NRSP6
PROJECT RENEWAL PROPOSAL

for FY 2011-15

**NRSP6 - the US Potato Genebank:**
**Acquisition, classification, preservation, evaluation and distribution of potato (*Solanum*) germplasm**

**Requested Duration:** FFY 2011-2015
**Administrative Advisor:** Molly Jahn
**CSREES Representative:** Ann Marie Thro

# Executive Summary

As the most consumed and most valuable US vegetable, potato substantially influences the farm economy and environment in many states. High value-added processing and high and regular consumption gives potato significant impact in all states with respect to the food economy and citizens' health. For these reasons, and because potato has more useful exotic germplasm than any other crop, there is much activity in federal and state breeding and research programs. NRSP6 is the only program in the nation responsible for providing potato genebank services. NRSP6 is the premier potato genebank in the world. This document details robust accomplishments over the past 5 years despite eroding inputs. Requests for NRSP6 germplasm were strong and were promptly filled. We not only preserved the materials, but conducted R&D that showed ways to make genebank techniques more efficient. We also discovered and characterized novel mutants/traits that will help users better exploit potato germplasm. We propose that the new project will place an increased emphasis on consumer-oriented traits, particularly nutritional ones. With some estimating that 1/3 of GDP will be spent on healthcare in the future, there is hardly a more important problem before society, and there are many unexplored opportunities for use of NRSP6 germplasm to address it. Recent restrictions on international germplasm collecting and sharing make what we already have at NRSP6 even more precious. While NRSPs are to transition to other funding sources, inputs from other partners have declined. Thus, we are asking for continuation of $150K per year in MRF funding. This proposed continuation of longstanding flat MRF funding represents a loss of buying power that will necessitate further streamlining/reduction of staff and germplasm evaluation projects and more efficient management unless we can backfill with grants. Virtually all crop germplasm in the National Plant Germplasm System is genebanked in partnership with SAES. We believe that NRSP6 is a particularly good investment for MRF. It leverages about an 8-fold contribution of ARS, APHIS, UW and grant dollars by partner programs. NRSP6 gives SAES ownership of a renowned genebank for one of the nation's main food crops.

## A. PREREQUISITE JUSTIFICATION AND STATEMENT OF ISSUES:

### A. 1. How is NRSP6 service consistent with the NRSP research support mission?

a. NRSP6 is the only practical source of potato germplasm for US researchers and breeders:

NRSP6 is designated the sole official NPGS project filling the role of working potato genebank for the US. A good way to understand the importance of NRSP6 is to imagine the situation if no genebank was present for an individual researcher wanting to use exotic potato relatives. He would first need to study taxonomic boundaries to understand his material and how it related to cultivars. He would need to determine breeding system, requirements for growth, and interspecific crossing. If it did not exist in the US or he could not find or obtain it from a fellow US researcher, he would need to organize an expedition to Latin America. Since potato is a "prohibited" plant for import, he would have to negotiate APHIS quarantine and wait one or two years. When finally in hand, would he propagate the germplasm disease-free, and advertise it for sharing with all potato researchers worldwide? NRSP6 does and coordinates all these things for the potato research community, avoiding the confusion, inefficiency and costs associated with duplication of these efforts by many individuals.

b. NRSP6 provides enabling technologies and materials.

1. *Germplasm stocks*. As described above, providing the germplasm itself enables advances in potato research and breeding. In the past project term NRSP6 has met this need by freely and promptly distributing materials and doing the associated work that supports these distributions. Accomplishments for past project term are detailed and quantified in Appendix A.

2. *Germplasm data*. NRSP6 provides users with a central source of current germplasm information: What is available in US and globally, taxonomic relationships, natural origin, characterization and evaluation data with respect to useful traits. To do this NRSP6 must also develop and maintain acquisition; classification; seed increase, inventory, disease status and distribution data. Accomplishments for past project term are detailed and quantified in Appendix B).

3. *R&D for best techniques and tools for germplasm collecting, preservation, and evaluation*. Diversity is the goal, but while the scope of potential diversity we could collect and keep is virtually unlimited, genebank funding is not. Thus, R&D that characterizes diversity richness and enables the most efficient techniques for collecting and preservation is of great importance for our own genebank and others worldwide. NRSP6 has become the world leader in developing such information and tools by examining specific practical questions with DNA markers, often using materials from collecting expeditions organized and conducted by genebank staff. In the past project term, NRSP6 has devised techniques for germplasm handling like optimal seed germination, and plant care, as well as discovery, characterization, publication and distribution of novel useful mutants such as genetic stocks, hormone deficient mutants, absolute sterile floral development mutants, inbred lines, interspecific hybrid bridging stocks, and extreme tuber dormancy standards. Accomplishments for past project term are detailed and quantified in Appendix C.

4. *Custom materials for germplasm evaluation*. It would not be appropriate for genebank staff to specialize in any one evaluation discipline. Instead, genebank staff expertise in germplasm genetics and handling is used to devise studies, then select and prepare materials for testing in partnership with various extramural scientists with the specific expertise and infrastructure for generating the data. Accomplishments for past project term are detailed and quantified in Appendix D.

5. *A platform to leverage associated USDA, Wisconsin, Intergenebank and Grant support*. The genebank's federal component is linked with USDA/ARS Vegetable Crops Research Unit scientists who contribute potato classification (D. Spooner), pathology (D. Halterman), physiology (P. Bethke) and germplasm evaluation and enhancement (S. Jansky). The genebank's Wisconsin component also supports significant contributions of the UW potato breeding and research (J. Palta) programs. Germplasm responsibilities are shared through partnerships with potato genebanks in other countries. D. Spooner developed collaboration with VIR scientists in Russia, resulting in important progress in taxonomy and characterization of germplasm. Genebank staff also initiated cooperative work in Peru with CIP to create and characterize frost tolerant hybrids using exotic germplasm, germplasm responsive to calcium fertilization (resulting in up to 60% yield increases to primitive farmers), to examine best collecting methods, and to examine the effects of agrichemicals on wild potato populations. Accomplishments for the past project term are detailed and quantified in Appendix E.

**A. 2. How does NRSP6 pertain as a national issue?**

NRSP6 is an important national project because there is widespread relevance, need and use of potato germplasm, and, the genetic improvement of potato as a food has great potential to bring broad-based and significant *national health and economic benefits*.

a. Widespread relevance, need and use of potato germplasm. Potato is the most widely grown and consumed vegetable in the US and world, being among the most palatable and versatile of foods. World production is growing at about 4% per year, more than that of rice, wheat or corn. Potato accounts for 28% of all vegetable consumption in the US. About 70% of the crop is processed at great economic added value. A production value in the US is over $3B, with values for states shown in Appendix F.

Exotic germplasm has great genetic impact and opportunities. More exotic germplasm is available and used for potato than for any other major crop. Over 70% of potato varieties grown in the US have germplasm in their pedigrees from the genebank, and all varieties released in the past five years do. Appendix G details some of the past breeding accomplishments. Some estimates have been made of the economic return from germplasm utilization. About 50% of the four-fold advance in potato yields have been due to genetic improvement and about 1% of annual value of all crops may be credited to exotic germplasm. Pro-rated, this is a total of $10-25 million per year for potatoes in the USA. It would be a tragedy to let the flow of NRSP6 germplasm to breeding efforts dwindle because: 1) To see the benefit of NRSP6 germplasm in new, conventionally-bred cultivars 10-15 years from now, we must continue to put it in the pipeline now, and 2) Since we will soon be able to rapidly identify valuable genes in exotic potato and efficiently move them into popular existing cultivars *already having consumer* *acceptance*, the discovery and characterization of NPSP6 traits/genes is an investment with a payoff that is poised to mature with a many-fold increased return.

