**Point-by-point response to Review Committee “5-questions”**

**August 10, 2010**

**Sent:** Tuesday, June 29, 2010 9:01 AM
**To:** bbrancel@cals.wisc.edu; Curtis, Larry; Edward Ashworth; Dr. Craig Nessler
**Cc:** Thro, Ann Marie; Bamberg, John; escop-nrsp@lists.ncsu.edu
**Subject:** NRSP6, The US Potato Genebank

To:          Ben Brancel, Larry Curtis, Edward N. Ashworth, Craig Nessler

From:      Mike Vayda, NRSP Review Committee Chair

The NRSP Review Committee met on June 8-9, 2010 and discussed your proposal for the National Research Support Project, NRSP\_temp 006, *The US Potato Genebank: Acquisition Classification, Evaluation and Distribution of Potato (Solanum) Germplasm*.  The committee agrees that the proposed activity is a high priority but had some critical questions on points that were unclear in the proposal.  Therefore, the committee requests a revised proposal addressing the following five questions by **August 1**.  This will allow the committee to finalize its recommendation concerning the proposal and corresponding budget request to the Experiment Station Section during our conference call in mid-August.  The proposal revision should address these specific questions:

1.      The Peer Review report raises a question about the lack of specific types of milestones.  The response to this comment by NRSP-6 was inadequate;  the Review Committee is in agreement that a strategic plan with specific milestones is essential for the viability of the facility.  The Committee understands the rapidly changing resource and policy climate but also feels that NRSP-6 should be able to identify more specific milestones for the five-year period of the proposal against which progress could be measured.

Response: Appendix J (p. 35) now lists those yearly milestones.  These milestones are prefaced with the note to also refer to Section C., Implementation, C.1.a.i., ‘Plan for future activities’, p. 8-9 of the proposal and Appendix B, ‘Accomplishments’ which we affirm also may be regarded as a quantitative measure of expectations for the next term:

**MILESTONES for service to SAES scientists**1

*Revised 07 20 10 pursuant to RC questions #1, #3 and #4*

*(see also* *Section C., Implementation, C.1.a.i., ‘Plan for future activities’, p. 8-9 of the proposal. Appendix B, Accomplishments also provides a reasonable quantitative measure of expectations for the next term).*

**Each year, FY11-15**

1) Conduct a study to identify, acquire and advertise availability of new cultivars and wild relatives of potato that would be of most use to SAES customers.

2) Plan and conduct one collecting trip to the southwest USA.

3) Consult with the four Technical Representatives who will have surveyed SAES customers in all states in their respective regions, then pool, prioritize, and implement ideas for improving service and customer satisfaction.

4) Multiply at least 200 populations, 900 in vitro stocks and 70 tuber families; with associated 800 virus and 1000 germination tests in order to support rapid and complete SAES access to vigorous, disease-free samples of genebank holdings.

5) Process all orders within one week of receipt.

6) Update inventory and health status records of all germplasm on GRIN.

7) Update website and contact customers announcing germplasm and other news three times per year.

**FY11**

(this addresses *NRSP-RC questions #3 and #4* regarding other sources of support)

8) During FY11, genebank staff will work with UWisc administration and the TAC to gather information pursuant to: a) a proposal for fees for services, and b) potential mechanisms for state, industry and private support of the genebank. These will be discussed and moved to action at the 2012 Technical Advisory Committee meeting [also addresses R. Cavalieri phone remarks 07 23 10].

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1 these yearly milestones mesh with and efficiently reinforce those of the corresponding USDA/ARS genebank project 3655-21000-051-00D “Conservation and Utilization of Potato Genetic Resources”

2.      The proposed 5-year flat budget is not realistic given anticipated increases in salaries, wages, etc.  The proposal does not include a plan for addressing cost increases.  There does not appear to be any other means to support such increases.  Will activities be eliminated  over time to match activities with resources?  The committee would like a better understanding of a plan for maintaining viability of the facility.

Response: We revised Appendix I to show a progression of 2.8% salary increases and corresponding declining supplies for a $150K total.  Salary increases are shown in the ARS side without loss of non-salary inputs.   We do not know if that is realistic, much less have a guarantee that ARS inputs can increase to compensate for a flat NRSP6 over the 5-year term.   If cuts are needed, they will be made according to rational germplasm conservation priorities, e.g., in a  pinch, it is more important to preserve than evaluate:

**c. BUDGET REQUESTS SUMMARY**

**FY11-15**

**NRSP6 - the US Potato Genebank:**

**Acquisition, classification, preservation, evaluation and distribution**

**of potato (*Solanum*) germplasm**

*See also Appendix I, Section b above for introductory comments*



Assuming 2.8% salary increases.

