

# **UNITED STATES OF AMERICA:**

## **COUNTRY REPORT**

### **TO THE FAO INTERNATIONAL**

#### **TECHNICAL CONFERENCE**

##### **ON PLANT GENETIC RESOURCES**

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## Note by FAO

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# Table of Contents

<b>CHAPTER 1</b> <b>INTRODUCTION TO THE USA AND ITS AGRICULTURAL SECTOR</b>	<b>5</b>
<b>CHAPTER 2</b> <b>INDIGENOUS PLANT GENETIC RESOURCES</b>	<b>8</b>
2.1 WILD RELATIVES OF CROP PLANTS	8
2.2. CONSERVATION OF U.S. GENETIC RESOURCES	13
2.3 LANDRACES AND OLD CULTIVARS	14
<b>CHAPTER 3</b> <b>NATIONAL CONSERVATION ACTIVITIES</b>	<b>16</b>
3.1 <i>IN SITU</i> CONSERVATION ACTIVITIES	16
3.2 <i>EX SITU</i> COLLECTIONS	17
3.3 STORAGE FACILITIES	25
3.4 DOCUMENTATION	27
3.5 EVALUATION AND CHARACTERIZATION	29
3.6 REGENERATION	31
3.7 OTHER CONSERVATION PROGRAMS	33
<b>CHAPTER 4</b> <b>IN-COUNTRY USES OF PLANT GENETIC RESOURCES</b>	<b>34</b>
4.1 USE OF PGR COLLECTIONS	34
4.2 CROP IMPROVEMENT PROGRAMS AND SEED DISTRIBUTION	36
4.3 BENEFITS DERIVED FROM THE STORAGE OF RESEARCH ON AND USE OF PGR	37
4.4 IMPROVING PGR UTILIZATION	38
<b>CHAPTER 5</b> <b>NATIONAL GOALS, POLICIES, PROGRAMS AND LEGISLATION</b>	<b>40</b>
5.1 NATIONAL PROGRAMS	40
5.2 TRAINING	41
5.3 NATIONAL LEGISLATION	42
5.4 OTHER POLICIES	45



<b>CHAPTER 6</b>	
<b>INTERNATIONAL COLLABORATION</b>	<b>46</b>
6.1 INTERNATIONAL AGRICULTURAL RESEARCH CENTERS (IARCS) AND THE CONSULTIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH (CGIAR)	46
6.2 REGIONAL INTERGOVERNMENTAL INITIATIVES	48
6.3 BILATERAL INTERGOVERNMENTAL INITIATIVES	49
<b>CHAPTER 7</b>	
<b>NATIONAL NEEDS AND OPPORTUNITIES</b>	<b>50</b>
<b>APPENDIX A</b>	
<b>U.S. NATIVE PLANT GENETIC RESOURCES</b>	<b>52</b>
<b>APPENDIX B</b>	
<b>ACQUISITION POLICY FOR THE NATIONAL PLANT GERMPLASM SYSTEM</b>	<b>63</b>
<b>ACKNOWLEDGEMENTS</b>	<b>67</b>
<b>References</b>	<b>68</b>
<b>Abbreviations</b>	<b>70</b>



# CHAPTER 1

## Introduction to the USA and its Agricultural Sector

The United States of America (USA) is the fourth largest country in the world in geography, with an area that spans 9,809,155 square kilometers and a total population of 260,713,585 (26.6 persons per square kilometer). The terrain features a large central plain drained by the Mississippi River system, with the high Rocky Mountains in the western region, and the lower Appalachian mountain range in the eastern region. Deserts are located in the southwestern states of Arizona, California, Nevada, New Mexico, Texas, and Utah. The annual average temperature ranges from a mild 29°C in Florida to a chilly -13.3°C in Alaska. Annual statewide rainfall averages 735 mm per year-ranging from a low of 106 mm in Nevada to as much as 1,640 mm in Alabama although unique environments in some states may be drier than the driest or wetter than the wettest.

U.S. exports for fiscal year 1993 totaled \$449 billion, with agricultural goods contributing \$42.5 billion to the total. The top 15 agricultural exports for fiscal year 1993 (October 1, 1992 to September 30, 1993) were: wheat (\$7.7 billion), soybeans (\$4.6 billion), corn (\$4.3 billion), red meats (\$3.3 billion), processed fruits, vegetables and juices (\$2.1 billion), feeds and fodder (\$1.7 billion), fresh fruit (\$1.7 billion), cotton (\$1.5 billion), soybean meal and oil (\$1.5 billion), tobacco (\$1.4 billion), hides and skins (\$1.3 billion), poultry meat (\$1.0 billion), fresh vegetables (\$1.0 billion), snack foods-excluding nuts (\$1.0 billion), and tree nuts (\$0.9 billion). In 1995, statisticians project an increase in the number of U.S. agricultural goods to be exported, with a notable demand for wheat, corn, soybeans, rice, and cotton. The projected increase is due to an expected growth in world incomes, an abundant supply of exports, a favorable U.S. exchange rate, and less foreign competition for bulk commodities.

