ANNUAL REPORT
FY 2016

NRSP-6: UNITED STATES POTATO GENEBANK

Acquisition, Classification, Preservation, Evaluation and Distribution of tuber-bearing *Solanum* Species.

COOPERATIVE AGENCIES AND PRINCIPAL LEADERS

State Agricultural Experimental Stations		**Representative**
Technical Representatives		
Southern Region	Vice Chair (2017)	C. Yencho
Western Region		D. Holm
North Central Region		D. Douches
Northeastern Region	Chair (2017)	W. De Jong
Administrative Advisors		
Southern Region		C. Nessler
Western Region		J. Loper
North Central Region	Lead AA	B. Barker
Northeastern Region		E. Ashworth

United States Department of Agriculture

ARS		
Technical Representative		R. Novy
National Program Staff		P. Bretting
		G. Wisler
Midwest Area		R. Matteri & P. Simon
NIFA		E. Kaleikau & L-S Lin
APHIS		R. French
NRSP-6 Project Leader		J. Bamberg
Agriculture & Agrifood Canada		B. Bizimungu
Industry	Secretary (2017)	J. Parsons

PROGRESS AND PRINCIPAL ACCOMPLISHMENTS

A. Acquisitions and associated work

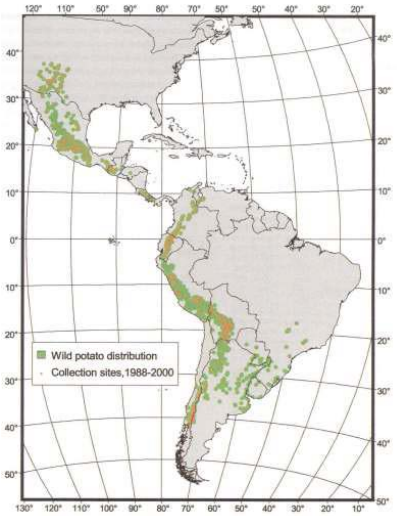
In 2016, we collected 26 germplasm accessions from Arizona, with the support of K. Williams of the USDA Plant Exploration office at Beltsville. We found robust populations in places never previously reported. A detailed trip report is available on GRIN. We also sought and received many new breeding stocks from H. DeJong. We began the process of acquiring clones for which PVP has expired.

(L-R) Alfonso del Rio, Ingrid Bamberg and Charles Fernandez collecting at a new site near Woods Canyon Lake.

Two manuscripts were published on the dynamics of germplasm acquisition in the genebank. One reported on a mega-population of *jamesii* that captures over 80% of the known diversity for that species. This would be a one-stop-shopping site for *in situ* collecting and study. Another manuscript was published that used model species to show the pattern of expected accumulation of diversity in the collection indicates that 100 populations essentially maximized diversity and unique alleles.

The NRSP-6 web page (http://www.ars-grin.gov/nr6) was updated to include all new stocks and screening information. Clients who have ordered from NRSP-6 within the past four years were contacted three times in 2016, informing them of new stocks of true seed, tubers, *in vitro* plantlets, or other samples. We used email and the website to extend technical instructions of various types.

B. Classification



Dr. Spooner's monograph on the species of southern South America is now available and another on the species of northern South America is coming soon. Arrangements have been made to move and incorporate PTIS into the University of Wisconsin herbarium. We began making high quality digital scans of plants of all stocks to accompany the accession records in GRIN.

C. Preservation and Evaluation. About 3,500 individual field plots, greenhouse and screenhouse growouts were done locally and at the HARS research farm at Hancock, WI.

1. Propagation: In 2016, 143 seed increases and 3090 clonally (based on 1030 in vitro clones being transferred 3 times/year).

2. Germplasm health monitoring: We tested 698 accessions for PSTV and 310 clones for the six common potato viruses..

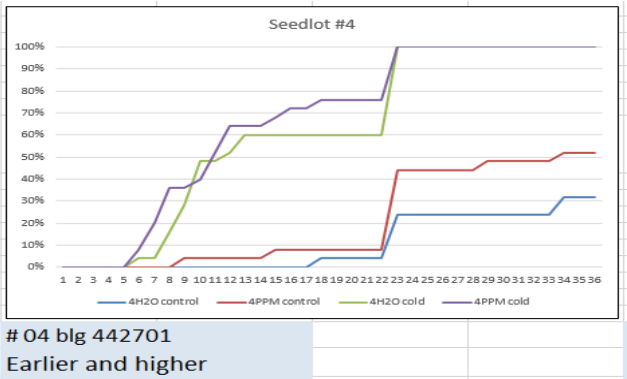
3. Characterization: We did 1509 germination tests, 34 ploidy evaluations and 31 tetrazolium seed viability assays. We demonstrated that some seedlots that have very low germination by conventional methods are actually highly viable if germination is nursed *in vitro.*

4. Evaluation and Technology:

Peru connection: With Peru cooperator J. Arcos and J. Palta of UW, we continued to make crosses of various elites for wart, drought, frost, late blight, tuber calcium for Puno, a major center of potato production and breeding in Peru. One of our hybrids is being tested for cultivar release.

