APPENDIX CONTENTS

Minutes

NRSP6 Technical Advisory Committee meeting 2015

June 23-24, Sturgeon Bay WI

The meeting was hosted by the US Potato Genebank at their facilities in Sturgeon Bay.

Tuesday, June 23rd

Attending - Genebank personnel: M. Martin, J. Schartner, J. Bamberg. Tech Reps: R. Novy, D. Douches, D. Holm, W. De Jong. Administrative Advisors: R. Lindroth, E. Ashworth (by phone). Quarantine: J. Abad. AAFC - B. Bizimungu. Industry: D. Ronis (Frito-Lay), G. Gusmini (Frito-Lay), R. Gieringer (CETS), K. Coakley (CETS), R. Coakley (CETS), J. Petrick (CETS), S. Petrick (CETS). Local scientists and miscellaneous guests: A. Cassity, C. Caravati, R. Hoopes (retired), S. Jayanty, J. Endelman, S. Jansky, H. De Jong (retired), D. Spooner.

Minutes following are numbered according to the Agenda (attached).

1. M. Martin called the meeting to order at 8:55 am

2. Agenda – no changes made (unanimous)

3. Minutes from 2014 meeting – unanimously approved.

4. Chairman Holm appointed R. Novy, D. Douches and W. De Jong to the resolutions committee.

5. Lead AA R. Lindroth report – NRSP-6 renewal was recently submitted. [NRSP-6 represents about 1/6 of genebank funding]. ESCOP unanimously recommended it be approved, with additional recommendation that external funding be secured in the future. Experiment station directors will vote on renewal in late September. Also, State of Wisconsin has reduced funding of UW-System by $250 million, to take effect on July 1. Genebank is located on a UW-Madison agriculture research experiment station, one of twelve such stations in the state. Effect of cuts, if any, on these research stations is currently unknown.

6. Regional AA E. Ashworth report – variety development in Maine continues, led by G. Porter.

7. Tech rep reports – written reports from tech reps are attached. Some highlights: R. Novy is the new USDA/ARS tech rep, succeeding C. Brown. T. Michaels now oversees potato breeding at U. Minnesota. Bamberg mentioned that genebank plants 100 clones per year to generate tubers – these are used to meet requests for clonal material from researchers as well as hobby growers (all receive 2-3 tubers of clones of interest). Both D. Douches and D. Spooner have observed that some clones of *Solanum phureja* are not diploid, but tetraploid.

8. Agriculture and Agrifood Canada Report – distributed by B. Bizimungu (attached).

9. Industry and Cooperator Reports – Gabe Gusmini is part of a new unit of PepsiCo looking at genetics and agronomics of sustainable production. Working with Bamberg to look at potato diversity. Are collecting genotyping-by-sequencing data, much of it will be made public. Curzio Caravati initiated the Kenosha Potato Project, which has an emphasis on urban potato production; see their Facebook page. Attending this meeting as unofficial representative of Seed Saver's Exchange, which maintains 650 clones, most of which have virus, and some of which are presumably duplicates. Scott Petrick from Controlled Environment Technology Systems (CETS) gave a presentation about the company's product, a growth chamber for seed potato production, which gives 40x the output of greenhouse multiplication.

10. Genebank report – Bamberg has already made it available online. Some highlights: have found extra large tubers in *S. cardiophyllum*; are now using embryo rescue with some crosses; have developed 'Harlequin Moon', an egg-yolk style potato with better dormancy than *S. phureja*; are preparing a core collection of *phureja*, *verrucosum* and *demissum*; 'Seeds of Time' film has a segment that features genebank staff collecting wild potato germplasm.

11. USDA/ARS Madison report – Spooner distributed a summary of his life's work (Botanical Review (2014) 80: 283-383. Systematics, Diversity, Genetics and Evolution of Wild and Cultivated Potatoes). Jansky is moving away from screening germplasm to moving desirable alleles found in screens to more adapted germplasm, for breeders to use. Emphasis on resistance to Verticillium, PVY (from *S. chacoense*) and common scab (also from *S. chacoense*). Has recently worked to develop several recombinant inbred lines (RILs), each emphasizing different traits; RILs will be hosted at genebank.

12. P. Bretting (National Program Leader) submitted a written report (attached).

13. NIFA – no report submitted.

14. APHIS Quarantine – Abad presented overview of potato quarantine facility. To bring potatoes into country, need to contact Abad beforehand. Material enters as tissue culture plantlets, is tested for virus, cleared of virus in necessary. Process takes 1 year. Mid-July is deadline for requesting import of new clones. At present, 120 clones per year can be imported (total number for the entire country).

In the ensuing discussion Dr. Abad reiterated a story he told last year, about 55 Peruvian cultivars that had been hand-carried into the USA with an import permit that had been issued in error. Peru did not give permission for these clones to be exported. On hearing this, G. Gusmini left the room, asking to be informed when the discussion ended. Voting members unanimously passed the following motion: "We advise Jorge to raise the issue of the 55 clones with the USDA Crop Germplasm Committee, and in the strongest terms recommend that these clones be immediately destroyed. More generally, we recommend

that the quarantine service not process any materials that have been imported without the originating country's permission". Many present have worked hard and long to build trust with Peru and other South American countries regarding the characterization and utilization of wild and cultivated potato germplasm. Allowing this material to be distributed would destroy that trust and substantially hamper future research and collaboration with our South American colleagues in improving potato for all humankind.

15. Resolutions – unanimously approved:

1. Whereas Charles Brown, USDA-ARS, Prosser WA, served faithfully and conscientiously as the USDA/ARS technical representative of the NRSP-6 technical advisory committee from 1999 until 2014, let it be resolved that we thank Chuck for his many years of dedicated service and advice to the US potato genebank. His warm character and delightful sense of humor were appreciated at the advisory meetings over the years.
2. Whereas John Bamberg, Max Martin, Jesse Schartner and other genebank staff organized an excellent meeting, complete with an overabundance of delicious snacks, as well as presentations that provided a thorough overview of the excellent work they conduct to maintain, characterize and disseminate germplasm resources for the benefit of scientists in the USA, Canada, and around the world, let it be resolved that the genebank staff be commended in the highest possible terms for their hospitality and scientific contributions to the potato community.
3. We would like to recognize the support from Janina and Scott Petrick, Randy and Kris Coakley, and Judge Raymond Gieringer of the CETS company for providing an evening of collegial interaction and fellowship for the attendees of the genebank meeting.

16. Election of New Officers and Venue for 2016 – In the longstanding (and exceptionally good-natured) tradition of the committee, Craig Yencho was nominated and unanimously acclaimed to become Secretary in 2016 – because he didn't attend this year's meeting.

New TAC officers for 2016:

Yencho = Secretary
De Jong = Vice Chair
Novy = Chair (Brown was scheduled to be chair, but has stepped down from the committee; Novy to become chair as he is Chuck's successor).

Venue for 2016: Colorado, likely Fort Collins. Dates to be announced.

Meeting concluded at 9:05 am, Wednesday June 24th. Meeting was followed by an in depth-tour of the Peninsular Ag Experiment Station and Potato Genebank facilities.

Respectfully submitted,
Walter De Jong, Secretary

NRSP-6 TAC15

Meeting Schedule

Sturgeon Bay, WI
June 23-24, 2015

MONDAY, June 22nd
Suggested arrival and lodging: Stone Harbor, 107 North First Ave, Sturgeon Bay, WI 54235. Phone: (920) 746-0700.

TUESDAY, June 23rd
8:30AM: Business meeting (see Agenda). Lunch on site. Group supper.

WEDNESDAY, June 24th AM
Tour genebank & PARS, meet staff.

THURSDAY, June 25th
Optional diploid breeding meeting at Madison hosted by Jansky and Charkowski for those interested.

INSTRUCTIONS FOR TELECONFERENCE CALL:

Conference number: 888-844-9904

Participant code: 9232041

We are also going to test our conference room Internet line in a webinar/conference setting to see how it performs. We will NOT be sending audio through the webinar – audio will only be available through the conference phone line. If you want to see how the webinar performs, here's the login info:

Link: http://connectpro70289319.adobeconnect.com/tac/

1. Click the above link to enter the web conference. Log in as a guest participant with your name.
2. Call into the conference line listed above and enter participant code.

Note that it may take an extra minute or two to login if it's the first time you use Adobe Connect.

If you are coming to Sturgeon Bay and want your presentation projected during the meeting, we'll have the projector and laptop setup. For those of you giving a report remotely, if you want to provide your report to me before the meeting, we can project your presentation to the group. Any reports I receive before the meeting can also be put on our website before the meeting and will be accessible to all before and during the meeting.

AGENDA

NRSP6 TAC 2014 BUSINESS MEETING

Tuesday, June 23, 2015

Chair = Holm
Vice Chair = Novy
Sec = De Jong

Preliminaries

1. Welcome, introductions, announcements, distribution of documents (Brown & Holm); collect registration fee of $25
2. Approve, add to, schedule and prioritize agenda items
3. Review of 2014 minutes
4. Chairman Holm appoints Resolutions Committee

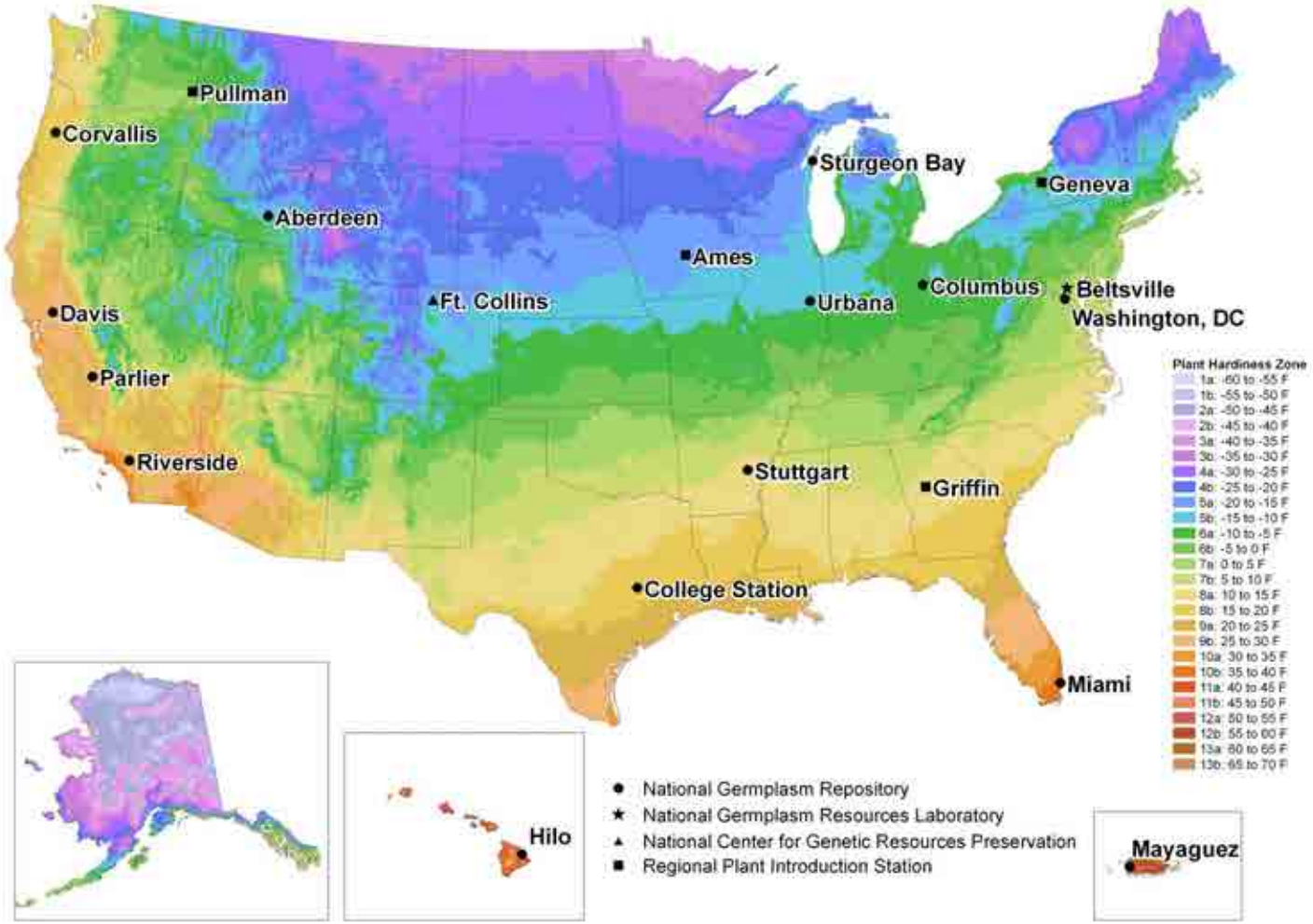
Reports and topics for discussion

5. Lead AA (Lindroth)
6. Other regional AAs (Nessler, Ashworth, Curtis)
7. Regional and USDA Tech Reps (Holm, Douches, DeJong, Yencho, Novy)
8. Agriculture and Agrifood Canada (Bizimungu)
9. Industry and other cooperator perspectives/reports (Blauer, Ronis, Curzio, Petrick, others)
10. NRSP6 Project Sturgeon Bay leadership (Bamberg, Martin)
11 USDA-Madison taxonomy and enhancement (Spooner, Jansky)
12. USDA/ARS Madison, MWA, & NPL admin (Simon, Matteri, Bretting, Wisler)
13. NIFA (Thro)
14. APHIS/Quarantine (Abad)
15. Review and approve resolutions
16 Elect new officers and set next meeting venue