***UW to continue contributions of facilities, utilities & related services estimated at not less than $40K in FY10 dollars.***

Direct salary support by UW discontinued at start of FY09.

3.      The budget plan includes funding from the MRF and ARS.  It includes no other sources of funding including in-kind support from U of W, SAES’s and industry.  What is the total amount of funding available for the acquisition, classification, preservation, evaluation and distribution of potato germplasm?

We confirmed the estimate U of W given as a footnote to the budget table on p. 32: “UW to continue contributions of facilities, utilities & related services estimated at not less than $40K in FY10 dollars” (see above). We do not have commitments of other SAES or industry support for FY11-15, but, of course, do intend to continue to seek such extramural funds.

4.      The NRSP-RC asserts that it is appropriate to ask commercial users of NRSP-6 services to pay for those services.   It is argued that these services are important to the industry being served and it is not made clear in the proposal  why the industry would not be willing to pay for them.

We lack the information and mechanism to implement charging for services at present, but created a milestone for FY11 to make a good faith study and plan for application in FY12 (see abov e).

5.      Appendix G provides some information on the impact of the program.  Can NRSP-6 provide or describe how they will provide more specific quantifiable documentation of its impact on the industry?

We added to Appendix J with enhanced general impact statement (p. 36-), a narrative of specific SAES impact (p. 38-), a table documenting SAES research output based on publications (p. 41), and tables detailing germplasm distributions to SAES and related workers in comparison to other domestic and foreign recipients (p. 42-), (see below):

US Potato Genebank, NRSP6

*Revised 07 20 10 pursuant to RC question #5*

 GENERAL IMPACT STATEMENT

Potato is the number one US and world vegetable in terms of production, value, and consumption. Considering its high satiety index and palatability, and its balanced protein, wide adaptability, and high productivity, it will play an increasingly important role in providing food security in developing countries and delivering new health-promoting nutrients to diets worldwide. Such food and health benefits carry with them a great economic impact, *even in areas where potatoes are not grown*. Annual healthcare cost of obesity is about $147B. In 2009 we started working with Kemin company to improve the yield of PI2, a safe and effective appetite suppressant from potato. Cancer costs the nation about $90B. With cooperators R. Navarre and C. Miller we made progress in identifying anti-cancer potato germplasm (*jamesii* antiproliferation and high tomatine *okadae*) for use in breeding. Stroke is the 3rd leading cause of death in the USA, the leading cause of disability, and costs $43B annually. Hypertension promoted by sodium is a prominent risk factor. Estimates indicate that a high potassium diet would reduce hypertension and avert 100,000 deaths each year and $12B in annual healthcare costs would be saved. In 2009 we prepared test samples and arranged funds and cooperators for screening for high potassium germplasm. The total US cost of just these three diseases each year is about 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. With R. Navarre, we also identified a *phureja* clone with extremely high antioxidants, well-known for their health-promoting effects. With the high per capita consumption of potato, and a genebank with the world’s most diverse and available source of new genes and germplasm information, NRSP6 is well positioned to support such contributions.

Beyond providing stocks, NRSP6 staff members are involved in discovering and developing associated germplasm tools and information. Among these are self compatibility, gibberellin, and 2n gamete mutants; cut-stem pollination, hormone pre-treatment of seeds for better germination, haploid-extracting pollinators, and 2n gamete breeding technique. Yukon Gold, one of the most popular and name-recognized tablestock cultivars, has *S. phureja* 195198, an exotic cultivated species from NRSP6 as a grandparent, and was bred using the 2n gamete technique.

Evaluation for a wide variety of useful traits has also been designed, contracted and documented by staff. Such work is the foundation for deploying exotic genes in new cultivars. One recent example is the release of cultivar PA99N82-4 bred with the Mexican wild species *S. bulbocastanum* from NRSP6. It has high resistance to nematodes that can only be controlled by fumigation at an estimated cost of $20M per year, not counting the “cost” in risks to human and environmental health posed by use of toxic chemicals.

