

ANNUAL REPORT

Calendar Year 1998

1. PROJECT: NRSP-6: INTER-REGIONAL POTATO INTRODUCTION PROJECT

Introduction, Preservation, Classification, Distribution and Evaluation of *Solanum* Species.

2. COOPERATIVE AGENCIES AND PRINCIPAL LEADERS

State Agricultural Experimental Stations

		<u>Representative</u>
Southern Region		J. C. Miller, Jr.
Western Region	Chairman	A. R. Mosley
North Central Region	Secretary	D. S. Douches
North Eastern Region		A. F. Reeves

United States Department of Agriculture

Agricultural Research Service		
Technical Representative	Vice Chairman	J. J. Pavsek
National Program Staff		P. K. Bretting
Area Director, Midwest Area		R. L. Dunkle
Cooperative States Research Education & Extension Service		M. Stanton
Animal and Plant Health Inspection Service		A. T. Tschanz
Inter-Regional Potato Introduction Project	Project Leader	J. B. Bamberg

Agriculture Canada

T. R. Tarn

Administrative Advisors

North Central Region	Lead	R. L. Lower
Western Region		M. J. Burke
Southern Region		E. Young
North Eastern Region		D. R. Mackenzie

3. PROGRESS AND PRINCIPAL ACCOMPLISHMENTS

A. Introduction of New Stocks

Dr. Spooner, in collaboration with Alberto Salas (CIP, Peru), Zozimo Huaman (CIP, Peru), and Robert Hijman (CIP, Peru) participated in a successful expedition to collect wild species of potato in Peru from February 18th to April 18th 1998. This collection trip resulted in 57 new accessions of *Solanum* species.

Dr. Bamberg led two trips to the southwest USA to obtain new materials for the collaborative intergenebank project. As a result, 16 new germplasm accessions from new locations in New Mexico and Arizona were added to the collection.

A total of 97 accessions were assigned PI's in 1998, and are now available from the NRSP-6 *Solanum* germplasm collection, 14 in vitro clones, 67 quarantine clones, and 16 accessions from the Southwest United States.

In 1998, 93 new accessions were planted out in the spring quarantined increase. Of the 93 accessions, 64 germinated and were grown out. Sixty-three of these were released and added into the collection (one was virus suspect and not released). Of the 63 accessions, 42 were from Spooner's 1995 Guatemala collection, 9 were from Spooner's 1996 Costa Rica collection, 7 were from Spooner's 1993 Bolivia collection, and 9 others from various other collection trips.

A total of 33 clones were added to the in vitro collection in 1998 as foreign varieties or genetic stocks.

B. Preservation and Increase of Stocks

In 1998, 128 accessions were increased. From US Quarantine, 93 accessions were received for a joint seed increase and quarantine virus testing at NRSP-6. Of the 93 accessions, 29 failed to germinate, one was virus suspect and not released, and 55 failed to produce seed in the spring seed increase and are being carried over as cuttings or tubers to be tried again in the 1999 summer seed increase.

This year a total of 678 potato spindle tuber viroid (PSTV) tests were performed on seed increases, seed lots and research materials. Germination tests were performed on 948 accessions, and ploidy determinations were done on 158 accessions.

C. Classification

Dr. Spooner continues to resolve problems in taxonomic classification which impede efficient documentation and use of the germplasm. This year an extensive study was conducted which suggests several species in the series *Longipedicellata* are not actually significantly different. Insights gained from this and similar studies will allow accessions to be assigned stable species names based on empirical differences.

D. Distribution

NRSP-6 distributed 5,460 units of seed, 46 tuber families and 2,355 in vitro stocks to clientele in 22 states of the United States and 13 other countries. Internally, NRSP-6 used 9,741 units of seed for chromosome counts, germination tests, identification and taxonomic check plantings, in-vitro maintenance, seed increases, PSTV tests, and miscellaneous plantings. The volume and types of stocks sent to various consignee categories are summarized in the table below.

VOLUME AND TYPES OF STOCKS DISTRIBUTED

Category	Units ¹				TOTAL	PI's
	S	TF	IVS	FSG		
Domestic	4,082	33	2112	42	6,269	2,593
Foreign	1,378	13	243	248	1,882	1,360
NRSP-6 ²	9,741	0	0	0	9,741	1,263
Total	15,201	46	2,355	290	17,892	5,216

¹ Types of stocks sent/(number of seeds, tubers or plantlets per standard shipping unit):

S= True Seeds/(50), TF= Tuber Families/(10), IVS=In Vitro Stocks/(1), FSG=Fine Screening Genotypes/(1).

