find what they need. The store has to keep a sufficient inventory of stock on hand, and in working order (*preserve* enough germplasm, free of disease, with good germination, e.g.). The best case scenario is if the staff also develops helpful manuals describing the uses for the tools, and even become proficient in their use themselves, so they can give first-hand advice to customers (*evaluation*). Finally, the store needs to be able to effectively advertise what is available, and efficiently deliver it to the customer (*distribution* of information, technology and germplasm). All these concepts parallel the germplasm service of *genetic* tools we hope to provide at USPG.

Contribution to the crop

Potato has about 100 species-- more wild relatives which are accessible to breeding than any other crop. At least 70% of new cultivar releases have exotic germplasm from USPG in their pedigrees. One such stock is the grandparent of Yukon Gold. For many traits, like disease, pest and stress resistances, as well as tuber desirable components (nutritional and other), exotic germplasm has much greater extremes than found in the cultivar breeding pool. Resistance to cold sweetening, frost resistance, late blight resistance, high tuber antioxidant and calcium content, and many more are examples. But the exotic germplasm also has use as research tools. For example, the special qualities of stocks from USPG made it possible to sequence the potato genome and develop Simplot's Innate technology. One downside of exotics is that they are often weedy, so conventional

breeding brings along a lot of undesirable traits into the unadapted hybrid progeny. But as our genetic knowledge and technology advances, this should become less of a problem, making the raw germplasm in USPG increasingly valuable.

"Genes, not genotypes"

About 90% of the items in USPG are represented in about 5,000 botanical seed populations. Each population might be composed of 40,000 seeds, and for outcrossing species, each seed represents a different genotype. We cannot afford to keep that many genotypes clonally. Clonal stocks like *in vitro* plantlets are much more bulky and perishable than botanical seeds (seeds take very little space in the freezer and may maintain high germination for 20+ years). State seed certification organizations and NGOs like SeedSavers need to keep particular cultivars to be grown true-to-type from tuber "seed". USPG rarely wants to do that, since the overwhelming application of our stocks will be for crossing, which scrambles the genetics anyway. Thus, we are intent on gathering and securing the maximum number of useful genes, but the combinations they are packaged in within individual plants does not matter so much.

Outreach

We don't have much interaction with growers because we are at the bottom of the ladder leading to food on the table. Breeding, *per se*, is not even our job, being one rung up from germplasm enhancement. On the other hand, it would be bad if we were naïve about the needs of the people who are producing the product that pays the bills and who care most about promoting potato. So we try to keep in touch by going to professional meetings and doing at least some cooperative projects that are relevant to breeding cultivars and crop production. We think about consumers a lot, since potato needs to expand demand to stay profitable. So we are working on evaluating and developing unusual forms like the Colombian orange-fleshed egg-yolk specialty type. We try to keep abreast of nutritional news and trends, since any kind of nutritional improvement in potato could make it a more attractive choice to consumers. Since we do not expect people to eat more, especially pertinent in this context is to consider how potato could compete better with grains. We are also on the lookout for totally new outlets for potato. Finally, we put substantial attention on how our germplasm can address the needs of growers in Latin America, since this is a way to say "thank you" to the people who originally donated it to the USPG.