The genebank goal is maximum diversity. But because funds for collecting, preserving, distributing and evaluating are limited, reaching that goal depends on maximizing efficiency through quality control and technology R&D. Thus, we collaborate with other world genebanks to study the partitioning and vulnerability of diversity in our collections. Examples of impact of this area are the intergenebank potato database, identification of more diversity-intense sites for future collecting, and confirming that the rare alleles within some populations within certain species are not explained by introgression of alleles common in another sympatric species.

One way the overall impact of these contributions can be measured is by the occurrence of NRSP6 germplasm in the pedigrees of new, improved potato cultivars. About 70% of all potatoes grown in the US have germplasm from the genebank in their pedigrees. Both cultivar releases published in the American Journal of Potato Research in 2008, ‘Premier Russet’ and ‘Dakota Diamond’, have exotic species from NRSP6 in their pedigrees. The great-grandmother of the latter is *S. chacoense* 472812, a wild potato species originally collected in Argentina.

Another gauge of impact is in the numerous publications in 2009 providing information that pushes potato science forward. In 2009, 51 papers, 18 abstracts, and 4 theses reporting the results of studies associated with NRSP6 *Solanum* stocks were recorded.

The impact of the genebank is expected to increase in the future for several reasons. 1) Mutants discovered and characterized by staff will be increasingly valuable as research models. 2) Intragenic transformation of potato has now been demonstrated and identified as a kind of GMO much more accepted by the consumer, so useful exotic potato genes will be increasingly valuable as the technology to easily insert them into existing cultivars improves. 3) Potato is rapidly expanding in large new growing regions, so the need for genetic resources for breeding in new environments and for new tastes will surge. 4) Loss of wild habitats and other limits on collecting will make it even more important to understand how to efficiently keep what we already have—thus, enhancing the importance of in-house R&D on the partitioning and vulnerability of diversity. 5) The revolution in electronic information exchange gives NRSP6 an opportunity to provide more complete and timely germplasm data, advice, and stocks, and detect and develop opportunities for new traits and germplasm applications. 6) Potato genetic resources will be increasingly mined for nutritional traits that reduce healthcare costs and suffering as evaluation and breeding technology advances.

**SPECIFICS OF NRSP6 GERMPLASM IMPACT**

 **ON SAES SCIENCE**

[In response to R. Cavalieri phone remarks of 07 23 10]

Below are highlights of regional narrative reports of NRSP6 germplasm use (from NRSP6 TAC meeting reports 2006-2009). This is followed by a table summarizing the number of peer reviewed publications recorded in Annual Reports 2006-2009 for selected state scientists by Region (full details available on genebank website).

These show germplasm research is promoting advances of knowledge and improved cultivars *which would not be possible if NRSP6 germplasm were not available to SAES scientists*.

**WESTERN**

**Tristate program** involves several OSU, UI, and WSU scientists and breeders who are working with ARS colleagues to use NRSP6 germplasm to improve many potato traits: corky ring spot, nematodes, antioxidants, black dot, iron content, tube worm, PVY, late blight.

**Amyeric Goyer** (OSU) testing NRSP6 stocks for Thiamine and Folate 2009 and 2010.

**Isabel Vales** (OSU) used genebank stocks for PVY, late blight resistance, value added potatoes (antioxidants, colorants, etc.). Used two sources of resistance to PVY (*stoloniferum*, and  *andigena*) and MAS.

**NORTH CENTRAL**

**James Bradeen** (UM): Characterizing *verticillium* resistance in *polyadenium* potato somatic hybrids in the field and in the greenhouse. Resistance Gene Diversity Assessment: completed optimization of LR-PCR for recovery of RB (late blight resistance) alleles from genomic DNA of *bulbocastanum*. R gene genetics and comparative genomics, isolating more than 120 candidate resistance genes from *bulbocastanum*. Herbicide Tolerance: used ten primitive (1EBN) potato species to establish herbicide usage guidelines for field research. Using material from the NRSP-6 potato genebank to study avirulence proteins of late blight using *demissum* derivatives.

**Christian Thill** (Univ Minn):Genetic diversity for many traits having economic importance is being found. Resistance to late blight 13 Mexican and South American species was evaluated. Reported that male fertility and the production of 2n pollen was sufficient to facilitate introgression of resistance to cultivated potato. Manipulated ploidy (*pinnatisectum*) for hybrids to cultivated potato. Using South American germplasm, reported resistance to both tuber worm and blight, and proposed a breeding strategy to co-introgress both traits from the wild potato species. Also working on scab and virus resistance using NRSP6 germplasm.