² Includes chromosome counts, germination tests, ID and Taxonomic check plantings, in vitro maintenance, seed increases, PSTV tests, and miscellaneous plantings and NSSL seed backup.

E. Evaluation of Stocks

Mission

The project's mission with respect to evaluation is to locate and characterize useful traits so that the best materials and most efficient approaches are available for subsequent germplasm enhancement.

1. Late Blight Screening

New forms of the late blight pathogen have developed into a severe threat to the US potato crop. In 1998 we continued four cooperative projects:

- 1) BC, Canada with Dr. Ken Ng: This project characterized segregation for extreme LB resistance in a family of the South American Series Tuberosa member *S. okadae*.
- 2) Cornell, New York: Dr. Fry characterized segregation for extreme LB resistance in a family of the South American Series Tuberosa member *S. microdontum*.
- 3) Lansing, Michigan with Dr. Douches: This project involves inoculated greenhouse testing of selected late blight resistant genotypes.
- 4) Toluca, Mexico with Hector Lozoya: This project did field screening for resistance in various South American and Mexican species, as well as Russian elite breeding families.

2. Tuber Traits

Wild species do not produce tubers in the long days of Sturgeon Bay summers, so their tuber traits cannot be assessed in the field. A project was initiated in 1993 in which wild accessions are being systematically crossed with adapted (cultivated) forms to produce F₂ true seed families. We also found and successfully tested a site for wild species tuber production at Weslaco, TX (in cooperation with TAES). This will allow more efficient production of tubers and allow evaluation under field conditions (for such traits as calcium accumulation potential).

3. Frost Hardiness

In cooperation with Dr. J. Palta and YuKuang Chen, work was continued on recurrent selection for earliness, good tuber characteristics, and frost resistance. Progress was made in generation of substitution backcross families with cold sensitive genomes within cold hardy cytoplasm.

4. Tuber Calcium

Tuber calcium has been shown to be closely associated with resistance to important storage rots and other tuber quality traits. F₂ hybrids between clones which accumulate very high calcium in a high calcium environment and clones which accumulate very little calcium in the same environment were analyzed. High calcium accumulation and cold sprouting vigor were found *not* to be well correlated. Tuber calcium segregation within the family was continuous between the parental levels. These materials should be a valuable tool for investigating the physiology and genetics of tuber calcium.

5. RAPDs to estimate vulnerability of alleles in the genebank

RAPDs were used to characterize populations of two very heterogeneous wild potato species. About 25 plants in each population were individually tested to reveal "allele" frequencies. Allele frequencies less than 25% were not uncommon, but these markers were almost always fixed or nearly fixed in another population. Therefore, vulnerable alleles (i.e., ones which have a good chance of being lost from the genebank using current seed increase methods) appear to be very rare.

6. Screening the Wild Species for Root Mass

The mini-core collection was screened for root mass in the screenhouse in Perlite. Significant differences were found which parallel those of previous work. This information may provide insights into breeding for water and fertilizer use efficiency.

7. Characterization for Utility Traits

The success of using *Solanum* germplasm for breeding is influenced by relative plant vigor, flowering, pollen shed and pollen viability. Characterization of the collection for these traits continued in 1998.

F. Inter-genebank Collaboration

The Association of Potato Intergenebank Collaborators (APIC) has initiated a joint research project to investigate the effects of seed increases on the genetic integrity of germplasm conserved *ex situ*, and whether germplasm in genebanks still represents the *in situ* populations from which they were collected. Work on the final phase, finding factors which predict the patterns of diversity among accessions, nears completion. Some findings defy conventional wisdom, such as the idea that genetic diversity is correlated with spacial separation of collections. Results from this work will guide collection methods to maximize diversity. New samples of *S. jamesii* were collected in New Mexico and Arizona, expanding the range of our research samples and adding unique germplasm to the genebank. The 8th meeting of APIC is planned to be held in conjunction with the Global Potato Conference in New Delhi, December, 1999. APIC has been invited to present a symposium on international germplasm cooperation.

4. USEFULNESS OF FINDINGS

NRSP-6's purpose is to provide a ready source of raw materials, technology and information which support potato enhancement, breeding and research in the US and around the world. Thus, one way the success of NRSP-6 can be measured is by the use of NRSP-6 germplasm in the pedigrees of new, improved potato cultivars. Another is in the use of NRSP-6 stocks in more basic research programs which also ultimately contribute to human utilization of the potato crop, these being reflected in publications.

Four cultivar releases were published in the American Journal of Potato Research in 1998: 'Andover', 'NorValley', 'OAC Royal Gold', and 'Pike'. All are known to have wild species in their pedigrees.