Numerous germplasm users. Not all states have extensive direct involvement in potato research or breeding, and not all states have large potato crop acreages. Some states, particularly those of the NCR do more of the type of broad, preliminary screening research that uses large number of germplasm items from the genebank. But all regions and many foreign countries are actively using NRSP6 stocks (see Appendix A). The benefits of NRSP6 activities by potato states by no means stay within their borders. Private breeding companies like Frito-Lay and Simplot are heavy users of NRPS6 germplasm and are involved in potato crop management and production, processing, and sales in all regions (Appendix G). *Every* state has a significant and direct involvement in marketing, transportation and consumption of potato as a major part of the diet of its population. Scientists in every state benefit from advance of knowledge published by researchers using NRSP6 germplasm (Appendix B lists 96 publications by NRSP6 staff in the past 5 years, and another 553 by cooperators are listed on the NRSP6 website).

b. The genetic improvement of potato as a food has unmatched potential to bring broad-based and significant n*ational health and economic benefits*. Two thirds of Americans are overweight or obese, costing society an estimated $147B per year, with associated diabetes costs (medical treatment and lost work time) of over $174B per year. Increased potassium intake would prevent an estimated 100,000 annual deaths due to sodium-induced high blood pressure, not to mention mitigate non-lethal strokes that are the leading cause of chronic, severe disability. Cancer has surpassed heart disease as the leading cause of deaths of all individuals except the very old, at an annual estimated cost to society of $210B. Aging baby-boomers are expected to exacerbate these already severe challenges to national health and insurance costs. We are spending nearly 20% of GDP on healthcare costs, a 4-fold increase in just a couple of generations. Because potato is the most highly and regularly consumed US vegetable, NRSP6 has opportunity to enable significant contributions toward reducing these problems.

In the current project term, we found plants in one species with levels of antioxidant much higher than any previously tested in common potato. Similarly, extracts of another potato species were shown to significantly inhibit the growth of colon and prostate cancer cells. We discovered anti-cancer alkaloids in a new, breeding-friendly species. We are pursuing broad screening for anti-appetite chemicals to address obesity, tuber potassium to lower blood pressure, and pH to potentially reduce glycaemic index and acrylamide. Most of these studies were initiated by NRSP6 staff who produced custom materials for testing by cooperators (see Appendix D).

Evaluation efforts in the past project term have moved toward an emphasis on nutritional traits and other factors that enhance desirability at the consumer level. *The new project will continue this course, pursuing improvement of potato as a food, thereby increasing relevance to all states with potato consumers, not just the predominant potato breeding and growing states.*

## B. RATIONALE FOR NRSP6:

### B. 1. Relationship to Priorities Established by ESCOP (Science Roadmap)

<u>Challenge 1</u>. *We can develop new and more competitive crop products and new uses for diverse crops and novel plant species.* This is the heart of what NRSP6 aims to promote. Genetic diversity of the exotics at NRSP6 represents the potential diversity of improvements in productivity, quality and resource use efficiency realized in new cultivars.

<u>Challenge 3</u> . *We can lessen the risks of local and global climatic change on food, fiber, and fuel production.* Potato is cultivated across a broader range of latitudes than any other major crop. Thus, the effects of climate change could be different in different growing regions, and require the screening for multiple new traits in exotic germplasm which can be incorporated into the crop. Potatoes also exist in nature in a great diversity of ecological niches, so the impact of climate change on in situ genetic diversity may be variable and call for especially close monitoring of how diversity in the genebank represents that which exists in nature. For example, changes in natural selection pressures may also implicate the need for re-collecting done by genebank staff.

<u>Challenge 4</u> . *We can provide the information and knowledge needed to further improve environmental stewardship* Research supported by NRSP6 will continue to find ways to make a crop that is more efficient at using fertilizer and water inputs and can naturally resist pests and diseases. That means less impact on the environment through less production and use of pesticides.

<u>Challenge 5</u> . *We can improve the economic return to agricultural producers.* This can be achieved through lower input costs keeping all other factors steady. Or, quality can improve to support higher prices at the same market share. Or, yield can improve with expansion of both potato's unit value and market share so current prices are not depressed due to overproduction. <u>As described in detail above, the evaluation function of the new project will be geared toward nutritional and other consumer-impact traits that will increase demand for potato, thus increasing profitability for farmers and better health for consumers.</u> The optimal scheme for the potato crop is to use germplasm to make gains in all three areas: less input costs, higher yield per area of land, and higher quality. Other initiatives that will contribute to these general goals are increasing *net* yield by reducing storage losses, and capitalizing on virtual demand by removing the physiological limits to potato production due to the climate, diseases and pests.

<u>Challenge 6</u> . *We can strengthen our communities and families.* NRSP6 can have an impact on primitive farmers in developing countries who could improve their standard of living and maintain their culture because germplasm inputs gave them a more marketable and nutritious crop (by increasing frost tolerance for high altitude farmers, for example). Food security in developing countries often has a favorable influence on political stability, which reduces the money US citizens must spend to maintain international relations and foreign aid. A healthy populace can also have a higher standard of living due to more productivity and less need to spend the profits from that productivity on insurance, medical care and government intervention programs.

<u>Challenge 7</u>. *We can ensure improved food safety and health through agricultural and food systems.* As already mentioned, improved potato has outstanding potential to have a significant health and nutrition impact on a population basis because it *already has a regular, high level of consumption* across all demographic categories in the US. Compare, for example, to blueberries

which have famous levels of antioxidants per serving, but are very expensive, and are eaten only in small quantities and irregularly. Potato has had obvious appeal—it is relatively cheap, good-tasting in many forms, and filling. Because 1.5 M acres of potato are cultivated in North America and 47.7 M worldwide, reducing the need for chemical inputs in the potato crop through genetic means could significantly reduce the exposure at all levels at which agrichemical use now poses a health risk (manufacture, transport, storage, grower, consumer). Genetic improvements via NRSP6 germplasm are resulting in a more productive, versatile, profitable, nutritious and environmentally safe potato crop.

**B. 2. Relevance to stakeholders:**

NRSP6 stakeholders are researchers, breeders, those who use their product (producers), food suppliers, and, ultimately, consumers. Here are the reasons why there is a continued need and relevance of NRSP6 service to stakeholders, and why US scientists (and foreign ones) will depend on NRSP6 germplasm more in the future:

1) No other public or private programs have come forward to provide the unique services of NRSP6. Sixty years of public support of this genebank has resulted in the world's premier collection of over 5,000 items of germplasm for the world's most important non-cereal crop. At least 45% of these are unique.

2) The need for potato research and breeding is increasing. Development of technology has enhanced the quantity and impact of research and publications involving germplasm. There are more private breeders, more seedlings grown for yearly selection, more sophisticated facets of evaluation, and more varieties being released. There is increasing challenge to gather, format and distribute information with the greater speed and detail made possible with advances in data management technology.

3) Acquisition of germplasm from foreign genebanks or directly from the wild is becoming even less practical for US researchers. Other genebanks have faced financial problems or reorganization which has reduced their capacity to maintain availability of germplasm and services. Countries with native potato germplasm to share are doing so less freely due to policies reflecting feelings of national ownership and problematic expectations of "benefit sharing" that have delayed access from Latin America since 2000. So, dependence on raw materials we have in-country at NRSP6 is greater than ever.

4) Potato is listed as "prohibited" by APHIS, making quarantine testing of all imports for one-two years necessary, at an estimated cost of $4,100 per item. To avoid the wasted time and expense of having quarantine repeatedly process the same material for multiple importers, we need the coordination, information and preservation provided by NRSP6.

5) We need to reduce agrichemical inputs that are costly and may threaten the health of humans and the environment. So, for farmers and consumers, genetic solutions through germplasm are increasingly important.

