Contents: Page

Minutes

NRSP6 Technical Advisory Committee meeting 2013

June 25-26, Sturgeon Bay, WI

Tuesday, June 25th

Members present in person: Douches, Bamberg, Yencho, Abad, Bizimungu, Lindroth
Members by phone: Brown, Bretting, Caroline Gray (for Holm), Wisler, Nessler, Thro
Industry and other guests present in person: Janina & Scott Petrick, & Ray Gieringer (CETS), Curzio Caravati & Angela Cassity (Kenosha SSE Potato Project), Hoopes (formerly Frito-Lay), Palta (UW), Krucker (Simplot), Genebank staff.

Acting chair Douches opened the meeting at 9 AM and those present introduced themselves. Resolutions committee was appointed as Douches & Yencho. Old minutes were approved. New SR rep Yencho (replacing C. Miller) was welcomed to the TAC. Industry cooperator reports were moved up on the agenda:

Petrick presented CETS activities by PowerPoint. This Wisconsin company aims to fill the need for rapid, reliable ramp-up of clonal propagules for the crop through computer controlled growth chambers (15,000 minitubers in 56 square feet growth chamber). The genebank has helped CETS by having particular clones that they want to demo to international clients. Bamberg remarked appreciation for their financial support.

Hoopes is retired from Frito-Lay but continues breeding unique and specialty lines as a private endeavor.

Curzio Caravati is involved in outreach to the non-professional gardener and farm markets and a Seed Saver Exchange member. Interested in hobby growing technology. Wants to help genebank by generating taste data, and promoting appreciation for potato diversity to general public through website and Angela's writings, e.g., www.kenoshapotato.com/daytrip.

Krucker presents powerpoint of Simplot activities. Innate is their patented technology aimed at using a GM approach that is consumer-accepted (no foreign DNA). Transformed varieties are familiar and ostensibly identical except for the improved trait. Bamberg remarked that the financial support by Industry including Simplot, Kemin, CETS, Frito-Lay are essential to the continued success of getting NRSP6 budgets passed by SAES directors.

Thro gave the NIFA report. Projects are successful if they can communicate a story with an idea, technology, and impactful implementation for the public good, like examples in the NRSP6 2012 Annual Report p. 6.

Bretting gave the NPL report. One of our own former NPGS curators (Ellis) is now head of the genebank at CIP. Budget for FY13 reduced by 7.8%, but Congress may bring it back and add some for FY14. Bamberg noted FY13 losses to genebank resources: $13K federal CRIS, $11.5K NRSP6's MRF. Bretting noted push to update Crop Germplasm Vulnerability statement (many TAC members are also potato CGC members). Bamberg (CGC chair) noted we have a plan and schedule to do so.

Caroline Grace WR report (for Holm), going over germplasm recipient comments: Germplasm received is high quality and in good condition. Many traits being mined from it-- "an invaluable resource".

Lindroth reports for administrative advisors, noting a new potato breeder has been hired at Wisconsin. Midterm NRSP6 project review was very favorable and is on genebank website.

A catered lunch was enjoyed on site with ad lib tour of the the PARS "Garden Door" show garden.

Bamberg reviewed CY12 Annual Report which has been posted on genebank website since January: http://www.ars-grin.gov/nr6/admin.html. Was asked to check on the availability of clip from film (Hungry Film) made about USA collecting in Arizona last fall. Outlook for resumed collecting in Latin America was discussed. Outlook for use of colored-flesh genebank stocks for health and other metabolic processes was remarked by Brown.

Brown referred to his report giving germplasm recipient responses. His own research with exotics includes using trap crops for nematodes, Cooper conducts germplasm research on phsyillids, Haynes on nitrogen use efficiency, Novy on non-greening and Jansky on scab, reducing sugars, calcium, verticillium and starch.

Yencho reports on stocks requested by SR for a variety of purposes. They are interested in health components in specialty potatoes as well. The SR uses more NRSP6 germplasm than suggested by their volume of orders, since SR breeding is done primarily using germplasm-improved breeding stocks developed in other regions.

Douches presents NCR report, inviting Palta to cover Wisconsin, who sketches the objectives of the state's breeding program, and puts particular emphasis on abiotic stress, use of calcium, and frost hardiness research. Douches reviews germplasm recipient comments from the NCR, and presents MSU research on studies of diversity partitioning in a spectrum of NRSP6 species using the SolCAP 8303 SNP array. Bamberg is collaborating with Douches to publish the SNP analysis of the genebank core collection.

Abad presents the situation at APHIS as it impacts the genebank. His lab functions to protect the genebank from import of exotic diseases. Prioritization of imports may need to be done in the future. The idea of continuing first-come-first-served, but after setting a ratio of public and private imports was suggested. Pay for service is not a viable option.

Bizimungu reports for Canada. Funding is declining, but still have a strong program of germplasm use, mostly by the federal breeding program. Nutritional traits are of particular interest. Techniques such as in vitro screening, protoplast fusion, somaclonal selection , and metabolic profiling are being used.

The group enjoyed a dinner at Stone Harbor Resort.

Tuesday, June 25th

The group met at 8:30 for final business.

Resolutions were presented by Yencho:

> Whereas the NRSP6 project has met in Sturgeon Bay, Wisconsin at the NRSP6 project site located at the Univ of Wisconsin Peninsular Agricultural Research Station during June 25-26, 2013.
>
> And, whereas we have had another productive, informative and enjoyable meeting.
>
> And, whereas we wish to acknowledge the following individuals and groups:
>
> Dr. Lindroth for his service as the NRSP6 administrative advisor;
>
> Dr. Jiwan Palta for his longstanding service to the Potato industry and the NRSP6 project;
>
> Dr. Robert Hoopes for his longstanding service to the Potato industry and the NRSP6 project;
>
> The CETS and J. R. Simplot company, and the Kenosha Potato Project for their interest and participation with the NRSP6 project;
>
> And last, but certainly not least, the Sturgeon Bay potato germplasm team and PARS farm staff including Max, Jesse, Sheila, Tim, Adele, John and Matt for being such fine hosts.
>
> Therefore be it resolved that we have officially concluded this meeting at noon on June 26th, 2013 and we wish everyone safe travels home.
>
> Respectfully submitted, Resolutions Committee
> Dr. Dave Douches, Michigan State University Dr. Craig Yencho, NC State University

New TAC officers for 2014:

DeJong =Secretary
Holm = Chair
Brown = Vice Chair

Next meeting venue

Hosted by Brown at Spokane and/or Prosser, WA: Tentatively, July 25-26, the Friday and Saturday before the Potato Association of America annual meeting 2014 at Spokane.

Conclusion of business was followed by a tour of genebank facilities and demonstrations by genebank staff, then a wagon tour of the PARS farm fields and orchards by Superintendent Matt Stasiak. Those remaining departed after a catered pizza lunch in the conference room.

NRSP-6 Meeting Schedule

Sturgeon Bay, WI
June 25-26, 2013

MONDAY, JUNE 24th

Suggested arrival and lodging at Stone Harbor

TUESDAY, JUNE 25th

9:00: Business meeting (genebank conference room, 4312 Hwy 42)
Fruit, Cinnamon Rolls and Coffee will be available at the conference room at 8:30 am

12:00-1:00: LUNCH
We will cater in lunch and eat in the Garden Door, weather permitting.

Supper will be at Stone Harbor at 6:30.

WEDNESDAY, JUNE 26th

8:00: Wrap up unfinished business and site tour
Fruit, Coffee Cake and Coffee will be available at the conference room at 7:30am

Noon: Departures and/or lunch on premises
For those staying late we will order Pizza for lunch.

There will be a $15.00 charge to cover the lunch and coffee breaks

If you have any questions or want local area information contact Max
mwmarti1@wisc.edu
Work 920-743-5406
Cell 920-495-8457

PHONE IN INSTRUCTIONS:
The toll-free dial in number will be **1-888-858-2144** with an access code for the participants of **5513528**

NRSP6 TAC 2013 BUSINESS MEETING TOPICS

Tuesday, June 25, 2013

Preliminaries

1. Welcome, introductions, misc. announcements, distribution of documents
2. Approve, add to, schedule and prioritize agenda items [1]
3. Review of 2012 minutes
4. Vice-chair Douches (sub for *Holm*) appoints Resolutions Committee and Secretary

Reports and Action (*) items

5. Lead AA (Lindroth)
6. Other regional AAs (*Nessler, Ashworth, Curtis*)
7. Regional and USDA Tech Reps (*Holm*, Douches, *DeJong*, Yencho, *Brown*)
8. Agriculture and Agrifood Canada (Bizimungu)
9. Wisconsin potato research and breeding (Palta)
10. Industry and other cooperator perspectives/reports (Krucker, Ronis, Curzio, Petrick)
11. NRSP6 Project Leader report (Bamberg)
12 USDA-Madison collecting, taxonomy, and enhancement (*Spooner*, *Jansky*)
13. USDA Madison, MWA, NPL admin (*Simon*, *Matteri*, *Bretting*, *Wisler*)
14. NIFA (*Thro*)
15. APHIS/Quarantine (Abad)
16. *Review and approve resolutions
17 *Elect new officers and set next meeting venue

---

[1] Participants noted in italic will not be here in person. We propose that topics in bold be scheduled together and started at 10:30 am.

Executive 3-year summary for NRSP6 Midterm Review, CY2010-2012

A. Acquisition. A total of 74 new germplasm stocks were collected in the wild and 33 more imported from cooperators.

B. Preservation schedule was maintained and **Evaluation** was successful for many useful traits: Seed populations multiplied = 660, germination tests = 4014, virus tests = 2110. Over 3000 field plots were grown for evaluation and taxonomy. We worked with numerous cooperators, providing germplasm handling technology, custom samples and hybrids resulting in identification of elite new materials for antioxidants, anti-appetite proteins, orange flesh, folate, thiamine, starch balance, low acrylamide, anti-cancer, resistance to greening, frost tolerance and calcium use efficiency. We discovered a new floral mutant. We demonstrated that hotspots of genetic diversity can be identified in the wild for collecting, and that an AFLP-based core collection of model species will capture all of the known useful traits. We showed that pesticide overspray of wild populations near farmers' fields in Peru may reduce fecundity, but probably not gentic diversity of the wild populations.

C. Classification reduced the number of species to about 100, for a more stable and predictive taxonomy.

D. Distribution totals were strong showing continued interest and value in our germplasm:

Category	Seed	TU	TC	IV	DNA	Plants	Herb	Total	Populations
Domestic	6,709	13	7,681	4,435	123	586	11	19,558	13,236
Foreign	2,537	0	0	1,578	3	0	0	4,118	2,460
Total	9,246	13	7,681	6,013	126	586	11	23,676	15,696

[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. A robust website including access to all NRSP6 stock data, ordering information, technology tips, mapping features, publications, and complete reference to administrative reports was maintained. We hosted numerous visiting scientists, were featured in two documentary films and a syndicated article by the Milwaukee Journal Sentinel, gave invited keynote lectures at the US Botanic Gardens (DC), and Latin American Potato Association (Cuzco); served as Editor in Chief for American Journal of Potato Research and chairman of the Potato Crop Germplasm Committee. We returned benefits to Peru by cooperatively selecting and testing productive frost hardy and calcium responsive lines in the highlands. We trained two summer interns attending UW-Madison and Princeton.

F. Impact. Ten cultivar releases were published, each having at least one of nine different exotic potato species in their pedigrees. No other crop matches potato in use of exotics in practical breeding. Staff published 55 scholarly research papers, and nearly 400 more were cited by others using NRSP6 species.

Work Plans / Staff & Funding / administration / Integration

Acquire wild germplasm in southwest USA and valuable germplasm from other genebanks and/or scientists
Preserve/multiply 200 populations per year, with associated maintenance of purity, germination, and health
Classify in a way that maximizes the groupings of germplasm by genetic value
Distribute germplasm and info rapidly to clients in a way that maximizes their research and breeding success
Evaluate traits already under study and engage new traits, especially nutritional ones (like anti-diabetes)
Publish results of evaluation and technical research (see above)
Lead Crop Germplasm Committee and American Journal of Potato Research
Maintain integration with UW-Madison as full professor in Dept of Horticulture
Maintain >$45K level of 2012 industry support and $150K maintenance level of Multistate Research Funds

ANNUAL REPORT
Calendar Year 2012

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 (2013)	D. Holm
North Central Region	Vice Chair (2013)	D. Douches
Northeastern Region		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	Secretary (2013)	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

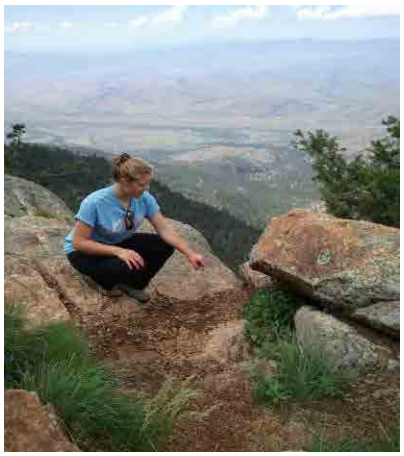
Agriculture & Agrifood Canada — B. Bizimungu

PROGRESS AND PRINCIPAL ACCOMPLISHMENTS

A. Acquisitions and associated work

In 2012, the collecting and research activities in the southwest USA passed the 20-year milestone, and represented our most ambitious trip thus far. We accomplished each of six objectives: 1) Venue scouting for Hungry Film Inc., 2) Re-discover *fendleri* at Demlong 119 at Riggs Lake (Pinaleno Mts.) diversity hotspot, 3) *Matryoshka* fruit mutant re-collections 4) Fruit gall collecting 5) Patagonia and Canelo Mountains exploration (20 new germplasm accessions), 6) 20th anniversary reunion collecting and Hungry Film Inc. documentary shooting. USDA/ARS/Plant Exploration Office supplied $5K. A detailed trip report is available on request.

Hungry Film at Rincons trailhead by Tanque Verde Ranch (L-R: del Rio, Gallup, Johnson, McLeod, Bamberg)



We imported 11 elite breeding stocks from other countries. We conducted an expedition to Arizona to collect 20 wild populations (B4dRFS).

Jana Suriano makes Demlong 119 re-discovery

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 2012, informing them of new stocks of true seed, tubers, in vitro plantlets, or herbarium samples. We used email and the website to extend technical instruction like transplanting techniques and use of nylon slipper socks for preparing samples.

B. Preservation and Evaluation

A total of 203 accessions were increased as botanical seed populations and 1818 clonally. About 1010 potato virus tests were performed on seed increase parents, seedlots and research materials. Germination tests were performed on 1131 accessions, ploidy determinations were made on 28 accessions, and tetrazolium seed viability tests were done on 26 seedlots.