Section 6 lists 74 papers, 60 abstracts, and 4 theses which report the use of NRSP-6 *Solanum* introductions this year.

5. WORK PLANNED FOR 1999

Dr. Spooner will participate in a second collecting expedition to Peru .

Evaluation experiments will be continued on *Solanum* species for the following traits: frost hardiness, rooting vigor, tuber calcium, late blight resistance, hormone mutants, glycoalkaloids, and fertility in heat stress.

The general objective of NRSP-6 to promote and facilitate potato research and breeding will be pursued by continuing high quality service with respect to introduction, preservation, classification, evaluation, and distribution of potato germplasm to clients in the U.S. and around the world.

We will continue APIC intergenebank research projects determining the cause of observed differences *in situ* and genebank accessions, and correlations of geographic/habitat data with partitioning of diversity.

An APIC meeting is planned for December 1999 in India.

6. PUBLICATIONS ISSUED DURING THE YEAR

A. Publications issued by NRSP-6 Personnel

- Bamberg, J.B., A.H. del Rio, and M.W. Martin. 1997. Expanding the geographical representation of *ex situ* germplasm samples of wild *Solanum jamesii* and *S. fendleri* from the USA. *Am. Potato J.* 74(6):416-417. (Abstract).
- Bamberg, J.B., D.J. Ormrod, and W.E. Fry. 1997. Screening wild *Solanum* germplasm for resistance to late blight. *Am. Potato J.* 74(6):417. (Abstract).
- Bamberg, J.B., J.P. Palta, L.A. Peterson, M.W. Martin, and A.R. Krueger. 1998. Fine screening potato (*Solanum*) species germplasm for tuber calcium. *Am. J. Potato Res.* 75(4):181-186.
- Chen, Yu-Kuang, J.B. Bamberg, and J.P. Palta. 1997. Cold hardiness and tuber production in progeny derived from somatic hybrids between *Solanum tuberosum* and *S. commersonii*. *Am. Potato J.* 74(6):422. (Abstract).
- Chen, Yu-Kuang, J.B. Bamberg, and J.P. Palta. 1998. Incorporation of freezing tolerance and tuber traits in sexual progeny derived from *Solanum tuberosum* (+) *S. commersonii* somatic hybrids. *Am. J. Potato Res.* 75(6):273. (Abstract).
- Clausen, A.M. and D.M. Spooner. 1998. Molecular support for the hybrid origin of the wild potato species *Solanum x rechei*. *Crop Sci.* 38:858-865.
- Del Rio, A.H. and J.B. Bamberg. 1997. Use of rapid markers to optimize potato genebank management: Identification of a "mystery" *Solanum sucrense* accession. *Am. Potato J.* 74(6):461-462. (Abstract).
- Del Rio, A.H. and J.B. Bamberg. 1998. Effects of sampling size and RAPD marker heterogeneity on the estimation of genetic relationships. *Am. J. Potato Res.* 75(6):275. (Abstract).
- Douches, D.S., W.W. Kirk, and J.B. Bamberg. 1997. Fine screening wild *Solanum* species for resistance to late blight. *Am. Potato J.* 74(6):426. (Abstract).
- Errebhi, M., C.J. Rosen, F.I. Lauer, M.W. Martin, J.B. Bamberg, and D.E. Birong. 1998. Screening of exotic potato germplasm for nitrogen uptake and biomass production. *Am. J. Potato Res.* 75(2):93-100.
- Lozoya-Saldana, H., A. Hernandez, R. Flores, and J. Bamberg. 1997. Late blight on wild *Solanum* species in the Toluca Valley in 1996. *Am. Potato J.* 74(6):445. (Abstract).

- Rivera-Pena, A., D.M. Spooner, R.G. van den Berg, and K. Schuler. 1998. Wild tuber-bearing species of *Solanum* hosts of *Phytophthora infestans* (Mont.) De Bary in natural habitat in Mexico. *Am. J. Potato Res.* 75(6):294. (Abstract).
- Spooner, D.M., R. Hoekstra, R. van den Berg, and V. Martinez. 1998. *Solanum* sect. *Petota* in Guatemala: Taxonomy and genetic resources. *Am. J. Potato Res.* 75(1):3-17.
- Spooner, D.M., V. Martinez, R. Hoekstra, and R.G. van den Berg. 1997. Collecting of potato wild species in Guatemala. *Agro. Mesoamericana* 8(2):59-66.
- Spooner, D.M., A. Rivera-Pena, R. Grandenberg, and K. Schuler. 1998. Wild potato collecting expedition in Mexico in 1997. *Am. J. Potato Res.* 75(6):300. (Abstract).
- Van den Berg, R.G., J.T. Miller, M.L. Ugarte, J. Kardolus, J. Villand, J. Nienhuis, and D.M. Spooner. 1998. Collapse of morphological species in the wild potato *Solanum brevicaule* complex (sect. *Petota*). *Am. J. Bot.* 85:92-109.
- Vega, Sandra E., J.B. Bamberg, and J.P. Palta. 1997. Potential for improving freezing stress tolerance of wild potato germplasm by supplemental calcium fertilization. *Am. Potato J.* 74(6):473-474. (Abstract).