The top six crops produced in 1994 included corn for grain (252,576 MT); all wheat--winter, durum, spring (62,656 MT); soybeans for beans (69,075 MT); peanuts for nuts (1,938 MT); sunflowers (2,198 MT); and tobacco (724 MT). Due to a decline in the number of people engaged in farming and consolidation of farms into fewer but larger units, one might think that production output in the USA could decrease. However, the amount of output is increasing because of increased efficiency in utilizing inputs.

**FIGURE 1. TEN MAJOR FARM PRODUCTION REGIONS IN THE USA**

There are ten major farm production regions in the USA. The Northeastern States and the Lake States are principally milk producing areas. Maine, Delaware, and Maryland are major producers of fruits and vegetables. The Appalachian region is a major tobacco-producing region for the nation. Other products from Appalachia are peanuts, cattle, and dairy products. The Southeast region contributes fruits, vegetables, and peanuts. Florida is a prime supplier of citrus fruits and winter vegetables. The Delta States are noted for the production of cotton, rice, sugarcane and soybeans. The Corn Belt's major commodities are corn, feed grains, soybeans, and wheat. The Northern Plains region produces three-fifths of the nation's wheat. Additionally, small grains, grain sorghum, hay, forage crops, and pastures for raising cattle are found in this area. The Southern Plains region produces cotton, rice, citrus and vegetables. Conditions in the Mountain States are favorable for wheat, barley, oats, hay, sugar beets, potatoes, fruits, and vegetables. In the Pacific Coast region, Washington and Oregon produce wheat, fruit, potatoes, dairy products and lumber. California, currently the most important dairy producing state, also harvests over 300 commercial crops including cotton, fruits, and vegetables. Sugarcane and pineapples are primary commodities of Hawaii; and greenhouse, nursery, and dairy products are important commodities in Alaska.

Approximately 9 out of 10 farms are classified as individual operations and these account for the largest share of farmland and gross farm sales. For all



practical purposes, there are no subsistence farmers in the USA. Partnerships and corporations make up a very small share of farms, however they have the highest average farm sales. Average farm area is highest for corporate farms with 1,423 hectares, compared with 623 hectares for partnerships, and 178 hectares for individuals. Approximately 1 percent of privately owned farmland in the USA is owned by foreign persons or corporations. The seed industry is an important part of U.S. agriculture and virtually all farmers purchase their seed from commercial seed producers.

The forecast for field crop trends in 1995 and 1996 appears favorable for most goods. Wheat crops show a strong potential for increase this year due to more beneficial planting conditions. Cotton exports are expected to be the largest in over a decade, because of consumer preferences for natural fibers and an increase in textile exports. Total corn usage for 1995 is likely to be up and the average season prices will drop. Export of corn is also likely to increase due to lower prices, larger demand, and a drop in China's exports. In addition, the high yield of soybeans harvested in 1994 has pushed prices down, making an increase in exports for the upcoming year likely. Although rice acreage in 1995 may drop, competitive prices and a large harvest from 1994 will increase the country's share of exports.

Prices for specialty crops, like winter fresh vegetables, will be higher in 1995 as a result of damage done by Tropical Storm Gordon in 1994. Potato, apple, orange, grapefruit, and onion prices for 1995 will be lower because of the large storage supplies that are currently available. Higher stocks for processed fruits and vegetables will drive retail prices of those items down for the first time in several years. Statisticians foresee an increase in beet sugar production for 1995, due in part to consumer preferences for beverages like iced teas and fruit drinks that have boosted consumption of high fructose corn syrup.



## CHAPTER 2

# Indigenous Plant Genetic Resources

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Many plants native to the USA are important crop genetic resources. Plants native to the USA that are progenitors or wild relatives of current commercial agricultural and forage plants are grouped into tables (Appendix A) based on the following crop categories:

1. Grain and cereal crops (Table A-1),
2. Fruit crops (Table A-2),
3. Nut crops (Table A-3),
4. Vegetable crops (Table A-4),
5. Forage and turf crops (Table A-5), and
6. Industrial crops (Table A-6).

All native species in the same genus are listed for most crops in order to include most of the primary, secondary and tertiary gene pools. Many of these species were utilized by native Americans before the European colonization of America. Some outstanding examples of native genetic resources of crop plants, medicinal plants, and potential new crops are discussed in the following sections.

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### 2.1 WILD RELATIVES OF CROP PLANTS

#### **Sunflower**

The genus *Helianthus* contains 49 species and 19 subspecies, all native to the United States. This genus has provided two food plants, the sunflower (*H. annuus*) and the Jerusalem artichoke (*H. tuberosus*), both of which were originally domesticated by North American Indians. Sunflower is now an important crop in many regions of the world. The wild species have provided the cultivated *H. annuus* with genes for resistance to *Verticillium* wilt, rust, and downy mildew, as well as genes for cytoplasmic male sterility, fertility restoration, and recessive branching. As methods of incorporating wild species into the genetic base continue to improve, *Helianthus* species have the potential to significantly increase commercial sunflower



production. Wild species are potential sources of genes for insect and disease resistance, salt tolerance, increased seed protein, increased fatty acid concentration, and new cytoplasm.