6) Physiological constraints such as a need for cold tolerance (applied especially to the mountain growing regions like the Andes but everywhere subject to the global cycle of wider weather

fluctuations), heat and $CO_2$ (global warming), water and fertilizer use efficiency (loss of water rights, phosphates in lakes, nitrates in groundwater, energy costs for pumping water and making fertilizer) have increased, as well as a general need to increase the adapted range of potato to production areas where it would increase food security and benefit the world economy. All these point to an increasing need for the "new blood" available in NRSP6 exotic germplasm.

7) Technology has increased the possibilities for germplasm use making it more valuable. The prospects of easily identifying and mining genes from exotic germplasm (reducing the long and expensive process of conventional breeding) makes the service of NRSP6 even more valuable to stakeholders.

## C. IMPLEMENTATION:

### C. 1. Management, Budget and Business Plan.

#### C. 1. a.i. PLAN for future activities.

<u>Acquire germplasm</u>.

Collecting in Latin America. Continue to pursue efforts to collect in Latin America, notably Peru, before native populations are lost to habitat degradation.

Collecting in the USA. Stocks collected in the past project have been shown to have valuable traits (strong resistance to the *chitwoodi* nematode and extreme tuber dormancy), and, provided valuable insights when used as models for genebank R&D studies on collecting efficiency. We will continue yearly collections to unexplored areas.

Import from other genebanks. Work in the past project term has shown a remarkable concentration of valuable traits in the ~90 populations we have of *S. microdontum*, so we intend to acquire all other existing populations of this species from other world genebanks.

<u>Classify germplasm</u>. The ARS taxonomist will continue to assign species names to all items in the genebank and do the research and evaluation work necessary to make the classification system more stable and useful.

<u>Preserve germplasm</u>.

We will continue increasing seedlots at the rate of 150-200 per year for a 25-30 year cycle.

We will initiate long-term backup storage of clonal tissue culture stocks at the National Center for Genetic Resources Preservation (NCGRP) in Ft. Collins, CO.

Continue vigorous, comprehensive disease testing.

Continue R&D studies which show us where genetic diversity is concentrated and vulnerable to loss, so we can prioritize stocks for preservation and optimize techniques as needed. For example, in the past project term, we found that certain species are homogeneous spontaneous selfers, so can be multiplied in covered field plots, allowing saved supplies and labor to be directed to other stocks that must be hand-pollinated in the greenhouse.

Continue technical research. For example, in the past project term we found that storage at lower temperatures results in better long-term germination.

<u>Keep records for management and outreach</u>. Continue maintenance of local data records and those on-line in GRIN and Intergenebank databases.

<u>Evaluate germplasm</u>. Continue conducting preliminary screening and characterization for novel traits and novel applications of exotic germplasm, especially nutritional ones. We will do additional work on traits discovered/developed in the past project term: tuber pH, antioxidants, tomatine, anti-appetite and anti-cancer chemicals, tuber calcium, frost tolerance. We plan to explore new traits, anti-microbial compounds in tuber skin, and anti-Pb potato components. Data generation for these will all be done by cooperating labs, so our role will be initiation and design of experiments, and selection and preparation of materials, analysis of data. We will continue efficient multiplex testing of the entire set of *S. microdontum* population tubers.

<u>Manage personnel and resources</u>. We will: Manage staff time and budget to maximize efficiency and flexibility. Strive to make prudent decisions on what we should do in-house and what should be contracted or purchased. Direct experienced base staff to tasks requiring technical expertise and reserve routine work for part-time staff. Hold regular group meetings to make sure the team is working together cooperatively and safely. Conduct annual self-review of overall project progress each year with local staff, and individual staff performance evaluations. Hold TAC meeting on-site every other year to report, tour facilities, provide "face time" with all local staff, and solicit management input from national experts. Each year prepare CSREES Annual Report, UW Hort Department Professional Activity Report, and ARS Performance Plan Appraisal, as ways to invite feedback on methods, focus and management.

<u>Deliver germplasm and services</u>. Continue the rapid delivery of high quality germplasm and information. Continue to advise on selection of research germplasm, and the most appropriate form and techniques by which to study or hybridize it. To do so, continue to invest time in keeping "in touch" with the science by studying the literature, training students, participating in professional societies and collaborating with many state and federal potato researchers in the US and with our counterparts in potato genebanks abroad.

**C. 1. a.ii. PLAN for resource inputs** (see budget information pages for figures)

1. Human resource inputs. The plan to accomplish the above will include national administration through a Technical Committee, and local administration by the ARS Project Leader, ARS and UW staff and associated ARS scientists and administration (see Appendix H & I).

2. ARS inputs. Associated base research budgets from ARS scientists and various sources of outside grant funds also support technical research, labor, supplies and equipment that directly enhance NRSP6 service. See Appendix E, H & I for details of structure and contributions. ARS administration costs at the Midwest Area and National Levels are also significant. USDA/ARS

and USDA/APHIS also provide data management services through GRIN, and for quarantine, respectively.

3. University of Wisconsin inputs. The University of Wisconsin Department of Horticulture (HORT) will provide lab and office space for on-campus R&D that supports the NRSP6 service, with administrative and secretarial support for Madison personnel provided jointly by ARS and HORT. The University of Wisconsin Peninsula Agricultural Research Station at Sturgeon Bay (PARS) will continue to be the headquarters of NRSP6. PARS will contribute much of the needed facilities and associated resources: 10 greenhouses, 5 large screen houses, office and storage buildings, two labs, field plots, travel and farm vehicles, security and maintenance, utilities (including the major input of heat and light for greenhouses), plus some secretarial service. HORT also provides administration of personnel for local state employees and graduate students associated with the genebank. UW provides accounting services for the NRSP6 budget.

4. Grants and Collaborator inputs. ARS scientists will continue to seek grants and engage numerous state, federal and international collaborators who contribute expertise, facilities, equipment and funds to joint projects (see Appendix E). Project Leader will continue as chairman of the Crop Germplasm Committee, which provides $15-18K in germplasm evaluation funds each year.

5. No fees for service. Charging fees for services has been suggested several times in the past, but always determined to be impractical and counterproductive because: 1) implementation would be costly and complicated, 2) it would depress germplasm distribution and use, and 3) it would contradict US policy of free exchange and perhaps inhibit donations of germplasm to NRSP6.

6. CSREES – SAES input. NRSP6 is the NPGS working genebank for the top vegetable, so is perpetual in nature and national in scope. Multiple competitive grants or other soft sources will likely only assist with specific, short-term projects related to R&D for preservation, collecting and evaluation, perhaps some equipment, but will not provide the ongoing base service functions that represent most of the cost of running a national genebank. Foundations or industry interest in supporting long-term germplasm service and development is typically targeted at acute needs in poor countries.

For over 60 years, the important elements of funding and administration for NRSP6 have developed as a partnership of SAES, USDA/ARS, and UW. Continued significant funding and technical/administrative inputs on a multistate basis are seen as necessary to keep this partnership healthy so as to maintain the project's impact and efficiency.

7. Business plan.

**Plan:** The FY11-15 budget proposal is to continue at a base $150K per year, with annual inflation/COLA matching the Hatch increase. See budget tables in Appendix I.

**Alternate sources:** Pursuit of outside competitive grants and unfunded synergistic collaborations that boost the project's impact will continue (see also Section 6 above, "CSREES – SAES input"). USDA/ARS affirms its priority to maintain genebank service in the face of reductions in NRSP6 and UW funding. But compensations in the past project term have barely covered core staff all with tenures of 15-30 years, plus the most essential labor, supplies, and services.

**C. 1. b. Critical assessment of past accomplishments:** See Appendix J for CSREES Review report. Note that issues are categorized and corresponding accomplishments referenced to appendices under Section A., " PREREQUISITE JUSTIFICATION AND STATEMENT OF ISSUES".

Acquire germplasm to expand genetic diversity contained in the US *Solanum* germplasm collection**.** At total of 148 new stocks were added by USA collecting, requests from cooperators, and requests from genebank staff. Appendix A details and quantifies accomplishments in acquisition.

