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**
   - Southern Region: Chairman, J. C. Miller, Jr.
   - Western Region: Vice Chairman, A. R. Mosley
   - North Central Region: Secretary, F. I. Lauer
   - North Eastern Region: A. F. Reeves

   **United States Department of Agriculture**
   - Agricultural Research Service
     - Technical Representative, J. J. Pavek
     - National Program Staff, H. L. Shands
     - Area Director, Midwest Area, R. L. Dunkle
   - Cooperative States Research Education & Extension Service, C. Stushnoff
   - Animal and Plant Health Inspection Service, A. T. Tschanz
   - Inter-Regional Potato Introduction Project, J. B. Bamberg

   **Agriculture Canada**
   - T. R. Tarn

   **Administrative Advisors**
   - North Central Region: Lead, R. L. Lower
   - Western Region: A. B. Bennett
   - Southern Region: E. Young
   - North Eastern Region: R. C. Seem
3. PROGRESS AND PRINCIPAL ACCOMPLISHMENTS

A. Introduction of New Stocks

Dr. Spooner, in collaboration with Ing. Walter Quiros (Costa Rica) participated in a successful expedition to collect wild species of potato in Costa Rica from November 17th to December 15th. This collection trip procured 13 new accessions of *S. longiconicum*. Prior to the collection trip NRSP-6 had only one sample of this species.

Dr. Bamberg collected 15 accessions in two expeditions to the southwestern region of the United States. Three of these accessions were from areas further north than any of the current holdings for *S. jamesii* in the genebank, and this is the first wild potato germplasm from Texas, Utah, and Colorado.

A total of 137 accessions were brought through Quarantine in 1996, assigned PI’s, and are now available from the NRSP-6 Solanum germplasm collection, 94 accessions as true seed and 43 as in vitro clones.

Dr. Spooner, in collaboration with scientists from the associated countries, had 14 accessions come through Quarantine from Bolivia, Ecuador, and Chile. There were 30 accessions added from Mexico, 27 of them collected by Dr. Spooner’s former graduate student, Aaron Rodriguez.

There were an additional 24 accessions brought in through Quarantine for their late blight resistance, 12 of these were from the VIR (Russia) collection, 8 from the BGRC (German) collection, and 4 clones from Dr. L. Colon (Holland).

An additional 43 clones were added to the in vitro collection in 1996 as foreign varieties or genetic stocks.

A new catalog of NRSP-6’s holdings, “Inventory of Tuber-bearing Solanum Species”, was published and distributed to over 320 cooperators.

B. Preservation and Increase of Stocks

In 1996, 178 accessions were increased. Eighty-seven accessions were received from US Quarantine for a joint seed increase and quarantine virus testing at NRSP-6. Of the 87 accessions, 55 failed to germinate, and 32 are being incorporated into the NRSP-6 inventory.

This year a total of 1200 potato spindle tuber viroid (PSTV) tests were performed on seed increases, seed lots and research materials. Germination tests were performed on 946 accessions, and ploidy determinations were done on 342 accessions.
C. Classification

Dr. Spooner continues to resolve problems in taxonomic classification which impede efficient documentation and use of the germplasm. This year, in cooperation with Dr. R. G. van den Berg (Netherlands) and Ph.D. candidate Joe Miller, an extensive study of the Series Longipedicellata complex of species was initiated. Insights gained from this study will allow accessions to be assigned stable species’ names based on empirical differences.

D. Distribution

NRSP-6 distributed 4,645 units of seed (50 seeds per unit), 362 tuber families and 1,773 in vitro stocks to clientele in 22 states of the United States and 16 other countries. Internally, NRSP-6 used 5,866 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.

<table>
<thead>
<tr>
<th>Category</th>
<th>HERB</th>
<th>S</th>
<th>TF</th>
<th>IVS</th>
<th>TOTAL</th>
<th>PIS</th>
</tr>
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<tbody>
<tr>
<td>Domestic</td>
<td>12</td>
<td>3,482</td>
<td>137</td>
<td>1,156</td>
<td>4,787</td>
<td>3,088</td>
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<tr>
<td>Foreign</td>
<td>0</td>
<td>1,163</td>
<td>225</td>
<td>617</td>
<td>2,005</td>
<td>1,044</td>
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<tr>
<td>NRSP-6²</td>
<td>0</td>
<td>5,866</td>
<td>0</td>
<td>0</td>
<td>5,866</td>
<td>1,124</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>10,511</td>
<td>362</td>
<td>1,773</td>
<td>12,658</td>
<td>5,256</td>
</tr>
</tbody>
</table>

1 Types of stocks sent/(number of seeds, tubers or plantlets per standard shipping unit): H=Herbarium pressed plant/(1), S= True Seeds/(50), TF= Tuber Families/(10), IVS=in vitro stocks/(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. Special Quarantine Seed Increases
This cooperative project with the US Quarantine Lab, by which quarantine testing and seed increases are done concurrently at NRSP-6, has greatly reduced time and effort required to import valuable germplasm. This year we received elite late blight breeding stocks from VIR (Russia), and BGRC (Germany), and were able to rapidly process them through quarantine and have them available for screening.