Egg-yolk specialty potatoes: We continued evaluation of the best selections, and recurrent breeding. With cooperators at University of Minnesota, we began the process of creating an inbred diploid form of *Criolla* with exellent color, taste and tuber dormancy.

Genotyping genebank holdings: We received data from Frito genotyping of ~700 cultivars and breeding stocks and began analysis. This promises to be a tremendous tool to show us hot-spots of genetic diversity (core collections), which should lead to more efficient collecting, preservation, and evaluation of germplasm and mining of particular traits.



Seed germination. Diurnal temperature fluctuation effects on germination of recalcitrant seedlots was tested. Some "trickle-germinating" seedlots showed a beneficial burst of germination and increased final germ when exposed to cold nights.

Core collections and other intra-specific groupings: We made high quality digital scans of all ~225 members of *boliviense* and assessed ability to visually sub-group them.

Remote grow-outs: With U New Mexico cooperator at Farmington, we conducted remote field tuber grow-outs of all *jamesii* providing tissue for multiple analyses.

Tuber freezing resistance: Confirmed first reported significant tuber freezing survival. If we can dissect the physiology and apply it to other germplasm, it might lead to an efficient long-term germplasm storage tool.

Field tuber adaptation: We continued pursuit of large field tuber lines of *jamesii* and confirmed hybridity of other related species which are very rich in desirable traits but very difficult to cross with cultivated forms.

Potato beer. We continued to explore best approach to high quality product, and grew ~600 evaluation plots to identify high potassium materials. We shared samples with cooperators in Peru pursuant to a Peruvian potato beer that would benefit from Peru's reputation as native home of potato.

D. Distribution

Distribution of germplasm is at the heart of our service. The volume and types of stocks sent to various consignee categories are summarized in the table below. In 2016, distributions were typical: 221 domestic orders to 115 clients in 37 states and 16 foreign orders to 8 other countries. About 1/3 of the domestic orders are for breeding and genetics, 1/3 for home gardeners, and remainder 1/3 for pathology, physiology, entomology, taxonomy and education.

In 2016 we maintained the popular offering of 100 cultivars as tubers by devising and implementing an iron-clad disease control and quarantine program for their production (full details available at our website). We now only offer tubers of wild species by special order.

	Units of Germplasm Sent[1]							
Category	Seed	TU	IV	DNA	Plants	Herb	Total	PIs
Domestic	7739	2271	2277	1043	945	0	14275	6099
Foreign	4203	0	695	0	0	0	4898	4409
Total	11942	2271	2972	1043	945	0	19173	10508

[1]Types of stocks sent/(number of seeds, tubers or plantlets per standard shipping unit): Seed = True Seeds/(50), TU = Tuber Clones/(3), IV = *in vitro*/(3), DNA = dried leaf or tuber samples/(1), Plants = Rooted Cuttings/(1), Herb = Herbarium Specimens/(1).

E. Outreach

Trip to Peru in March solidified program for cooperative activities in Puno.

Chaired Potato CGC and AJPR Editorial Board meetings.

Volunteered presentations with published abstracts: Four at PAA in Grand Rapids, MI, Invited presentation at CSSA meeting in PHX.

Provided Master Gardeners' training and engagement in potato science with germination testing work days.

Hired and managed an undergrad student as summer interns with research projects.

Hosted international visitors from Peru, Chile, Japan

All germplasm documentation, and details about technology, outreach, and staff publications is available at our website: http://www.ars-grin.gov/nr6/.

IMPACT STATEMENT See attached appendix

WORK PLANS / STAFF & FUNDING / ADMINISTRATION

Continue the service program to acquire, preserve, classify, and promptly distribute high quality germplasm and data to all requesters. We will endeavor to say "yes" to requests for custom service and advice whenever we are able.

Continue study of status and dynamics of genetic diversity: Core collection, cogs, how best to collect from the wild.