Classify accessions with species names which will serve as stable identifiers, and promote efficient utilization. Species names were assigned to all new accessions. Taxonomic studies using both molecular and classical techniques were employed to determine stable species boundaries. The herbarium was updated to include all new collections. Appendix A details and quantifies accomplishments in classification.

Preserve NRSP6 germplasm in secure, disease-free, and readily available form. In the past project term 879 accessions were preserved with maximum genetic integrity in viable, disease-free form available for distribution. This effort included maintenance of data, performing seed and in vitro increases, purity tests, disease tests, germination tests, chromosome counts, equipment maintenance, R&D studies on best techniques. Appendix A & C detail and quantify accomplishments in preservation.

Distribute germplasm, associated data and advice to all researchers and breeders in a timely, efficient, and impartial manner. Orders remained strong in the past project term, and were filled within one week of receipt. A new project brochure was created. Appendix A & B detail and quantify accomplishments in maintenance and distribution of stocks and data, and distribution in the form of information as 96 formal publications by staff and associates.

Evaluate the collection for as many important traits as possible. Unpublished screening data of experiments conducted by cooperators was summarized and uploaded to GRIN. Evaluation initiated by staff and done in-house or with cooperators covered a broad range of topics pursuant to more efficient mining of the value of NRSP6 germplasm. See Appendix C, D & E for details of activities related to evaluation, namely, development of evaluation techniques and tools, generating custom materials, and leveraged participation of other evaluator scientists, respectively.

**C. 2. Objectives and Projected outcomes.**

**C. 2.a. Objectives, milestones and deliverables**. We will seek and introduce valuable new stocks, preserve them in the most effective manner (maintaining maximum genetic diversity and a sufficient quantity of propagules such that nearly 100% of the collection is available for distribution), enable their evaluation for useful traits, document them and manage records so that germplasm users are aware of this resource and deliver vigorous, healthy stocks to users according to their needs as detailed in Section C.1.a.i. above.

**C. 2.b. Assessment of Productivity.** Section 4 following details how we have produced and measured impact in the past and how we intend to build on that productivity in the future.

## 3. INTEGRATION:

The close working relationship and involvement of the major participants (ARS, PARS, UW) has already been described. In brief: The Project leadership is composed of ARS employees who must interact with ARS administration and be subject to performance evaluation related to NRSP6 service appointments. ARS administration is part of the NRSP6 TAC. PARS provides the physical location of NRSP6, and coordination between the objectives of the two programs takes place on a daily basis. Half of the local NRSP6 staff are UW employees, and half ARS. Part time staff are UW. ARS staff share equipment and participate in cooperative research with their state HORT peers. Thus, the UW HORT potato research program is fully engaged in NRSP6 project activities pursuant to the enhancement of NRSP6 service. NRSP6 has led the effort to coordinate the activities of world genebanks through the Association of Potato Intergenebank Collaborators (APIC). NRSP6 is a fully-engaged member of the National Plant Germplasm System. Staff attend all meetings of the advisory committee for genebank directors (PGOC) and the committee for the national germplasm management database (GRIN). NRSP6 staff are fully engaged in state potato programs. We participate in scientific, grower meetings, and field days and conduct collaborative research with a view to better understanding the needs of the industry and getting input regarding how NRSP6 can meet them. NRSP6 maintains email contact with 375 active cooperator/germplasm users.

## 4. OUTREACH, COMMUNICATIONS AND ASSESSMENT:

**4. a. Plan** (continue and expand the following initiatives)

4.a.i. <u>Audience and visibility</u>. The primary recipients of our service are breeders and the scientists doing research that supports breeding. We also serve researchers seeking to optimize germplasm management, and home gardeners and non-professional botanists. We have a general educational outreach through brochures, website, and popular press. NRSP6 staff routinely give tours, talks to public school classes and other groups. We give advice on germplasm use technology, or in personal correspondence associated with germplasm orders or cooperative research and evaluation projects.

NRSP6 staff:

> Attract publicity in popular media and communicate to scientists through published scientific research papers involving NRSP6 germplasm.
>
> Make collaborative partnerships with high-profile national and international potato experts and contribute to scientific meetings.

Serve in leadership roles in potato research associations and journals (Potato Association of America, *American Journal of Potato Research*).

Establish an email group and website with which to keep in regular contact with germplasm users and participate fully with GRIN.

Extend global outreach and awareness of NRSP6 through involvement in the Association of Potato Intergenebank Collaborators (APIC).

4.a.ii. Engage stakeholders. NRSP6 established an email group and offers stocks and services 3-4 times per year. We will continue to ask Potato Assn of America Breeding and Genetics section members for suggestions on how to improve service each year. Regional Tech reps annually poll germplasm recipients about satisfaction with service. As CGC chair, Project Leader must survey germplasm evaluation needs. We correspond meaningfully with recipients of *each order* to make sure their needs were completely met, ask for suggestions or other ways we could improve service.

4.a.iii. Method to measure accomplishments and impacts. The most important documented evidence with which to measure impact is the advance of practical knowledge about germplasm reflected by formal research publications using NRPS6 stocks and the presence of exotic germplasm in pedigrees of new cultivar releases (that practical knowledge transformed into a better crop). NRSP6 distributions of germplasm to the states and regions are documented in Appendix A & B.

4.a.iv. Communication pieces. Locally generated brochures, web pages, posters at meetings.

4.a.v. Mechanisms for distribution of the results. Annual Report, notes of accomplishments and plans in preliminary pages of annual Budget Requests, and TAC meeting minutes are on the web. NRSP6 has always had the philosophy that the best and only way to catch the attention of germplasm users, communicate effectively with them, and understand their needs is to become their peers by being germplasm users ourselves and vigorously participating in all aspects of the science.

**4. b. Assessment of past communication successes** (see accomplishment Appendices for full details, especially Appendix B.

# Appendices

## Enabling technologies and services provided in past 5 years

**APPENDIX A.** Stocks acquired, preserved, and distributed, with associated work "at a glance"

Current size of collection: Number of populations / clones maintained

| | |
|---|---|
| Botanical seed populations | |
| 123 wild species | 3,833 |
| 7 cultivated species | 1,061 |
| total | 4,894 |
| In vitro clones | |
| Named commercial cultivars | 265 |
| Primitive Andean cultivars | 47 |
| Genetic stocks | 285 |
| Breeding stocks | 186 |
| total | 783 |
| Total | 5,677 |

New acquisitions (including five collecting trips to southwest USA organized and led)

| | |
|---|---|
| Foreign donated clones | 92 |
| USA wild species collections | 56 |
| Total | 148 |

New taxonomic determinations = 431 (http://www.ars-grin.gov/nr6/potato_taxon_names.html)

Seed Increases (grow families of 20 parents in greenhouse, hand intermate 6-8 times, harvest berries, process and store seeds) = 879

Tissue culture maintenance transfers (take a nodal cutting from stock tube, transfer it to a tube with new media to revitalize) = 32,625

ID growouts (field plantings to confirm offspring are true to parental type) = 855