B. Journal Articles and Abstracts Reporting Research with NRSP-6 Stocks

- Acuna, I., B. Jacobsen, and D. Corsini. 1998. Thaxtomin-A screening assay for common scab resistance. *Am. J. Potato Res.* 75(6):269. (Abstract).
- Ali-Khan, S.T., G.R. Johnston, R. Coffin, V. Currie, J. Wilson, A. McKeown, and W. Langenberg. 1998. OAC Royal Gold: A new potato cultivar with purple skin and yellow flesh. *Am. J. Potato Res.* 75(4):179-180.
- Anjum, M.A. and T.A. Villiers. 1997. Induction of microtubers *in vitro* from stem segments of *Solanum tuberosum* L., *S. commersonii* Dun. and *S. acaule* Bitt. *Sci. Hort.* 70(2/3):231-235.
- Arnone, S., L. Bacchetta, S. Musmeci, R. Ciccoli, V. di Gioia, M. Cristofaro, and A. Sonnino. 1996. Breeding potato (*Solanum tuberosum* L.) for resistance to Colorado potato beetle and potato tuber moth in Italy. *Resistant Pest Mgmt.* 8(1):57-59.
- Arnone, S., S. Musmeci, L. Bacchetta, N. Cordischi, E. Pucci, M. Cristofaro, and A. Sonnino. 1998. Research in *Solanum* ssp. of sources of resistance to the potato tuber moth *Phthorimaea operculella* (Zeller). *Potato Res.* 41(1):39-49.
- Ashiv Mehta, S.P. Trehan, and H.N. Kaul. 1997. Calcium content in potato tuber in relation to keeping quality. *Agric. Sci. Digest* 17(3):165-168.

- Balbyshev, N.F. and J.H. Lorenzen. 1998. Defoliation and tuber yield of breeding clones derived from ND2858-1. *Am. J. Potato Res.* 75(6):299-270. (Abstract).
- Banfalvi, Z., A. Molnar, G. Molnar, L. Lakatos, and L. Szabo. 1996. Starch synthesis-, and tuber storage protein genes are differently expressed in *Solanum tuberosum* and in *Solanum brevidens*. *FEBS Letters* 383(3):159-164.
- Barone, A., D. Carputo, G. La Rotonda, and L. Frusciante. 1997. Discrepancy between spindle anomalies and 2n pollen production in *Solanum* interspecific hybrids. *Am. Potato J.* 74(6):399-403.
- Boluarte, T. and R.E. Veilleux. 1997. Characterization of a backcross population for anther culture response: First step to target genes controlling androgenesis in potato. *Am. Potato J.* 74(6):419. (Abstract).
- Boluarte, T. and R.E. Veilleux. 1998. Segregation of microsatellite alleles in reciprocal backcross populations of diploid potato. *Am. J. Potato Res.* 75(6):270-271. (Abstract).
- Brown, C.R., B. Schuck-Ennis, C.-P. Yang, H. Mojtahedi, and G.S. Santo. 1997. Genetic marker analysis of introgression of resistance to Columbia root-knot nematode. *Am. Potato J.* 74(6):419-420. (Abstract).
- Camadro, S.L., L.A. Verde, and O.N. Marcellan. 1998. Pollen-pistil incompatibility in a diploid hybrid potato population with cultivated and wild germplasm. *Am. J. Potato Res.* 75(2):81-85.
- Cani, Eduard, V. Ashkenazi, J. Hillel, and R.E. Veilleux. 1997. SSR analysis of the genetic composition of an anther-derived potato family. *Am. Potato J.* 74(6):420-421. (Abstract).
- Cardi, T. 1998. Multivariate analysis of variation among *Solanum commersonii* (+) *S. tuberosum* somatic hybrids with different ploidy levels. *Euphytica* 99(1):35-41.
- Carputo, D., M. Speggorin, P. Garreffa, A. Raio, and L.M. Monti. 1996, publ. 1997. Screening for resistance to tuber soft rot and blackleg in diploid *Solanum* species and *S. tuberosum* haploids. *J. Genet. Breeding* 50(3):221-226.
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- Christ, B.J. and K.G. Haynes. 1997. General combining ability for early blight resistance from open pollinated 4x-2x early blight resistant potatoes. *Am. Potato J.* 74(6):422-423. (Abstract).