### Blueberry

The blueberry has only been domesticated since early in the twentieth century. Cultivated blueberries are derived from the *Cyanococcus* subgenus of *Vaccinium* which has 24 species, all native to North America. *Vaccinium corymbosum*, the primary species of cultivated highbush blueberry, is produced in 17 states in the USA as well as in Canada, Australia and New Zealand. The most important commercially harvested lowbush blueberries are from managed native stands of *Vaccinium angustifolium* and *V. myrtilloides* in Maine and Quebec and the Maritime Provinces of Canada. *Vaccinium ashei* (incorporated in *V. corymbosum* in some reviews), the rabbiteye blueberry, is commercially produced in the southeastern USA. The potential for further blueberry improvement using wild germplasm includes incorporating broader tolerance to soil and climatic variability, improved resistance to pests, improved flavor and color, and higher productivity.

### Cranberry

The cultivated cranberry is derived from *Vaccinium macrocarpon*, an eastern North American endemic. Although *V. macrocarpon* occurs in 21 states in the USA, most of the commercially cultivated clones were directly selected from wild populations in only two states: Massachusetts and Wisconsin. The full range of the wild cranberry has not been completely surveyed and evaluated for useful genetic diversity.

### Pecan

*Carya illinoensis*, pecan, is distributed along the Mississippi River and its tributaries from Illinois and Iowa to the Gulf of Mexico in the USA. The most continuous groves occur along the rivers of Texas and Oklahoma; elsewhere they are disjunct. Pecan is the most valuable native U.S. nut crop. It is the most important nut crop in Mexico where it is also native. Pecan is grown on a smaller scale in Israel, South Africa, and Australia where it has been introduced. Effective pecan breeding programs began about 100 years ago. Pecan demonstrates high genetic variability and more research is necessary to accurately characterize the native populations. Useful traits present in native populations may include disease and insect resistances and climatic and edaphic adaptations.



## Strawberry

*Fragaria x ananassa*, the cultivated strawberry, is a hybrid of the two octoploid species, *Fragaria chiloensis* and *Fragaria virginiana*, both native to the USA. *Fragaria vesca*, a diploid, occurs in North America, northern Asia, Europe, and Hawaii. The genetic base of strawberry cultivars is quite narrow. Substantial ecological differentiation has occurred both among and within species of *Fragaria*. The wild species have many traits of potential use including resistance to heat and drought, frost tolerance, salinity tolerance, and higher photosynthetic rates. Recently, a clone of *F. virginiana* ssp. *glauca* from Utah was used to produce everbearing cultivars that have an extended fruiting season.

## Wild rice

Three species of wild rice, *Zizania palustris*, *Z. aquatica*, and *Z. texana* are native to the USA. Only *Z. palustris*, which is native to the Great Lakes region, is harvested for food. This species has been a staple crop since prehistoric times. Prior to about 1950, natural stands were the only source. Since then, cultivation has increased dramatically. The development of shattering resistant cultivars has greatly increased yields. Key traits important to increased domestication of the crop include better shattering resistance, tiller synchrony, disease resistance, grain/staw ratio, lodging resistance, and reduced seed dormancy.

## Pawpaw

The pawpaw (*Asimina triloba*) is the only temperate climate fruit in the Annonaceae. The eight species of *Asimina* are all native to the USA. Most pawpaws consumed in the USA. are gathered from the wild or from trees in home gardens. Only about 20 cultivars are commercially available -- many of the early cultivars have been lost. The potential exists for the pawpaw to become a commercial fruit crop of much greater importance if improvements are made in traits such as yield, fruit set, and seediness.

## Plum and Cherry

The USA has thirty native species of *Prunus*, two-thirds of which are plums. Many of the Japanese-type plum cultivars grown all over the world have important genetic contributions from North American species, notably *P. americana*. Beneficial traits found in the U.S. species of *Prunus* include winter hardiness, earliness, disease resistance, and desirable fruit characteristics. Numerous native American cherry species of *Prunus*, including *P. pumila*, *P. pensylvanica*, *P. serotina*, and *P. virginiana*, have been used in cherry breeding programs.



## Grape

Worldwide grape cultivation is dependent on the use of grape rootstocks developed from native U.S. *Vitis* species with resistance to the phylloxera insect (*Dactylosphaira vitifolia*). Most American *Vitis* species are tolerant to phylloxera, which devastated European vineyards in the 1800's. Genes for resistance to powdery mildew, *Uncinula necator*, are known only in American species of *Vitis* and have been successfully transferred to *V. vinifera* cultivars. Other examples of other useful traits found in native American species of *Vitis* include drought resistance in *V. rupestris*, salt tolerance in *V. cinerea* var. *helleri*, crown gall resistance in *V. labrusca*, and nematode resistance in *V. aestivalis* var. *aestivalis*.