Another excellent seed increase year

With help of cooperators, we made progress evaluating and improving germplasm on several ongoing projects. Over 2200 field plots at USPG, about 500 field plots in two sites in CA, and 4 large screenhouses at USPG full of stocks supporting screening for golden tuber flesh, antioxidants, folate, thiamine, tomatine, anti-obesity, forms in series LON, starch balance, % dry matter, anti-diabetes, allergenicity, tuber greening, K-reduction, *Matryoshka* fruit mutant, GA dwarfism, sessile tubers, taste, and floral volatiles.

New *Matryoshka* floral mutant

Orange flesh *papa criolla* type

This year, the project to select orange-fleshed stocks from hybrids of *S. phureja* based on taste, appearance and cooking quality evaluated by a native Colombian (FL) familiar with the ideal for traditional *papa criolla* resulted in the first selections declared good enough for market by cooperator. With A. Goyer (OR), we screened all *microdontum* populations for folate, produced materials for fine screening and MAS breeding. Lack of folate is associated with a broad range of serious physical *and mental* diseases.

The cooperative project with Kemin (IA) continued to make gains in 2012. Exotics were identified and hybridized that have over 6-fold the concentration of an anti-appetite compound of common cultivars. We selected some with very high levels and good tuber type. This addresses the US obesity epidemic, which is responsible for more than 1/5 of all healthcare-related costs.

We expanded work on the *Microdontum* Multifaceted Project (MMP) by identifying 1741 informative AFLP loci for help in selecting a core collection. AFLP loci were treated as though they were traits, with the banded condition considered to be the desired state. At least one band unique to a population was present in 45 populations, and these 45 populations together captured 98% of all bands. Adding another 14 populations for a total of 59 captured all bands. This core set was assessed for whether it encompassed those

Anti-obesity breeding selections

populations known to have useful traits, including nutritional and quality components, as well as disease, stress and pest resistances. As with AFLP bands, all 25 of the most desirable phenotypic traits were also found in populations in the core set of 59 populations. These AFLP markers may also reveal the influence of eco-geo parameters, and introgression from other species. In hybrids of this same species, we confirmed extreme tuber greening resistance after illumination exhibits high heritability.

Solanum microdontum

Short day winter growouts in three places in California continue to be used to extend our evaluation capacity.

This year, work with cooperators J. Palta (UW), International Potato Center, and the Peruvian national potato program resulted in selections from our cold hardiness breeding project with *S. commersonii* that were declared by local Puno farmers to be hardy and productive enough to be cultivars.

Tuber greening results in significant economic loss

Success of NRSP6 frost hardy hybrids in Peruvian highlands

It is hard to overestimate the importance of diabetes when one considers the recent rapid increase in diagnoses worldwide, the chronic nature of the disease, and how it exacerbates other major diseases of the kidneys, cardiovascular and nervous systems, and attendant amputations, and blindness. The ADA estimates diabetes at about 26m persons in the USA, and another 80m with prediabetes, for total annual healthcare costs at $174B. This year it was reported that potato cultivars contain significant levels of biguanides, the antigluconogenic compounds in Metformin. We have already produced and sent tubers of 25 representative wild species' tubers to cooperators at CSU in hopes of finding germplasm with high biguanide levels.

Coming soon… a potato that reduces occurrence and impact of diabetes?

C. Classification

David Spooner's work related to NRSP6 this year included: 1) the use of plastid microsatellites to investigate cultivated potato diversity and origins, 2) a summary of the use of next-generation sequencing techniques for plants, 3) a genomics in-situ hybridization (GISH) analysis of polyploidy in North and Central American hexaploid potato species, 4) an analysis of resistance to potato wart disease (*Synchytrium endobioticum*) in cultivated potatoes, 5) a treatment of potato in an upcoming encyclopedia of genetics.

Taxonomic implication in potato wart disease

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. **Total orders increased about 20% in 2012.** NRSP-6 distributed **190** domestic orders to clients in 23 states of the USA and **22** foreign orders to **12** other countries. About ½ of domestic orders are for breeding and genetics, about ¼ for home gardeners, and the remaining ¼ for pathology, physiology, entomology, taxonomy, and education. In 2012 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).

	Units of Germplasm Sent[1]								
Category	Seed	TU	TC	IV	DNA	Plants	Herb	Total	PIs
Domestic	2,069	3	3,210	1,692	6	73	0	7,053	4,981
Foreign	1,088	0	0	318	0	0	0	1,406	1,194
Total	3,157	3	3,210	2,010	6	73	0	8,459	6,175

[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

Milwaukee Journal Sentinel syndicated article on genebank
Wisconsin Public Television filming for *Wisconsin Gardener* show
Hungry Film Inc. of NY films our potato collecting for three days in Arizona
UW CALS dean K. VandenBosch visit
Southern Door HS student mock interview as English class exercise
Summer student interns participated in experiments: Kyle LaPlante (UW Madison): antioxidant and folate enhancement, grafting. Jana Suriano (Princeton): K-reduction, *Matryoshka* mutant genetics, tuber greening, germination enhancement with activated charcoal.
J.R. Simplot Co. geneticist Michele Krucker visits, proposes high protein screening.
Cornell postdocs S. Campbell and R. Halitschke visit to collect volatiles from jasmonate-treated flowers
Kemin Industry geneticist Brindha Narasimhamoorthy and Matt Parks visit and help field harvest
Curzio Caravati of *SeedSavers* Kenosha visits and engages taste evaluation cooperation
Methodist Men's Group of Sturgeon Bay given ppt presentation on genebank
Southern Door HS Spanish class given ppt presentation on genebank *in Spanish*

NCR potato genetics group meeting in Chicago presentation
Potato Association of America meeting in Denver-- four research presentations/abstracts
Santa Rita mountains (AZ) re-collection of *Matryoshka* floral mutant with student Jana Suriano
Chinese scientists (8) visit with host J. Palta
Bamberg served as PhD committee member for Cinthya Zorrilla-C
Tour and presentation to Lost Lake Garden Association

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, OSQR, CRIS, Annual Performance, Budget. NRSP6: Annual Report, Budget proposal, TAC meeting minutes. PAA: AJPR Editor in Chief report, support letter for Honorary Life Member and introduction at Awards Banquet. UW-Hort: 10-year review and 5-year faculty review, Annual Performance. PARS: Tour guide & field book.

Management of Grants & Awards: Potato CGC grants, AJPR Outstanding Paper, retiring AJPR senior editors and NRSP6 technical reps

Scholarly Publications: See below.

IMPACT STATEMENT

In 2012, seed increases were very successful (over 200) and orders for germplasm increased over 20%. We uploaded much evaluation data on percent dry matter and unique AFLP alleles to the public internet database.

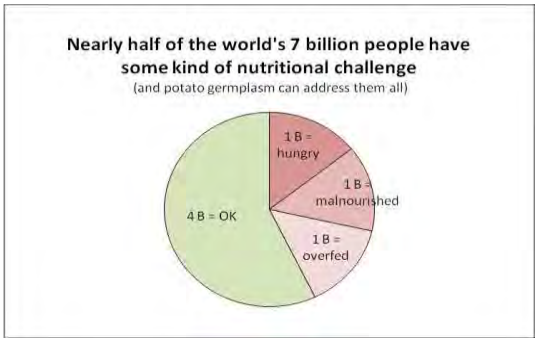
The payoff in funding the genebank is in discovering and deploying traits that are useful to the public and the industry. We participated in successful selection of better stocks for golden flesh, desired yellow fry color, very high levels of total antioxidants, frost resistance in Peruvian highlands, anti-diabetes compounds, folate, potassium, resistance to tuber greening, and a natural appetite suppressing protein,.

We continued work on improving germplasm management. We again collected germplasm in-country, finding populations at sites never before reported or collected.

We developed tech transfer like use of cheap nylon slipper socks for sample drying bags.

Cheap nylon slipper socks make great tuber sample drying containers

Salary and travel support plus cash gifts from industry totaled $48K in 2012.



Of the **7** billion people on earth, one billion lack enough calories, one billion have enough calories, but are hurting for lack of essential nutrients, and another billion are overfed (The Economist, Feb18, 2012). NRSP6 works with collaborators to impact each of these one-billion-man problems.

Stroke, cancer and obesity costs in the US are at least 100 times that of the total annual farmgate value of the potato crop, so we conclude that the prospect of making a significant impact through nutrition compares favorably with using germplasm to increase yield or reduce production costs.

However, a more nutritious potato may also be the best help for producers, if a better potato would increase demand and its competitiveness with other food alternatives.

The genebank's role is two-fold—providing the germplasm and also providing the ideas and technology for how it can be best deployed.

The genebank assists germplasm users by providing custom samples and technology.

We have generated adapted selections for… extremely high antioxidants, anti-appetite protein, orange flesh, frost resistance. Raw germplasm has been identified with extremely high folate, total protein, calcium use efficiency We are planning or started on anti-diabetes biguanides, potassium, salicylic acid, anti-cancer tomatine, low allergenicity.

Releases of potato varieties and germplasm in 2012 and NRSP-6 exotic species in their pedigrees

No other crop can compare to potato in utilization of exotic germplasm:

M7 Germplasm Release: Expanding the germplasm base for French Fry processing, *S. infundibuliforme*
AmaRosa: A red skinned, red fleshed fingerling with high phytonutrient value, *S. demissum*
Purple Pelisse: A fingerling potato with purple skin and flesh, *S. vernei*
Owyhee Russet: A high yielding variety with excellent processing quality and resistance to dry rot, *S. chacoense*
Palisade Russet: A late blight resistant variety with low incidence of sugar end and high specific gravity, *S. andigena*
Saikai 35: Germplasm release carrying resistance to Potato Cyst Nematode and Potato Virus Y, *S. phureja*

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

WORK PLANS / STAFF & FUNDING / ADMINISTRATION

Reduction in USDA/ARS funding in FY12 that resulted in losing ½ of a position (del Rio) will require limiting our activities to the highest priority genetic diversity management studies. We expect to continue to pinch labor pennies with inexpensive summer student interns and volunteers. Travel spending is expected to again be very conservative and significantly paid by outside sponsors. As reported last year, the upcoming year will require increased efforts to deploy equipment, facilities, and skills in the most efficient way. One strategy that has proved effective will be continued: Finding multiple uses, or gathering multiple types of data from each grow-out. We expect to spend the considerable time and effort needed to pursue the continuation of required industry contributions we received in 2012.

PUBLICATIONS

NRSP6 and associated USDA/ARS project staff publications

Bamberg, JB and JC Miller, Jr. Comparisons of ga1 with other reputed gibberellin mutants in potato. American Journal of Potato Research 89:142-149.

Cai, D, F Rodriguez, Y Teng, C Ane, M Bonierbale, LA Mueller, and DM Spooner. Single copy nuclear gene analysis of polyploidy in wild potatoes (*Solanum* section Petota). Bmc Evolutionary Biology 12:

del Rio, Alfonso H., JB Bamberg, Ruth Centeno Diaz, J. Soto, A. Salas, W. Roca and D. Tay. Pesticide contamination has little effect on the genetic diversity of potato species. American Journal of Potato Research 89:348-391.

del Rio, Alfonso H., JB Bamberg, Ruth Centeno-Diaz, A. Salas, W. Roca and D. Tay. Effects of the pesticide Furadan on traits associated with reproduction of wild potato species. American Journal of Plant Sciences 3:1608-1612.

Egan, A.N.,Schlueter, J.,Spooner, D.M. Applications of next-generation sequencing in plant biology. American Journal of Botany 99:175-185.

Goyer, A., C Brown, R Knowles, L Knowles and JB Bamberg. Attacking the acrylamide dilemma by developing low sugar high carotenoid processing potatoes. Potato Progress (Washington State Potato Commission): 12(1):2-3.

Haga, E.,Weber, B.,Jansky, S. Examination of potential measures of vine maturity in potato. American Journal of Plant Sciences 3:495-505.

Jansky, S.,Hamernik, A.,Cai, X. Rapid cycling with true potato seed. Seed Science and Technology 40:43-50.

Khiutti, A.,Afanasenko, O.,Antonova, O.,Shuvalov, O.,Novikova, L.,Krylova, E.,Chalaya, N.,Mironenko, N.,Spooner, D.M.,Gavrilenko, T. Characterization of resistance to *Synchytrium endobioticum* in cultivated potato accessions from the collection of Vavilov Institute of Plant Industry. Plant Breeding 131:744-750.

Kittipadukal, P.,Bethke, P.C.,Jansky, S.H. The effect of photoperiod on tuberisation in cultivated and wild potato species hybrids. Potato Research 55:27-40.

Pendinen, G.,Spooner, D.M.,Jiang, J.,Gavrilenko, T. Genomic in situ hybridization reveals both auto-and allopolyploid origins of different North and Central American hexaploid potato (*Solanum* sect. Petota) species. Genome 55:407-415.

Spooner, D., Jansky, S., Clausen, A., del Rosario Herrera, M. ,Ghislain, M. The Enigma of *Solanum maglia*. In: the Origin of the Chilean Cultivated Potato, *Solanum tuberosum* Chilotanum Group(1). Economic Botany 66:12-21.

Weber, B.N., Hamernik, A.J., Jansky, S.H. Hybridization barriers between diploid *Solanum tuberosum* and wild *Solanum raphanifolium*. Genetic Resources and Crop Evolution 59:1287-1293.

Weber, B.N., Jansky, S.H. Resistance to *Alternaria solani* in hybrids between a *Solanum tuberosum* haploid and *S. raphanifolium*. Phytopathology 102:214-221.

Publications by others using NRSP6 stocks

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 140 hits which the reader can regenerate independently, or which can be accessed through our website: http://www.ars-grin.gov/nr6.

The search net 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 2012 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 140 records in Agricola or CAB abstracts for 2012 -- 123 for 2010 and 129 for 2011

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:2012

2013 NRSP-6 Germplasm Utilization Report from the North Central Region

Compiled and Submitted by
David S. Douches, NC representative
June 21, 2013

University of Wisconsin
Felix Navarro and Jiwan Palta

Our ongoing strategies include the use of lines derived from the crosses made with several wild species obtained from the NRSP-6 genebank including *S. andigena, S. brevidens, S. bulbocastanum, S. chacoense, S. curtilobum, S. demissum, S. gourlayi, S. leptophyes, S. phureja, S. raphanifolium, S. stenotomum, S. sucrense and S. tarijense*. The traits that this germplasm contribute to our breeding effort include fungal, bacterial, virus and nematode resistance as well as chipping and French fry quality. We have on hand over 250 lines derived from these species that are used in our program. For example the newly released (White Pearl) and advanced chipping breeding lines W2324-1, Nicolet (W2133-1), Tundra (W2310-3), Lelah (W2717-5), W2978-3, and W5015-12 in our program were developed by using *S. tarijense* as the maternal grandparent providing chipping ability (*S. chacoense* also contributed on the paternal side of the pedigree). Our selections for late blight resistance include several wild or native species in their background such as *S. bulbocastanum, S. demissum, S. acaule, S. phureja, S. simplicifolium and S. stoloniferum*. We have a PVY selection project in collaboration with Amy Charkowski and Shelly Jansky in which we are screening resistance from existing varieties and germplasm from sources such as *S. andigena, S. stoloniferum, S. demissum, S. chacoense, S. jamessi* and *S. pinnatisectum*. Several clones with *stoloniferum* and *andigena* sources of PVY resistance and corresponding molecular markers for PVY resistance are being used in a marker assisted selection project to facilitate introgression of PVY resistance to susceptible potato clones. Other breeding clones obtained from the the NRSP-6 genebank are actively used to generate specialty potato varieties due to the richness of these accessions to provide novel color and shape and other valuable attributes for this segment of the market. We have developed breeding lines that are in early and late stage of selections. One of these lines is a purple fingerling (W10251P/PW fing) that has been identified to be released as a potential specialty potato variety in the near future.