**David Douches** (MSU) has a diploid breeding program for germplasm enhancement involving seven species from the genebank*.* For late blight, working with *microdontum* and *berthaultii*, *verticillium* resistance (*S. chacoense*), and Colorado potato beetle resistance. Michigan will soon release a cold chipper (*tarijense* and *phureja* are in its background). Evaluating a diploid population for Colorado Potato Beetle resistance. Also evaluating *microdontum* selections for tuber late blight resistance in cooperation with genebank staff, and have identified a potent R gene. Germplasm is being evaluated for ornamental potential. Looking for natural genetic variation for PVY resistance and the great potential for intragenic transformation developed by Simplot for using potato genes mined from the NRSP6 genebank stocks. Also using NRSP6 stocks for light chip color directly from field and after storage, dormancy, scab resistance, tuber moth. Douches and De Jong (Cornell) lead a SolCap grant that uses NRSP6 germplasm and involves many SAES scientists.

**Jiwan Palta** (UW) traits of interest include: cold chipping (*raphanifolium*), late blight (*bulbocastanum*), tuber calcium (*microdontum, kurtzianum*), pH involved with glycemic index, acrylamide formation, quality (25 species), vitamin content, cold tolerance (*acaule, commersonii*), anti-cancer (*okadae*), potassium (*phureja*), tuber dormancy (*jamesii*). The Wisconsin program is a closely integrated with the genebank's evaluation mission.

**Susie Thompson** (NDSU): Using NRSP6 stocks for breeding resistance for jelly end, ring rot, late blight, cold chipping—found that *verrucosum* has a gene complementary to the RB gene for late blight resistance. Used *demissum* and *chacoense* to hybridize with *tuberosum* to enhance disease, pest and stress resistance in breeding lines and potential releases, and also to improve quality traits, including processing qualities. Several hybrids are at various stages of early generation selection.

**David Hannapel** (Iowa State): Optimize stable, transgenic expression systems in select native Andean cultivars obtained from the genebank (*andigena, chaucha , stenotomum*) that eliminate unwanted marker DNA. Also working on genetics and physiology of tuberization.

**NORTH EASTERN**

**The NE breeding effort** has involved scientists from Penn State and Univ Maine cooperating with ARS Beltsville and the NC and NJ programs, studying many traits from NRSP6 germplasm (particularly *phureja* and *stenotomum*). New variety releases almost always have NRSP6 germplasm in their pedigrees.

**B. de los Reyes** (Univ Maine) used 15 wild species accessions screening for drought, salinity, and CPB resistance screening.

**Walter DeJong** (Cornell) uses germplasm for association analyses for shape, pigmentation, and carbohydrate metabolism.

**SOUTHERN**

**J. C. Miller, Jr.** (TAMU) uses genebank stocks for breeding and research. Found very high levels of antioxidants in *microdontum* and *pinnatisectum*, andshowed importance of GxE. Working on use of exotics to combat Zebra Chip complex, and genebank-developed mutant to study genetic basis of sports of Russet Norkotah. Has found strong anti-prostate cancer properties in extracts of the USA species *jamesii* from the genebank.

**Craig Yencho** (NCSU) is breeding for resistance to internal heat necrosis with exotic potato germplasm (*phureja*). A wild species (*chacoense*) is being used for Colorado potato beetle resistance breeding. Also exploring the potential of NRSP6 germplasm as ornamentals.

**Richard Veilleux** (VPU) created doubled monoploids (*phureja*) from the genebank which are the basis of the potato genome sequencing project, and is using NRSP6 germplasm to examine the inheritance of glycoalkaloids.

**Jeff Davis** (LA State Univ). Used 25 genebank accessions for Electrical Penetration Graph studies to determine the nature of the aphid resistance; antixenosis or antibiosis.



NRSP6 Distribution Detail Tables 2000-2009

a. Summaries:

USA University recipients



USA Non-University recipients



Foreign



TOTAL

b. University recipient: Region detail **NCR**



c. University recipient: Region detail **NER**



d. University recipient: Region detail **SR**



e. University recipient: Region detail **WR**



f. Distribution summary: **USA non-University**



g. Distribution summary: **Foreign**



Please forward this memo to other individuals involved in development of this proposal and subsequent revisions.  If you have any questions, please contact Ralph Cavalieri, the incoming NRSP Review Committee Chair (509-335-4563, agresearch@wsu.edu) or Dan Rossi (732-932-9375, x337, rossi@aesop.rutgers.edu).  Thank you.

cc: NRSP Review Committee