## Walnut

Six species of *Juglans* are native to the United States including *J. nigra*, the American black walnut, the most valuable hardwood produced in the USA. The wood of *J. nigra* is prized for furniture and gunstocks, and the nuts are used in candies, baked goods, and ice cream. Nuts of *J. cinerea*, the butternut, are harvested to a lesser degree. Most of the English walnuts (*Juglans regia*) grown in California are grafted onto rootstocks of hybrids of *Juglans regia* and *Juglans hindsii*, the walnut species native to California. All *Juglans* species have a diploid chromosome number of 32 and cross readily with each other. Studies of genetic diversity of *Juglans* germplasm have been very limited.

## Raspberry and Blackberry

*Rubus idaeus* subsp. *strigosus*, the North American red raspberry, is part of the ancestry of most modern red raspberry cultivars. Red raspberries are an important temperate fruit crop in northern Europe and North America and are becoming more important in Australasia and Chile. Another native species, *Rubus occidentalis*, the black raspberry, is an important fruit crop in North America and has contributed many useful traits to the improvement of the red raspberry. Purple raspberries are hybrids of red and black raspberries and are grown in some northeastern states in the USA. Several blackberry species are native to the USA, including *R. allegheniensis*, *R. argutus*, and *R. canadensis*. The genetic base for the world's leading cultivars of red and black raspberry and blackberry is extremely narrow. New germplasm is needed to provide disease and pest resistance and to extend environmental adaptations.

## Currant and Gooseberry

Forty-nine of the approximately 150 species of *Ribes* occur in the USA. Some of the useful characters found in the native species include resistance to mildew, leafspot, and other fungal pathogens, drought resistance, fruit size, aphid resistance, and spinelessness.



## Forage and Turf Grass Crops

Many forage crops (forage grasses and forage legumes) and turf grasses are native to the USA (Table A-5). Forage grasses are used for hay, pasturing, soiling and silage. They are often sown with legumes.

## Medicinal Plants

At least a thousand species of plants native to the USA have been documented as having medicinal properties. These are too numerous to list here, but noteworthy examples include:

1. *Rhamnus purshianus*, cascara sagrada, is native to the northwestern USA. The bark is widely used throughout the world as a cathartic.
2. *Panax quinquefolius*, ginseng, is native to the eastern USA. The roots are exported in large quantities. A large percentage of the exported roots come from cultivated sources, although the roots of the wild plants are considered more desirable. Overcollection has contributed to a significant decline in the supply of wild plants.
3. *Echinacea angustifolia*, rattlesnake weed, is a nonspecific immune system stimulant that is used in many pharmaceutical preparations.
4. *Hydrastis canadensis*, goldenseal, is one of the best-selling herbs in U.S. health food stores. It is used to treat inflamed membranes of the mouth, throat, digestive system, and uterus. It is also used for jaundice, bronchitis, and gonorrhea. It is becoming less common in forests due to overcollection.
5. *Podophyllum peltatum*, the American mandrake mayapple, has constituents whose derivatives are used to treat testicular and small-cell lung cancers.
6. *Sanguinaria canadensis*, bloodroot, is used commercially as a plaque-inhibiting agent in toothpaste, mouthwashes, and rinses.
7. *Salix alba*, white willow, is used as a source of salicylic acid which is derived from salicin in the bark. Salicylic acid is a precursor to acetylsalicylic acid (aspirin), which reduces pain, inflammation, and fever.
8. *Taxus brevifolia*, the Pacific yew, is a promising source of taxol, a drug found effective for treating some cancers.

## New Crops

Several plant species native to the USA are being investigated for potential as new crops. These include:



1. *Simmondsia chinensis*, jojoba, is an evergreen shrub native to the Sonoran Desert in southern Arizona and California. Seeds of jojoba contain a unique oil that can be used for cosmetics, lubricants, detergents and other products.
2. *Lesquerella spp.* contain a seed oil high in a hydroxy fatty acid that is similar to imported castor oil. This oil has potential use in adhesives, lubricants, plasticizers, pharmaceutical and medical products, waxes and polishes, soaps, inks, detergents, and cosmetics. Of current commercial interest is *Lesquerella fendleri*, which occurs over the southwestern USA and northern Mexico. Other species are found throughout North America. Breeding efforts are underway to develop lines with higher oil content and earlier flowering.
3. *Cucurbita foetidissima*, buffalo gourd, has multiple food and non-food uses. It grows wild on marginal lands in the southwestern USA. The seeds are edible and the large, fleshy roots with high starch content can be burned as fuel.
4. *Parthenium argentatum*, guayule, native to Texas, is a drought tolerant shrub with bark that is a good source of natural rubber. Recently developed techniques have alleviated previous problems with establishing stands by direct seeding methods.
5. *Grindelia camporum*, a herbaceous perennial native to California, is a source of resin used in inks, adhesives, and as a substitute for pine rosin.
6. *Asclepias speciosa* and *A. syriaca* have floss in their seed pods which is used as batting for such products as comforters, sleeping bags, and Arctic apparel.
7. *Cuphea viscosissima*, native to the southeastern and eastern USA, is a source of industrial seed oils that can be used for manufacturing soaps, detergents, lubricants, and other related products.
8. *Amelanchier alnifolia*, the saskatoon, is one of many species of *Amelanchier* native to the USA. Since the 1970's, commercial interest in the development of the saskatoon as a fruit crop has increased.