Disease tests (primarily for presence of systemic virus or viroid) = 3,900

Germination tests = 6,093 and seed viability (Tetrazolium) tests = 264

Ploidy determinations = 162

Germplasm distributions: Number of units and orders by state and region[1]

| State | Region | Units | Orders | Regional summary |
|---|---|---|---|---|
| Illinois | NC | 92 | 6 | |
| Indiana | NC | 26 | 1 | |
| Iowa | NC | 17 | 5 | |
| Kansas | NC | 3 | 2 | |
| Michigan | NC | 468 | 22 | 14,229 units = 64% |
| Minnesota | NC | 1,064 | 36 | 298 orders = 54% |
| Missouri | NC | 42 | 8 | |
| North Dakota | NC | 20 | 3 | |
| Ohio | NC | 68 | 13 | |
| Wisconsin | NC | 12,429 | 202 | |
| Connecticut | NE | 24 | 1 | |
| Dist of Colombia | NE | 61 | 1 | |
| Maine | NE | 222 | 12 | 2,449 units = 11% |
| Maryland | NE | 328 | 14 | 82 orders = 15% |
| Massachusetts | NE | 280 | 4 | |
| New York | NE | 1,418 | 40 | |
| Pennsylvania | NE | 116 | 10 | |
| Alabama | S | 3 | 1 | |
| Arkansas | S | 169 | 6 | |
| Florida | S | 26 | 4 | |
| Georgia | S | 5 | 1 | |
| Kentucky | S | 18 | 5 | 1,849 units = 8% |
| Mississippi | S | 16 | 2 | 48 orders = 9% |
| North Carolina | S | 78 | 5 | |
| South Carolina | S | 1 | 1 | |
| Tennessee | S | 15 | 3 | |
| Texas | S | 1,489 | 13 | |
| Virginia | S | 29 | 7 | |
| Alaska | W | 139 | 6 | |
| Arizona | W | 57 | 5 | |
| California | W | 488 | 27 | |
| Colorado | W | 54 | 6 | |
| Hawaii | W | 237 | 4 | 3,682 units = 17% |
| Idaho | W | 874 | 22 | 119 orders = 22% |
| Montana | W | 10 | 2 | |
| New Mexico | W | 77 | 2 | |
| Oregon | W | 479 | 16 | |
| Utah | W | 6 | 2 | |
| Washington | W | 1,261 | 27 | |
| **US Total** | | **22,209** | **547** | |

[1] Plus 29 foreign countries receiving a total of 6,832 units in 110 orders.

## **APPENDIX B.** Data and related service provided in past 5 years

Evaluation records maintained = 57,167 total observation records.
Seed Increase records generated and maintained = 1,562 accession increase records.
Field plots documented = 2,404 field plots computerized
Characterization data generated = 9,552 data points gathered from published literature.
Provenance data records maintained = 4,952
Cooperator records in GRIN maintained and updated = 740 total cooperators, 375 "active".
Records updated and contributed to Intergenebank Potato Database = 7,665 with 393 new.
Website updates = 25
Annual Technical Committee meetings organized = 5
Led *American Journal of Potato Research* as Editor in Chief
Led Potato Crop Germplasm Committee as Chairman
Foreign visitors hosted = 27
Domestic visitors hosted = many

Information dissemination = 96 publications. Scholarly publications below from NRSP6 staff and Wisconsin associated scientists documented in Annual Reports 2004-08. An additional 553 publications by other users of NRSP6 stocks are documented at http://www.ars-grin.gov/nr6/

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7. Bamberg, J.B. 2007. *Crazy Sepal*: A new floral *Sepallata*-like mutant in the wild potato *Solanum microdontum* Bitter. Am J Potato Res 84:76. (Abstract)
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**APPENDIX C.** R&D, techniques and tools that enable efficient germplasm collecting, preservation and evaluation (coded with numbered publication in Appendix B).

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| 29 | Is it necessary to create a balanced bulk of berries from seed increase parents to preserve genetic diversity? Conclusion: Little risk of genetic loss in an over-all seed bulk. Full paper accepted. |
| 27 | Is there an impact of high-use agrichemicals on native wild species populations growing close to cultivation in Peru? Conclusion: Screenhouse tests indicate that commonly-used chemicals have a marked impact on reproduction parameters, suggesting that populations in remote areas may be less impacted and have more diversity. |
| 56 | Is there a difference in efficiency of diversity capture by seeds versus tubers in two model species of the southwest USA? Conclusion: Diversity captured depends on breeding system. Full paper accepted. |
| | Does fertilization that increases seed yield also increase seed quality? Conclusion: Not consistently—better germination was not generally correlated with more seed yield. |
| | Can seed increased be performed in the field under floating row cover? Conclusion: Yes, high seed yield and germination resulted with no evidence of contaminating pollinations by bees. Abstract in press. |
| 10 | Can hidden recessives in disomic polyploids be revealed in outcross hybrids? Made 3rd of 4 generations to test this. |
| 18,28 | Do eco-geographic parameters predict genetic diversity? Conclusion: Yes, in some species, apparently based on breeding system. |
| 12,36 | Is more diversity captured at relatively inaccessible sites reached only by hiking and primitive camping, compared to easy drive-up sites? Conclusion: Yes, suggesting much more collecting is warranted. Full paper submitted. |
| 9 | Is diversity inadvertently lost by seedling selection when transplanting seed increase parents? Conclusion: No. |
| 31 | Are accessions in CIP and VIR genebanks really the same as their reputed duplicates at NRSP6? Conclusion: Mostly, with a few important exceptions. |
| 22 | Can re-collections of reputed nematode resistant stocks from Arizona provide additional resistance resources? Conclusion: Yes, suggesting re-collection is warranted. |
| 43,57 | Does propagule type and growing location change relative tuber antioxidant levels of species? Conclusion: Yes. |
| 44 | Does species' ploidy effect dispersion? Conclusion: Yes. |
| 95 | Do gibberellin mutants respond to GA differently in different genetic backgrounds? Conclusion: Yes, suggesting there are important modifiers of this locus. |
| 15 | Does cytoplasm contribute to the high frost resistance of *S. commersonii*? Conclusion: No. |
| 11 | Do potato species vary in within-population heterogeneity, and does this influence estimates of relatedness? Conclusion: Yes. |
| 45,46 | Does taxonomy predict economic traits? Conclusion: Generally not! |

**APPENDIX D.** Custom materials developed that enable germplasm evaluation [coded to publications in Appendix B]

**P-less mutant**. Discovered a unique pigmentless mutant in *S. fendleri* that demonstrates the potential of hidden recessives in allopolyploids and a tool for study of species dispersion in Mexico. [19]

**GA mutant**. Discovered and described a gibberellin deficient mutant ($ga_1$) useful for study of the many economically-important physiological processes in potato that an influenced by this hormone. Created pure populations for study at both diploid and tetraploid levels, and identified a spontaneous reversion clone. [8]

**Crazy sepal mutant**. Discovered an absolute sterile ($cs_1$) that serves as a research tool for floral development, and would reliably prevent transgene escape if incorporated into cultivars. [20]

**Inbred *S. chacoense* developed**. Close relatives to cultivars are usually heterogeneous heterozygotes, so not convenient for genetic analysis. This novel inbreeding mutant was advanced to the 11th selfed generation and made available for distribution.

***S. jamesii* extreme tuber dormancy**. Ability to study and manipulate tuber dormancy would of enormous value for potato. We identified germplasm with tubers that remain firm for 8+ years. [13]

**"*Cultivarish*" project**. To incorporate wild diploid species into the cultivated genepool, breeders need a good cultivated diploid parent. We are developing a diploid *tuberosum* population recurrently selected for good flowering and fertility, and produces cultivar-like (i.e., "cultivarish") tubers in the field.

**Coldbreeding.** Frost stress is a major worldwide problem of the potato crop. We have developed hybrids with extremely frost hardy wild species and organized their testing in the Andes. [63,85]

**Microdontum Multiplex Project (MMP)**. Created tubers for screening 90+ families of *S. microdontum* for an array of useful traits (calcium, pH, tomatine, antioxidants, late blight, soft rot, protein), looking for correlations between traits, and comparing core collections based on these phenotypic traits versus one derived by DNA markers.

**Tuber acidity**. Did first broad survey of tuber pH. Identified low pH germplasm that may associate with disease resistance, processing quality, nutritional and other valuable traits. Created broadest segregating populations for study. [17]

**Calcium**. Identified germplasm with high tuber calcium, which mitigates many tuber defects related to stress and disease. Created broadest segregating populations for study. [6, 14]

**PI2 natural anti-appetite component in potato**. Organized survey of many named cultivars and breeding stocks for higher levels of the active component of commercial diet aid “Slendesta” by Kemin Co.