In addition we are conducting following projects in co-operation with NRSP-6:

The frost resistant breeding clones have been developed in cooperation with NRSP6 staff using S. *tuberosum*, S. *andigena*, S *commersonii*, and S. *acaule*. Elite clonal selections from this population have been evaluated at Hancock, Wisconsin and had good tuber type and cold hardiness to -5^{o}C. New lines are being developed using these good tuber type and *S. andigena* to select for better performance under Peruvian Highlands.

In 2012 we conducted research to study polymorphism for a candidate genes associated to frost tolerance such as the steroyl-acyl carrier protein (ACP) desaturase (SAD) desaturase gene which catalyzes the desaturation of steroyl-ACP and provides changes in membrane lipid composition associated with variability for cold tolerance. For this pupose we are using several wild species including *S. sanctate-rosae, S. commersonii, S. demissum, S. megistracrobolum, S. cardiophyllum, S. polyadenium, S. bukasovii, S. acaule, S. chacoense and S. piurae*. In addition, F2 and BC_1 populations,generated from a cross made between the frost tolerant *S. commersomii* x *S. cardiophylum* (frost sensitive) accessions obtained from the NRSP-6, is being used to identify and validate molecular markers associated with frost tolerance using the SAD gene.

We have developed progenies segregating for tuber calcium and soft rot resistance, using *S. microdontum* and *S. kurtzianum* species as parents. In cooperation with NRSP-6, we are evaluating these progenies to understand the genetics of tuber calcium uptake. In addition the entire collection of *S. microdontum* is being evaluated for tuber calcium and soft rot resistance.

We are also using a population derived from backcrosses of Atlantic to *Solanum microdontum* to study genetics of tuber calcium uptake and tolerance to heat stress. Large phenotypic variability has been found in greenhouse study for response to heat stress as high as 35 ^{o}C.

We are continuing the cooperation with CIP to conduct calcium application trials in the highlands. We are getting impressive yield improvement with in-seasons calcium applications. These studies suggest our parallel ongoing program with NRSP-6 staff to enhance calcium uptake efficiency from *S. microdontum* introgression might also have application in some locations in the Andes.

We are also continuing our collaborative research on potato tuber as a source of potassium. Potato potassium is in a unique position to mitigate hypertension, which has huge health and economic impact. Potassium levels in the tubers are also correlated to the incidence of black spot bruise. We screened the 25 species of the mini-core collection and found significant species differences in K uptake potential. We are now testing 200 cultivars and breeding stocks for K.

In addition tuber acidity is being characterized in 25 species that form the mini-core collection at NRSP-6. This parameter is being evaluated in relationship to skin color and calcium uptake efficiency.

Christian Thill
University of Minnesota

Evaluation and characterization of cultivated and wild potato species germplasm for genes of economic interest and incorporation of these genes into the cultivated Solanum

gene pool reflect the primary uses of Inter-Regional Potato Introduction Project (NRSP6) germplasm.

We evaluated 400 lines for LB resistance, 475 lines for CS resistance, and 470 lines for PVY resistance and virus expression. For the first time in 15 years LB disease spread was not observed in our LB nursery due to hot, dry summer growing conditions. However, nine MN breeding lines with LB resistance (previous studies) were selected for tuber traits and will be used in breeding. LB resistance in these lines is derived from Tollocan, Zarevo, and Atzimba, and from crossing Solanum species S. bulbocastanum, S. cardiophyllum, and S. pinnatisectum with tetraploid breeding lines.

Twenty-two MN russet lines had CS resistance equal or better than 30 nationally breed lines tested in the national CS trial.

Solanum bulbocastanum Dun. is resistant to late blight, , green peach aphid, and potato aphid. S*olanum tuberosum* + *S. bulbocastanum* somatic fusions were created for introgression of these resistance genes into the cultivated gene pool. Among the 63 lines screened, nine expressed resistance to green peach aphid and five lines expressed resistance to potato aphid. Virus resistance field screenings over 4 years indicated 29 lines were resistant to PVY and five were resistant to PLRV. Of those, two were resistant to both PVY and PLRV. Lines were tested with markers linked to R genes for resistance to PVY as well as the marker for late blight resistance. Line K7G-319 has pyramided resistance to both aphid species. Line K7G-329 has pyramided *M. persicae*, *M. euphorbiae*, PVY and late blight resistance This study has shown that somatic hybridization can be used to introgress aphid resistance from wild potato species that are sexually incompatible with *S. tuberosum*.

Davis JA, EB Radcliffe, CA Thill, DW Ragsdale. Resistance to Aphids, Late Blight and viruses in Somatic Fusion and Crosses of Solanum tuberosum L. and Solanum bulbocastanum. Am. J. Pot. Res 2012. DOI 10.1007/s12230-012-9272-1. **DISEASE RESISTANCE**

Late blight we evaluated 590 lines for resistance. Lines B0718-3, AWN86514-2, B0718-3, AWN86514-2, and AF4191-2 continue to show LB resistance. Another 42 MN lines have equivalent resistance. A second MN breeding population developed by crossing LB resistant lines Tollocan, Zarevo, and Atzimba, and from crossing Solanum species *S. bulbocastanum, S. cardiophyllum,* and *S. pinnatisectum* with tetraploid breeding lines has facilitated the development of 50 germplasm lines with significant LB resistance. 2012 NCR variety trial reports performance of lines submitted.

Common scab we evaluated 575 lines for resistance. Lines MSQ279-1, MSR169-8Y, Superior, B1992-106, A01010-1, A00286-3Y, AF2850-9, and MN18747 show resistance to CS. Among MN germplasm, 21 lines had no CS and another 35 lines had limited surface lesions. 2012 NCR variety trial reports performance of lines submitted.

North Dakota State University

Susie Thompson

Utilization of Germplasm Resources from NRSP-6

In 2012 we did not request any germplasm from NRSP-6. Despite this, the NRSP-6 Potato Genebank program is invaluable to our potato breeding and improvement efforts at NDSU, by allowing access cultivars and Solanum species accessions from around the globe. Often 'pre-breeding' using this material is conducted by programs such as those of Drs. Shelly Jansky, Kathy Haynes, and Rich Novy. The NDSU potato breeding program often accesses their materials for use as parents, or via unselected seedling tuber exchange.

Our focus the past several years has been more on evaluation of traits in our wild species hybrids. We have many progeny with *Solanum chacoense* and have been evaluating this material for Colorado potato beetle (CPB) resistance, along with evaluating glycoalkaloid content of foliage and tubers. Verticillium wilt resistance has also been evaluated for some of the progeny lines using both the marker (Bae et al.) and qPCR (Pasche et al.). Additionally, we evaluate this material for processing quality attributes such as specific gravity (a measure of dry matter content) and chip/fry color. Similarly, we have been evaluating progeny of the Ebt lines (Novy) and J lines (Helgeson) for a myriad of traits including CPB resistance, late blight, virus, pink rot, Pythium leak, and *Phytophthera nicotianae*, amongst others (most recently we have become aware that some of this material may have resistance to Zebra chip complex or at least tuber symptom expression). We consider this material to be a treasure trove of resistances and are not surprised when we identify lines possessing resistances to important biotic and abiotic stresses important to producers in our growing region. This material is then used as parental material in our hybridizing efforts with released cultivars and advanced selections which are primarily of *S. tuberosum* lineage. We have just one *S. andigena* genotype remaining from a previous project with Dr. John Bamberg related to evaluation of materials for sugar end resistance. We struggled with late maturity and tuberization, which led to low or no yield for subsequent testing.

Michigan State University
David Douches

Germplasm Enhancement

We developed genetic mapping populations (both at diploid and tetraploid levels) for late blight resistance, beetle resistance, scab resistance and also for tuber quality traits. We have started to characterize these populations in 2011 and conduct the linkage analysis studies using the SNP genotyping. The mapping populations will be a major research focus for us over the next few years as we try to correlate the field data with the genetic markers. The diploid genetic material represent material from South American potato species and other countries around the world that are potential sources of resistance to Colorado potato beetle, late blight, potato early die, and ability to cold-chip process. We have used lines with Verticillium wilt resistance, PVY resistance, and cold chip-processing. We are monitoring the introgression of this germplasm through marker-assisted selection. Through

MSU/GREEEN funding, we were able to continue a breeding effort to introgress leptine-based insect resistance using new material selected from USDA/ARS material developed in Wisconsin. We will continue conducting extensive field screening for resistance to Colorado potato beetle at the Montcalm Research Farm and in cages at the Michigan State University Horticulture Farm. We made crosses with late blight resistant diploid lines derived from *Solanum microdontum* to our tetraploid lines. We have conducted lab-based detached leaf bioassays and have identified resistant lines. These lines are being used crosses to further transmit resistance. In the summer of 2012 we screened 75 accessions of wild species looking for drought resistance. Five different species are showing drought resistance. We are also using some inbred lines of *S. chacoense* that have fertility and vigor to initiate our efforts to develop inbred lines with our own diploid germplasm.

Late Blight: We used marker-assisted selection strategies to combine a resistance QTL through conventional breeding. One approach to breeding for foliar resistance to late blight is to use interploidy (4x-2x) crosses to introgress the late blight resistance from *Solanum microdontum*. Based on the previous year's data, eight of 10 4x-2x selections were resistant combining resistance from *S. microdontum* and varieties Stirling and Jacqueline Lee. At the diploid level 18 of 30 2x selections were resistant that combine resistance genes from *S. berthaultii* and *S. microdontum*. With these strategies, we are pyramiding common and unique R-genes for late blight resistance.

Assessing broad genetic diversity among wild relatives of cultivated potato based on high density SNP genotyping: Wild relatives of major crop species are important sources of genetic diversity for the improvement of germplasm in modern breeding programs. Wild species of potato (*Solanum* spp.) have been used to enhance traits such as disease resistance, abiotic stress tolerance, and tuber quality in cultivated potato (*Solanum tuberosum* L.), demonstrating their value as a resource for cultivar development. Using an Infinium array representing 8303 single nucleotide polymorphisms (SNPs) distributed across the potato genome, we evaluated genetic diversity in a core collection of 74 wild tuber-bearing potato species. To determine the relatedness between current taxonomic species classifications and SNP-based genetic distances, we generated a phylogeny that revealed three major groupings. In addition, we demonstrated that SNP heterozygosity was clearly associated with polyploidy and landrace accessions, with the greatest extent of genetic variation observed in landraces compared to diploid wild species from Central America. Interestingly, endosperm balance number was also an indicator of differential heterozygosity among wild species. A comparison between wild species and a panel of cultivated breeding lines and varieties revealed that varieties possess substantially greater allelic diversity as well as heterozygosity, averaging 57% in cultivars versus 8.6% in wild species. Our results suggest that in their natural environments, wild potato populations are far less heterozygous than their cultivated counterparts.

Core Collection Greenhouse Drought Assessment: A drought tolerance greenhouse study of the NRSP-6 core collection was conducted in 2012. Seven accessions were classified as drought tolerant (see table below).

Plant #	PI Code	Solanum Species	Ploidy	Potato Genebank Accession ID	Drought Respons
1	PI458324	S. infundibuliforme	2x	OKA 4348	
2	PI458425	S. jamesii	2x	UGR 16-78	
3	PI472894	S. infundibuliforme	2x	OKA 5381	
4	PI592422	S. jamesii	2x	BAM 039	
5	PI498359	S. kurtzianum	2x	HOF 1756 X 1755	
6	PI472941	S. kurtzianum	2x	OKA 4972	susceptib
7	PI472923	S. kurtzianum	2x	HOF 1757	
8	PI605370	S. jamesii	2x	BMPF 072	susceptib
9	PI 310979	S. microdontum	2x, 4x	ALN 64-11	
10	PI458355	S. microdontum	2x, 4x	OKA 4398	susceptib
11	PI498123	S. microdontum	2x, 4x	HHA 6653	
12	PI320327	S. okadae	2x	HHR 3741	
13	PI 458368	S. okadae	2x	OKA 5645	
14	PI498130	S. okadae	2x	HHA 6585	
15	PI184774	S. pinnatisectum	2x	HAW 1105	
16	PI275236	S. pinnatisectum	2x	HAW 1505	
17	PI347766	S. pinnatisectum	2x	TRN 205A	
18	PI296126	S. raphanifolium	2x	EBS 1881	
19	PI310953	S. raphanifolium	2x	UGN 4229	
20	PI473369	S. raphanifolium	2x	HHCH 5138	
21	PI161170	S. stoloniferum	allo-4x	COR 14246	
22	PI184770	S. stoloniferum	allo-4x	HAQ 1101	
23	PI655250	S. stoloniferum	allo-4x	BdRF 168	
24	PI195204	S. tuberosum spp. andigenum		CPC 712	
25	PI225710	S. tuberosum spp. andigenum		CCC 278	
26	PI281034	S. tuberosum spp. andigenum		WAC 911	
27	PI283141	S. tuberosum spp. andigenum		OCH 1402	
28	PI292110	S. tuberosum spp. andigenum		UGN 5543	
29	PI498232	S. demissum	6x	OCH 14158	
30	PI251065	S. hjertingii	allo-4x	HAQ 1357	tolerant
31	PI283103	S. hjertingii	allo-4x	HAQ 1353	
32	PI545715	S. hjertingii	allo-4x	TRHRG 163	
33	PI265867	S. infundibuliforme	2x	EBS 1806	
34	PI320355	S. tuberosum spp. andigenum		CCC 1219	
35	PI320377	S. tuberosum spp. andigenum		CCC 1374	
36	PI546023	S. tuberosum spp. Andigenum		HOHL 253	tolerant
37	PI607886	S. tuberosum spp. andigenum		SS 7223	
38	PI161173	S. verrucosum	2x	COR 14252	
39	PI275255	S. verrucosum	2x	HAW 1527	
40	PI498062	S. verrucosum	2x	TRHRG 193	susceptib
41	PI545751	S. bulbocastanum	2x	TRHRG 237	
42	PI265873	S. boliviense	2x	EBS 1793	
43	PI545964	S. boliviense	2x	HOHL 276B	
44	PI597736	S. brevicaule	2x, 4x, 6x	SFVU 6502	susceptib
45	PI458365	S. berthaultii	2x	HOF 1902	tolerant
46	PI498141	S. berthaultii	2x	HHA 6656	
47	PI243510	S. bulbocastanum	2x	ROC S-397 X S-359	tolerant
48	PI275188	S. bulbocastanum	2x	HAW 1585	
49	PI310927	S. berthaultii	2x	OCH s.n.	
50	PI 175395	S. acaule	allo-4x	EBS 9	