## 2.2 CONSERVATION OF U.S. GENETIC RESOURCES

From 1987 to 1995, the U.S. Department of Agriculture (USDA)'s Agricultural Research Service (ARS) funded 21 explorations in the USA to collect native plant genetic resources. Germplasm collected on these explorations is incorporated into the National Plant Germplasm System (NPGS) where it is available for distribution.



The U.S. Department of the Interior's Fish and Wildlife Service (FWS), Division of Endangered Species, has the authority to designate species in the USA as threatened or endangered and to take appropriate steps to conserve habitat, rescue species and reintroduce species to their native habitat. Designation by the FWS gives protection to plant species, but provides little protection to genetically unique populations. For agricultural purposes, unique traits at the population level are often of most interest for conservation. From a gene pool perspective, approximately 33 of the 404 plant taxa listed as threatened or endangered by the FWS in 1993 have potential as genetic resources of agronomic or horticultural crops. *Helianthus schweinitzii* and *Prunus geniculata* are among the crop relatives listed as endangered. *Ribes echinellum* is listed as threatened. Hundreds of other crop relatives are under review for possible listing by the FWS. These species merit protection because of their potential to provide unique genetic material for crop improvement. The emergence of new biotechnologies has made genes from wild crop relatives more accessible for crop breeding and improvement.

Several federal agencies are involved in the conservation of native plants in the USA. In addition to the FWS, these include the USDA Forest Service (FS), and the U.S. Department of the Interior Bureau of Land Management and National Park Service. Numerous state and private agencies are also active in monitoring rare plants.

Private organizations involved in native plant conservation include the Center for Plant Conservation (CPC) and The Nature Conservancy (TNC). The CPC is a network of 19 botanic gardens which collects rare species and maintains them *ex situ*, either as seed or living collections, with the goal of reintroducing them into the wild. Under a Memorandum of Understanding between ARS and the CPC, the National Seed Storage Laboratory (NSSL) of the NPGS has agreed to provide long-term storage for a base collection of seeds of rare and endangered plant species of the USA. NSSL conducts research on the long-term storage methodologies required for the preservation of seeds of these species.

The Nature Conservancy protects rare species through habitat preservation. The databases of the State Heritage Programs initiated by TNC contain information on rare species and their habitats in each state.

## 2.3 LANDRACES AND OLD CULTIVARS

The NPGS maintains many landraces of crops native to the USA. Also, many traditional varieties are maintained by informal conservation networks. For



example, Seed Savers Exchange is a nonprofit network of gardeners and farmers who maintain seeds of heirloom varieties. Their 1994 catalog of vegetables, fruits, and grains offered 16,492 listings of seeds available for exchange. Some conservation groups in the USA are actively involved with protection of wild species as well as species used as food crops, medicinal plants, and ornamentals. Most of these grassroots organizations manage a small number of plant species, but many maintain over 1,000 accessions.

There are only about 7,000 Native American farmers in the U.S. today. The number of these farmers growing native crops has decreased and many of the traditional landraces previously grown are believed to be extinct. On the other hand, some crop varieties that originated in Native American communities are now distributed by seed conservation groups and grown outside these communities. For instance, Native Seeds/SEARCH, a seed conservation organization in Arizona that concentrates on traditional crops of the Southwest USA and Northwest Mexico and their wild relatives, distributes seeds to approximately 4,000 gardeners each year.



# CHAPTER 3

## National Conservation Activities

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### 3.1 IN SITU CONSERVATION ACTIVITIES

It is recognized that *in situ* conservation of crop genetic resources, both wild and cultivated, is a valuable complementary strategy to *ex situ* seed banks and clonal repositories. Methods of *in situ* conservation include the maintenance of wild plant genetic resources where they occur naturally, or maintenance by farmers of domesticated landraces or heirloom varieties in their historic or traditional context. At the present time, *in situ* conservation of wild crop relatives occurs fortuitously, for the most part, on protected lands and other wilderness areas. Of the 648 million hectares of forest and rangeland in the USA, the USDA Forest Service (FS) manages 77.6 million hectares (8.3%). The U.S. Congress has set aside 14 million hectares of National Forest and grassland as wilderness. The FS has designated more than 250 Research Natural Areas (RNAs) that are permanently protected in part for the purpose of maintaining biological diversity. Other Federal agencies, including the Bureau of Indian Affairs, Bureau of Land Management, National Park Service, and U.S. Fish and Wildlife Service within the Department of the Interior, as well as the Department of Defense, Department of Energy, Tennessee Valley Authority, and U.S. Army Corps of Engineers have also established RNAs. State and local governments also manage hundreds of protected areas throughout the country. The Nature Conservancy (TNC), a non-profit conservation organization, manages over 1,400 preserves in the USA. Although these areas were not specifically designed for the conservation of crop genetic resources, they serve this purpose in many cases.