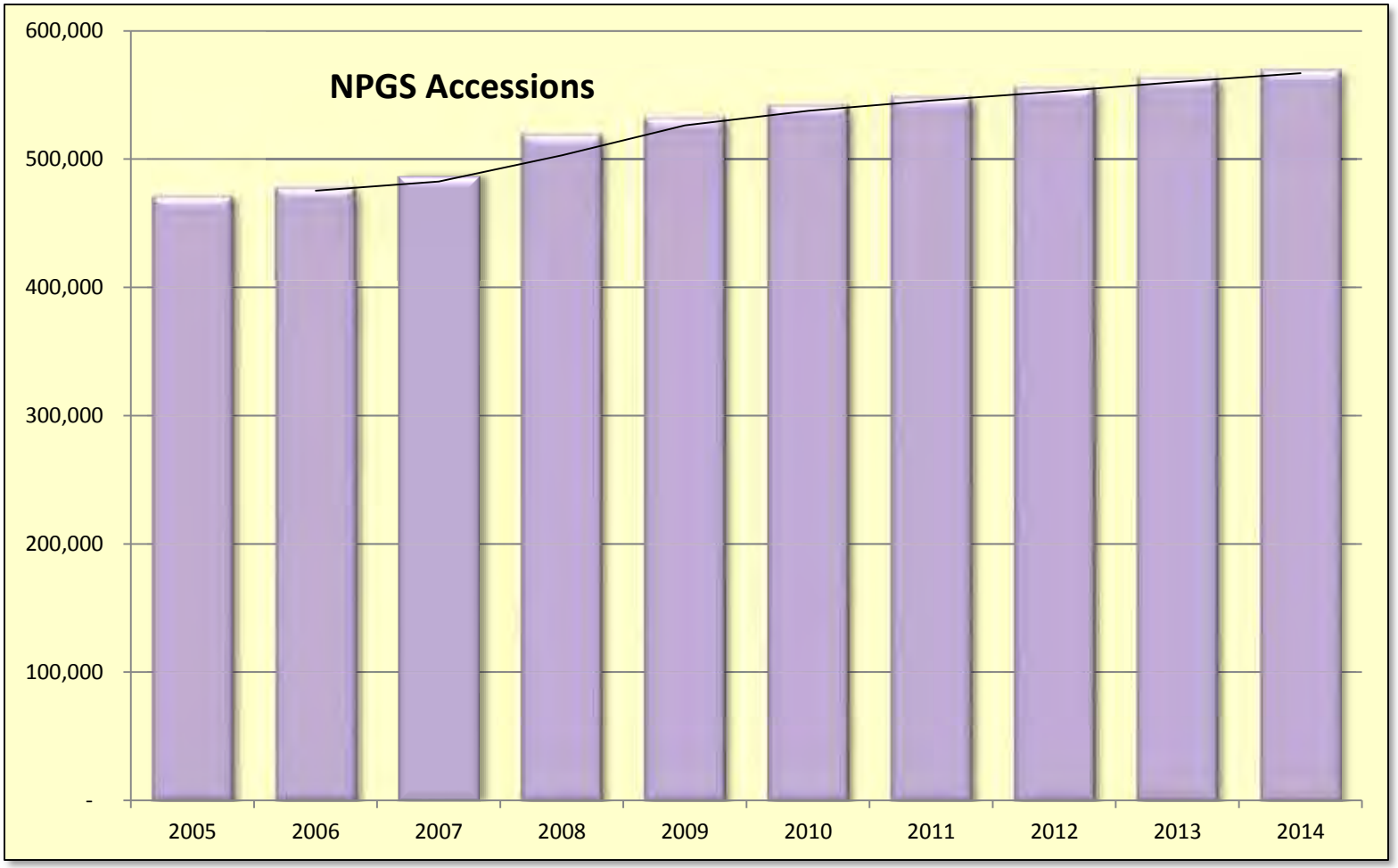
The National Plant Germplasm System: 2015 Status, Prospects, and Challenges

Peter Bretting
USDA/ARS Office of National Programs
Peter.bretting@ars.usda.gov
1.301.504.5541

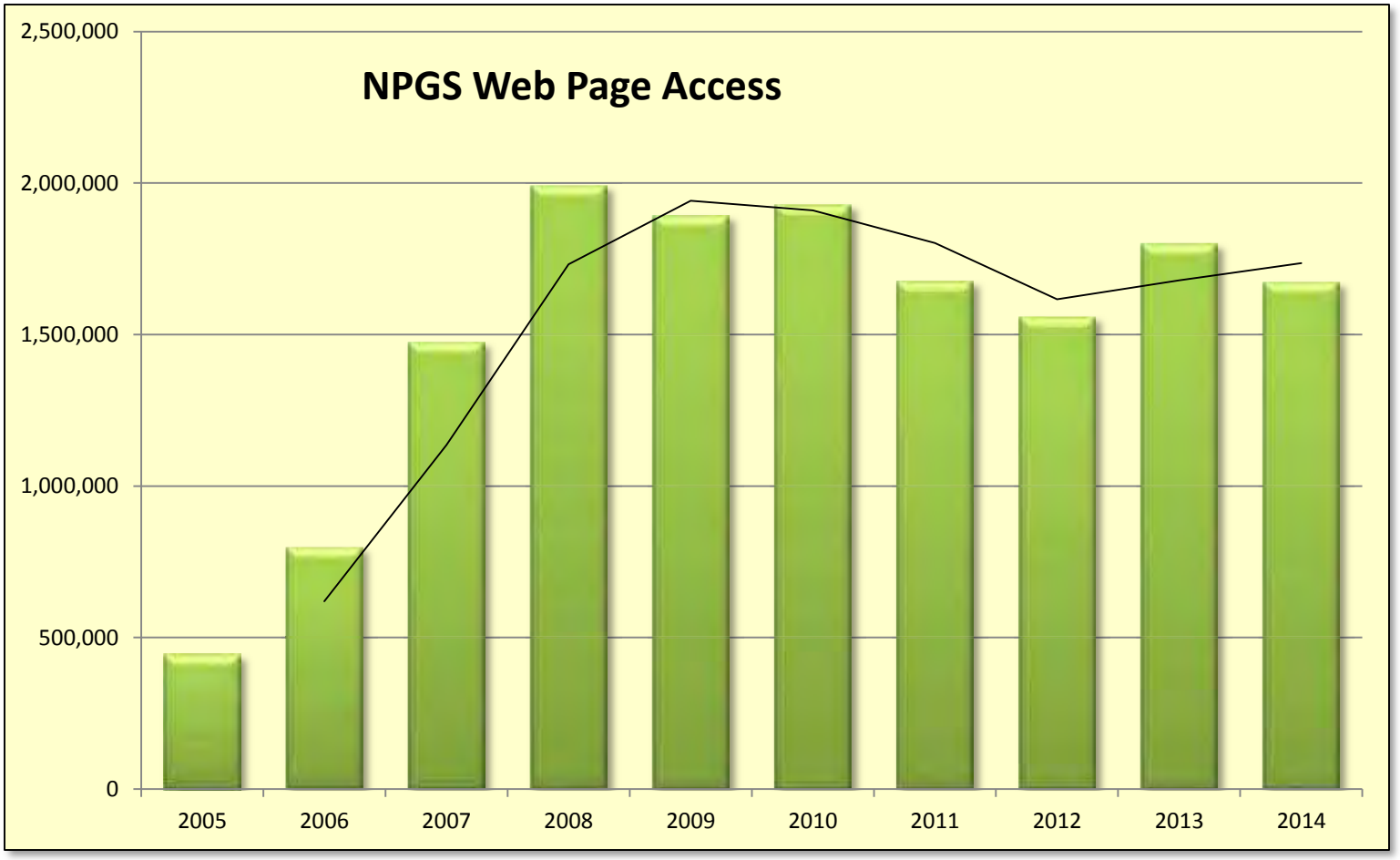
USDA National Plant Germplasm System (NPGS)