51	PI472661	S. acaule	allo-4x	OKA 3890A	
52	PI473481	S. acaule	allo-4x	HJT 5401	
53	PI205407	S. brevicaule	2x, 4x, 6x	BRU 1953.19	
54	PI265579	S. brevicaule	2x, 4x, 6x	COR 678A	
55	PI435079	S. brevicaule	2x, 4x, 6x	OKA 3829	
56	PI472978	S. brevicaule	2x, 4x, 6x	OKA 4067	tolerant
57	PI473011	S. brevicaule	2x, 4x, 6x	HOF 1800	
58	PI473062	S. brevicaule	2x, 4x, 6x	OKA 4831	
59	PI473185	S. brevicaule	2x, 4x, 6x	OKA 3967	
60	PI473190	S. brevicaule	2x, 4x, 6x	OKA 5477	
61	PI500053	S. brevicaule	2x, 4x, 6x	OKA 7512	
62	PI197760	S. chacoense	2x	FCE 104	
63	PI275139	S. chacoense	2x	HJT 297	
64	PI320293	S. chacoense	2x	HHR 3706	
65	PI472837	S. commersonii	2x	OKA 5174 X 5207	
66	PI473411	S. commersonii	2x	CST s.n.	
67	PI558050	S. commersonii	2x	BRU 20	susceptib
68	PI265863	S. candolleanum	2x	EBS 1825	tolerant
69	PI365321	S. candolleanum	2x	OCH S24	
70	PI458379	S. candolleanum	2x	HHCH 5220	
71	PI498116	S. circaeifolium	2x	HHA 6532	
72	PI498120	S. circaeifolium	2x	HHA 6510	
73	PI545974	S. circaeifolium	2x	HOHL 226	
74	PI160208	S. demissum	6x	COR 14212	tolerant
75	PI230589	S. demissum	6x	RDD 178	

Cryotherapy: We have also been experimenting with a cryotherapy method to remove viruses. If perfected, we will be able to more predictably remove virus from tissue culture stocks. Preliminary results show that we are able to remove both PVY and PVS from lines. We are continuing these evaluations.

Core Collection Drought Evaluation

- Core collection assembled by USDA potato genebank
- Consists of 75 wild species/landraces representing span of diversity in tuber-bearing *Solanum* potato species
- Mixture of diploids, tetraploids, hexaploids

2 primary projects:

- studying genetic factors controlling drought tolerance
- phylogenetic study of potato species diversity

Current Goal: Identify Parental Candidates

Summer 2012: screened entire core collection for lines showing tolerance/sensitivity

- grew 6 plants of each 75 accessions in greenhouse
- watered half of each set at full or 50% of approximated water use potential
- collected LICOR water use efficiency data and observed susceptibility to wilting damage

Fall 2012: follow-up screen using narrowed list of accessions

Ideally crossing 2 parents with different drought responses will generate a segregating population of progeny displaying a range of drought response phenotypes

(Photos taken after water withheld 6 days in greenhouse)

Screening Core Collection

Fall 2012 Trial

- Screened 18 accessions, 10 plants each
- Grew plants for ~3 weeks after transplanting into pots
- Used pot weights at FC capacity and post-24 hour weights to approximate water use
- After 3 weeks watered half of each accession to full or 50% of daily water use potential (stress treatment)
- Rewatered an entire accession to field capacity once 4/5 stressed plants wilted

Target phenotype data:

- LICOR data to approximate water use efficiency (1 early trial measurement, 1 late trial measurement)
- Differential biomass between stress/non-stress treatments
- Time it takes for accessions to wilt under limited watering

Results

- Obtained first round of LICOR data to approximate water use efficiency early in experiment, no second round due to foliage loss
- Approximated water use and time to wilt for accessions
- Used weights of pots at wilt to approximate the fraction available soil moisture at which wilt occurs
  - post-hoc, wasn't initially part of strategy

Fall 2012 Accessions

CC #	Species	Ploidy	EBN	Phenotype
3	S. infundibuliforme	2x	2	Resistant to wilt, moderate water use efficiency
9	S. microdontum	2x	2	Large leaves, wilts even in semi-moist conditions, low water use efficiency and high water requirement
10	S. microdontum	2x	2	Large leaves, wilts even in semi-moist conditions, low water use efficiency and high water requirement, fails to improve WUE under drought, doesn't appear to respond to stress
21	S. stoloniferum	4x	2	High water use, moderate resistance to wilt, recovers very quickly without damage after extended stress, moderate WUE

Fall 2012 Accessions

CC #	Species	Ploidy	EBN	Phenotype
35	S.t spp. Andigena (phureja)	2x	2	Slow growing with low water use requirement, low WUE, very resistant to wilt
36	S.t spp. Andigena	4x	4	Extremely high photosynthetic capacity compared to other accessions, resistant to wilt, moderate WUE
40	S. verrucosum	2x	2	No fall data, summer trials suggest very susceptible to wilt
43	S. boliviense	2x	2	High water use, sensitive to wilt and sustains tissue damage, moderate to low WUE
44	S. boliviense	2x	2	High water use, sensitive to wilt and sustains tissue damage, moderate to low WUE

Fall 2012 Accessions

CC #	Species	Ploidy	EBN	Phenotype
61	S. brevicaule	2x	2	Fairly tolerant of wilt, leaves recover quickly, moderately low water use efficiency under optimal conditions, WUE increases under stress
66	S. commersonii	2x	1	Very high water requirement, moderate to high water use efficiency but fails to react to drought, no increase in WUE under stress, wilts quickly and sustains heavy damage
67	S. commersonii	2x	1	Very high water requirement, moderate to high water use efficiency but fails to react to drought, no increase in WUE under stress, wilts quickly and sustains heavy damage

Crosses of Interest

#45 S. berthaultii

- ✓ Large, broad leaves
- ✓ High water use
- ✓ Highly resistant to wilt
- ✓ Avoids serious tissue damage
- ✓ Fairly high constitutive water use efficiency
- ✓ WUE increases significantly under stress

#10 S. microdontum

- ✓ Large, broad leaves
- ✓ High water use
- ✓ Highly sensitive to wilt
- ✓ Wilt damages foliage
- ✓ Low constitutive water use efficiency
- ✓ WUE increases poorly under stress

2012 NC REGION ORDERS

Baker, Chris
<aquafarm2011@yahoo.com>
PHONE: (517) 857-3132
FAX: ****

Aquafarm LLC
23738 T DR N
Olivet, Michigan 49076-9531

2 units shipped in 1 order/s

Beard, Richard
<rbeard70@comcast.net>
PHONE: 765-356-4367
FAX: ****

412 W. 33rd ST.
Anderson, Indiana 46013

3 units shipped in 1 order/s

Caravati, Curzio
<seedsaver@curzio.com>
PHONE: (262) 553-1305
FAX: ****

Kenosha Potato Project
403 8th St.
Kenosha, Wisconsin 53140

23 units shipped in 3 order/s

Charkowski, Dr. Amy
<amyc@plantpath.wisc.edu>
PHONE: (608) 262-7911
FAX: 608-263-2626

University of Wisconsin
Department of Plant Pathology
Madison, Wisconsin 53706-1598

30 units shipped in 1 order/s

Chen, Yu
<chen29@wisc.edu>
PHONE: (608) 265-2144
FAX: 608-263-2626

University of Wisconsin
Department of Plant Pathology
Madison, Wisconsin 53706

68 units shipped in 3 order/s

Coombs, Joseph
<coombs@msu.edu>
PHONE: (517) 353-3145
FAX: 517-353-5174

Michigan State University
Crop & Soil Science Department - A412
East Lancing, Michigan 48824

75 units shipped in 2 order/s

Del Rio, Dr. Alfonso
<adelrioc@wisc.edu>
PHONE: (608) 262-5350
FAX: (608) 262-4743

University of Wisconsin
Department of Horticulture
Madison, Wisconsin 53706

345 units shipped in 4 order/s

Douches, Dr. David S.
<douchesd@msu.edu>
PHONE: (517) 355-0271
FAX: 517-353-5174
Michigan State University
Department of Crop and Soil Science
East Lansing, Michigan 48824-1325

150 units shipped in 2 order/s

Flaherty, Stephanie
<sflaherty@wisc.edu>
PHONE: (414) 469-4702
FAX: ****
Univeristy of Wisconsin - Madison
Department of Horticulture
Madison, Wisconsin 53726

3 units shipped in 1 order/s

Genger, Ruth
<rkgenger@wisc.edu>
PHONE: (608) 265-3056
FAX: ****
University of Wisconsin
Department of Plant Pathology
Madison, Wisconsin 53706

45 units shipped in 1 order/s

Greaves, Dr. John A.
<john.greaves@kemin.com>
PHONE: (515) 559-5100
FAX: (515) 559-5232
Kemin Industries, INC
2100 Maury St.
Des Moines, Iowa 50317-1134

2115 units shipped in 18 order/s

Irwin, Justin
<irwin396@gmail.com>
PHONE: (573) 366-0362
FAX: ****
Fairview Farm
2258 Fairview Church Road
Bonne Terre, Missouri 63628

4 units shipped in 1 order/s

Malinski, Luke
<ltmkcc@mail.missouri.edu>
PHONE: (573) 882-3939
FAX: ****
University of Columbia
117 Schweitzer Hall
Columbia, Missouri 65211

3 units shipped in 1 order/s

McColly, Fred
<fmccolly@umail.iu.edu>
PHONE: (219) 962-6312
FAX: ****
Indiana University Northwest
2571 Wells Street
Lake Station, Illinois 46405

3 units shipped in 1 order/s

Meadows, Hoosier Chicken Guy
<thefireman66@hotmail.com>
PHONE: (317) 774-4675
FAX: ****
234 Pasadena Road
Noblesville, Indiana 46062

1 units shipped in 1 order/s

Miller, Joseph
<jmillersculpt@gmail.com>
PHONE: ****
FAX: ****
21822 Forest Hill Rd
Richmond, Minnesota 56368

1 units shipped in 1 order/s

Momotaz, Aliya
<aliya.momotaz@pepsico.com>
PHONE: ****
FAX: ****
Frito Lay
Ag. Research and Development
Rhinelander, Wisconsin 54501

3 units shipped in 1 order/s

Palta, Dr. Jiwan
<jppalta@wisc.edu>
PHONE: ****
FAX: ****
University of Wisconsin
Department of Horticulture
Madison, Wisconsin 53706

24 units shipped in 1 order/s

Rodreguez, Clara
<crod@madebycrod.com>
PHONE: 303-807-1435
FAX: ****
Portland State University
1937 Aldrich Avenue S #6
Minneapolis, Minnesota 55403

1 units shipped in 1 order/s

Ronis, Daniel H.
<daniel.ronis@pepsico.com>
PHONE: (715) 365-1618
FAX: 715-365-1620
Frito-Lay
2540 County Road C
Rhinelander, Wisconsin 54501

8 units shipped in 2 order/s

Simrell, Merle
<mojays8@yahoo.com>
PHONE: (417) 465-2342
FAX: ****
De Somerville Farm
12562 S. 2400 Road
Walker, Missouri 64790

40 units shipped in 2 order/s

Wielgus, Susan
<swielgus@wisc.edu>
PHONE: (608) 262-9796
FAX: 608-262-4743

University of Wisconsin
Department of Horticulture
Madison, Wisconsin 53706

1 units shipped in 1 order/s

Woods, David
<webmaster@psrseed.com>
PHONE: (218) 760-5842
FAX: ****

39229 N Clitherall Lake Rd
Battle Lake, Minnesota 56515

13 units shipped in 2 order/s

Zanola, Kim
<zanolakim@yahoo.com>
PHONE: 517-541-2350
FAX: ****

Aquafarm Inc.
172 First St.
Vermontville, Michigan 49096

3 units shipped in 1 order/s

**** = INFORMATION NOT PROVIDED BY COOPERATOR

Southern Region Report to NRSP-6 Technical Committee
G. Craig Yencho
June 25, 2013

Potato Research Programs and Use of NRSP-6 Stocks in the Southern Region

There are three states in the Southern Region with on-going active potato improvement and/or research programs utilizing NRSP-6 stock: North Carolina, Texas, and Virginia. Several other states periodically conduct potato research utilizing NRSP-6 stock.

Tweny-six Southern Region orders were filled, including 178 accessions.