Greater efforts need to be made to promote *in situ* conservation of native crop genetic resources within the USA. The land management agencies in the USA should be alerted to the presence of wild crop genetic resources on their lands so that management of these lands can preserve these resources. The databases of the State Heritage Programs initiated by TNC contain a tremendous amount of information about rare species in each of the 50 states. The correlation of data in these databases with data on native crop relatives would greatly facilitate conservation and monitoring of



valuable genetic resources. For many economically important crop species native to the USA, such as blueberries, cranberries, pecans, and *Rubus* species, *in situ* conservation may be accomplished through the designation of existing parks, wildlife refuges, or other protected areas as *in situ* reserves. The status of species or populations conserved in these areas would have to be monitored and the information could be maintained in the Germplasm Resources Information Network (GRIN) database.

A few private, non-profit organizations, such as Seed Savers Exchange and Native Seeds/SEARCH, promote *in situ* conservation of cultivated landraces and heirloom varieties of native or traditional North American crops. Native Seeds/SEARCH is also involved in promoting the *in situ* conservation and population management of certain wild crop relatives such as *Capsicum* and *Phaseolus*.

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### 3.2 EX SITU COLLECTIONS

The NPGS had its origins with a 1943 National Research Council report. This report resulted in authorizing legislation in 1946 to establish four regional plant introduction stations. These stations were formed in the late 1940s and early 1950s as a partnership between the State Agricultural Experiment Stations and ARS. Construction funding for the NSSL was appropriated in 1956, and that facility was opened in 1958. The Inter-Regional Potato Introduction Station was established in 1947, and various crop-specific breeders' collections (i.e., small grains, cotton, soybeans, etc.) were, over a period of several years, incorporated into the NPGS. The most recent additions to the NPGS were the National Clonal Germplasm Repositories which were established during the 1980s to provide more systematic maintenance of clonally propagated fruit and nut crop and landscape germplasm.

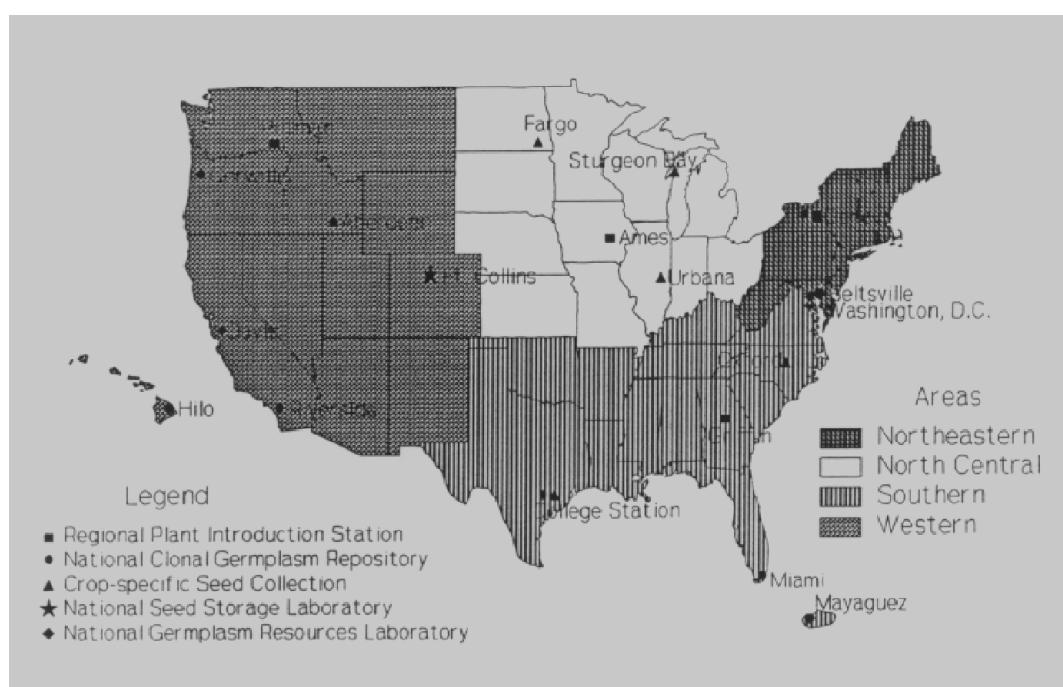
The NPGS is a network of public and private organizations charged with the responsibility to preserve the genetic diversity of crop plants. The NPGS encompasses a geographically decentralized network of germplasm collections. Designated curators and other scientists preserve, evaluate, and catalog this germplasm and distribute it for research purposes to others in the USA and around the world. Two types of collections exist, seed collections and vegetative or clonal collections. Some plant species and their genetic integrity can be maintained as seeds. Other species, particularly tree fruits, berry, nut, and tropical species, can only be



maintained as vegetative plantings which must be located in suitable environments for their sustained growth and where they can be most effectively evaluated for their genetic biological security, management efficiency, and accessibility reasons. A number of other crop-specific seed collections are located elsewhere because of environmental requirements and the need for close accessibility to research users. Many of the NPGS collections have been jointly developed and maintained by Federal and State scientists at State Agricultural Experiment Stations for many years. The State Agricultural Experiment Stations co-fund many of the collections, and Federal, State, and private sector scientists conduct evaluation and utilization research on them. Locations of current NPGS sites are shown in Figure 2.