**Antioxidants**. Organized first broad screening of antioxidants in exotic potato, identifying populations in breeding-friendly species with extremely high levels. [43,57,58]

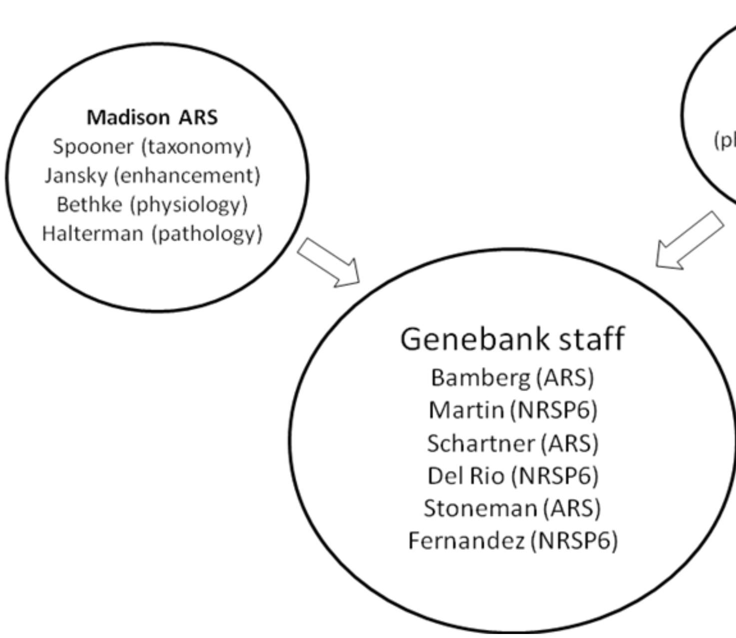
**Nematodes**. Found new sources of resistance by comparing NRSP6 and VIR collections. [48]

**Tuber potassium**. Found large variation for K accumulation capacity of tubers among species. [16]

**Potato Carboxypeptidase Inhibitor**. Found wide species variation for this unique anti-cancer protein. [85, 92]

# APPENDIX E.

A platform to leverage associated contributors from USDA/ARS and UW and Grant support




**Publications**:

Appendix B lists publications by NRSP6 staff and associates in the past 5 years that demonstrate support for the NRSP6 collection by resources beyond the NRSP6 budget. These include those by:

D. Spooner (ARS) with 35 publications using NRSP6 germplasm for taxonomic determinations and methods, origins of wild and cultivated potato, ploidy effects on speciation, predictivity of taxonomy (based on evaluation of germplasm for traits of early blight, Colorado potato beetle, white mold), with several of these involving international and/or intergenebank collaboration.

S. Jansky and/or P. Simon (ARS) with 5 publications evaluating disease and pest resistance traits in NRSP6 stocks and their relationship with taxonomic predictivity.

J. Palta (UW) with 24 publications on physiological studies related to use of NRSP6 germplasm for enhanced tuber calcium, characteristics of gibberellin mutants, frost tolerance, potassium accumulation, anti-cancer screening for potato carboxypeptidase inhibitor, and calcium fertilization in the Peruvian highlands.

**Grants**:

In addition to salary and base budget contributions from these associates, below are notable extramural awards (total grant amounts summed by category), where PI or Co-PI are NRSP6 associated scientists pursuing characterization and evaluation of the collection (in $K).

J. Palta et al.

Genetics and physiology of tuber calcium: 569

D. Spooner et al.

Taxonomic documentation, determination and predictivity : 1,035

Intergenebank collaboration with Vavilov Inst. genebank: 67

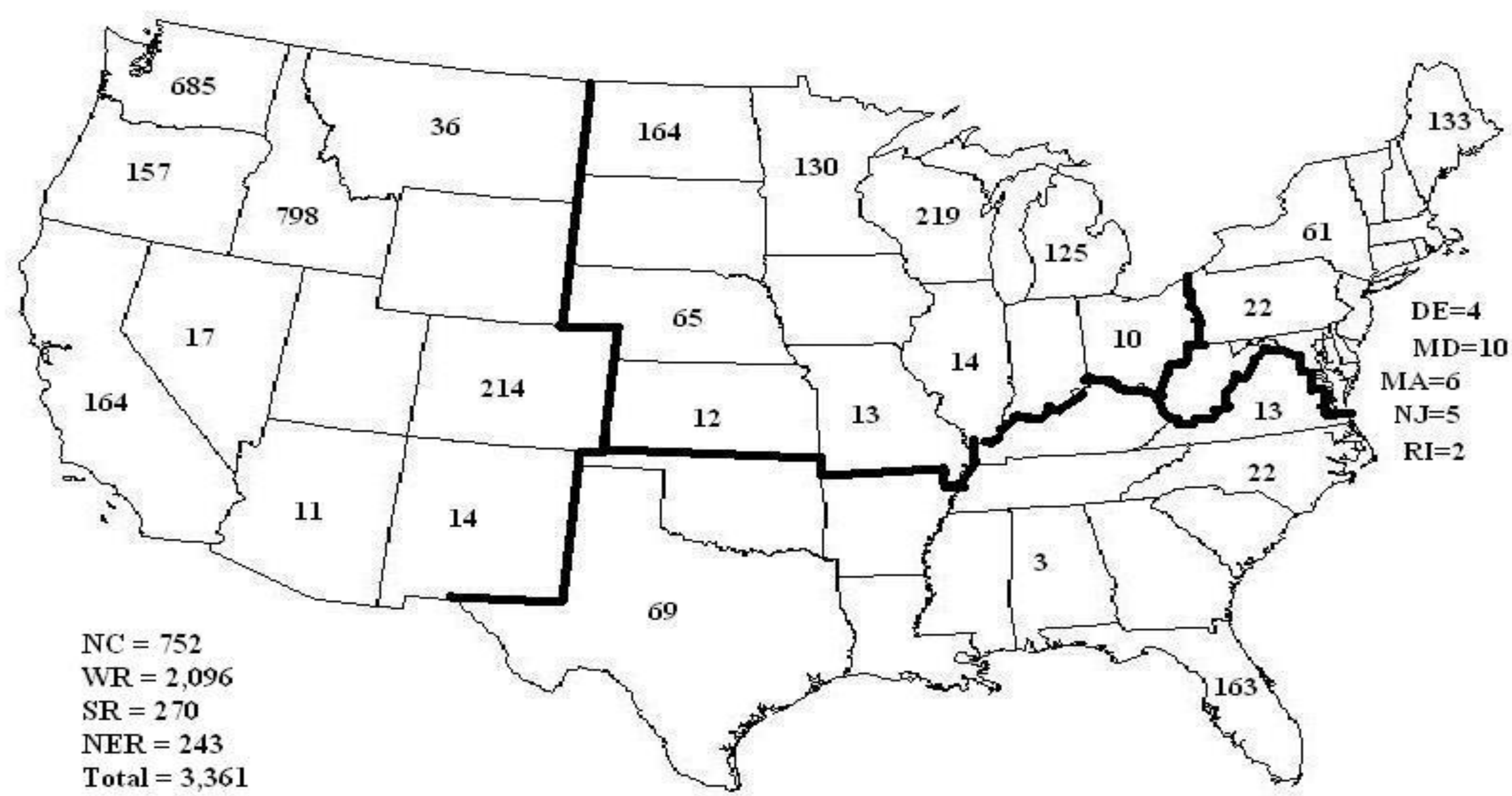
Intergenebank collaboration with International Potato Center (CIP, Lima, Peru): 400

S. Jansky et al.

Evaluation of germplasm for starch, PVY, *Verticillium*: 362

# How does NRSP6 pertain as a national issue?

**Appendix F**. Potato production value in $M by state and region, 2007



# **APPENDIX G**. Impact of breeding with NRSP6 stocks

## Past five years

A total of 27 varieties were published in *American Journal of Potato Research* in the past 5 years, and all have NRSP6 exotic germplasm in their pedigrees. Notably:

*LRC 18-21* (Canada) advanced breeding line. Used *S. chacoense* from NRSP6 as a potent source of resistance to *Verticillium,* the 2nd leading constraint to potato yield in North America.
*Defender* (Idaho et al.). Late blight resistance from NRSP6 germplasm originally obtained from Poland that has wild resistant species from Mexico in its pedigree. Late blight is the leading disease of potato with control costs of $3B annually worldwide.
*Dakota Diamond* (North Dakota et al.). Great-grandmother is *S. chacoense* 472812, a wild potato species from NRSP6 originally collected in Argentina.
*PA99N82-4* (Washington et al.). Advanced line (bred with the Mexican wild species *S. bulbocastanum* from NRSP6), contributing high resistance to nematodes that can only otherwise be controlled by fumigation with highly toxic chemicals at an estimated cost of $20M per year in the US.