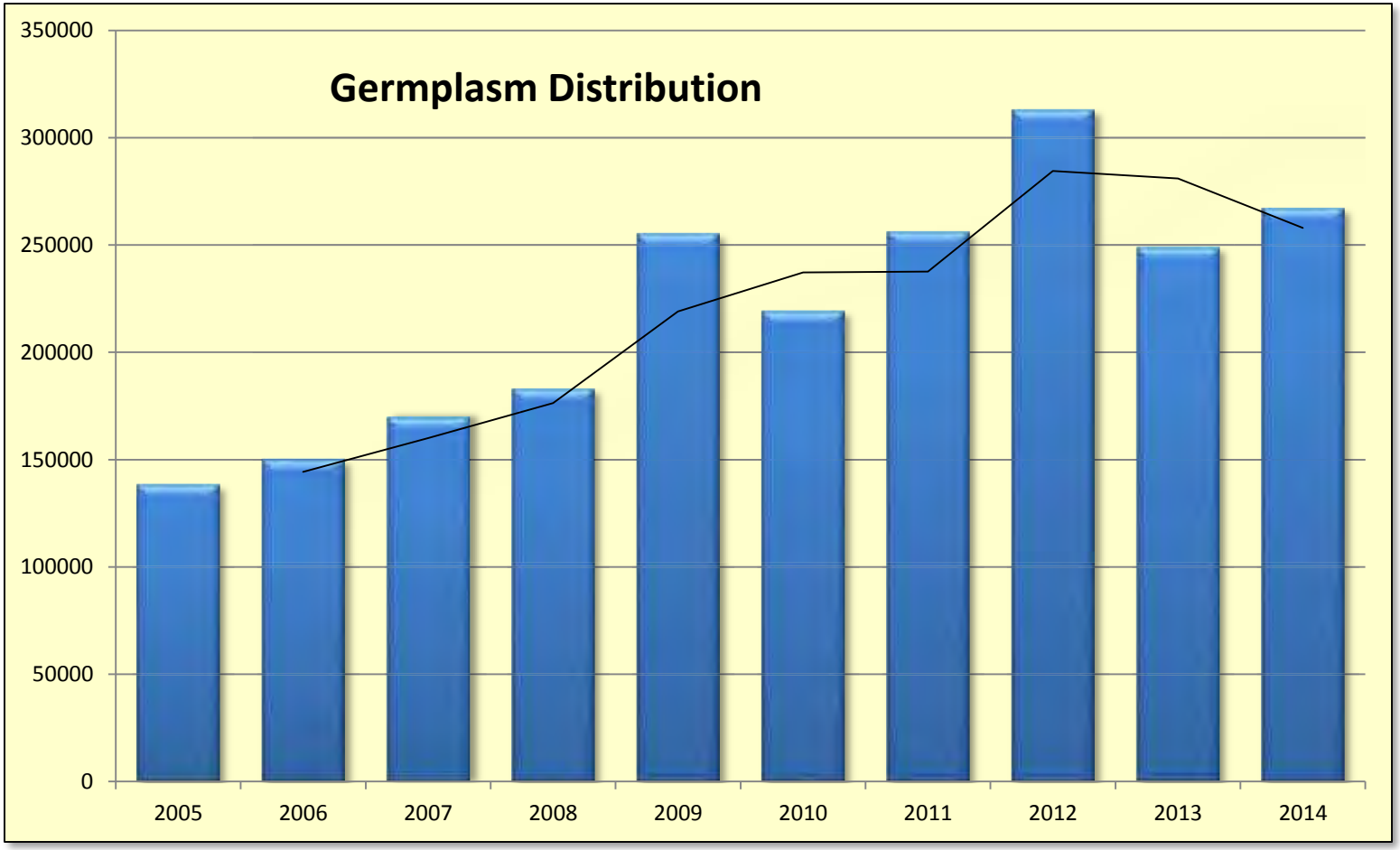
NUMBER OF NPGS ACCESSIONS 2005-2014



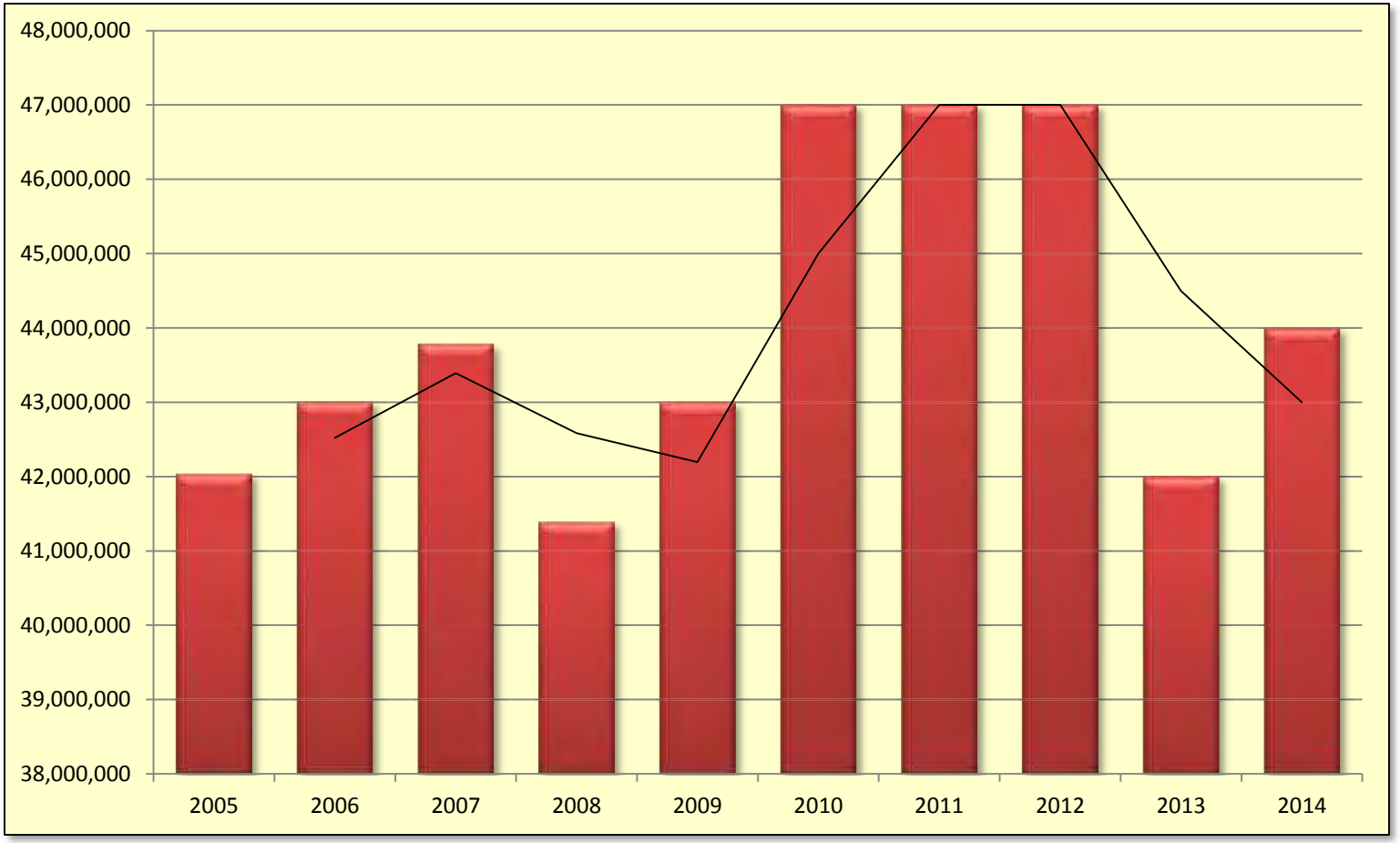
DEMAND FOR NPGS INFORMATION 2005-2014



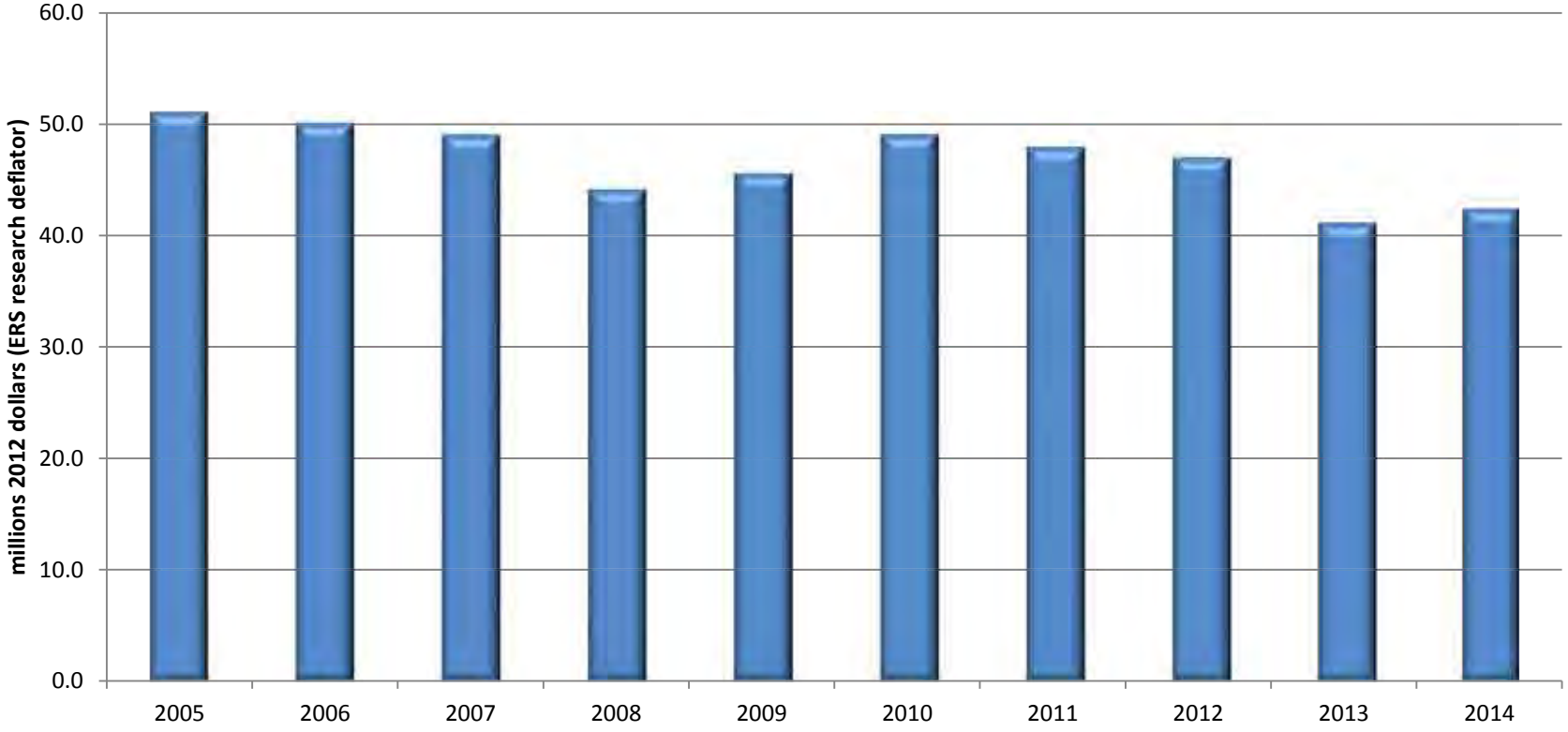
DEMAND FOR NPGS GERMPLASM 2005-2014



ARS National Plant Germplasm System budget 2005-2014



Real ARS National Plant Germplasm System Budget, 2005-2014 converted to 2012 dollars with ERS research deflator



FY 2016 President's Budget Proposal

- **The President's FY 2016 budget proposal for the USDA/ARS requests funding increases of about $3.475 million for the National Plant Germplasm System.**

- **$1.5 million: under the Sustainable Small Farm Initiative, specifically the sub-initiative Expand the National Plant Germplasm System ($1 million increase) and Provide training/information to Native Americans on conserving/improving traditional crops ($500,000 increase).**

- **$1.5 million: under Translational Crop/Livestock Genetics Initiative, specifically under the sub-initiative Analyze genetic stocks/specialized populations using advanced genomics/genetic technologies.**

- **$475,000: under Vertical Farming Initiative, specifically under the sub-initiative Develop high value horticultural varieties that are adapted for growth in greenhouses/urban environments.**

Some key challenges that stretch the NPGS's budgetary resources

- **Managing and expanding the NPGS operational capacity and infrastructure to meet the increased demand for germplasm and associated information**
- **Fulfilling the demand for additional germplasm characterizations/evaluations**
- **Acquiring and conserving germplasm of crop wild relatives**
- **Managing genetic/genomic seed stocks**
- **BMPs and procedures for managing accessions (and breeding stocks) with GE traits and the occurrence of adventitious presence (AP)**

Genetic Resource Management Priorities

- Acquisition
- Maintenance
- Regeneration
- Documentation and Data Management
- Distribution

- Characterization
- Evaluation
- Enhancement
- Research in support of the preceding priorities

DiversitySeek (DivSeek) Initiative

- **Mission--to enable breeders and researchers to mobilize a vast range of plant genetic variation to accelerate the rate of crop improvement and furnish food and agricultural products to the growing human population.**
- **Build on existing, emerging and future initiatives to characterize crop diversity and develop a unified, coordinated and cohesive information management platform to provide easy access to genotypic and phenotypic data associated with genebank germplasm.**
- **Its partners currently include 58 public-sector agricultural research institutions from many nations, including Clemson, Cornell, Iowa State, UC-Davis, Georgia, Minnesota, Missouri, and USDA/ARS.**
- **The DivSeek Steering Committee (includes P. Bretting) met on 29 May 2015 in Rome to address specific details for the organization, function, and scope for the Initiative.**

ARS Big Data Initiative

- **FY 2015-2019, $25 M**
- **“Science DMZ”**
  - **Dedicated scientific research network for data computing**
- **High-performance computing (HPC) system**
  - **Hybrid of local and cloud resources**
  - **Storage and efficient processing of ARS data**
- **Virtual research support core**
  - **Experts to staff the new infrastructure**
  - **Provide computational research support**

2015 NRSP-6 Germplasm Utilization Report from the North Central Region

Compiled and Submitted by
David S. Douches, NC representative
June 23, 2015

University of Wisconsin
Jeff Endelman

The Endelman research program received two groups of clones from the potato genebank in FY2015. The first group were European standards for culinary traits (Dore, Saturna, Bintje, and Charlotte), and the second group were haploid inducer lines (PHU460, PHU035, IVP048, IVP101, PHU1.22).