## FIGURE 2. NATIONAL PLANT GERMPLASM SYSTEM



NPGS sites of major importance are:

- The NSSL located in Fort Collins, Colorado. The NSSL serves as the base collection for long-term, backup storage of NPGS active collections. Of its more than 268,000 accessions, about 60,628 are not duplicated at other sites.



- Four regional stations (Table 1) in Pullman, Washington; Ames, Iowa; Geneva, New York; and Griffin, Georgia are responsible for the management, regeneration, characterization, evaluation, and distribution of the seeds of more than one-third of the accessions of the national system (i.e. nearly 197,000 accessions of almost 4,000 plant species).

**Table 1. Regional Plant Introduction Stations of the NPGS**

Location	Accessions held	Primary Crops Preserved
<b>Ames, Iowa</b>	40,079	Maize, amaranth, oilseed brassicas (e.g., rape, canola, mustard), sweet clover, cucumber, pumpkin, summer squash, acorn squash, zucchini, gourds, beet, carrot, sunflower, millets
<b>Geneva, New York</b>	14,180	Tomato, birdsfoot trefoil, brassicas, onion
<b>Griffin, Georgia</b>	82,277	Sweetpotato, sorghum, peanut, pigeon pea, forage grasses, forage legumes, cowpea, mung bean, pepper, okra, melon, sesame, eggplant
<b>Pullman, Washington</b>	60,276	Common bean, garlic, onion, lupine, pea, safflower, chickpea, clover, wild rye, lettuce, lentil, alfalfa, forage grasses, horsebean, common vetch, milkvetch

- Eight National Clonal Germplasm Repositories (Table 2), located at sites around the country, where fruit, nut, and landscape cultivars and wild relatives that cannot readily be stored as seed are maintained.



**Table 2. National Clonal Germplasm Repositories**

Location	Accessions held	Primary Crops or Species Conserved
Brownwood, Texas	191	Pecan, hickory, chestnut
Corvallis, Oregon	8,238	Filbert, pear, strawberry, raspberry, blackberry, cranberry, blueberry, mint, hops
Davis, California	5,276	Grape, stone fruits, walnut, almond, pistachio, persimmon, olive, fig, pomegranate, mulberry, kiwi
Geneva, New York	4,999	Grape, apple, sour cherry
Hilo, Hawaii	579	Macadamia, guava, passion fruit, Barbados cherry, breadfruit, jackfruit, pineapple, papaya, lychee, <i>Canarium</i> (pili nut), <i>Guilielma</i> (peach palm), <i>Nephelium</i> (rambutan, pulasan), carambola
Miami, Florida and		
Mayagüez, Puerto Rico	5,464	Banana, mango, avocado, Brazil nut, Chinese date, jujube, cacao, soursop, bamboo, sugarcane, cassava, tropical yam, cocoyam
Riverside, California	900	Citrus and related genera, dates
Washington, D.C.	1,714	Woody ornamental species

- Several crop-specific collections devoted to maintaining and managing particular species (Table 3). The National Small Grains Collection in Aberdeen, Idaho, is responsible for more than 119,000 accessions of wheat, barley, oats, rice, rye, *Aegilops*, and triticale. The Interregional Potato Research Station (National Research Support Project-6) in Sturgeon Bay, Wisconsin maintains about 5,300 potato germplasm accessions, including cultivated forms of the white potato and more than 100 related wild species. Other crop-specific collections include cotton at College Station, Texas (more than 7,100 accessions) and soybean at Urbana, Illinois (nearly 16,000 accessions).

**Table 3. Crop-Specific Collections of the NPGS**

Collection	Location	Accession
Small Grains	Aberdeen, Idaho	119,775
Soybean	Urbana, Illinois	15,733
Cotton	College Station, Texas	6,098
Potato	Sturgeon Bay, Wisconsin	5,360
Flax	Fargo, North Dakota	2,659
Tobacco	Oxford, North Carolina	2,080

- Genetic stock collections (Table 4) include genetic marker lines, aneuploid stocks, etc. that merit preservation because of their genetic characteristics and scientific value. In many cases, these collections are requested more often than the designated active collections of the same crop.