## Other specific examples of NRSP6 germplasm success

*Yukon Gold*, one of the most popular and name-recognized tablestock cultivars. Has *S. phureja* 195198, an exotic cultivated species from NRSP-6 as a grandparent, and was bred using the Wisconsin-developed 2n gamete technique.
*Alaska Frostless* was bred with *S. acaule*, a potato species from NRSP6 with extreme frost hardiness.
*Prince Hairy & King Hairy* were bred introgressing glandular hairs from the NRSP6 wild species *S. tarijense* as a defense against insects.
*Atlantic* and its progeny are the backbone of chipping cultivars in the US, deriving these qualities from *S. chacoense* from NRSP6.

## General

About 50% of the four-fold advance in potato yields have been due to genetic improvement and about 1% of annual value of all crops may be credited to exotic germplasm. Pro-rated, this is a total of $10-25 million benefit from germplasm per year for potatoes in the USA.

# Example voucher of NRSP6 impact on industry

J.R. SIMPLOT COMPANY 5369 W. IRVING STREET BOISE, IDAHO 83706
(208) 322-1540

PLANT SCIENCES

July 21, 2009

Dear Dr. Vales,

Simplot Company has received germplasm from NRSP-6 during 2008 and the years before that, and wants to express its gratitude for this very important service. Indeed, much of our discovery work would be impossible without the support of the United States Potato Genebank. In all cases, the material requested arrives in excellent condition, ready for further in-depth analysis. The US Potato Genebank is an essential resource and represents a critical component in United States potato Research and Development.

Over this past year, we have requested and received material to support four important Simplot research areas, listed below:

1) We requested and received mini-tubers of hundreds of accessions of the wild potato species *Solanum phureja*. These tubers were all grown in our greenhouse to produce material for sensory analyses to identify new sources for texture and taste. From this analysis, we were able to determine a handful of accessions with better flavor and texture; this material is undergoing further analysis.
2) We also requested and received various wild potato accessions with glandular hairs that protect plants against aphids. These plants were propagated and confirmed to display aphid resistance. Currently, we are evaluating the top candidates, and will use them in modern breeding programs to transfer the aphid resistance to cultivated material. We hope to eventually create new varieties with enhanced aphid resistance and thereby limit the amount of insecticide sprays used by growers.
3) Another important material transfer consisted of wild potato species with extreme resistance against the important viral pathogen PVY. This material is currently also being used as source of resistance in breeding experiments. PVY is a serious threat to the Potato Industry and we believe we must lean on resistance inherent in wild species to offer the most durable resistance.
4) Finally, we requested and received late blight resistant material that was propagated and grown in the greenhouse and subsequently confirmed to display resistance. This material is considered for further studies.

From this work, we expect to eventually identify robust sources of disease and insect tolerance, which will be mobilized into commercially-important potato varieties. Again, we thank the USDA for its continued support of NRSP-6. This Genebank is extremely valuable for efforts aimed at improving the quality and stress tolerance of potato.

Sincerely,

Caius Rommens, Ph.D.
Director, Simplot Plant Sciences
J.R. Simplot Company
(208) 327-3287

Bringing Earth's Resources to Life

# Implementation / Plans / Participation

## APPENDIX H. Administration, NRSP6 staffing and Associated contributors and participation.

## Administration and Technical (current configuration)

*State Agricultural Experimental Stations*

| | | |
|---|---|---|
| Technical Representatives | | |
| Southern Region | Secretary (2010) | J. C. Miller, Jr. |
| Western Region | Chair (2010) | I. Vales |
| North Central Region | D. Douches | |
| Northeastern Region | Vice Chair (2010) | W. De Jong |
| Administrative Advisors | | |
| Southern Region | | vice-R. Guthrie |
| Western Region | | L. Curtis |
| North Central Region | Lead AA (2010) | M. Jahn |
| Northeastern Region | | E. Ashworth |

*United States Department of Agriculture*

| | |
|---|---|
| Agricultural Research Service | |
| Technical Representative | C. Brown |
| National Program Staff - Germplasm | P. Bretting |
| National Program Staff - Potato | G. Wisler |
| Midwest Area Director | L. Chandler |
| Vegetable Crops Research Unit Leader | P. Simon |
| Lead Scientist, NRSP-6 Project Leader & Curator | J. Bamberg |
| Cooperative States Research Education & Extension Service | A. M. Thro |
| Animal and Plant Health Inspection Service | J. Abad |
| *Agriculture and AgriFood Canada* | B. Bizimungu |

**Full contact information at:** http://www.ars-grin.gov/nr6/techlst.html

### NRSP6 staff

See Appendix I, budget proposal detail

### Associated contributors

See Appendix E

## Participation

The sense of “participation” as formatted in the NRSP Guidelines “Appendix E” is not a good fit with how NRSP6 functions, and the current entries in NIMSS are not representative.

Administrative and technical participation in NRSP6 is configured as per the first section of this appendix. Those individuals represent all of their respective SAES directors and germplasm users, as well as USDA/APHIS, -ARS, -CSREES, and Canada. Although not official participants, private industry is always represented at annual meetings and communications to the TAC. In addition, Appendix E of this document details how local USDA/ARS and University of Wisconsin staff play a special participatory role in enhancing NRSP6 service. Concerning Intergenebank linkages, the project renewal text cites evidence of participation (in various contexts like collecting; technical exchanges, training & research; data management) of other potato genebank throughout the world. Finally, the multitude of germplasm users (represented in the distributions and publications data presented in Appendix A & B) may be considered participants since they use raw NRSP6 germplasm to create new breeding stocks and publish results of studies, all which eventually cycle back through NRSP6 to enable and inform germplasm use by future germplasm users.

# APPENDIX I. Budget Request with History and Status details

**a. History and status -- staff.**

It is difficult to objectively apportion contributions from various associated programs, so this section presents only resources under the direction of the Project Leader. The table below shows that over the past 15-20 years, the program has lost significant strength in terms of base human resources in the proposed FY11-15 budget (temporary labor is not included, as it is relatively difficult to track, but this has also surely declined).

| Staff | historic FTE | FY11-15 plan FTE |
|---|---|---|
| Lead Scientist | 1.00 F | 1.00 F |
| Research support | 1.00 F | 0.50 M + 0.50 F* |
| Project Assistant | 1.00 W&M | 0.80 M |
| Seed tech | 1.00 M | 0.75 F |
| IT tech | 1.00 M | 1.00 F |
| Gardener | 1.00 W&M | 0.50 F* |
| Grad Student | 0.50 M | 0.00 |
| Subtotals | 4.50 W&M | 1.30 M |
| | 2.00 F | 3.75 F |
| Total | 6.50 | 5.05 |

NOTES

1. Employer: F=Fed, M=MRF, W=UWisc, F*=UW staff paid with ARS funds.
2. In several pre-FY90 years, two Techs, two Grad Students, and Equipment were funded by NRSP6.
3. Since FY90, research support for Lead Scientist has not been provided by ARS as appointed TY, but paid by NRPS6 Grad student funds, grants, and ARS discretionary. In FY04, switched this research support position's employer with federal IT Tech for no net gain. ARS increased staff support represented in 0.75 Seed Tech = $32K current. Proposed ARS FY11-15 support is for 0.50 Research and 0.50 Gardener.
4. In FY09, 1.2 FTE (0.40 Proj Asst + 0.80 Gardener) UWisc salary support lost.
5. Besides these FTE losses, funds for supplies, extra labor and evaluation have, of course, substantially eroded with NRSP6 flat budgets over past 20 years. ARS discretionary funding also was reducing with uptick expected in FY10 (discretionary totals for FY05 through FY10 = $94K, $83K, $88K, $77K, $71K, $110K). These reductions have eliminated contracted cooperative evaluation studies except those supported by grants.