Continue participation in "teaching" activities by hiring summer student interns who learn about potato science and help us explore promising new research and technology ideas.

Continue service to industry partners that has been attracting their strong support, and similarly maintain strong ties with our sister genebanks around the world.

Continue developing germplasm-use technology like big-tuber mutants, double pollination.

Continue looking for more efficient ways to evaluate germplasm, like specialized tuber-generating growth chambers.

Continue screening for traits of high priority to both producer and consumer.

Continue administrative leadership services on national germplasm committees and editorial service to *American Journal of Potato Research*.

PUBLICATIONS

Many other scientists are publishing research that directly or indirectly originated from NRSP6 stocks. The search below produced hits which the reader can regenerate independently, or which can be accessed through our website: http://www.ars-grin.gov/nr6. Staff publications (for 2016 and previous) which give details on the initiatives summarized above can be readily accessed through the personnel links for Bamberg, Spooner, and Jansky at the genebank website.

The search below does not catch cultivars, breeding stocks and genetic stocks, which have some 900 particular names to search, or are *tuberosum* and therefore more likely to be of independent origin. Note that even when the publication is of foreign origin, and the researcher probably received materials from another genebank, that foreign genebank may have originally received those materials from USPG. Since potato research and breeding is a slow process, materials published in 2016 could, of course, have been ordered many years previously. Similarly, these articles may only cite previous work with exotic species as related background information published by others, not because they were the materials used in the present experiment. Because of reporting lag, the result for 2015 is most representative = **161 papers**.

Digitop > browse by type: Databases > AGRICOLA > (log in) > cut and paste string below into "simple search" box > click "go"