University of Minnesota
Tom Michaels

Tom Michaels has taken the leadership in the potato breeding efforts at the University of Minnesota. 2014 was a transition year and he expects to start accessing diploid germplasm from the

Michigan State University
David Douches

We are refocusing our diploid breeding effort to incorporate the dominant Sli gene, which imparts self-compatibility (SC), into our diploid germplasm base. The major source of the gene is *S. chacoense* M6 from Shelley Jansky's program. Have established an accelerated recurrent selection program that has a one year cycle. We have completed three rounds of crossing and two rounds of selection for tuber shape, size, photoperiod adaptation and SC. The germplasm in this population is a combination of *S. phureja, S. berthaultii*, *S. tarijense*, *S. chacoense, S. microdontum* and *S. tuberosum.* These species have been chosen over the years because of late blight resistance, PVY resistance, beetle resistance, verticillium wilt resistance, chip-processing quality, high solids, dormancy and yellow flesh. Some of the selections are being used to develop populations for genetic studies that will be SNP genotyped. Our ultimate goal is to develop inbred diploid lines that can be used as true-breeding varieties or be parental material in F1 hybrids.

We have also have hybridized the first cycle of selections to Atlantic and Dakota Diamond haploids. We are extracting more haploids from *S. tuberosum* varieties and advanced breeding lines.

We have crossed a set of *S. berthaultii* PIs that have high densities of leaf trichomes to the SC parent lines we have selected from our recurrent selection population. The goal is to select SC hybrids that can be used to develop RIL populations that fix the desirable trichome traits. Aphid bioassays are planned for the summer of 2015.

We have also used the species *S. berthaultii* for developing a mapping population to conduct QTL analysis for late blight resistance, tuber dormancy and tuber number and size. The population was SNP genotyped last year. This population is currently in the field for field late blight data collection to complement the detached leaf bioassay data collected this winter. Right now we have a major late blight QTL on Chr. 10. Tuber dormancy is preliminarily mapped to Chr. 4, 5 and 7.

We have used Alca Tarma as a source of PLRV resistance. Through marker-assisted selection we have a population that contains over 90 progeny that have both markers for PVYadg and PLVR resistance.

We have approximately 150 *S. demissum* accessions planted in the greenhouse. They will be transplanted to the field for foliar late blight testing.

Two papers with John Bamberg were published:

Bamberg, J., del Rio, A., Coombs, J., & Douches, D. (2015). Assessing SNPs Versus RAPDs for Predicting Heterogeneity and Screening Efficiency in Wild Potato (Solanum) Species. American Journal of Potato Research, 1-8.

Michael A. Hardigan, John Bamberg, C. Robin Buell, and David S. Douches. 2014. Taxonomy and Genetic Differentiation among Wild and Cultivated Germplasm of Solanum sect. Petota. The Plant Genome doi:10.3835/plantgenome2014.06.0025

Ph.D. student Michael Hardigan is continuing to study some of these species with Robin Buell. A subset was chosen for sequencing. This complements the *S. tuberosum* sequencing effort of Ph.D. student Gina Pham with Robin Buell.

North Dakota State University
Susie Thompson

The primary goal of the NDSU potato breeding program is to identify, develop, and release superior, multi-purpose cultivars, that are high yielding, possess multiple resistances to diseases, insect and other pests and environmental stresses, have excellent processing and/or culinary quality, and that are adapted to production in North Dakota and Minnesota, the Northern Plains, and beyond. The potato improvement team uses a combination of germplasm enhancement and dedicated crossing blocks to develop resistance to abiotic and biotic stresses, and to improve quality attributes. Improvement team efforts include continued use of wild species hybrids, including genotypes with Solanum species (*phureja, chacoense, etuberosum, berthaultii, raphanifolium, and bulbocastanum*) in their immediate pedigree. This material is created in some cases within our own program, but also in programs under the direction of Drs. Shelly Jansky, Kathy Haynes, Rich Novy, and Chuck Brown, which often conduct 'pre-breeding' efforts following identification of accessions with desirable traits. The NDSU improvement team strives to introgress resistance genes addressing traits based on grower, potato

industry, and consumer needs, and we emphasize disease, insect pest, and stress resistance, including late blight, cold-sweetening, Colorado potato beetle, *Verticillium* wilt, pink rot and *Pythium* leak, sugar end, silver scurf, *Fusarium* dry rot, PVY, and aphid resistance breeding, and new and emerging pests including powdery scab and potato mop top. In 2013, we accessed 18 accessions (*S. cardiophyllum, S. jamesii, and S. stoloniferum*) from the Potato Introduction Project at Sturgeon Bay to enhance our insect resistance breeding efforts. These were grown in the field in 2014 and those that tuberized will be used in greenhouse evaluations and subsequent increase in 2015, and in our crossing efforts in winter 2015/2016. Additionally, several *phu-sto* hybrid progeny created by Dr. Kathy Haynes have been incorporated into our program for accessing many traits, including colored flesh and associated antioxidants. A limited number were used as parents in our winter 2014/2015 crossing block and several are being increased for trait assessment in the field in summer 2015.

The NRSP-6 Potato Genebank and Potato Introduction Project are invaluable to the NDSU potato breeding and improvement efforts NDSU. We will be accessing an additional line for insect breeding resistance summer 2015, and prior to crossing in winter 2015/2016 will be securing germplasm for use in initiating diploid breeding efforts and haploid extraction.

Report to NRSP-6 Technical Committee, June 2015

Northeast Region Representative: Walter De Jong

The Northeast region received 142 units of germplasm, spread across 20 requests, in 2014.

Forty-six of the accessions were sent to researchers at land grant universities and 25 units were sent to researchers at non-land grants. Forty-eight of the accessions were sent to the Scatterseed Project (www.gardeningplaces.com/scatterseed.htm), an independent program that seeks to preserve genetic diversity for future generations. The remaining 23 accessions were distributed to eight individuals interested in one or more specific varieties for home gardening, or for hobby breeding.

Comment received from one recipient, Mark Lichtenwalner (Pennsylvania):

I'm still doing some potato breeding work, and rely on the gene bank at times for new material. I haven't been doing much work with TPS since I haven't been doing any international work recently, but it's still on my list of objectives. I'm spending more time looking at heat and drought tolerance and scab resistance. So with the current weather pattern here, I'll probably go broke this year, but will have a great year for identifying new lines.

Last year was a nice growing season, so everything grew well, difficult to identify lines for heat and drought tolerance. I have a few comments, hope there will be useful:

VEKARO, nice set of red tubers that also sized up well. Not many flowers, was not useful last year for breeding.

AURA, I was interested in trialing this one for fingerling types. It looked very nice on it's own, could be a useful variety if it grows that nice every year. Not many flowers, but it is workable for crossing.

MEDUZA, TEENA, TORRIDAON, again all grew well, good flowering, should be potential breeders.

CANASTA, adapted surprising well in my climate, making a good set of 1-2 inch tubers.

SAIKAI 35, I requested this in 2013 for it virus Y resistance and it's phureja background. The tubers are very attractive with a bright, smooth skin and red eyes. I found it very useful as a male, and currently growing out a number of crosses from this line, will be interesting to see the results.

Western Region Report - NRSP-6 Technical Committee
David G. Holm

During 2014, NRSP-6 supplied stocks to the following Western states: Arizona, California, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah and Washington (Table 1). Western Region USDA/ARS requests are not included in this report.

Twenty-eight entities via 40 requests ordered 1,380 units. Potato materials were requested by universities and research institutes (University of California, University of Idaho, Montana State University, and Oregon State University) and many private companies and farms (Table 1).

Table 1. NRSP-6 Distribution in the Western Region - 2014.

Name	Organization	City	State	Reported
Timothy Carrol	Simplot Plant Sciences	Boise	ID	
Gary Cass	Tom Wagner Seed	Paauilo	HI	
Stephen Facciola	Tom King Farms	Vista	CA	
Fahrettin Goktepe	SunRain Potato Varieties	Idaho Falls	ID	
Aymeric Goyer	Oregon State University	Hermiston	OR	
Christopher Homanics	Skipley Farm	Snohomish	WA	✓
Denise Hunter		Central Valley	UT	✓
Michele Krucker	J. R. Simplot Company	Boise	ID	✓
Joseph Kuhl	University of Idaho	Moscow	ID	✓
Rick Machado	Machado Farms	Menifee	CA	✓
Dusty Nugget		Oatman	AZ	
Anthony Palethorpe		Cottonwood Heights	UT	
Garry Pearson	University of California - Davis	Davis	CA	
Douglas Penning		Longview	WA	
David Rhode	Desert Research Institute	Reno	NV	✓
Caius Rommens	Nightshade LLC	Boise	ID	✓
Cristian Saldana		Porterville	CA	
David Sands	Montana State Unversity	Bozeman	MT	
Vidyasagar Sathuvalli	Oregon State University	Hermiston	OR	✓
Lura Schroeder	University of Idaho Extension	Aberdeen	ID	
Joseph Simcox	The Rare Vegetable Seed Consortium	Belen	NM	
John Stewart		Cashmere	WA	✓
Terry Tolbert	Escalante Interagency Office	Escalante	UT	
Peter van Hest	Bejo Seeds, Inc.	Oceano	CA	✓
Thomas Wagner		Everett	WA	✓
Gloria Welch		Mira Loma	CA	✓
Bill Whitson	Cultivariable Seeds	Moclips	WA	
Javier Zapata		Oakland	CA	

General Reports

Christopher Homanics

USDA GRIN is in my opinion a world-class genebank that supports public access in a way that makes it a viable model in a world of too often closed private or proprietary sources. GRIN is providing unique and precious germplasm to breeders to adapt material to modern needs in a world of climatic uncertainty.

In 2014, I requested 6 accessions of TPS of potato germplasm within the main petota complex that was found in the Bamberg frost study to have high frost tolerance. I requested the material and received it promptly but it was after my main seeding date, so I planted the material this year. I have transferred 54 seedlings to the field and will be evaluating them this season. In future seasons, the best clones will be crossed into existing late blight resistant lines, culinary lines, and high antioxidant lines.

The material had excellent germination rates considering that the seed lots were collected decades ago. I have personally never had any issue with requested seed and in particular NRSP6 had an extremely quick turn around time.

Michele Krucker

Our team requested germplasm to use as controls for late blight resistance and drought tolerance. The material arrived in great condition and the Genebank Staff were extremely helpful. Some of the varieties requested could only be found at the Genebank and were very useful in our studies.

Joseph Kuhl

All the material requested arrived in good shape. Seed germination rates were very similar to what was indicated for each accession. Tissue culture plantlets have been propagated without issue.

Solanum acaule and S. chacoense have been used as tetraploid and diploid Solanum standards for chromosome counts and flow cytometry. The five Solanum tuberosum lines were obtained for use as Phytophthora infestans differential lines and potato cyst nematode differential lines. These lines act as controls in infection experiments, needless to say the controls are important to completing the experiments successfully.

Requests were handled quickly and professionally. Any questions were answered immediately. I have no complaints regarding my orders or the quality of the germplasm. NRSP6 should continue to be funded so that they can continue this important work.

Denise Hunter

The nrsp6 was received in excellent shape. Seems were planted. Plant in small containers tell sprouts were three to four inches tall, with six to eight leaves. The seeds produced 8 healthy plants last year. 2015 spring they restarted and have multiplied I have counted 19 plants to this 6/5/2015. Individual potatoes are smaller than walnuts. We are transplanting them to the field this year to see if they will continue to produce so well.

Rick Machado

We received tubers last year, and because of the GRIN program we have been successfully breeding potatoes for over 15 years now.

All tubers arrived healthy and on time for spring planting. They have all grown well the first year, and after we have multiplied the original tuber, we put the progeny through a series of heat/drought tests. These tests involve the limited use of water, using a summer growing season, not mulching, not fertilizing, using drip irrigation with emitters spaced a long distance away, and forcing them to grow and multiply far outside of their comfort zone.