2012 SOUTHERN REGION ORDERS

Ali, Gul gsali@ufl.edu PHONE: (407) 884-2034 FAX: 3 units shipped in 1 order/s	University fo Florida – MREC 2725 Binion Road Apopka, Florida 32703 ****
Bain, Karen bainofmyexistence@gmail.com PHONE: (843) 259-1703 FAX:**** 1 units shipped in 1 order/s	7815 Wise Lane Knoxville, Tennessee 37920
Chambers, C. Edward cec4242@gmail.com PHONE: 615-943-9040 FAX:**** 11 units shipped in 1 order/s	Harpeth Bend Community Garden 713 Harpeth Parkway West Nashville, Tennessee 37221
Chretien, Robert rchretien@proteiosbio.com PHONE: (434) 766-6679 FAX:**** 10 units shipped in 1 order/s	ProteiosBio, LLC 150 Slayton Avenue Danville, Virginia 24540
Clough, Mark E./G. Craig Yencho mark_clough@ncsu.edu PHONE: (252) 793-4428 FAX:252-793-5142 127 units shipped in 2 order/s	NCSU/VGJREC Department of Horticultural Science Plymouth, North Carolina 27962

Cox, Jesse
<texasboy36@comcast.net>
PHONE: (404) 862-3750
FAX:****
4 units shipped in 1 order/s

4080 Summit Dr
Marietta, Georgia 30068

Cross, Nella
taderlady@hotmail.com
PHONE: (423) 569-8823
FAX:****
5 units shipped in 2 order/s

291 Sherman Carson Road
Oneida, Tennessee 37841

Douglass, Daniel
iddoug2000@yahoo.com
PHONE: (305) 253-5931
FAX:****
28 units shipped in 1 order/s

11420 SW 108 Avenue
Miami, Florida 33176

Garner, Sarah
snorkellover64@gmail.com
PHONE: (678) 925-8569
FAX:****
1 units shipped in 1 order/s

East Side After School Program
1144 Wonder Lane
Marietta, Georgia 30062

Hardison, Melissa
gardeninthepocket@gmail.com
PHONE: 850-228-6399
FAX:****
1 units shipped in 1 order/s

DeSoto County High School
6741 Visalia Pl
Tallahassee, Florida 32317

Johnson, Trent
tjfood@hotmail.com
PHONE: ****
FAX:****
1 units shipped in 1 order/s

1701 NE 127th Street
North Miami, Florida 33181

Kelley, Ryan
ryan.kelley@desoto.k12.fl.us
PHONE: (941) 223-4108
FAX:****
1 units shipped in 1 order/s

4251 Wordsworth Way
Venice, Florida 34293

Kozal, Chris
buzz1606@gmail.com
PHONE: (479) 674-8112
FAX:****
2 units shipped in 1 order/s

1606 Brewer Lane
Lavaca, Arkansas 72941

Lavezzo, Angie
aml10377@yahoo.com
PHONE: 828-665-7054
FAX:****
335 Oak Hill Road
Candler, North Carolina 28715
2 units shipped in 1 order/s

Li, Lei
xy2y@virginia.edu
PHONE: (434) 982-5774
FAX: ****
University of Virginia
Department of Biology - Gilmer Hall 244
Charlottesville, Virginia 22904
1 units shipped in 1 order/s

Logan, Michael
tiggerray6518@gmail.com
PHONE: (210) 454-1711
FAX:****
6518 Ridge Peak
San Antonio, Texas 78233
1 units shipped in 1 order/s

Madrigal, Randy
****
PHONE: 3183469134
FAX:****
P.O. Box 275
Evergreen, Louisiana 71333
7 units shipped in 1 order/s

Madrigal, Rebecca
becky3221971@aol.com
PHONE: 3378267903
FAX:****
197 Garland Station Rd
Bunkie, Louisiana 71322
17 units shipped in 3 order/s

Maul, Dr. Dora Pilar
pmaul@stu.edu
PHONE: (305) 628-6603
FAX:(305) 628-6706
St Thomas University
School of Science, Technology & Enginee
Miami Gardens, Florida 33054
10 units shipped in 1 order/s

Moran, Jeff
jeff@hggp.com
PHONE: (336) 899-9308
FAX:****
House Gardens Greening Project
1613 Ternberry Road
High Point, North Carolina 27262
1 units shipped in 1 order/s

Nurik, Jenna
jjnuri1991@gmail.com
PHONE: (678) 485-8084
FAX:****
University of Tennessee at Chattanooga
818 University St. - Apt. 3340
Chattanooga, Tennessee 37403
2 units shipped in 1 order/s

Peele, Sherry J.
speele@wilson-co.com
PHONE: 252-373-8119
FAX:252-985-2909
3 units shipped in 1 order/s

Carolina Wreath Company
PO Box 820
Sharpsburg, North Carolina 27878

Pereira, Andy
apereira@uark.edu
PHONE: 479-575-8435
FAX:****
9 units shipped in 1 order/s

University of Arkansas
115 Plant Science Building
Fayetteville, Arkansas 72701

Scheuring, Douglas
d-scheuring@tamu.edu
PHONE: (979) 845-0135
FAX:979-845-0627
27 units shipped in 1 order/s

Texas A&M University
Department of Horticultural Sciences
College Station, Texas 77843-2133

Shoatz-Bey, Khadijah
sermonskhadijah@yahoo.com
PHONE: (404) 503-3864
FAX:****
2 units shipped in 1 order/s

1434 Fairbanks St SW
Atlanta, Georgia 30310

Shubert, Jeanie
jeanieison@yahoo.com
PHONE: (832) 385-4545
FAX:****
1 units shipped in 1 order/s

935 Avenue B
Bacliff, Texas 77518

**** = INFORMATION NOT PROVIDED BY COOPERATOR

GENERAL REPORTS

North Carolina - G. Craig Yencho and Mark Clough

The goal of the North Carolina breeding program is to develop potato cultivars that are adapted to North Carolina, and the mid-Atlantic and southeastern US. We are a member of the NE1231 (formerly NE1031) Regional Potato Variety Development Project, and we collaborate with the USDA-ARS, Univ. of Maine (ME) and Cornell University (NY) potato breeding programs, as well as other potato breeding programs in the US and Canada.

Breeding and Variety Development - The bulk of our breeding work is conducted at the Tidewater Research Station (NCDA&CS)/Vernon G. James Research and Extension Center (NCSU) in Plymouth, NC. We also conduct 4-5 on-farm trials each year as part of our variety development efforts. Crossing work is done at our greenhouses in Plymouth, and we grow and share mini-tubers with the USDA-ARS yearly. In 2012, we planted 13,000 single-hills. We

selected 287 clones (2.2%) from these materials. From the 338 clones planted in our 2nd yr. 6-hill plots, 53 (16%) were selected for future evaluation. From the 29 clones planted in our 3rd yr. 20-hill plots 11 (38%) were selected for further evaluation, while in our 4th yr. 60-hill plots, 14 (53%) of 26 were selected. A similar amount of materials were planted in 2013.

Yield trials are conducted on-farm and/or at the TRS/VGJREC. We try to evaluate advanced clones and newly released varieties at more than one site in NC each year, but funding reductions have begun to severely limit these efforts.

Our breeding and the yield trial results are summarized and can be viewed and downloaded at our website http://potatoes.ncsu.edu/. NC also hosts the website and database for the NE1231 project, and the database for the National Chip Processors Trial which are also present at this site.

Germplasm Development - To address the internal heat necrosis (IHN) problems endemic to the mid-Atlantic and southeastern states, we have been working on a long-term project with Dr. Kathleen Haynes. The materials for this study were derived from 4x-2x *S. tuberosum* x (*S. phureja* X *S. stenotomun* (phu-stn)) hybrids developed by Dr. Haynes.

Our Colorado potato beetle (CPB) germplasm enhancement project seeks to introgress CPB resistance derived from *Solanum berthaultii* and *S. chacoense* into cultivated potato. The project began in 1998 using materials obtained from the USDA-ARS Potato Genebank, the USDA-ARS BARC, and Cornell University. We screen lines for resistance and adaptation using a rapid advance strategy that consists of simultaneous selection for CPB resistance and adaptation using separate plots planted the same year.

Much of the germplasm requested by our program from the NRSP6 project this year were materials that possessed PVY resistance derived from *S. andigena* and *S. stoloniferum*, or were high in anthocyanin content. These are two additional traits that we intend to incorporate into our program in the coming years.

NC Reports - 2012

Yencho, G.C. and M.E. Clough. 2012. NC Potato Variety Trial and Breeding Report. 42 pp.

Yencho, G.C. and M.E. Clough. 2012. Progress Report to the NC Potato Association. 12 pp.

Yencho, G.C. and M.E. Clough. 2012. NE-1031 NC Potato Variety Trial Report. 7 pp.

Yencho, G.C. and M.E. Clough. 2012. Snack Food Association, NC Potato Variety Trial Report. 11 pp.

NC Peer-reviewed manuscripts - 2012

Haynes, K.G., D.M. Gergela, C.M. Hutchinson, G.C. Yencho, M.E. Clough, M.R. Henninger, D.E. Halseth, E. Sandsted, G.A. Porter, P.C. Ocaya. 2012. Early Generation Selection at Multiple Locations May Identify Potato Parents that Produce More Widely Adapted Progeny. Euphytica Vol 186 Issue 2: 573-583.

Haynes, K.G., G.C. Yencho, M.E. Clough, M.R. Henninger, S.B. Sterrett. 2012. Genetic Variation for Potato Tuber Micronutrient Content and Implications for Biofortification of Potatoes to Reduce Micronutrient Malnutrition. American Journal of Potato Research, Vol 89 Issue 3: 192-198.

Texas – J. Creighton Miller, Jr.

The Texas Potato Variety Development Program continues to strive for the development and identification of improved early maturing russet, colored flesh, chip, and red varieties adapted to Texas growing conditions, in order to enhance the competitiveness of the Texas potato industry. In 2012, 67,193 first-year seedlings representing 647 families were grown, and 507 original selections were made. We cooperate with the North Dakota, USDA/ARS Aberdeen, ID, Oregon, Wisconsin, and Colorado breeding programs through exchange of first-year seedling tubers and/or advanced selections. We continue to participate in the Western Regional Trials (russet, red/specialty and chip) and the Southwestern Regional Trials (russet, red, specialty, and chip), and the National Chip Potato Trials. The advanced selection ATTX 961014-1R/Y was released in 2012. A major effort continued in 2012 involving research on the Zebra Chip Complex with emphasis on screening for host plant tolerance/resistance including evaluation of several NRSP-6 accessions. Additional information about the Texas breeding program can be found at: http://potato.tamu.edu

TX Reports - 2012

Miller, C., D. Scheuring, and J. Koym. 2012. Texas Potato Breeding Report, 2011. Texas AgriLIFE Research, College Station and Lubbock. 384p.

Miller, J.C., Jr., J.W. Koym, D.C. Scheuring, and J.P. Miller. 2012. Southwest Regional Potato Variety Trial Report 2011. Texas AgriLIFE Research, College Station and Lubbock. 27p.

Miller, C., J. Koym, and D. Scheuring. 2012. 2012 Field Day Handbook. July 19, 2012. Texas Potato Variety Development Program. Texas AgriLIFE Research, College Station and Lubbock. 34p

TX Peer-reviewed manuscripts - 2012

Brown, C. R., K.G. Haynes, M. Moore, M.J. Pavek, D.C. Hane, S.L. Love, R.G. Novy, and J.C. Miller, Jr. 2012. Stability and Broad-sense Heritability of Mineral Content in Potato: Calcium and Magnesium. Amer. J. Potato Res. 89:225-261.

Bamberg, J. and J.C. Miller, Jr. 2012. Comparisons of *ga1* with other reputed gibberellin mutants in potato. Amer. J. Potato Res. 89:142-149.

Brown, C.R., I. Vales, S. Yilma, S. James, B. Charlton, D. Hane, M. Pavek, R. Knowles, J. Stark, R. Novy, J. Whitworth, J.C. Miller, Jr., D. Holm, and R. Navarre. 2012. "AnnaRosa", a red skinned, red flesh fingerling with high phytonutrient value. Amer. J. Potato Res. 89:255-261.

Virginia – Richard Veilleux

The genomic toolkit developed as part of the effort to sequence the potato genome included the Infinium 8303 Potato Array (SNP Chip). Several populations have been genotyped on the array including a diversity panel of more than 200 potato cultivars and breeding lines, two populations derived from crossing the sequenced doubled monoploid (DM) with heterozygous diploid pollinators, and an interspecific S. chacoense/S. phureja population segregating for quality and quantity of steroidal glycoalkaloids (SGAs). With the diversity panel, we were able to separate cultivars into market classes based on common genetic elements. Genetic maps were constructed rapidly after genotyping 96 individuals in each of the DM derivative populations. Comparison of the maps revealed a high degree of concordance that verified the quality of the potato genome assembly. Unique regions of distorted segregation were found in each population. SNP chip analysis of the population segregating for SGAs allowed the nomination of several candidate genes in genomic regions that were highly significantly associated with genetic markers.

Variety trials were conducted by Josh Freeman at the Eastern Shore Agricultural Research and Extension Center in Painter, Virginia.

Hybrids between potato cultivars and diploid derivatives of the DM that have 2n pollen were evaluated in the field in Maine, Virginia and North Carolina.

A project to examine the influence of allelic diversity of candidate genes expected to affect iron and zinc accumulation in tubers of South American primitive cultivars was initiated.

VA Peer-reviewed manuscripts - 2012

Hirsch CN, Hirsch CD, Felcher K, Coombs J, Zarka D, Van Deynze A, De Jong W, Veilleux RE, Jansky S, Bethke P, Douches DS, Buell CR (2013) Retrospective View of North American Potato (Solanum tuberosum L.) Breeding in the 20th and 21st Centuries. G3: Genes|Genomes|Genetics

Levy D, Coleman WK, Veilleux RE (2013) Adaptation of potato to water shortage: irrigation management and enhancement of tolerance to drought and salinity. American Journal of Potato Research 90: 186-206

Felcher KJ, Coombs JJ, Massa AN, Hansey CN, Hamilton JP, Veilleux RE, Buell CR, Douches DS (2012) Integration of two diploid potato linkage maps with the potato genome sequence. PLoS ONE 7: e36347

Ginzberg I, Thippeswamy M, Fogelman E, Demirel U, Mweetwa A, Tokuhisa J, Veilleux R (2012) Induction of potato steroidal glycoalkaloid biosynthetic pathway by overexpression of cDNA encoding primary metabolism HMG-CoA reductase and squalene synthase. Planta 235: 1341-1353

Mweetwa AM, Hunter D, Poe R, Harich KC, Ginzberg I, Veilleux RE, Tokuhisa JG (2012) Steroidal glycoalkaloids in Solanum chacoense. Phytochemistry 75: 32-40

Manrique Carpentero, NC (2013) Genetic studies of candidate genes in the glycoalkaloid biosynthetic pathway of potato. Ph.D Dissertation, Virginia Polytechnic Institute & State University, Blacksburg.

Western Region Report - NRSP-6 Technical Committee
David G. Holm
June 25, 2013

During 2012, NRSP-6 supplied stocks to the following Western states: California, Colorado, Idaho, Montana, New Mexico, Oregon, and Washington (Table 1). Western Region USDA/ARS requests are not included in this report.

Twenty-eight entities via 45 requests ordered 1,312 units. Potato materials were requested by universities and research institutes (University of California, Colorado State University, International Institute of Los Angeles, Montana State University, and Oregon State University) and many private companies and farms (Table 1).

Table 1. NRSP-6 Distribution in the Western Region - 2012.