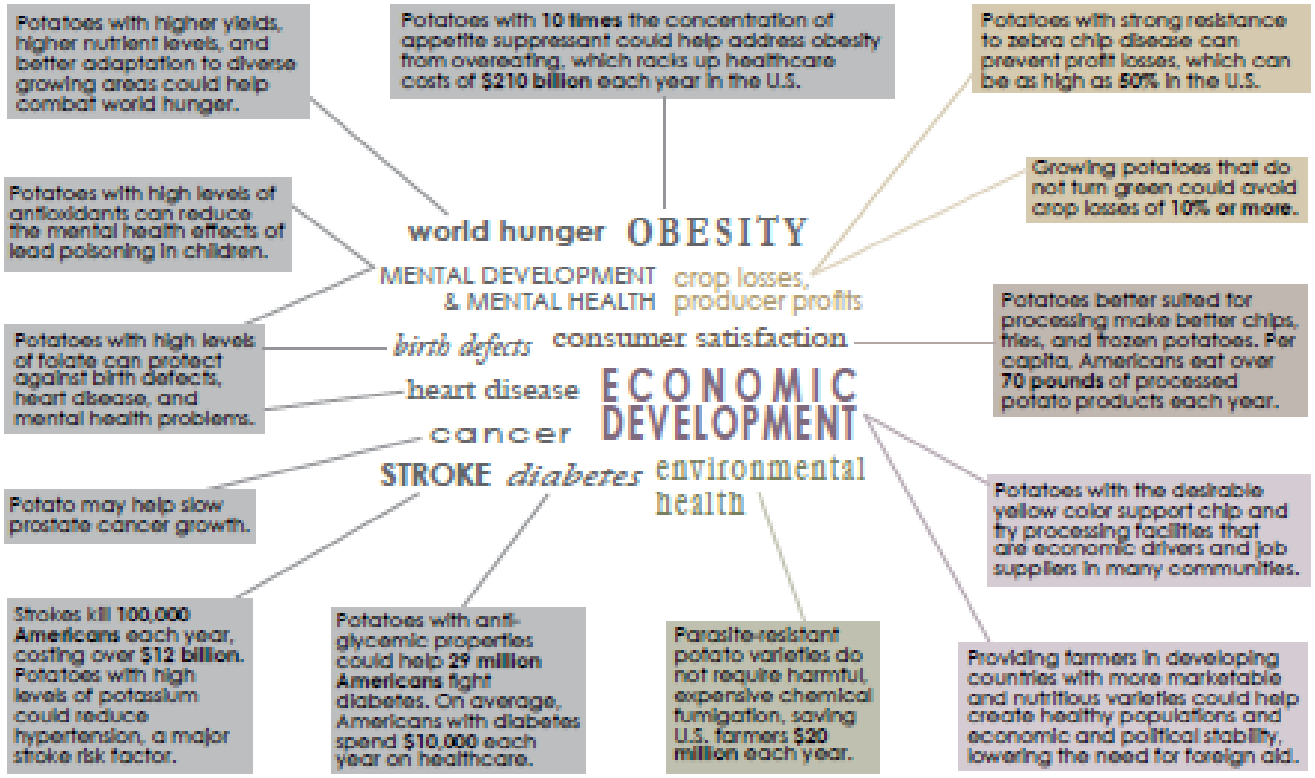
Solanum and (abancayense or acaule or achacachense or acroglossum or acroscopicum or aemulans or agrimonifolium or ajanhuiri or alandiae or albicans or albornozii or ambosinum or andreanum or arnezii or astleyi or avilesii or aymaraesense or berthaultii or blanco-galdosii or boliviense or brachistotrichum or brachycarpum or brevicaule or buesii or bukasovii or bulbocastanum or burkartii or cajamarquense or canasense or candolleanum or capsicibaccatum or cardiophyllum or chacoense or chancayense or chilliasense or chillonanum or chiquidenum or chomatophilum or circaeifolium or clarum or coelestipetalum or colombianum or commersonii or contumazaense or curtilobum or demissum or doddsii or dolichocremastrum or edinense or edinense or ehrenbergii or etuberosum or fendleri or fernandezianum or flahaultii or gandarillasii or garcia-barrigae or gourlayi or guerreroense or hintonii or hjertingii or hondelmannii or hoopesii or hougasii or huancabambense or hypacrarthrum or immite or incamayoense or infundibuliforme or iopetalum or irosinum or jamesii or juzepczukii or kurtzianum or laxissimum or leptophyes or leptosepalum or lesteri or lignicaule or limbaniense or lobbianum or longiconicum or macropilosum or maglia or malmeanum or marinasense or matehualae or medians or megistacrolobum or michoacanum or microdontum or minutifoliolum or mochiquense or morelliforme or moscopanum or multidissectum or multiinterruptum or nayaritense or neocardenasii or neorossii or neovalenzuelae or okadae or oplocense or orocense or orophilum or otites or oxycarpum or palustre or pampasense or papita or paramoense or pascoense or paucijugum or paucissectum or phureja or pinnatisectum or piurae or polyadenium or polytrichon or raphanifolium or rechei or sambucinum or sanctae-rosae or sandemanii or santolallae or scabrifolium or schenckii or soestii or sogarandinum or solisii or sparsipilum or spegazzinii or stenophyllidium or stipuloideum or stoloniferum or subpanduratum or sucrense or sucubunense or tarijense or tarnii or trifidum or tundalomense or tuquerrense or ugentii or velardei or venturii or vernei or verrucosum or violaceimarmoratum or weberbaueri or yungasense or goniocalyx or stenotomum or andigenum or andigena or (USDA and "Solanum tuberosum")) (doc-type:Articles or doc-type:Books) pub-year:2015.

BREEDING BETTER POTATOES

As the most widely grown and consumed vegetable in the U.S., potatoes can have a huge impact on the economy, the environment, and human health. Potatoes are a popular food choice because they are filling, palatable, nutrient-dense, and affordable, and the international market for frozen potatoes, French fries, and potato chips is booming. The value of potato production in the U.S. totals over $4.3 billion each year, with over $1 billion in exports.

Improving potato varieties is key to sustaining this important crop. Since 1947, researchers, breeders, and farmers have used seeds and data from the U.S. Potato Genebank to conduct potato research and cultivate new, desirable potato varieties. A group of researchers coordinates the genebank and supports its efforts by improving techniques and tools for collecting, analyzing, and preserving potato specimens from around the world. A diverse genebank means that researchers, breeders, and farmers will have the resources they need to overcome potato production challenges and sustain the crop for future generations.

Benefits of Genebank Research & Potato Varieties



Want to know more?

National Research Support Project NRSP-6 is supported, in part, through USDA's National Institute of Food and Agriculture by the Multistate Research Fund established in by the Agricultural Research, Extension, and Education Reform Act, which encourages and enhances multistate, multidisciplinary research on critical national or regional issues. Additional funds have been provided by USDA's Agricultural Research Service, private industry sponsors, and the University of Wisconsin. NRSP-6 has been renewed through 2020. For more information on the project, visit http://www.ars-grin.gov/ars6/. For more information on the Multistate Research Program or the Impact Writing Initiative that produced this document, visit http://www.multistateresearchimpacts.org/.