As of now, we have about 10 entirely new varieties that perform from fair to well in these stress tests. Most of the new varieties have an s.chacoense background, and colors range from white to dark blue, with flesh color also changing from white to dark blue. We will further press forward with additional tests, which involve intensifying the soil temperatures. So far, we have grown modest size yields with temps up to 125f.

Without GRIN, it would have never been possible, period. The world is far richer for this program, and we continue to stay involved with them, and this year have several hundred plants from GRIN TPS. We thank them for their hard work, dedication and continued help.

David Rhode

My request for germplasm in 2014 was a sample of Solanum tuberosum seeds to be part of a large seed reference collection. I incorporated this sample into the reference collection, which is geared toward identification of seed remains from archaeological sites. I have not had occasion to use the material in identification of archaeological specimens, but I appreciate having the material in the collection in case I will need it in the future.

Caius Rommens

Material from the U.S. Potato Genebank is currently being used to develop varieties for the inland Northwest. The most important aspect of this material is a potato mini-core collection, which consists of 75 diverse accessions of ten different wild species. The mini-core collection was acquired from the Genebank early in 2015. Another aspect of

the material consists of 39 European varieties, tubers of which were provided by the Genebank during the spring of 2014. Some of the traits that are of particular importance include drought, heat and insect tolerance, as well as earliness. The Potato Genebank provides an essential resource to breeding programs throughout the United States.

Vidyasagar Sathuvalli

1. Field evaluation of primitive cultivars and foreign varieties:
Tubers from 56 different cultivars were obtained from Potato Genebank for their field performance at Hermiston Agricultural Research and Extension Center. They were planted as four hills. Two primitive cultivars and three foreign varieties looked promising as they produced nice tubers and performed well in storage. We plan on utilizing these clones in the breeding program

2. Screening and identification of new sources of resistance to Columbia root knot nematode (CRKN) and Verticillium wilt (VW)
True potato seeds from 46 PI's from nine different Solanum sp. were obtained from Potato Genebank to screen for resistance to CRKN and VW. Our goal is to screen 10 plants per population for their resistance to CRKN and VW. Upon identification of potential resistant sources, the new sources will be further evaluated for their resistance to other major nematode pests of potato.

3.Developing whole genome sequence resource for Solanum bulbocastanum clone SB22.
Solanum bulbocastanum clone SB22 is the source of resistance for CRKN and the resistance has been introgressed into russet potatoes by Dr. Chuck Brown. We are currently developing whole genome sequence resource for SB22 through illumina sequencing. A genome browser is being developed and will be available to public under solanum.cgrb.oregonstate.edu

4. Introgression of high folate from wild Solanum germplasm to commercial potatoes
Dr. Goyer's group screened wild germplasm for high folate concentration in potatoes and identified few clones (~10) from S. vernei and S. andigenum with high folate concentrations. We are planning to introgress high folate genes from these clones to the commercial potatoes.

John Stewart

All of the potato tuber germplasm we receive here at Gardens of Eden starts off in potted culture while we take slips and cuttings to build up our volume for field trials. The more vigorous varieties make it to the field in the first year, others we attempt to propagate until the next season if they are particularly slow growing or very small (as some of the primitive cultivars from the Andes are).

Most seasons we trial the primitive cultivars, as well as some of the other varieties that are deemed potentially suitable, in a traditional Andean tuber polyculture with Lupinus mutabilis, Oxalis tuberosa, Tagetes minuta, Tropaeolum tuberosum & Ullucus

tuberosus. In the future we hope to incorporate Mirabilis expansa into these polyculture field trials as well. Andean primitive cultivars and some of the older hierloom varieties are usually the best candidates for these trials as they often have similar daylength requirements as the other Andean tubers and crops. Of our 2014 accessions, Canasta PI 642439 and Tollocan PI 587067 performed well in these trials, we were able to maintain the germplasm throughout the season, and they will be continuing in the trials this season.

Varieties that are considered less appropriate for the Andean polycultures are subjected to rigorous field trials for adaptability to a semi-arid climate, cold hardiness and perenniallity. Of our 2014 accessions, Clavella PI 527976, Myatt's Ashleaf PI 666142 and Saikai 35 PI 666964 performed well, was maintained, and will be continuing to this seasons trials.

All of the germplasm we have received from NRSP-6 has been in good to excellent condition and very acceptable. With the exception of Yari Blanco PI 611096 (requested 2015), which simply rotted, all tuber accessions have grown fairly well to exceptionally well.

I would like to take this opportunity to suggest that NRSP-6 consider adding some of the other Andean tuber crops to the collection of accessions maintained there. They should mostly all be similar to the primitive potato cultivars as far as cultivation requirements. As far as I know, all of the other Andean tubers being maintained in the US are exclusively in the private sector.

If possible, could these reports be taken care of through snail mail in the future? I live and work in the mountains, where I do not have regular internet access. There are times, especially in the growing season, when I am unable check my email for a month or more. It would be greatly apprecciated and would make it easier to get these reports to you in a timely fashion.

Thomas Wagner

I plant the tubers in various locations for the purpose of making crosses and to get open pollinated potato berries in order to extract tps.

I don't publish per se, but I do release germplasm ...mostly as tps from crosses and selfed pollinated berries.

Great quality and received in great shape.

I would like to help co sponsor imports through quarantine many in vitro potato varieties from places like CIP and Gross Lusewitz.

Gloria Welsh

The only information that I can share with you for your statistics (being that I hadn't received my order) is that I intended to grow the potato seeds and share the information with other desert gardeners. I have a gardening blog in which I share and receive growing information form other's who are having the same problem with growing potato and other vegetables in extreme heat and in regions that have "Santa Ana Winds". Santa Ana's are winds that are hot and can be extremely damaging.

Two weeks ago we had Santa Ana's that peaked at 60 mph and I lost an entire bed of a particular lettuce yet a romain variety from Pakistan withstood the wind and heat. Seeking out particular varieties of seed is tedious yet, rewarding. Even though most fruits and vegetables, fish, poultry and beef are grown commercially here in California, folks in other states don't realize that we often pay more for them here. Most households here have some sort of garden, or have chickens or live stock. You'll find folks from Los Angeles to Palm Springs who grow a bit of something to offset the cost of commercial nutrition.

I'm sure my feedback doesn't help you much. I just wanted to let you know that I received your letter yet, I didn't receive any potatoes.

Peter van Hest

In 2014 Bejo seeds, Inc. requested and received various clones and true seed lines from the collection of the Irish potato (Solanum) maintained by the **National Plant Germplasm System.** Typically 40 – 75 lines are acquired each year.

For more than a decade, Bejo seeds has received true seed, in vitro and in vivo material in this fashion in order to evaluate these lines in its breeding program to create true seed potato varieties.

Of the hundreds of clones received over the years, 31, or about 4% of total clones, have provided their genes towards potential parent lines which are currently being evaluated.

Because of the breadth of genetic material available from the **National Plant Germplasm System**, access to it is of utmost importance to Bejo Seeds, and it is highly appreciated to receive the material.

Over the years there has been a rare instance of questionable phytosanitary condition, but that is the rare exception rather than the rule. In addition, we were alerted to this possibility and to destroy the clone in question, which speaks of the high standards the NPGS follows.

In summary, Bejo Seeds, Inc, is very appreciative of the clones available from the Potato Genebank, and will continue with yearly requests.

USDA/ARS Report on use of NRSP-6 Germplasm in 2014
Rich Novy
June 23, 2015

In 2014, there were 2302 units shipped in 48 orders to thirteen USDA/ARS cooperators in seven states and Washington, D.C. The seven states represented were: California, Maryland, North Dakota, New York, South Carolina, Washington, and Wisconsin (Table 1). Eleven of the 13 recipients responded regarding the use of requested germplasm, with two ARS recipients having e-mail addresses that were no longer valid, and no evidence of current employment in a search of the ARS personnel directory.

Varied usage of NRSP-6 germplasm was reported with highlights given below. More specific detail of research provided by each respondent is also presented in the remainder of this report. NRSP-6 germplasm was used for:

- ✓ Disease Resistance: Zebra chip, wart, late blight, early blight, and Verticillium wilt
- ✓ Pest Resistance: Potato psyllid (vector of zebra chip disease) and potato cyst nematode
- ✓ Tuber Qualities: Starch composition and its association with cold-inducted sweetening, non-tuber greening, glycoalkaloid composition and content, lengthening of tuber dormancy, and flavor attributes
- ✓ Unique/Enhanced Marketability: *Criolla* egg yolk class, tuber shape (e.g., tuberose), and improved attractiveness of skin and boiling qualities
- ✓ Nutritional: Iron, folate, and phytonutrients
- ✓ Environmental tolerances: Salinity, acidity, and heat
- ✓ Identification of New Sources of Self-Compatibility
- ✓ Molecular Marker Development: Verticilllium wilt resistance

Table 1. NRSP-6 Germplasm Distribution to USDA/ARS in 2014.

Recipient	City	State	Response
Bamberg, John	Sturgeon Bay	WI	Yes
Bandla, Pratyusha	Beltsville	MD	Yes
Brown, Chuck	Prosser	WA	Yes
Cooper, Rodney	Wapato	WA	Yes
Haynes, Kathy	Beltsville	MD	Yes
Jansky, Shelley	Madison	WI	Yes
Li, Rugang	Charleston	SC	No. Non- active e-mail and no listing in ARS directory
McCue, Kent	Albany	CA	Yes
Navarre, Roy	Prosser	WA	Yes
Romano, Gabriela	Parlier	CA	No. Non-active e-mail and no listing in ARS directory
Suttle, Jeff	Fargo	ND	Yes
Thro, Ann Marie	Washington DC		Yes
Wang, Xiaohong	Ithaca	NY	Yes

Reported Use of NRSP-6 Germplasm:

John Bamberg, Sturgeon Bay, WI

The things I am doing with Genebank stocks are in the Annual Report-- with a time lag, of course. For the actual things I ordered in 2014, here are the research themes:

- Screening for Colombian *Criolla* egg yolk type potatoes.
- Checking differences in re-collections of USA southwest populations
- Detecting distinct cog forms in *okadae*
- Core collection of *jamesii* and diversity of Mesa Verde "mega-population"
- *S. bulbocastanum* for Zebra chip resistance evaluation and breeding
- *S. microdontum* for testing glycolkaloids of non-greening lines
- *S.microdontum* for folate evaluation
- *S. verrucosum* and *jamesii* for mentor-pollen-mediated hybrids between the two
- *megistcrolobum, commersonii, ajanhuiri* for frost and wart resistance project in Puno, Peru
- Standard mini-core array of 25 species for SNP analysis and tuber samples
- Standard mini-core array for acidified medium growth adaptation survey
- Set of all LON for survey of acidified medium seed sprouting differentiation
- All 2x primitive cultivated pops for DNA core collection and *Criolla* screen
- All inbred *chacoense* forms for DNA comparisons
- All *demissum* for late blight screening and DNA core collection

Pratyusha Bandla/Jorge Abad, Beltsville, MD

I do not recall receiving any material from NRSP-6 for research purposes. I am copying this email to my team leader, Dr. Jorge Abad. He will respond to any questions you have.

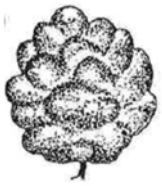
Jorge Abad: I only recall receiving material for therapy. Perhaps Jesse can help with it.

Chuck Brown, Prosser, WA

We have carried out hydroponic testing of the ability of potato root systems to reduce iron. We used NRSP-6 in vitro resources to put together red-skinned versus white skinned genotypes. First we did find a large range iron reduction and an orthogonal test comparing red-skinned to white skinned found a highly significantly higher iron reduction [FE (III) to Fe (II)]. This generates more questions than it answers. Red-skinned potato breeding population have become differentiated because crosses between red-skinned parents are more productive of commercially viable progeny for the red-skinned market. It is possible that a genetic difference in iron reduction has become fixed and isolated in the red-skinned subpopulation. Alternatively the genetic components needed for production of red skin could promote iron reduction in ways we have not anticipated.