Name	Organization	City	State	Reported
Paul Brookhouzen	Patriot Seed Company	Sacramento	CA	✓
Clieo Clayborn	High Desert Plant and Fauna Research	Littlerock	CA	
Johna Cochran		Vancouver	WA	
Chandra and Orion Comstock		Inglewood	CA	
Stephen Facciola	Tom King Farms	Ramona	CA	
Robert Foss	International Institute of Los Angeles	Los Angeles	CA	
Anne Fraser		Encinitas	CA	
Fahrettin Goktepe	SunRain Potato Varieties	Idaho Falls	ID	✓
Oscar Gonzalez		Palmdale	CA	
Aymeric Goyer	Oregon State University	Hermiston	OR	✓
Andrea Gray-Hoover	Hillcrest Community Garden	Montrose	CO	
Sastry Jayanty	Colorado State University	Center	CO	✓
Alec Kerstein		Seaside	CA	
Michele Krucker	J. R. Simplot Company	Boise	ID	✓
Rick Machado	Machado Farms	Menifee	CA	✓
Theresa Maresca	Seattle Indian Health Board	Issaquah	WA	✓
Ernie Meyers	Mountain Valley Produce LLC	Center	CO	
Garry Pearson	University of California - Davis	Davis	CA	
Alice Pilgeram	Montana State University	Bozeman	MT	
Dr. Felix Serquen	Syngenta Seeds, Inc.	Woodland	CA	
Joseph Simcox	The Rare Vegetable Seed Consortium	Belen	NM	✓
Jessica Stewart		Anza	CA	
John Stewart	Gardens of Eden	Sweet Home	OR	
Peter van Hest	Bejo Seeds, Inc.	Oceano	CA	✓
Clifford Wagner	Pecos Community Gardens	Denver	CO	
Robert Wagner	New World Seeds and Tubers	Seattle	WA	
Thomas Wagner		Everett	WA	✓
Soloman Yilma	Oregon State University	Corvallis	OR	

General Reports

Bejo Seed, Inc. - Peter van Hest

Each year for the past 13 years, Bejo Seeds acquires from 50 to 100 lines in vivo, in vitro and/or in true seed form.

Bejo Seeds screens these lines for use in their potato variety development program, with the aim to create true botanic seed F1's for sale into the market.

Thus far the program has not yet come forth with a marketable line.

The annual 'gifts' from the germplasm bank are extremely valuable to our program, however, and some offspring of these NPGS lines are in the background of promising materials.

I assume Bejo Seeds will acquire a PVP on any line that will be marketed, and if any NPGS material is in its background, that will of course be divulged at that time.

I should note that in recent years the quality of in vivo lines has improved, in that materials with pathogens are rare indeed.

Machado Farms - Rick Machado

We routinely receive tubers, TPS, and advice from GRIN. They have proved to be an invaluable resource for our farm.

We received the tuber Bora Valley some years ago, and it has proven to be extremely heat and drought tolerant. We crossed this back to an *s.chacoense,* a primitive variety, and created a new cultivar we are calling Blue Leslie. We have increased our planting of it every year, and continue to plant and harvest in extreme heat. We have released it in small quantities in N San Diego County to small farmers and gardeners, and it has proven to be reliable, pest and heat resistant, and have large yields.

We continue to use the *s.chacoense* genetics in most new cultivars, and this year we expect at least 5 more new varieties. These are multi-colored, have known only poor, alkaline soil, and limited water. We are excited about creating several new varieties that can all handle 100f temps.

We also continue to grow out several GRIN tubers, old standards like Reserv, Gem Chip, Sebago, and so on. We are looking for TPS mainly, and will keep the ones that flower and produce berries. Jesse was kind enough to send me some Ollala tubers, he says they have a reputation for drought tolerance. We again hope to pass along *s.chacoense* genetics in the future with these, or maybe Blue Leslie.

We have some TPS lines going, as usual, Low Bay, Suylla, Negra Guicho, and so on, more primitive lines. We are looking for those that are sexually promiscuous, setting and breeding on a mass scale, lots of berries, tolerating heat.

We also found some very interesting tubers, resulting from mass crosses, mixed flesh color and skin color. As soon as we find the best ones, we hope to send them to the President and his wife for planting in their White House Garden. This will give great exposure to GRIN, assuming, of course, if all goes well.

It's most certain that without GRIN, we would be growing the common, hybrid, commercial cultivars that do poorly for us. We would in fact, be raising potatoes using massive amounts of fertilizer and water, rather than raising them with a genetic strategy. Being able to access GRIN helps us preserve water, keeping soil organic and intact, and managing the crop rather than letting the crop manage us.

Patriot Seed Company - Paul Brookhouzen

I cannot thank the USDA and all those helping to maintain the germplasm collections enough. We are able to locate germplasm with a variety of useful genes, including those with drought and even frost tolerance. Without this germplasm we would have to start from scratch. This would be very difficult and costly and as a result we would not be able to work on improving plants for the 3rd world countries (those needing them most). The large companies only work on the markets that will afford them maximum profits and have monopolized much of the improved germplasm through patents and other legal avenues. This has made it very difficult for the smaller humanitarian organizations to compete with them. Only in the small niche's where it is not profitable for the large companies, can the smaller companies compete. They can compete in these small niche's only because there is germplasm available in the USDA collections. Please continue to maintain and collect germplasm. This is a wise and useful expediter of public funds.

Seattle Indian Health Board - Terry Maresca

I received Ozette Potato germplasm in 2012. It arrived on agar slant tubes in excellent condition. The goal of my small project was to raise this cultivar and spread awareness of cultural legacy of indigenous plant foods among urban and reservation based American Indian communities, with outcomes of expanding interest and participation in projects promoting indigenous foods for wellness and chronic disease treatment/prevention.

The growth conditions in my test garden in June in Western Washington were not ideal, however, with persistently cold (low 60s F) and soggy. The material never reached a propagation state.

However, the concept of the project was described in detail during 3 forums that I presented at during the year. These included the Snoqualmie Tribe Advancing Indigenous Ecologic Knowledge conference, August 2012 in Skamania, WA; Northwest Indian College Traditional Foods Summit, Bainbridge Island, WA; and the 41st annual meeting of the Association of American Indian Physicians in Anchorage, AK in August 2012. The total number of persons impacted was 200, the majority of whom are of American Indian/Alaska Native descent.

In addition, one tribal contact planning a diabetes specific garden in Rosebud, SD was given information on the germplasm bank.

Potato Seed Solutions & SunRain Potato Varieties - Fahrettin Goktepe

We have received the materials in excellent shape and condition: we were trying to see if the material will perform and tuberize at our local condition both at field and greenhouses. The materials we have received were reported to carry some level of drought and cold tolerance and some of them were reported to have resistance against common potato diseases. We have lost some of the materials either at the transplanting or they didn't produce tubers. We are still working on the materials they adapt to our local conditions. We are deeply appreciated for the service and material gene bank is providing for the research community

Thomas Wagner

I have collected potato germplasm for many years since I first started out breeding potatoes nearly 60 years ago. I try to maintain clones not by the tubers themselves but through breeding work to compile a huge inventory of TPS. I have thousands of lines of TPS obtained through selfing, OP, and/or hybridization. I may have a Khuchi Akita x Pirampo hybrid and then cross it with a Skagit Valley Gold (phureja hybrid) and offer samples of that TPS with cooperators numbering in the hundreds of folks. I seldom send out tubers but I do send out thousands of samples of TPS to interested parties for research, home growing and the like.

Through repeated hybridization many of the NRSP6 clones or TPS are in my advanced TPS. These are evaluated for late blight resistance, flavor, dormancy, frost resistance, yield, etc., in the Washington counties of King, Snohomish, Skagit, Grays Harbor and Clark. I have a minimum of 10,000 collections of TPS on hand and over the years have grown out from 10,000 to 100,000 seedling TPS lines per year.

I have evaluated hybrids and clones received from NRSP6 for starch content with the goal to produce new varieties with low levels of amylopectin and high levels of the good starch amylose. Those tests are being done in Montana with the university at Bozeman.

I am testing out many TPS lines in Hawaii for adaptation to tropical conditions for potential production....and many of the low land tropic lines and land races are performing well.

My main objective is to get as many potato species and clones into highly fertile lines that form their own potato berries or are easily crossed if they happen to be male sterile.

In the past, some of my created varieties were grown my certified seed producers in Washington and California....Kern Toro, Negro Y Azul, Nordic October, Golden Amey, Tom Boy, Skagit Valley Gold, etc. A few of my varieties fell into the heirloom class such as Blue Tom Cat.

The materials were always in good condition be they tubers or TPS. The quality was excellent.

My request to get more tuber families from Sturgeon Bay would be honored only if the station gets more money to finance that effort. *If I could spearhead a project to get public awareness for that effort.* I would like the dialogue to be enhanced between my research and theirs. I would like to invite visits to my research and be more involved with theirs as well...visitation as a colleague as it were. I have lots of new varieties being grown around the country by gardeners and would like publicity on those.... sadly they fall out of the realm of existing protocol.

Oregon State University - Aymeric Goyer

The materials were of very good quality and were received in excellent conditions.

Folate deficiencies in the diet are still common and linked to the increased risk of various serious pathologies, including birth defects, cardiovascular diseases, some cancers, anemia, and impairment in cognitive performance. Most of these deficiencies are due to low folate intake. Potato is the world's third most important food crop in overall production, and has therefore huge potential to deliver the needed amount of folate to the widest populations.

We have been exploring the natural genetic diversity of folate contents in a wide range of potato germplasm. Our studies focused on over 130 genotypes that included commercial varieties and advanced breeding clones, indigenous cultivars (landraces) (54 accessions from the Groups Phureja, Stenotomum, and Andigena) and wild potato species (Solanum section Petota) (64 accessions) from South and Central America, as well as the Southwestern United States. Overall, we found a huge range of folate concentrations amongst potato germplasm, far greater than reported for any other plant. The broadest range of concentrations were found within primitive cultivated and wild potato species while modern potato varieties had a relatively narrow range of folate concentrations, illustrating the narrowing effect of selection. Species that had the highest concentrations of folate are all within the Primary or Secondary Gene Pool

which is desirable from a breeding perspective. Crucially, clones with high or low folate content are stable over harvest years, and so are suitable for deeper characterization.

A new project about pre-breeding and breeding for folate enhancement in potato has been initiated from data obtained on germplasm received form NRSP6. A proposal has been submitted to the Agriculture and Food Research Initiative.

Publication:

Goyer A, Sweek K (2011) Genetic diversity of thiamine and folate in primitive cultivated and wild potato (Solanum) species. Journal of Agricultural and Food Chemistry 59: 13072-13080.

J. R. Simplot Company - Michele Krucker

Plant and seed material received from the NSRP6 were received in excellent condition, accurately inventoried and sent in a very timely manner. Correspondence was very professional and the team often provided additional information that was very helpful towards our goals.

Samples from the Genebank are currently playing an essential role of several projects including disease resistance and water use efficiency. Most of these samples do not exist in another location or could be very difficult to obtain if access to the Genebank was not available.

Colorado State University - Sastry Jayanty

Screening for Biguanide related compounds NRSP-6 core collection:

Biguanides such as metformin are widely used worldwide for the treatment of type-2 diabetes. Identification of guanidine and related compounds in French lilac plant led to the development of biguanides in the history. In spite of its plant routes, no biguanides from plants are reported so far. Plants are the source of medicinal treatments for thousands of years, and they continue to play an essential role in the primary health care of 80 % of the world's developing and developed countries

We initiated a study testing different medicinal plants including potato for biguanide related compounds (BRCs). Our initial results of Voges-Proskauer (V-P) assay suggest that moderate amounts of BRCs are present in potato. Liquid chromatography-mass spectrometer (LC-MS) analysis further confirms presence of biguanide, triguanide, galegine, and other guanidine and urea compounds (Perla et al., 2013).

We are expanding our study to include different accessions of potato germplasm. We received 25 different accessions of potato germplasm to identify and quantify biguanide

and related compounds (BRCs). Tubers of all accessions will be cored, freeze dried and will be screened initially using (V-P) assay followed by LCMS analysis for precise identification and quantification in the selected accessions.

Outcome of this research will identify germplasm that the breeders could use for developing specialty cultivars with medicinal properties.

Publication:

Venu Perla and Sastry S. Jayanty* (2013). Biguanide related compounds in traditional antidiabetic functional plant foods. Food Chemistry. 138:1574–1580.

Summary of the Clonal and True Potato Testing

at

The Plant Germplasm Quarantine Programs

NRSP-6 Technical Committee Meeting

Sturgeon Bay, WI/ June 25-26, 2013

Jorge Abad, PhD
Senior Plant Pathologist-Project Leader
Potato and Sweet Potato Quarantine Programs
Field Operations
Plant Protection and Quarantine (PPQ)
USDA APHIS
Bldg. 580, Powder Mill Road, Beltsville, MD 20705
Phone 301-313-9317
Email jorge.a.abad@aphis.usda.gov

Introduction

The mission of the Potato Quarantine Program (PQP) is to test germplasm for pathogens as a condition for the entry of this valuable plant 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 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 14 different indicator plants and perform grafting onto healthy potatoes.
We also perform very sensitive molecular tests, routinely: RT-PCR and 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. Furthermore, in collaboration with the International Potato Center (CIP) in Peru, we are identifying difficult unknown viruses by deep-sequencing analysis, a new method where no specific primers are needed.

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 infected accession by therapy. This season, four accessions from Japan were imported for the Genebank. In addition, as part of our continuing collaboration, last year, six accessions already introduced into the collection at the Genebank were treated to eradicate PVS in our tissue culture lab. Of the six accessions that were sent to us from Sturgeon Bay, five of them successfully went through therapy and were tested and released. One accession is still undergoing therapy and will be tested this year. Thermotherapy and chemotherapy were used in the treatments. In March of this year, six more accessions were sent to us from the Genebank. Those are currently undergoing therapy and will be tested later in the 2013 – 2014 potato season. Additionally, this year we have requested from CIP three more cvs. for the Genebank.

Clonal Testing at the Potato Quarantine Program

Table 1 show that there were 91 potato clones in the PGQP in the 2012-2013 season. From those, 76 clones were received this season; 3 accessions as tubers and 73 as *in vitro* cultures. The remaining 15 clones were obtained the previous years. Eighty two clones were released, 7 clones were infected and sent to therapy and 2 clones died before testing was finished. One more time we surpassed our quota (75 accessions/year) and the requests for the next testing season are already over one hundred.

2012-2013 PGQP Potato Season

Clonal Potatoes

There were 91 potato clones in the PGQP in the 2012-2013 season.

1	clone was received in 2010	
1	from Spain	for M. Martin

14	clones were received in 2011	
12	from Chile	for G. Secor
2	from New Zealand	for C. Brown

76	clones were received in 2012	
	73 were received *in vitro*	
1	from Poland	for C. Brown
16	From Germany	for Valley Tissue Culture
4	from Peru	for S. Marquardt
11	from The Netherlands	for Valley Tissue Culture
20	from Peru	for R. Veilleux
4	from Japan	for M. Martin
9	from Germany	for L. Ewing
1	from Scotland	for J. Miller
3	From Germany	for C. Keller
3	From Germany	for Summit Plant Labs
	3 clones were received as tubers	
1	from Scotland	for C. Keller
1	from Japan	for M. Martin
1	From Germany	for Valley Tissue Culture

Of these 91 clones:		
	2 died before testing began	
	89 were tested	
7	were positive	(PVS, PVX, and unknowns were found)
82	were released	

True Potato Seed

There were 12 TPS lots tested in the PGQP in the 2012-2013 season.