2. Late Blight Screening
New forms of the late blight pathogen have developed into a severe threat to the US potato crop. In 1996 there were four cooperative late blight screening projects:
   1) BC, Canada with Dr. Ormrod: This project facilitated screening of promising germplasm from the collection in an area of BC, Canada where climate and pathogen diversity combine for a consistent and severe challenge from late blight.
   2) Cornell, New York with Dr. Fry: This project facilitated inoculated tests of promising germplasm from the NRSP-6 genebank collection at Cornell, NY.
   3) Toluca, Mexico with Dr. Lozoya-Saldana: This project facilitated field screening of germplasm and other breeding stocks in the Toluca valley.
   4) Lansing, Michigan with Dr. Douches: This project involves inoculated greenhouse testing of the best late blight resistant accessions from the above screening projects. This project conducts evaluation at the genotype level (fine screening) to identify elite parents from within segregating families.

3. Tuber Traits
Wild species do not produce tubers in the long days of North American 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. This moved the potentially valuable tuber traits of species to a background in which they can be revealed. We will advertise these to our cooperators as they become available.

4. Frost Hardiness
In cooperation with Dr. Palta and Yu-Kuang Chen, work was continued on frost hardiness. New sources of hardiness and breeding combinations exhibited outstanding frost resistance. Crosses made in 1995 were evaluated and seedlings with good frost tolerance and earliness were identified. In 1996 evidence of interspecific variation for speed of cold acclimation and deacclimation among wild species was found.

5. Tuber Calcium
Progress was made on a stepwise "fine screening" program identifying species, then accessions within species, and then individuals within accessions with outstanding ability to accumulate tuber calcium. This trait has been shown to be closely associated with resistance to important storage rots and other tuber quality traits.

6. Colorado Potato Beetle (CPB)
In 1995 screening identified a population nearly pure for extreme CPB resistance. But these are high in glycoalkaloids. We are following up on this by selecting progeny with low glycoalkaloids to determine whether glycoalkaloids are the necessary basis of resistance in this family.
7. Glycoalkaloids
A spectrum of species were evaluated for leaf and tuber glycoalkaloids in cooperation with Dr. K. Deahl. Accessions with reputed high resistance to Colorado potato beetle and high foliar glycoalkaloids (not leptines in S. chacoense) were deliberately chosen. Some accessions had as much as 18 times the TGA in leaves as tubers. These materials are being further investigated in hopes of finding and characterizing new genetic systems for controlling tissue specificity of anti-bug glycoalkaloids.

8. Root Mass and Nutrient Uptake
A working aeroponic system was developed by Dr. P. Barak and calibrated for potato species to assess root parameters that may be valuable for breeding. We are now screening a preliminary sample of Solanum germplasm and will eventually screen the entire mini-core collection. This research will provide the first precise characterization of the diversity available in potato germplasm with respect to root mass and nutrient uptake.

9. Screening the Wild Species for Rooting Vigor
The mini-core collection was screened for rooting vigor in cooperation with Dr. J. Lorenzen. The plants were grown in the greenhouse and field in extended tree planting tubes, and a marker herbicide was used causing rapid foliar symptoms when the roots reached the herbicide treated soil layer. These techniques are a promising new screening method, and have made a start in characterizing exotic germplasm with respect to rooting features which may be valuable for breeding.

10. Characterization for Utility Traits
The success of using Solanum germplasm for breeding is influenced by relative plant vigor, flowering, pollen shed and pollen viability. Relative scores for these parameters were published in the Elite Selections... publication. Characterization of the collection for these traits continued in 1996.

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. RAPD markers were used to establish genetic relationships between various generations of the same accession increased in the genebank, and between these populations and the samples currently growing in situ at their original collection sites in nature. Solanum jamesii (2n=2x=24) and S. fendleri (2n=4x=48) were used as models. In both species populations separated by one generation and sister populations generated from a common original source were never significantly different and averaged greater than 96% similarity. In contrast, significant genetic differences were found between genebank-conserved populations and populations collected from original sites 14 to 35 years later. Our results showed that although current ex situ seed increase procedures cause only minor genetic changes, there might be major differences between ex situ and in situ populations due to natural evolution in the latter. In 1996 we continued
collecting individuals for the 3rd phase of this project (Evaluating factors which predict genetic diversity) by collecting germplasm from the extremes of the natural range in the US (CO, TX, UT).

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.

Three cultivar releases were published in the American Potato Journal in 1996: ‘OAC Ruby Gold’, ‘OAC Temagami’, and ‘St. Johns’. All are known to have wild species’ introductions in their pedigrees.

Section 6 lists 73 papers, 28 abstracts, and 5 theses from which report the use of NRSP-6 Solanum introductions this year.

5. WORK PLANNED FOR 1996

Dr. Spooner will participate in a collecting expedition to Mexico September-October 1997.

Evaluation experiments will be continued on Solanum species for the following traits: nitrogen-use efficiency, frost tolerance, rooting vigor, tuber calcium, tuber and foliar glycoalkaloids, late blight, Rhizoctonia, gibberellin mutant genetics, 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 tentatively planned for this summer in Scotland.
6. PUBLICATIONS ISSUED DURING THE YEAR

A. Publications issued by NRSP-6 Personnel


B. Journal Articles and Abstracts Reporting Research with NRSP-6 Stocks
(Note: Publications from previous years are included if missed in previous annual reports.)


C. Theses Reporting Research with NRSP-6 Stocks


Ravichandran, Vidya. 1996. Application of molecular markers to characterize potato plants derived from anther culture and protoplast fusion. M. S. Thesis. Virginia Polytechnic Institute and State University, Blacksburg, VA.


Teparkum, Sirasak. 1996. Embryogenic response of potato anther culture to colchicine. M. S. Thesis. Virginia Polytechnic Institute and State University, Blacksburg, VA.
7. **APPROVED**

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<th>R. L. Lower, Lead, Administrative Advisor</th>
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