We also used the in vitro annual tuber production to augment genetic diversity in our specialty potato breeding subpopulation. We are looking to diversify tuber shape, decrease eye depth, improve the brightness and attractiveness of the skin, lengthen tuber dormancy, and increase boiling quality. We

have used an NRSP-6 clone called Llunchuy Huapaqui (the potato that makes the daughter-in-law cry, LL Hu) as a source of the rare so-called "tuberose" shape (see figure below). It turns out that LL Hu is tetraploid even though it is described as being a triploid *S. chaucha*. The Oregon program has selected one seedling from a cross where one parent is LL Hu."



TUBEROSED

Ortiz, R. and Z. Huaman. (1994) Inheritance of morphological and tuber characteristics. In: Bradshaw, J.E. and Mackay, G.R. (eds.) *Potato Genetics.* CAB International, Wallingford, UK, p. 277.

Rodney Cooper, Wapato, WA

We screened all *Solanum bulbocastanum* and *S. verrucosum* accessions for resistance to potato psyllid and *Liberibacter solanacearum*. Plants from six *S. bulbocastanum* accessions exhibited psyllid resistance. John Bamberg's group created tissue culture clones from several plants from each resistant accession and several susceptible accessions, which were then screened for psyllid resistance. Resistant clones will be used to determine the heritability of resistance traits. Experiments to screen *S. verrucosum* for psyllid resistance have produced ambiguous results; although some individual plants appeared to unsuitable for psyllids, resistance does not correspond to entire accessions as we observed with *S. bulbocastanum*. All plants screened thus far, regardless of species, is susceptible to *Liberibacter*. Some *S. bulbocastanum* plants initially appeared tolerant and survived longer than expected despite detection of *Liberibacter* using PCR, but were stunted and eventually died before producing tubers. We are currently screening accession of *S. hjertingii* for psyllid resistance, but do not yet have results.

Publication: Cooper, WR, and JB Bamberg. 2014. Variation in Bactericera cockerelli (Hemiptera: Triozidae) oviposition, survival, and development on *Solanum bulbocastanum* germplasm. *American Journal of Potato Research*. 91: 532-537.

Kathy Haynes, Beltsville, MD

Hybridizations were attempted with requested germplasm, but were unsuccessful. Tubers were harvested off plants for future use.

Shelley Jansky, Madison, WI

For FY14 requests, tuber samples were evaluated for amylose content in starch and some tuber and in vitro samples were grown in the field (Hancock 2014) to produce tubers for flavor analyses. No clones with exceptional flavor were identified. TPS was ordered for studies to look for salinity tolerance in accessions collected from coastal areas (this project is not underway yet), and for heat tolerance (planted at Hancock in 2014, but it was a cool summer, so we couldn't score for heat tolerance). I also ordered seeds of accessions that Marty Cipar indicated are self-compatible. I plan to look for new sources of Sli, I have not sown the seeds yet.

Austin Meier completed his Ph.D. thesis entitled “Improvements to Potato Breeding for Disease Resistance Through the Use of Germplasm Enhancement and Genomic Analysis.” He developed breeding clones with combined resistances to early blight and late blight introgressed from wild potato species.

In addition, three publications in 2014 were based on research using wild potato relatives:

Uribe, P., S. Jansky, and D. Halterman. 2014. Two CAPS markers predict Verticillium wilt resistance in wild *Solanum* species. Molecular Breeding. 33:465-476. Verticillium wilt of potato is a persistent problem in the USA and worldwide. The disease, which is caused primarily by the fungus *Verticillium dahliae*, is difficult to manage, causes yield losses, and contaminates soil for subsequent plantings. Control strategies based on host resistance are seen as long term stable solutions, but difficult to achieve given the genetic nature of the host and the challenges associated with resistance evaluations. To provide breeders with marker-assisted selection opportunities, we generated a pair of cleaved amplified polymorphic sequence molecular markers within the coding region of Ve2, a potato gene with homology to the tomato *Ve1* gene that confers resistance to *V. dahliae*. The position of the marker was determined according to the consensus sequences of Ve2 homologs of wild Solanum species with resistance to V. dahliae. Marker testing indicated their broad applicability, being able to track the resistance to V. dahliae in progeny containing genetic information derived from species *S. chacoense*, *S. brevicaule, S. berthaultii, S. tarijense,* and *S. tuberosum*. Furthermore, the two isolates of V. dahliae used in our inoculation experiments differed in virulence and demonstrated specificity for some wild potato species. Experimentation leading to the development of the markers and tests of their usefulness against a wide range of diploid potato germplasm is presented.

Jansky, S.H., Y.S. Chung, and P. Kittipadukal. 2014. M6: A diploid inbred line for use in breeding and genetics research. Journal of Plant Registrations. 8:195-199. M6 (Reg. No. GP-1, BS 228) is a diploid self-compatible inbred line of the potato wild relative *Solanum chacoense*.
It is a vigorous, homozygous breeding line derived by self pollinating the diploid wild potato relative *S. chacoense* for seven generations. While most wild *Solanum* species are self incompatible, this clone is homozygous for the dominant self incompatibility inhibitor gene *Sli*. In addition, it is homozygous for 90% of single-nucleotide polymorphism markers in the Infinium Array developed by the SolCAP consortium. M6 is vigorous and both male and female fertile, producing seeds in crosses to diploid cultivated and wild potato germplasm. These traits enable us to systematically develop diploid inbred lines, which was not possible in potato breeding until the discovery of *Sli*. M6 produces tubers under both short and long photoperiods, unlike other wild potato relatives. In addition, M6 has several desirable traits, including high dry matter content, good chip processing quality, and resistance to soft rot and Verticillium wilt. M6 is being used to develop recombinant inbred line populations.

Jansky, S.H. and D.A. Fajardo. 2014. Tuber starch amylose content is associated with cold-induced sweetening in potato. Food Science and Nutrition. 2:628-633. Cold-induced sweetening (CIS) is the accumulation of reducing sugars in potato tubers at low storage temperatures. It is undesirable because it results in dark fry products. Our study evaluated the relationship between genetic resistance to CIS and two starch parameters, amylose content and starch granule size. We found that the amylose content in four CIS-resistant varieties was higher than that in five susceptible varieties. Amylose content was influenced not only by variety but also storage, production year, and field location. However, interactions between amylose content and environmental variables were not detected. In contrast, starch granule size was not associated with CIS resistance. No effect of storage on starch granule size

was detected, and interactions among variety, production year, and field location were observed. Tuber starch amylose content should be considered a source of variability for CIS.

Kent McCue, Albany, CA

Requested material was for replenishing transformation stock

Roy Navarre, Prosser, WA

Our NRSP-6 material received in 2014 was used for glycoalkaloid analysis, and in particular to examine the relationship between greening and glycoalkaloid concentration. Bamberg was senior author on a published work out of this that showed some of the genotypes did not green when exposed to light, nor did preliminary data show an increase in glycoalkaloids in these non-greening samples exposed to light. Greening is a big problem for potatoes, as it can lead to unacceptably high levels of glycoalkaloids and trade issues with countries in Asia that have a very low tolerance for greening. This work generated promising results and point towards new opportunities for future studies to further understand the issue. As for past germplasm received, it has been invaluable in our nutrition research, resulting in multiple publications, including in the top food journals. A Phureja genotype was identified that had the highest amounts of various phytonutrients ever reported in potatoes. Identification of genotypes with very low amounts of solanine/chaconine but good amounts of tomatine, a better tolerated, less toxic glycoalkaloid with known health benefits, has led to ongoing work to introduce this trait into domesticated potatoes.

Jeff Suttle, Fargo, ND

I had requested this germplasm to initiate a new line of inquiry on the hormonal control of tuber dormancy and sprout growth. Unfortunately, the budget cuts my project has experienced in the past several years resulted in the loss of technical support and the consequent abandonment of this project (along with others).

Ann Marie Thro, Washington D.C.

NRSP 6 provided about a dozen accessions of yellow potatoes.

The question of interest was whether the accessions would be useful *per se*, or as parents, for yellow potatoes as used in traditional South American cooking.

I asked members of a local Hispanic church to give an assessment. The potatoes were cooked and eaten by new U.S. citizens and residents who are of Colombian and Bolivian origin, i.e., Andean regions where yellow potatoes are part of the traditional diet. These individuals had grown up eaten yellow potatoes and still eat them on occasional visits to family in South America. I.e., it is unlikely that they have become out of touch with the flavors and textures. This was informal; not a structured experiment, conducted in the home kitchen of a Colombian family (U.S. citizens since mid-2000's), using their usual cooking equipment. The potatoes were boiled and eaten, and used in soup.

Questions asked were

> " Do they meet your expectations for a good traditional potato for cooking and eating?" ; "Would you cook and eat the others? (which would you buy?)"; "Which are the best?" " Which ones should be kept for more research, and which ones could be discarded?" ; "Any other comments ?"

All of the accessions were eaten with pleasure and judged as good, happily eaten again, happily purchased.

> I was surprised and asked several times, Are some better than others? Some worse? Taste? Texture? But the answer came back each time, no, they are all good.
>
> I am not sure if this was because the considerable pleasure taken by all in the event may have outweighed critical culinary perception? or
>
> > -- if the accessions were really all equally enjoyable from a culinary and taste and texture standpoint.
> >
> > I.e., this group did not assign different ratings to the different accessions.
> >
> > It does suggest that none of the accessions would be problematic from a culinary standpoint. I.e., they could be used based on field performance and other traits.

Xiaohong Wang, Ithaca, NY

Yes, we have ordered a variety of wild potato accessions and used them in three projects: 1. We are using effectors from potato cyst nematodes (PCN) to screen the wild potato accessions with a goal of identifying new resistance genes against PCN; 2) We are screening the wild accessions for PCN resistance with a goal to discover new germplasm that may be used to breed for broad-spectrum resistance against PCN; 3) We are using the wild accessions to study the molecular mechanisms of CLE effector-mediated nematode parasitism. We are only in the early stage of these studies and therefore we don't have any publications yet.

NRSP-6 provides very good service and we always get our ordered material in a timely manner.

Summary of the Clonal and True Potato Seed Testing

At

The Plant Germplasm Quarantine Programs

NRSP-6 Technical Committee Meeting

Sturgeon Bay, WI/ June 23-24, 2015

Jorge Abad, PhD
Senior Plant Pathologist-Program Manager
Potato, Sweet Potato and Cassava Quarantine Programs
Plant Protection and Quarantine (PPQ)
USDA APHIS
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Introduction

The mission of the Potato Quarantine Program (PQP) is to test germplasm for pathogens as a condition for the entry of this valuable crop into the United States. Special emphasis is given to the detection of viruses, viroids and bacteria including phytoplasmas. This program is the first line of defense against the inadvertent introduction of new potato diseases into the USA. Such diseases have the potential to create both economical and environmental burden to the crop. In addition, in our program, any infected material is subjected to therapy for the elimination of pathogens and then retested to ensure the success of the treatment. In the end, all the accessions received in our program are released to the requesters. Furthermore, PQP has a strong and an efficient collaboration with the NRSP-6 promoting: the acquisition, sanitation and further use of clean germplasm.

Accomplishments

Our program keeps very high standards in pathogen detection tests for potato diseases. We perform very sensitive, state of the art molecular tests, routinely: PCR and RT-PCR with generic primers for: luteoviruses, carlaviruses, potexviruses, potyviruses, geminiviruses and phytoplasmas and qRT- PCR (real time) to detect *Potato yellow vein virus,* a potentially damaging and true-seed transmitted virus and *Potato leaf roll virus.* Furthermore, in collaboration with the International Potato Center (CIP) in Peru, we are identifying difficult unknown viruses by next-generation sequencing analysis, a new method where no specific primers are needed. Remarkably, we continue using a sound biological test under optimum conditions that ensures the interception of unknown or unusual viruses. ELISA and the current molecular based methods will not allow the detection of those viruses. For this test, we mechanically inoculate 9 different indicator plants and perform grafting onto healthy potatoes.