12	Grown and tested at PGQP	
12	from The Netherlands	for J. Debons
12	were released.	

2013 OFFICE OF NATIONAL PROGRAMS REPORT

FOR THE U. S. NATIONAL PLANT GERMPLASM SYSTEM
OFFICE OF NATIONAL PROGRAMS, NATIONAL PROGRAM 301: PLANT GENETIC RESOURCES, GENOMICS, AND GENETIC IMPROVEMENT

(PETER BRETTING, JACK OKAMURO, SALLY SCHNEIDER, ROY SCOTT, GAIL WISLER, DA KAY SIMMONS)

1 Personnel changes:

1.1 Farewell and best wishes to Dave Ellis, who left the NCGRP in Ft. Collins, CO to curate the potato and sweet potato genebank in CIP, Peru; and to Molly Welsh, who retired as the Phaseolus curator at the WRPIS, Pullman, WA.

1.2 Welcome to Carolyn DeBuse, new Prunus curator at the NCGR-Davis; and Josef Pohl, new IT specialist at the NCGRP, Ft Collins.

2 Site developments and changes:

2.1 Researchers at the USDA/ARS NERPIS at Geneva, New York applied new statistical genetic approaches to identify, from tomato breeding stock, latent genes that originated from tomato wild relatives. They uncovered not only genes from wild relatives introduced into tomato through deliberate breeding, but also other genes genetically-linked to the target traits. Furthermore, previously-unrecognized hybridizations in nature between tomato and wild relatives were identified. These results will enable these genes from tomato wild relatives to be characterized, undesirable "hidden" variants eliminated from breeding stocks, and tomato genetic resources more effectively conserved and utilized in breeding.

2. 2 USDA/ARS researchers at the NGRL Beltsville and collaborators from the University de San Carlos in Guatemala, Bioversity International, and the International Center for Tropical Agriculture (CIAT) completed the Guatemalan Atlas of Crop Wild Relatives. The Atlas provides detailed information on 105 species of wild plants--related to 29 different crops--which will support genetic resource conservation efforts. Because Guatemala and adjacent nations are very rich in plant biodiversity, these efforts will also support global efforts to conserve plant genetic resources. Available at http://www.ars.usda.gov/ba/atlascwrguatemala

2.3 USDA/ARS researchers at the WPRIS in Pullman, WA; Children's Nutrition Research Center in Houston, TX; and their university collaborators analyzed the genetic diversity, population structure and genome-wide marker-trait association with seed nutrients for pea (Pisum) accessions in the NPGS pea core subset, identifying 28 significant marker-trait associations for eight of the seed mineral nutrient concentrations, including Ca, Cu, K, Mo, Ni and P. This information could help breeders implement marker-assisted selection in pea for improved mineral nutrient content.

2.4 The USDA/ARS NCRPIS, ONP, and OCIO partnered with the Oregon State University PRISM group and Esri, Inc. to deliver an updated edition of the USDA Plant Hardiness Zone Map (PHZM) on the web at http://planthardiness.ars.usda.gov/PHZMWeb/ Unlike prior editions, the new PHZM is GIS-based, identifies the PHZ for any zip code, and includes an interactive map for exploring variation in PHZ with the resolution of 800 m.

2 Budgets:

2.4 The current Administration's research priorities for USDA include climate change, food safety, children's nutrition/health, international food security, and bioenergy.

2.5 ARS has implemented the Consolidated and Further Continuing Appropriations Act, 2013 (FY 2013 appropriations) which includes rescissions and other reductions to the ARS's budget due to sequestration. The President's FY 2014 budget proposal, presented on 10 April 2013, would increase ARS's funding by about 2.7% above the FY 2012 appropriated funding level, and specifically would increase the NPGS's budget by $581,000. The House Agriculture Appropriations Subcommittee "mark-up" the FY 2014 budget would provide a 5.6% increase above the enacted FY 2013 operating level, which translates to a total that is 2% lower than the FY 2012 appropriated funding level.

3 National Programs:

ARS's research portfolio is organized as a series of 17 national programs. Plant and microbial genetic resource management, genetic improvement, genomics, molecular and biological processes, biotechnology risk assessment, bioinformatics, and genome database management are incorporated into National Program 301 (see the WWW at: http://www.nps.ars.usda.gov/programs/programs.htm?NPNUMBER=301). NP 301 recently completed its second five year cycle. Based on customer/stakeholder comments, the NP 301 Action Plan, and other input, ARS researchers developed individual Project Plans for its third five-year cycle, 2013-2017. More than 92% of the individual NP 301 Project Plans received "passing grades" during initial external reviews, and will now proceed to implementation.

4 National Plant Germplasm Coordination Committee (NPGCC):

The NPGCC seeks to promote a stronger, more efficient, more widely-recognized and better utilized NPGS. Its goals are to facilitate the coordination of ARS, NIFA and SAES planning and assessment mechanisms for NPGS policy, organization, operations and support; promote awareness and understanding of the NPGS across ARS, NIFA, and SAES and more broadly to the scientific community; and serve as a vehicle for improving communications and discussions about issues impacting the NPGS with ARS, SAES, and NIFA. It will assess, develop and recommend to the SAES, ARS and NIFA

strategies for improved coordination of NPGS activities; develop and recommend a process for improved communication of the value of the NPGS; initiate a strategic planning effort for the NPGS to better define and communicate the vision, mission and short- and long-term goals; and to evaluate the current funding models for the NPGS and report findings to the SAES directors, ARS and NIFA.

The current members of the NPGCC are T. Burr (Cornell University-SAES), Chair; E. Young (Executive Director, Southern Region), Secretary; L. Sommers (Colorado State-SAES), J. Colletti (Iowa State-SAES); G. Arkin (University of Georgia-SAES); A. M. Thro (NIFA); E. Kaleikau (NIFA); P. S. Benepal (NIFA); P. Bretting (ARS-Office of National Programs); D. Upchurch (ARS-Southern Plains Area); and G. Pederson (ARS-Griffin). Representatives of the Association of Official Seed Certifying Agencies (AOSCA--Chet Boruff); the American Seed Trade Association (ASTA—Tim Cupka); and the National Association of Plant Breeders (NAPB, David Baltensperger) attend the annual NPGCC meetings as observers.

NPGCC members made a joint presentation on the NPGS to the 2006 Experiment Station Section/State Agricultural Experiment Station/Agricultural Research Directors Workshop September 24-27, 2006. That presentation, plus testimonials from key Directors about the NPGS's value, increased the NPGS's visibility to this important group. In May 2007, the NPGCC recommended to the National Research Support Project Review Committee that it recommend restoring off-the-top funds designated for NRSP-5 (the Prosser, WA virus-free pome and stone fruit project) and NRSP-6 (the potato genebank project at Sturgeon Bay, WI) to their FY 06 levels to sustain these valuable efforts. Since then, funding for NRSP-5 has been assumed by the National Clean Plant Network. Support for NRSP-6 has been maintained at the FY 06 level since then. The NPGCC met on June 5, 2008, in conjunction with the annual PGOC and biennial CGC Chairs meetings. It discussed the NPGS's budget levels, funding for NRSP-5 and NRSP-6, the location of crop collections, and mechanisms for publicizing the NPGS. Similarly, the NPGCC met on 23-24 June 2009, 9 June 2010, 16-17 June 2011, 12 June 2012, and 13-14 June 2013 in Beltsville, MD to continue its work on these priority issues.

5 International germplasm items:

The FAO International Treaty (IT) for Plant Genetic Resources for Food and Agriculture came into force on 29 June 2004, and beginning in 2007 its standard material transfer agreement (SMTA) for plant genetic resource exchange was adopted by Parties to the IT and the CGIAR Centers for distributing plant genetic resources. On 7 July 2008, the White House transmitted the IT to the Senate; ratification would require the advice and consent of a 2/3 majority of the Senate. The Senate Foreign Relations Committee (SFRC) held hearings on the IT on 10 November 2009. During their last Business Meeting of the 111th Congress (30 November 2010), the SFRC voted the IT out of committee, for consideration by the full Senate. Unfortunately, the Senate adjourned on 22 December 2010 without voting on the IT. It is uncertain whether the SFRC will

schedule new hearings on the IT during 2013, which might enable vote for consent (or not) to IT ratification to occur during the 113th Congress.

Concurrently, the Convention on Biodiversity (CBD) adopted the voluntary, non-binding Bonn Guidelines on Access and Benefit-Sharing during the sixth Conference of Parties (COP-6) of the CBD at The Hague in April 2002. Starting in 2006, Parties to the CBD began negotiating what became the legally-binding Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization. Adopted by the COP-10 on 29 Oct. 2010, the Nagoya Protocol is quite complicated, with many ambiguous components; its ramifications are currently under analysis (see http://ictsd.org/downloads/2010/11/abs-protocol.pdf for the text).

The preceding developments at FAO and with the CBD will substantially affect international exchange of plant genetic resources, and the NPGS, whether or not the U. S. is ultimately a Party to either or both treaties. Precisely how these treaties will affect U. S. users of germplasm depends on the treaties' implementations.

6 **National Genetic Resources Advisory Council (NGRAC):**

The National Genetic Resources Advisory Council (NGRAC) includes nine members, was originally established by the 1990 Farm Bill, and had been inactive since 1999. Secretary of Agriculture Vilsack re-established the NGRAC in 2012 to formulate recommendations on actions and policies for the collection, maintenance, and utilization of genetic resources; to make recommendations for coordination of genetic resources plans of several domestic and international organizations; and to advise the Secretary of Agriculture and the National Genetic Resources Program (NGRP) Director of new and innovative approaches to genetic resources conservation. The NGRAC will advise on ways to ensure that the NGRP serves the needs of all farmers for high-quality and diverse seed (both genetically engineered and non-genetically engineered) for their particular farming operations. The NGRAC will also advise on how the USDA can develop a broad strategy for maintaining plant biodiversity available to agriculture, and strengthening public sector plant breeding capacities.

Last year, the NGRAC held an initial organizational teleconference, and its first meeting occurred in Beltsville 5-6 March 2013. The members of the NGRAC include Drs. Manjit Misra (Chair, Iowa State University), Jane Dever (Texas A & M), Karen Moldenhauer (University of Arkansas), Stephen Smith (DuPont Pioneer), Allison Snow (The Ohio State University), Mulumebet Worku (North Carolina A & T), Mr. Matthew Dillon (Seed Matters, Clif Bar Family Foundation), Dr. Herman Warren (Warren and Associates Seeds), and Mr. Terry Williams (Tulalip Tribes). Ex officio members include Drs. Gary Pederson (ARS-Griffin), and Peter Bretting (ARS-ONP), and representatives from other Federal science and technology agencies.

Orientation to Crop Vulnerability Statements

Crop vulnerability statements (CVS) communicate periodic assessments of the challenges that crops face, particularly from reduced genetic diversity resulting from genetic erosion. Collections of genetic resources are key mechanism for reducing crop vulnerability resulting from genetic erosion and uniformity, and for supplying crop breeding and research programs with novel traits and underlying genes to satisfy evolving demands.

Crop vulnerability statements will be reviewed as part of the periodic (usually annual, sometimes biennial) Crop Germplasm Committee (CGC) meetings. During the CGC meetings, the crop-specific curators will be encouraged to communicate a status update for the crop germplasm collection along the lines of CVS section 3 (see outline below).

After the CGC meetings, the CVS will be updated by the CGC chair, secretary, or designate, and submitted to the CGC for review along with the meeting minutes. After internal review by the CGC, the updated CVS text will be provided to the CGC Coordinator at the National Germplasm Resources Laboratory (NGRL). The updated CVS will then be posted on the GRIN-Global website for public access.

Following an initial update according to the outline below, the CVS might change relatively little from one year to another, but considerably over a multi-year time span. CGCs should conduct a more comprehensive assessment of current conditions every five or so years, focused particularly on updating CVS sections 2 and 5.

Maximum page lengths are suggested for the different sections of narrative text. Additional information in the form of text, tables, illustrations, etc. could be included as appendices to the narrative text.

Crop Vulnerability Statement Outline

Summary of key points (1 p. maximum)

1. Introduction to the crop (2 pp. maximum)

1.1 Biological features and ecogeographical distribution

1.2 Genetic base of crop production

1.3 Primary products and their value (farmgate)

1.4 Domestic and international crop production

1.4.1 U.S. (regional geography)

1.4.2 International

2. Urgency and extent of crop vulnerabilities and threats to food security (4 pp. maximum)

2.1 Genetic uniformity in the "standing crops" and varietal life spans

2.2 Threats of genetic erosion in situ

2.3 Current and emerging biotic, abiotic, production, dietary, and accessibility threats and needs

2.3.1 Biotic (diseases, pests)

2.3.2 Abiotic (environmental extremes, climate change)

2.3.3 Production/demand (inability to meet market and population growth demands)

2.3.4 Dietary (inability to meet key nutritional requirements)

2.3.5 Accessibility (inability to gain access to needed plant genetic resources because of phytosanitary/quarantine issues, inadequate budgets, management capacities or legal and bureaucratic restrictions)

3. Status of plant genetic resources in the NPGS available for reducing genetic vulnerabilities (5 pp. maximum)

3.1 Germplasm collections and in situ reserves

3.1.1 Holdings

3.1.3 Genetic coverage and gaps

3.1.3 Acquisitions

3.1.4 Maintenance

3.1.5 Regeneration

3.1.6 Distributions and outreach

3.2 Associated information

3.2.1 Genebank and/or crop-specific web site(s)

3.2.2 Passport information

3.2.3 Genotypic characterization data

3.2.4 Phenotypic evaluation data

3.3 Plant genetic resource research associated with the NPGS

3.3.1 Goals and emphases

3.3.2 Significant accomplishments

3.4 Curatorial, managerial and research capacities and tools

3.4.1 Staffing

3.4.2 Facilities and equipment

3.5 Fiscal and operational resources

4. Other genetic resource capacities (germplasm collections, in situ reserves, specialized genetic/genomic stocks, associated information, research and managerial capacities and tools, and industry/technical specialists/organizations) (2 pp. maximum)

5. Prospects and future developments (2 pp. maximum)

6. References

7. Appendices (number and lengths at the CGC's discretion)

Summary of USDA/ARS Utilization of NRSP-6 Accessions, 2012

Baker, Dr. Barbara University of California
<bbaker@berkeley.edu> Plant Gene Expression Center, USDA
PHONE: (510) 559-5912 Albany, California 94710
FAX: ****
5 units shipped in 1 order/s

To understand late blight resistance gene regulation we comparatively analyzed the structure, expression and RNA silencing of late blight and other resistance genes in S. tuberosum (phureja) (provided germplasm) and other Solanaceae.

We used our bioinformatic pipeline (a comprehensive set of bioinformatic analyses tools) for analyses of our large and comprehensive sequence datasets of small silencing RNAs (micro (mi)RNA sand small interfering (si)RNAs) and mRNA transcripts from S. tuberosum (phureja), S. demissum, S. tuberosum, S. lycopersicum, N. benthamiana, and N. tabacum (including sRNA biosynthetic pathway mutants in different species).