**b. History and status – resources.**

Introduction. Given recent budget uncertainty (detailed below), reliably tabulating projections of total resources in section c. following (i.e., for up to 6 years into the future) is difficult, and it is even less clear precisely how the spending of those funds would be partitioned. Thus, we present each year as an equal average of expected spending assuming annual inflation equal to that of recent years (2.8%). At these funding levels, actual spending in the first years will be a little less than shown for salaries and a little more than shown for discretionary outlays (supplies, labor, travel), and vice versa in later years. As for the staff analysis above, budget request Table c. figures show only resources under the direction of the Project Leader.

MRF. The original FY06-10 project renewal proposed budget increases above the current $162K to address inflation. Then a revision was requested for 5% progressive reductions per year. Then a phase-out revision was requested for years 1-5 at $150K, $110K, $75K, $50K, $50K, respectively. We were on that course for the first two years, so lost $40K in FY07. Dialog by NPGCC convinced the directors that a flat $150K should be restored in FY08, but a mistake in the annual budget request process required an extraordinary vote to avert a loss of $40K again that year. FY09 is at $150K and the same is anticipated for FY10.

UW. During the current project term, UW reconsidered its 25+ year partnership with the genebank, and a phase-out of the 1.20 FTE support was decided, becoming complete at the start of FY09. UW continues to contribute substantial infrastructure and utilities (the latter at least $40K annually) at the Peninsula Agricultural Research Station (PARS) farm where NRSP6 is located, with no formal direct charges. It is unclear how or if the state budget crisis and resulting mandate for spending reductions at UW Ag Research Stations will impact NRSP6 guest status at PARS.

USDA/ARS. ARS continues commitment to vigorous support of the genebank project.

It should be noted that USDA also devotes substantial resources through USDA/APHIS quarantine services for potato imports, and development and maintenance the GRIN national germplasm data computerization system. Both of these are critical to NRSP6 success.

**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*

| NRSP-6 US Potato Genebank Project FY11-15 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| MRF (in $K) | | | | | | | | | | |
| MRF inputs | Proposed FY11 (year 1) | | Proposed FY12 (year 2) | | Proposed FY13 (year 3) | | Proposed FY14 (year 4) | | Proposed FY15 (year 5) | |
| | Dollars | FTE | Dollars | FTE | Dollars | FTE | Dollars | FTE | Dollars | FTE |
| SALARIES & Sal Fringe | 111.0 | 1.30 | 111.0 | 1.30 | 111.0 | 1.30 | 111.0 | 1.30 | 111.0 | 1.30 |
| WAGES & WageFringe | 27.0 | 0.80 | 27.0 | 0.80 | 27.0 | 0.80 | 27.0 | 0.80 | 27.0 | 0.80 |
| TRAVEL | 4.0 | | 4.0 | | 4.0 | | 4.0 | | 4.0 | |
| SUPPLIES & Maintenance | 8.0 | | 8.0 | | 8.0 | | 8.0 | | 8.0 | |
| EQUIPMENT/ CAPITAL IMPROVEMENT | | | | | | | | | | |
| TOTAL | **150.0** | **2.10** | 150.0 | 2.10 | 150.0 | 2.10 | 150.0 | 2.10 | 150.0 | 2.10 |

957

| NRSP-6 US Potato Genebank Project FY11-15 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| USDA/ARS (in $K) | | | | | | | | | | |
| **ARS inputs** | **Proposed FY11 (year 1)** | | **Proposed FY12 (year 2)** | | **Proposed FY13 (year 3)** | | **Proposed FY14 (year 4)** | | **Proposed FY15 (year 5)** | |
| | **Dollars** | **FTE** | **Dollars** | **FTE** | **Dollars** | **FTE** | **Dollars** | **FTE** | **Dollars** | **FTE** |
| **ARS employee SALARIES & Sal Fringe** | 278.0 | 2.75 | 278.0 | 2.75 | 278.0 | 2.75 | 278.0 | 2.75 | 278.0 | 2.75 |
| **Other SALARIES & Sal Fringe** | 77.0 | 1.00 | 77.0 | 1.00 | 77.0 | 1.00 | 77.0 | 1.00 | 77.0 | 1.00 |
| **WAGES & WageFringe** | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 |
| **TRAVEL** | 10.0 | | 10.0 | | 10.0 | | 10.0 | | 10.0 | |
| **SUPPLIES & Maintenance** | 17.0 | | 17.0 | | 17.0 | | 17.0 | | 17.0 | |
| **EQUIPMENT/ CAPITAL IMPROVEMENT** | 5.0 | | 5.0 | | 5.0 | | 5.0 | | 5.0 | |
| **TOTAL** | **387.0** | **3.75** | 387.0 | 3.75 | 387.0 | 3.75 | 387.0 | 3.75 | 387.0 | 3.75 |

## NOTES

**Figures for all years** at 112% of FY09 costs, which is average of accrued **2.8% annual inflation** in FY11-15 period.

Only resources **directed by Project Leader** are listed here. Other federal and state resources contributed by associated projects, grants and other extramurals are extra.

**UW** to continue contributions of facilities, utilities & related services, at least $40K.
**Direct input proportions**: MRF = 26%, ARS = 67%, UW = 7%

# Assessment

**APPENDIX J.** CSREES Review report

Suggested external reviewers:

USDA/ARS genebank leaders:

Candy Gardner -- Ames, IA (candice.gardner@ars.usda.gov, 515-294-3255)
Gary Pederson -- Griffin, GA (gary.pederson@ars.usda.gov, 770-228-7254)
Randy Nelson – Urbana, IL (randall.nelson@ars.usda.gov, 217-244-4346)
Kim Hummer – Corvalis, OR (kim.hummer@ars.usda.gov, 541-738-4201)

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Jiwan Palta -- Madison, WI (jppalta@wisc.edu, 608-262-5782)
Chrisian Thill – St. Paul, MN (thill005@umn.edu, 612-624-9737)

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Kathy Haynes – Beltsville, MD (kathleen.haynes@ars.usda.gov, 301-504-7405)
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Canadian

Ken Richards – Ag Canada, Saskatoon, SK (ken.richards@agr.gc.ca, 306-956-7641)
Agnes Murphy – Ag Canada, Fredericton, NB (agnes.murphy@agr.gc.ca, 506 459-5679)
Larry Kawchuk – Ag Canada, Lethbridge, AB (kawchuk@agr.gc.ca, 403-317-2271)

Industry and individuals

Bob Hoopes -- Frito-Lay, Rhinelander, WI (robert.hoopes@fritolay.com, 715-365-1615)
Caius Rommens -- Simplot, Boise, ID (caius.rommens@simplot.com, 208-322-1540)
Dan Ronis -- Frito-Lay, Rhinelander, WI (daniel.ronis@fritolay.com, 715-365-1618)
Rick Machado – Menifee, CA (farmrik@gmail.com, 909-672-3094)