Our primary stakeholders continue to be potato breeders from universities, government and the private industry. We are also continuing our collaboration with the NRSP-6 US Potato Genebank by introducing more potato accessions through our quarantine program and cleaning their infected accessions by therapy. This season four accessions were imported and/or treated by therapy for the Genebank. Also, seven virus-infected accessions that were sent to us from Sturgeon Bay, completed therapy and testing therefore released back to Genebank. Thermotherapy and chemotherapy were used in the treatments. Additionally, this year we have introduced one more cv. for the Genebank, coming from the International Potato Center in Peru.

Clonal and True Potato Seed Testing at the Potato Quarantine Program

Clonal.- This season there were 179 potato clones in our program. From those, 136 clones were received this year, 72 as *in vitro* cultures and 64 as tubers. The remaining 43 accessions were received in 2012-13. After the testing 75 clones this season, we released 67 accessions. Twelve clones either died or did not grow, and 8 clones tested positive for carlaviruses, *Potato leaf roll virus* and potyviruses consequently remain in therapy.

82 clones arrived too late for testing therefore will be tested this season. One more year we have surpassed our yearly quota (75 clones) for potatoes (See table 1)

TPS.- Twenty seed lots were introduced and tested this season. Seventeen were released and three were retained due to suspicious symptoms for a potential unknown virus. Identification of these pathogens is underway (Table 1).

Table 1.- 2014-2015 Potato Quarantine Program Activities

Clonal Potatoes

There were 179 potato clones in the PGQP in the 2014-2015 season.

1	clone was received in 2012		
	1	from Japan	for M. Martin
42	clones were received in 2013		
	3	from the Repository	for M. Martin
	39	from Chile	for G. Secor
136	clones were received in 2014		
	3	in vitro from Germany	for F. Goktepe
	1	in vitro from the Netherlands	for D. Bernhardson
	5	in vitro from Germany	for C. Higgins
	55	tubers from Peru	for D. Hoffman*
	5	in vitro from New Zealand	for G. Ebe
	2	in vitro from Germany	for T. Lübberstedt
	1	in vitro from the Netherlands	for J. Wallace
	14	in vitro from the Netherlands	for J. Bragg
	3	tubers from Canada	for A. Witherell
	5	tubers from Peru	for A. del Rio
	1	in vitro from Germany	for J. Düsing
	1	in vitro from Peru	for M. Martin
	1	tuber from Scotland	for C. Keller
	6	in vitro from Brazil	for R. Novy
	4	in vitro from Peru	for S. Marquardt
	9	in vitro from Peru	for D. Norman
	5	in vitro from Ethiopia	for K. Perry
	12	in vitro from Chile	for G. Secor
	3	in vitro from Scotland	for N. Gudmestad

* This group of tubers were field-collected and intercepted with a mistakenly-issued permit. They were brought to PGQP too late for this year's testing.

Of these 179 clones:

12	died before testing began (field-collected tubers arrived rotted.)	
9	were still in therapy from last year	
82	arrived too late for testing	
1	was discarded (a replicate of a released clone)	
75	were tested	
	8 were positive	(Carlavirus, Luteovirus, Potyvirus, and unknown viruses)
	67 were released	

True Potato Seed

There were 20 TPS lots in the PGQP in the 2014-2015 season.

15	from The Netherlands	for J. Bragg
5	from The Brazil	for D. Douches

Of these 20 seed lots:

20	seed lots were tested	
	17 were released	
	3 were positive	(Unknown viruses)

Totals

- Total accessions = 199
- Total tested = 95
- Total released = 84
- Total positive = 11
- Total died = 12
- Total discarded = 1
- Total carried over to next year = 91

ANNUAL REPORT
FY 2014

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		C. Yencho
Western Region	Chair (2015)	D. Holm
North Central Region		D. Douches
Northeastern Region	Secretary (2015)	W. De Jong
Administrative Advisors		
Southern Region		C. Nessler
Western Region		L. Curtis
North Central Region	Lead AA	R. Lindroth
Northeastern Region		E. Ashworth

United States Department of Agriculture		
ARS		
Technical Representative	Vice Chair (2015)	C. Brown
National Program Staff		P. Bretting
		G. Wisler
Midwest Area		R. Matteri & P. Simon
NIFA		A. M. Thro
APHIS		J. Abad
NRSP-6 Project Leader		J. Bamberg
Agriculture & Agrifood Canada		B. Bizimungu

PROGRESS AND PRINCIPAL ACCOMPLISHMENTS

A. Acquisitions and associated work

In 2014, we collected 18 germplasm accessions from Arizona under the BdRF (Bamberg, del Rio, Fernandez) prefix, with the kind support of K. Williams of the USDA Plant Exploration office at Beltsville. This trip followed the Mogollon Rim from Springerville to Flagstaff. We found robust populations at new sites quite separated from any previous collections, and extending the range of *S. fendleri* north by about 50 miles. The detailed trip report is available on request and on GRIN. We also sought and received 15 new cultivars and breeding clones from cooperators (La Rouge, Igorota, Amey, Peter Wilcox, Harley Blackwell, Sandy, Sylvia (CPVPA), Marine, Cynthia, (ver x cph) -8-1, (ver x cmm) -1, -2, -21-1; (ver x pnt) -1, -2.

C. Fernandez on Mogollon Rim near Woods Canyon Lake, AZ, site of new *S. fendleri* collection.

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 2014, 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. For example, we produced and selected the best 10% of seedling tubers in the winter at Davis, CA (see at right and insert). When planted in Wisconsin the following summer, they far outperformed random seedlings, allowing us to skip one field selection season.

B. Preservation and Evaluation

This year, 218 accessions were increased as botanical seed populations and 2,700 clonally. Over 700 potato virus tests were performed on seed increase parents, seedlots and research materials. Germination tests were performed on 1523 accessions, ploidy determinations were made on 23 accessions, and tetrazolium seed viability tests were done on 63 seedlots. Taxonomic status was assessed on all stocks grown. Nearly 4,000 individual field plots, greenhouse and screenhouse growouts were done locally, at the research farm at Hancock, WI, or with cooperators at Davis, CA. We initiated a new test of winter field growouts for tuber evaluation with cooperators at Hastings, FL and Yuma, AZ. We continued breeding for improved *Criolla* or "egg yolk" style specialty potato with golden flesh (cooperator Douglass from FL). We completed a project using SNPs (cooperator Douches from MI) to assess partitioning of genetic diversity in model potato species with a view to understanding their best management.

We evaluated for heat stress tolerance (cooperators at Parlier, CA), folate (cooperator Goyer from OR), glycoalkaloids (cooperator Navarre from WA), anti-obesity (cooperator Kemin from IA), new *Double Corolla* mutant, Zebra Chip resistance in *bulbocastanum* (with R. Cooper in WA).

We tested all *S. verrucosum* accessions for crossability to *S. jamesii* through mentor pollination (right).

Testing *S. jamesii* introgress with *verrucosum*

C. Classification

Dr. Spooner is working on monographs that will fully document the taxonomic reduction of the genebank's holdings to about 100 species.

D. Distribution service

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 2014, we had 200 domestic orders to clients in 37 states and 18 foreign orders to 9 other countries. Half of the domestic orders are for breeding and genetics, ¼ for home gardeners, and remainder ¼ for pathology, physiology, entomology, taxonomy and education.

In 2014 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).

Clean tuber growout for distribution

	Units of Germplasm Sent[1]								
Category	Seed	TU	TF	IV	DNA	Plants	Herb	Total	PIs
Domestic	2282	2212	21	1149	282	24		5970	4463
Foreign	122			328				450	232
Total	2404	2212	21	1477	282	24		6420	4695

[1] Types of stocks sent/(number of seeds, tubers or plantlets per standard shipping unit): Seed= True Seeds/(50), TU = Tuber families/(12), TC = Tuber Clones/(3), IV = *in vitro* stocks/(3), DNA = dried leaf samples/(1), Plants = rooted cuttings /(1), Herb= herbarium specimens/(1).

E. Outreach

Media coverage, Tours, Teaching, TechTran and Trips with presentations done

Summer student interns participated in experiments: Ahna Keilar (seed germ and seedling transplant tech), Abe Keilar (crossing tech for jam and blb), Hannah Haight (prebiotic assay and nutrient microbial bioassays), Rosa Lozano, (Colombian student visitor for *Criolla* potatoes).

Potato Association of America meeting in Spokane--research presentations/abstracts.

Chinese, Russian, and Japanese potato scientists, UW River Falls Horticulture students, and Southern Door HS Spanish class tour genebank.

Staff Horticulturist T. Kazmierczak and vistiting Colombian student Rosa Lozano

Leadership: Bamberg continued as Editor in Chief for the American Journal of Potato Research, and Chair of the USDA/ARS Potato Crop Germplasm Committee.

Reports & Plans: ARS: PGOC, CGC, CRIS, Annual Performance, Budget. NRSP6: Annual Report, TAC meeting minutes, Project Renewal FY16-20. PAA: AJPR Editor in Chief report. UW-Hort: Annual Performance. PARS: Tour guide & field book.

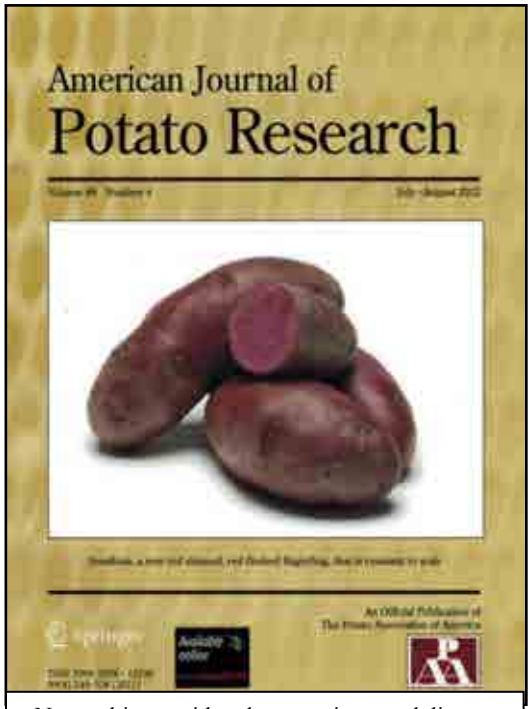
Management of Grants & Awards: Potato CGC grants, AJPR Outstanding Paper

IMPACT STATEMENT

In 2014, seed increase success and distributions were steady, supporting the needs of the nation and world for resources to genetically improve the potato crop.

As the most consumed and most valuable US vegetable, potato substantially influences the farm economy and environment in many states. High value-added processing and high and regular consumption gives potato significant impact in all states with respect to the food economy and citizens' health.

Because potato has more useful exotic germplasm than any other crop, there is much activity in federal, state, and private breeding and research programs using genebank stocks. Potato is a high input crop with many opportunities of improvement that can be addressed by germplasm. Potato is a prohibited import crop, so genetic resources already in the US genebank are the only ones readily available to germplasm users. Continuing restrictions on international germplasm collecting and sharing make what we already have at NRSP6 even more precious. NRSP6 is the premier potato genebank in the world, and the only program in the nation responsible for providing these potato genebank services.

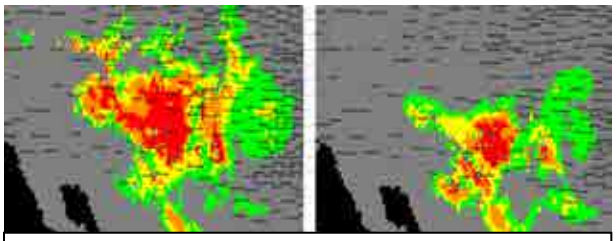


New cultivars with colors, nutrients and disease resistances contributed by exotic germplasm

The payoff in funding the genebank is in discovering and deploying traits that are useful to the public and the industry. We participated in successful selection of better stocks for golden flesh, frost resistance in Peruvian highlands, folate, potassium, resistance to tuber greening, glycoalkaloids, and a natural appetite suppressing protein. Many new cultivars were published this year: Yukon Gem, Classic Russet, Clearwater Russet, Alta Crown, Cooperation-88, Alpine Russet, Sentinel, Huckleberry Gold, Teton Russet, Elkton, M7 Germplasm Release, AmaRosa, Purple Pelisse, Owyhee Russet, Palisade Russet, Saikai 35. They all have NRSP6 exotic germplasm in their pedigrees, including species *S. andigena, acaule, chacoense, demissum, infundibuliforme, phureja,* and *vernei*.