We discovered new and conserved classes of miRNAs and as well as novel silencing RNAs that regulate late blight and other disease resistance genes across the Solanaceae. We determined the biogenesis pathways of these new classes of R-gene-regulating silencing RNAs. We identified novel mechanisms of silencing of R-genes and we identified potential silencing networks for R-genes and defense gene regulation. Additionally we discovered that introgression of a resistance locus from a wild species into a cultivated line can result in the loss of a microRNA locus that targets and regulates R-genes. We predicted that this may occur based on our previous work.

This work supports our proposal that RNA silencing facilitates evolution of complex multi-copy R-gene loci. Our work suggests that silencing of R-gene expression reduces the fitness costs associated with expression of multiple resistance genes that are associated with the generation of structurally and functionally diverse R-proteins for recognition of emerging pathogen effectors. Our work also supports the proposed role of silencing in fine-tuning R-gene expression following pathogen infection.

This work contributes significantly to our understanding of how silencing networks regulate disease resistance and suggest common mechanisms for crop protection.

Bamberg, Dr. John USDA, ARS
<john.bamberg@ars.usda.gov> Potato Introduction Station
PHONE: (920) 743-5406 Sturgeon Bay, Wisconsin 54235
FAX: 920-743-1080
1207 units shipped in 24 order/s

Bethke, Paul USDA, ARS
<paul.bethke@ars.usda.gov> Department of Horticulture
PHONE: (608) 890-1165 Madison, Wisconsin 53706

FAX: 608-262-4743
32 units shipped in 2 order/s

Brown, Dr. Chuck R.
<chuck.brown@ars.usda.gov>
PHONE:
FAX: 509-786-9277
(509) 786-9252
USDA, ARS
WSU Irrigated Ag. Research Center
Prosser, Washington 99350
36 units shipped in 3 order/s
One of the projects that we have pursued is the identification of Solanm species that could serve as a trap crop for pale cyst nematode, a quarantine pest in Idaho. Some of germplasm comes from Georgia, Solanum sisymbriifolium (Ss), for instance, some from The Charles Rick Tomato Collection at UC Davis, S. juglandifolium, for instance, and some from NRSP 6, S. circaeifolium, for instance. There is a lot of background work on Ss done in Holland for precisely this aim. I, in my role as a breeder, am developing Ss that is less prickly, quick to germinate, and late to flower. In addition, there is the characteristic that some genotypes of Ss produce only staminate flowers during the first period of flowering, which deters seed production. The strategy in Idaho is to sow Ss and manage the crop to reach a certain foliar mass and then kill it before fruits can develop. The idea is to reach a target root mass and distribution that will effectively impact the cysts and eggs, causing hatching of juveniles that will die without a host. Ss is a non-host for G. pallida. A group at the University of Idaho has been funded to find the genes in Ss responsible for hatch stimulation and non-host status. To this aim, I have been crossing Ss with S. suaveolens and S. americanum, which are good hosts for G. pallida. Seeds have been produced and will be grown and checked for hybridity using an informative SSR marker set that differentiates species in this group of the “spiny nightshades”. If hybridity is confirmed these F1’s will be backcrossed to the susceptibles to produce a segregating BC1. It has been found that Ss is highly resistant to Meloidogyne spp., Pratylenchus spp., and to Colorado Potato Beetle.

A second project has studied the ability to use a common set of markers to track resistance to Columbia root-knot nematode in introgression populations where the resistance gene is derived from S. bulbocastanum, S. stoloniferum ex-fendleri, and S. hougasii. In short, the markers are useful in all three breeding populations. This suggests that a common genome present in all three species harbors the resistance locus. This adds weight to the work of others that have shown the presence of homeologous genomes in such polyploid series. Interestingly, these species are in three separate Series now (Bulbocastana, Longipedicellata, and Demissa). Perhaps they should be placed in a single Series. It also suggests that S. bulbocastanum is a treasure trove for resistance genes which are extant also at higher ploidy levels. See Rodney Cooper’s report below.

Cooper, W. Rodney
<rodney.cooper@ars.usda.gov>

PHONE:
FAX: 509-454-5646
(509) 454-4463
Yakima Agricultural Research laboratory
5230 Konnowac Pass Road
Wapato, Washington 98951
94 units shipped in 1 order/s

I received 53 *Solanum bulbocastanum* and 41 *S. verrucosum* accessions in July of 2012 to screen the wild potato plants for resistance to the potato psyllid. These species were chosen because their native range overlaps with that of the psyllid.

Much of our time last winter was spent developing methods to accurately screen accessions for psyllid resistance. We completed initial screening of all *S. bulbocastanum* accessions and observed significant variation in host suitability for the potato psyllid. The accessions 283096, 243510, 243512, 275194, 275197, and 255518 exhibited strong psyllid resistance in initial studies whereas the accessions 25516, 347757, 365379, and 604073 appeared to be highly susceptible to psyllids. Assays to verify results of our initial findings on *S. bulbocastanum*, and assays to screen *S. verrucosum* have been delayed until next fall so that unrelated field studies can be completed.

Plants are being maintained for future assays. We will screen *S. verrucosum* plants for psyllid resistance, and confirm resistance among *S. bulbocastanum* and *S. verrucosum* using nymph development and survival assays. Please let me know if you need any further information.

Haynes, Dr. Kathy
<kathleen.haynes@ars.usda.gov>
PHONE:
FAX: 301-504-5555
(301) 504-7405
USDA, ARS - Vegetable Laboratories
10300 Baltimore Avenue
Beltsville, Maryland 20705-2350
217 units shipped in 3 order/s

Here you go:

ARS-Beltsville requested S. chacoense accessions to initiate a program on breeding for Nitrogen Uptake Efficiency which is related to root biomass. Also related to root biomass are drought and salinity tolerance.

So far, a few accessions of chc have been established in tissue culture and we are using tissue culture to measure the root biomass of these accessions under different N regimes (part of a U FL graduate student's PhD research).

A visiting scientist from Egypt recently completed his studies examining the salinity tolerance of these same accessions. He found some that were salt tolerant and some that were not. Using RT PCR he was able to identify genes involved in salt tolerance. The U FL cooperators will be evaluating these accessions in FL under high and low salt fields to verify tissue culture and genetic evaluations of salt tolerance.

We are also beginning to evaluate these same accessions for drought tolerance using tissue culture.

Jansky, Dr. Shelley
<shelley.jansky@ars.usda.gov>
PHONE:
FAX: 608-262-4743
(608) 262-8324
USDA - ARS
University of Wisconsin - Dept of Hort
Madison, Wisconsin 53706
660 units shipped in 8 order/s

A white paper was published as an outcome of the potato collection and germplasm utilization meeting in Lima, Peru, organized by the Global Crop Diversity Trust.

> Jansky, S.H., H. Dempewolf, E.L. Camadro, R. Simon, E. Zimnoch-Guzowska, D. Bisognin, and R. Simon, and M. Bonierbale. 2013. A case for crop wild relative preservation and use in potato (*Solanum tuberosum* L.). Crop Science. 53:1-9.

An improved molecular marker system was developed for detecting clones carrying Verticillium wilt resistance derived from the *Ve* ortholog.

> Uribe, P, S. Jansky and D. Halterman. 2013. Two CAPS markers predict Verticillium wilt resistance in wild *Solanum* species. Molecular Breeding. In press.

The germplasm release of clone M7 was published in AJPR. M7 is a long, russet, tetraploid clone that resulted from bilateral sexual polyploidization in a cross between *S. tuberosum* and *S. infundibuliforme*.

> Jansky, S.H., A. Hamernik, and Y.S. Chung. 2012. M7 germplasm release: A tetraploid clone derived from *Solanum infundibuliforme* for use in expanding the germplasm base for French fry processing. American Journal of Potato Research. 89:448-452.

Male sterility and stylar barriers were described in early blight resistant hybrids derived from *S. raphanifolium*.

> Weber, B., A Hamernik, and S.H. Jansky. 2012. Hybridization barriers between diploid *Solanum tuberosum* and wild *Solanum raphanifolium*. Genetic Resources and Crop Evolution 59:1287-1293.

Sarah Rosenthal Braun completed her Ph.D. thesis entitled "Quantitative Trait Loci Analysis and Breeding for Resistance to Common Scab in Potato." A major QTL for scab resistance and two major QTL for cold-induced sweetening resistance were found in an F2 population derived from crossing susceptible haploid US-W4 to the resistant inbred *S. chacoense* clone 524-8. Efforts are underway to develop PCR-based markers for these QTL. The diploid scab resistant F2 clone 4-48 produces 2n pollen and 2n eggs, and has been crossed as a male and female to four cultivars. Offspring are being evaluated in replicated field trials in Michigan (Douches), Pennslyvania (Haynes) and Wisconsin (Gevens).

A candidate gene for calcium uptake in tubers of a *S. microdontum* x *S. kurtzianum* F2 family was evaluated (Yong Suk Chung, Ph.D. candidate). Members of the candidate gene family CAX have been tested for association with tuber calcium levels. A marker within the CAX3 gene explains 33% of the phenotypic variability in the F2 population.

Predictivity of taxonomy and biogeography for late blight resistance was evaluated (Alexander Khiutti, visiting scientist, St. Petersburg, Russia).A collection of 143 accessions representing 34 wild *Solanum* species was screened for foliar late blight resistance using whole plants and for tuber late blight resistance using greenhouse-generated tubers. Data analysis is underway.

Meyering, Bryce USDA, ARS - USHRL
<bryce.meyering@ars.usda.gov> 2011 South Rock Road
PHONE: (772) 462-5927 Fort Pierce, Florida 34945
FAX: ****
35 units shipped in 1 order/s

Navarre, Dr. Duroy A. USDA, ARS - Washington State Universit
<roy.navarre@ars.usda.gov> Department of Plant Pathology
PHONE: (509) 786-9261 Prosser, Washington 99350
FAX: 509-786-9277
9 units shipped in 1 order/s

Novy, Dr. Richard USDA, ARS
<rich.novy@ars.usda.gov> University of Idaho R&E Center
PHONE: (208) 397-4181 Aberdeen, Idaho 83210-0530
FAX: (208) 397-4311

16 units shipped in 2 order/s
During the past year, three *S. microdontum* families representing 30 individuals that had been identified as having non-greening tubers in the presence of light, were used as parents in hybridizations in our program. Research regarding the identification of non-greening tubers among *Solanum* species had been conducted and reported by NRSP-6 due to tuber greening being a problem in grocery stores with green fresh-pack potatoes being discarded. Non-greening tubers would be of benefit for the fresh-pack industry, with a subsequent request of that germplasm from NRSP-6 for use in our breeding program. In addition, Sakai 35, Japanese potato germplasm notable for having PVY resistance derived from R*ychc* was requested for use a parental material in 2014 to diversify the Aberdeen potato breeding program's sources of extreme PVY resistance, with extreme resistance from R*ysto* and R*yadg* currently being utilized in the program.

Romano, Dr. Gabriela USDA, ARS
<gabriela.romano@ars.usda.gov> National Arid Land Plant Gen Res Unit
PHONE: (559) 596-2980 Parlier, California 93648
FAX: (559) 596-2981
20 units shipped in 1 order/s
We regenerated 14 accessions of potatoes for John Bamberg as a service to his germplasm bank. He sent seeds from crossings and transformed plants. We grew them in the greenhouse and sent the tubers back to him.

Suttle, Dr. Jeffrey USDA-ARS-NCSL
<jeff.suttle@ars.usda.gov> Sugarbeet & Potato Research Unit
PHONE: (701) 239-1257 Fargo, North Dakota 58102-1257
FAX: 701-239-1349
1 units shipped in 1 order/s

Respectfullly Submitted, Charles R. Brown, June23, 2013

Report to NRSP-6 Technical Committee, July 2013

Northeast Region Representative: Walter De Jong

The Northeast region received 167 units of germplasm, spread across 14 requests, in 2012.

Sixty of the accessions were sent to researchers at land grant universities. Three accessions were sent to a large US company. Eighty 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 24 accessions were distributed to seven individuals interested in one or more specific varieties for home gardening, or for hobby breeding.

NRSP-6
Sturgeon Bay, Wisconsin
June 25, 2013
CETS Perspective

CETS Controlled Environment Phytotrons

- Designed to rapidly produce potato tubers (AstroTubers™)
- Best suited for seed
- Patented technology
- Sold and fabricated to order
- Includes user training and technical support

CETS technology offers the following advantages:

- Cost effective propagation using plant cuttings
- Small footprint yet eliminates the need for Greenhouses
- Generates therapeutic protein from large scale plants

Effectively, without modification, each phytotron is a molecular farming facility.

As one example, potato tubers can be used as biological media to generate drugs that would otherwise be difficult or expensive to produce by other means.

Production of other crops can be developed by special order.

www.cetstech.com

Key Features of the CETS AstroTubers™ Production System:

- Yields zero pathogen potato nuclear stock (AstroTubers™)
- Requires planting of stem cuttings
- Thousands of AstroTubers™ from a single plant
- Output every 60 days
- 6 growth cycles possible every year
- Controlled environment phytotrons operation is climate and season independent
- Unique software for programming optimal environmental conditions *by cultivar*
- Small production space requirements
- Economical operation and production costs
- Initial field multiplication starts with high quality disease–free AstroTubers™

CETS Technology Facilitates:

- Early field evaluation of new potato cultivars
- Rapid multiplication of new potato cultivars to commercial quantities
- New cultivar back-crossing program – 2 or more generations per year
- Production of either organic or genetically modified materials

CETS Operational Economics

Year 1

30 Plantlets

2 Phytotrons (56 Sq Ft Growing Area)

312 Labor Hours (2 hrs 3X each week for a year)

$1260 Electricity (@ $0.07 / kwh)

$400 Media & Nutrients

↓

15000 AstroTubers™ (1/2” to 1+”)

↓

Year 2

1 Acre Planted On 3’ X 1’ Centers

↓

350+ cwt (FG1)

↓

Year 3

10 Acres Planted

↓

4000+ cwt (FG2)

Pictures From A Prior Year FG1 Planting (Same Variety After 1 Month)

Conventional

AstroTuber™

Special Thanks from CETS LLC to the US Genebank for filling our orders and supplying plants from your collection that otherwise are not available at any other institution in the USA.

This enables CETS to demonstrate our technological viability to international clients before they purchase our technology.

For additional technical information, please contact Dr. Raymond Bula, inventor of the CETS Phytotron: RJB78720@TDS.NET or 608-798-3772

To schedule a visit to the CETS facility in Grand Marsh WI, please contact Janina Petrick: J_Petrick@GBMS.US or 262-246-1799

www.cetstech.com