- Conicella, C., G. Genuardo, R. Lucia, K.S. Ramulu, and T. Cardi. 1997. Early tapetal degeneration and meiotic defects are involved in the male sterility of *Solanum commersonii* (+) *S. tuberosum* somatic hybrids. *Theo. Appl. Genetics* 95(4):609-617.
- Cutright, R.J. and R.E. Veilleux. 1997. Derivation of monoploid potato families by anther culture and pseudogamy. *Am. Potato J.* 74(6):425. (Abstract).
- Cutright, R.J. and R.E. Veilleux. 1998. Derivation and comparison of androgenic and gynogenic monoploid potato families. *Am. J. Potato Res.* 75(6):274. (Abstract).
- Davies, H.V. 1998. Physiological mechanisms associated with the development of internal necrotic disorders of potato. *Am. J. Potato Res.* 75(1):37-44.
- Deahl, K.L., A. Rivera-Pena, and H. Lozoya-Saldana. 1998. Characterization of *Phytophthora Infestans* populations from wild *Solanum* species in Mexico: Dynamics of mating types and metalaxyl sensitivity. *Am. J. Potato Res.* 75(6):275. (Abstract).
- Debabrata, Sarkar and P.S. Naik. 1998. Factors affecting minimal growth conservation of potato microplants *in vitro*. *Euphytica* 102(2):275-280.
- Dong, F., J.P. Helgeson, and J. Jiang. 1998. Genome painting to differentiate chromosomes from different *Solanum* species. *Am. J. Potato Res.* 75(6):275-276. (Abstract).
- Gamarra, D.C., V.H.P. Bueno, J.C. Moraes, and A.M. Auad. 1998. Influence of glandular trichomes of *Solanum berthaultii* on the predation of *Scymnus (Pullus) argentificus* (Weise) (Coleoptera: Coccinellidae) on *Myzus persicae* (Sulzer) (Homoptera: Aphididae). *Anais da Sociedade Ent. do Brasil* 27(1):59-65.
- Garcia, D., M.E. Gonzalez, and O. Sam. 1996. Several characteristics associated with ploidy in potato. *Cultivos Tropicales* 17(1):65-66.
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- Hamalainen, J.H., V.A. Sorri, K.N. Watanabe, C. Gebhardt, and J.P.T. Valkonen. 1998. Molecular examination of a chromosome region that controls resistance to potato Y and A potyvirus in potato. *Theo. Appl. Genetics* 96(8):1036-1043.
- Hamernik, A.J. and R.E. Hanneman, Jr. 1998. Breeding 2x haploid X species potatoes that chip from 2 C cold storage. *Am. J. Potato Res.* 75(6):278-279. (Abstract).
- Hanneman, Jr., R.E. 1997. Building blocks for enhancement. *Am. Potato J.* 74(6):433-434. (Abstract).

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- Hawkes, J.G. 1997. Cultivated plant diversity and taxonomy. In *Species: The units of biodiversity* (Eds. M.F. Claridge, H.A. Dawah, M.R. Wilson; London, UK, Chapman & Hall Ltd. 191-198.
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- Helgeson, J.P., J.D. Pohlman, S. Austin, G.T. Haberlach, S.M. Wielgus, D. Ronis, L. Zambolim, P. Tooley, J.M. McGrath, R.V. James, and W.R. Stevenson. 1998. Somatic hybrids between *Solanum bulbocastanum* and potato: A new source of resistance to late blight. *Theor. Appl. Genetics* 96(6/7):738-742.
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- Jansky, S.H., A.E. MacGuidwin, and D.I. Rouse. 1998. The effect of root lesion nematodes on Verticillium resistant potato clones. *The Badger CommonTater* 50(8):14-15.
- Janssen, G.J.W. 1997. Fighting root-knot nematodes with resistance from wild potato species. *Pesticide Outlook* 8(5):29-31.
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- Kowalski, S.P., G.C. Yench, R.S. Kobayashi, F.G. Perez, S.L. Sinden, and K.L. Deahl. 1997. QTL analyses as a tool to study biosynthetic pathways: Mapping of solanidine and solasodine genes in potato. *Am. Potato J.* 74(6):441-442. (Abstract).
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7. **APPROVED**

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