Salary and travel support plus cash gifts from industry totaled $45K in 2014.

The ability to efficiently evaluate traits is rapidly improving. We are on the brink of a leap forward in breeding through molecular markers and genetic technology. Potato is an increasingly important world food. Climate is changing, and health issues and their economic impact are increasing in our aging population. Because of these factors, there has never been a more important (or exciting) time to be involved in


Modeling expected changes in suitable habitats for potato

improving potato through mining the rich deposits of traits in the US Potato Genebank.

WORK PLANS / STAFF & FUNDING / ADMINISTRATION

In FY15, we plan to 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.

We plan to restore the ½ position of A. del Rio that was cut due to funding shortfalls in recent years, thus rebuilding our program in the area of genetic diversity management research (making use of the new, more powerful DNA markers now available), collecting research (predicting sites likely threatened by climate change), and benefit sharing collaborations with Andean germplasm donor countries (in particular, the successful frost resistance breeding effort in Puno.

We expect to 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 (this has resulted in students participating in germplasm collecting, formal presentations at PAA, and authorship on peer reviewed publications). Rapport with potato science and scientists will be maintained by service as editor of American Journal of Potato Research, and participation in the Potato Association of America.

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

We intend to seek opportunities to evaluate and deploy germplasm in ways that impact the consumer, notably with respect to nutritional traits, thus enhancing the reputation, demand, and positive health and economic impact of the potato crop on society.

We expect to continue and expand approaches to evaluation and technology that multiply information gathering:

1. Multiple data collection schemes for a single grow-out, multiplex testing.
2. Synergistic cooperation with specialists in various disciplines, and Latin American projects for benefit sharing and developing systems for testing germplasm that mitigates impact of climate change.
3. Testing for links between easily assessed traits and more difficult traits.
4. Making use of our *in vitro* facilities and expertise to investigate microbial bioassays and selecting agents.
5. Characterizing visual (cog), genetic, geographic, and trait differences within species as predictors of germplasm application
6. DNA-based tests for assessing genetic diversity with respect to collecting and preservation techniques, and climate change.

PUBLICATIONS

Many other scientists are publishing research that directly or indirectly originated from NRSP6 stocks. Publications that mention potato species (both old and new taxonomy) are likely to have such a connection to USPG germplasm and service. 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 2014 and previous) which give details on the initiatives summarized above can be 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 2014 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.

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

This hits records in Agricola or CAB abstracts: 208 in CY2012, and 158 in CY2013

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 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:2013

ANNUAL REPORT to TAC
updated to June 2015

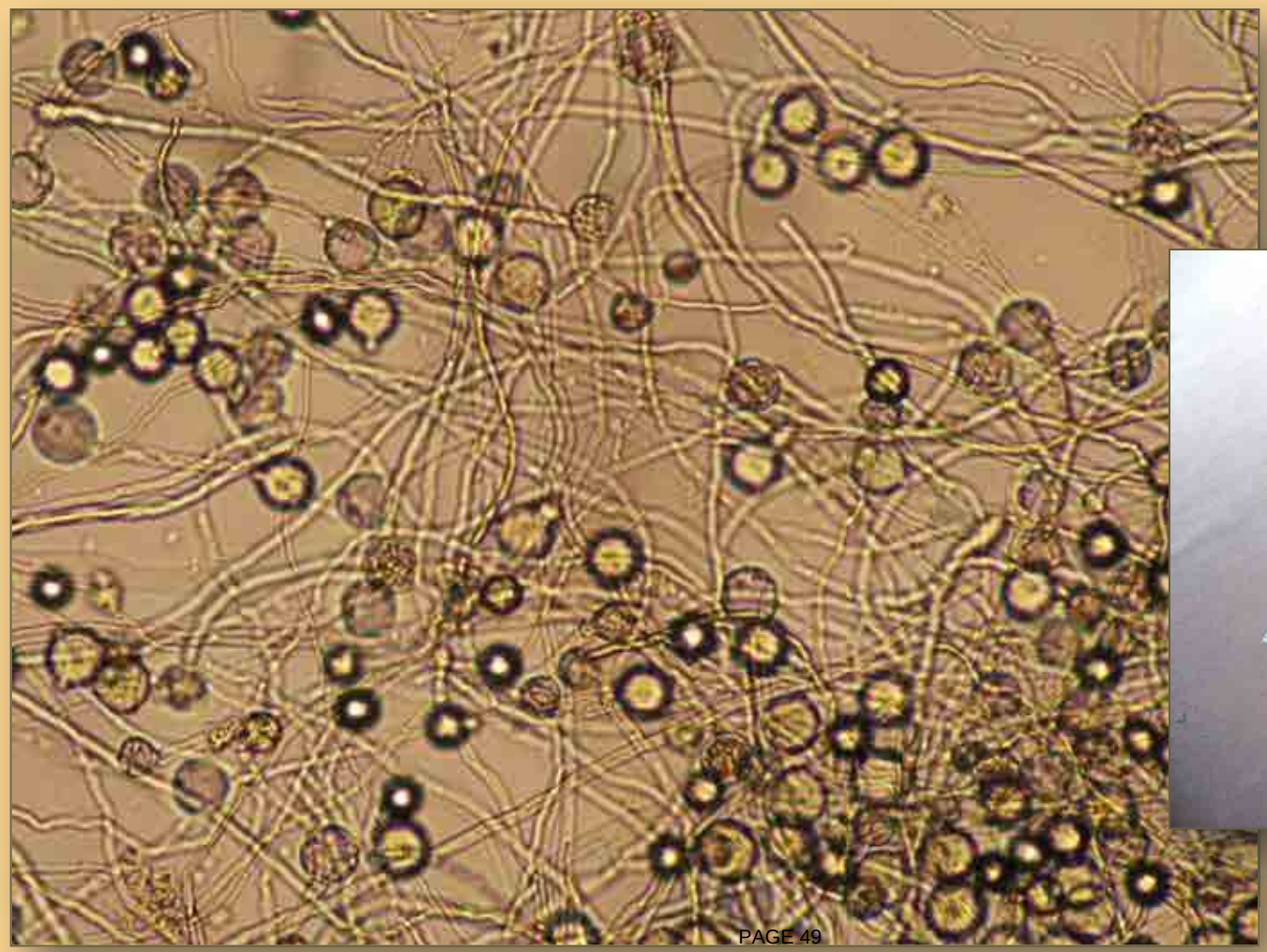
Exceptionally good seed increases even with very difficult species

S. cajamarquense

SNP and GBS genotyping of all clonals

Found *commersonii* and *cardiophyllum* with very large tubers

Improved pollen viability assay



Established embryo rescue tech for difficult crosses

Expanded Peru cooperation

--Comparing genetics of wild species at spot collected 40 years ago ☞

--Donating hybrids that National Program at Puno incorporated into their cold resistance breeding program with release expected next year

--Coordinating seed increase exchanges with CIP

--Alfonso and Jiwan play leading roles

Progress in comparison and development of diploid *tuberosum* nobilizing males

Yoshi-6 (654351) is a highly male fertile and homozygous selfable diploid *tuberosum*

Progress in search for an adapted *Criolla* type

Egg Yolk – style potatoes
With cooperators Dan & Irene Douglass, Kathy Haynes, Curzio, Linc Zotarelli, Tinita Lozano

Harlequin Moon

ZEBRA CHIP resistance

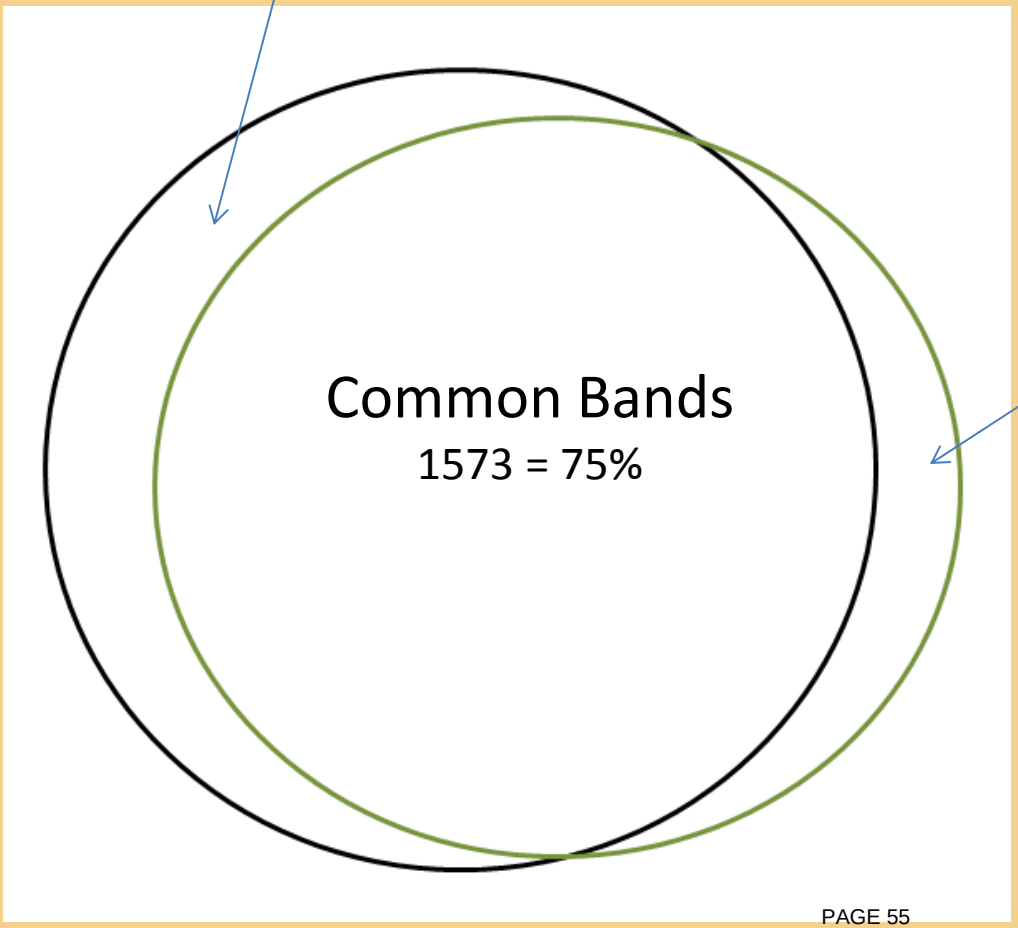
With cooperator Rod Cooper

S. bulbocastanum has separate forms of insect resistance as anti-feeding and anti-development. We made crosses to stack them.

jamesii MegaPopulation analysis

128 (all other) *jamesii*

347 unique bands = 16½%



78 Mesa Verde *jamesii*

180 unique bands = 8½%

Initiated selection of core collections
from *phureja, verrucosum, demissum*

Conducted systematic tests of various influences on germination

Diurnal cold/warm fluctuation

Position on greenhouse bench

Concentration and timing of GA_3 pretreatment

First hybrid with *jamesii*

verrucosum female with mentor pollination

Seeds of Time film now out

(*featuring Alfonso, Chico & John*)

--Getting a lot of recognition from germplasm system and others

--Opportunity for attracting donors?

Cooperating with industry to expand use of NRSP-6 germplasm

Frito – tuber calcium
Kemin – safe anti-appetite compounds
CETS – evaluating cultivar collection
Curzio – taste and cooking quality
Simplot – Innate and various traits