**Table 4. Genetic Stock Collections of the NPGS**

Crop (Genus)	Location
Barley ( <i>Hordeum</i> )	Aberdeen, Idaho
Brassica ( <i>Brassica</i> )	Madison, Wisconsin
Clover ( <i>Trifolium</i> )	Lexington, Kentucky
Cotton ( <i>Gossypium</i> )	College Station, Texas
Lettuce ( <i>Lactuca</i> )	Salinas, California
Maize ( <i>Zea</i> )	Urbana, Illinois
Pea ( <i>Pisum</i> )	Pullman, Washington
Pepper ( <i>Capsicum</i> )	Las Cruces, New Mexico
Sorghum ( <i>Sorghum</i> )	College Station, Texas
Soybean ( <i>Glycine</i> )	Ames, Iowa
Tomato ( <i>Lycopersicon</i> )	Davis, California
Wheat ( <i>Triticum aestivum</i> )	Columbia, Missouri
Wheat ( <i>Triticum durum</i> )	Fargo, North Dakota

In the early 1970s, the NPGS solidified its collaborative federal and state ties, with some cooperation from private industry, to better manage germplasm of importance to U.S. agriculture. Since that time, the NPGS's participation in and support of international cooperation in managing germplasm has grown. Today, the NPGS is the world's largest single distributor of plant germplasm. Eighteen specific U.S. crop collections, including those of maize, rice, sorghum, wheat, soybean, citrus, tomato, and cotton, were designated by the International Board for Plant Genetic Resources (IBPGR, reorganized as the International Plant Genetic Resources Institute (IPGRI)) as regional or global base collections in its international network. The NPGS also provides backup storage to other national and international collections.



The U.S. government recognizes the important role and responsibility of the NPGS in acquiring, characterizing, conserving, documenting, and distributing germplasm to scientist users in the USA and abroad. However, support and funding for the NPGS comes from both Federal and State contributions. In FY 1995, ARS provided about \$20.074 million for germplasm-related activities. Facilities, equipment, services, and personnel at NPGS sites are frequently provided as in-kind support by the State Agricultural Experiment Stations and universities where germplasm facilities are located. Private industry underwrites selected projects, such as the Latin American Maize Project, provides germplasm, and develops and transfers germplasm in the form of hybrids and varieties to farmers and other consumers.

The NPGS attempts to make the composition of the national collections as comprehensive as can be practically achieved. The collections are crop-oriented and strive to encompass as broad a range of genetic diversity as possible within each crop's genepool, including improved cultivars and elite breeding lines as well as landraces and related wild species. Virtually all of the NPGS collections may be considered to be global in scope and importance. All of the crop-specific germplasm collections are considered to be invaluable resources. An effort is made to ensure that most samples are replicated at a backup site. In most cases, existing facilities have the capacity to maintain the collections at acceptable standards.

NPGS distribution records for the three year period of 1992-1994 (Table 5) show that 66.4% of the germplasm distributed was requested by users within the USA, 32.5% by foreign users, and 1.1% by International Agricultural Research Centers (IARCs). The vast majority of the germplasm distributed by NPGS in the USA was requested by state and federal researchers, somewhat less by private researchers, and only a small percentage by U.S. industry. The large majority of the germplasm distributed abroad was requested by foreign industry, with only a comparatively small proportion requested by foreign private and public researchers.



**Table 5. Summary, NPGS Germplasm Accession Distribution, 1992-1994**

	UNITED <sup>1</sup> STATES	FOREIGN <sup>2</sup>	IARCs <sup>3</sup>	YEARLY TOTALS
1992	75,997 (60.9%)	48,475 (38.8%)	389 (0.3%)	124,861 (100%)
1993	71,055 (66.6%)	32,508 (30.5%)	3,028 (2.9%)	106,591 100%
1994	91,337 (71.7%)	35,914 (28.2%)	288 (0.2%)	127,539 (100%)
3-year average	79,463 (66.4%)	38,966 (32.5%)	412 (1.1%)	119,664 (100%)

**1** Includes U.S. private, industry, state and federal government requests.

**2** Includes foreign private, industry, government and USAID requests.

**3** International Agricultural Research Centers.

The NPGS exchange and collecting program is based primarily on the identification of gaps in the existing collections, after which attempts are made to fill those gaps either through exchange or ad hoc collecting expeditions (Table 6). Collection activities are usually mission-oriented; however, the policy is flexible enough to be able to take advantage of opportunistic collection circumstances, such as germplasm for one crop collected during an expedition specifically seeking another. A comprehensive effort has been made to obtain landrace materials, as well as related wild species. The Acquisition Policy adopted by the NPGS in 1989 is included (Appendix B).

**Table 6. Countries Cooperating With NPGS Plant Explorations, 1987-1994**

Algeria
Argentina
Armenia
Australia
Belgium
Bolivia
Brazil
Bulgaria
Canada
Chile



## Countries Cooperating With NPGS Plant Explorations, 1987-1994

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China  
Colombia  
Denmark  
Ecuador  
France  
Georgia  
Guatemala  
India  
Ireland  
Japan  
Kazakhstan  
Kyrgyzstan  
Malaysia  
Mexico  
Mongolia  
Morocco  
Netherlands  
Pakistan  
Papua New Guinea  
Philippines  
Russia  
Spain  
Sweden  
Taiwan  
Tunisia  
Turkey  
United Kingdom  
USA  
USSR  
Venezuela  
Vietnam  
West Germany  
Yugoslavia

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### 3.3 STORAGE FACILITIES

The NSSL at Fort Collins, Colorado houses the base collection of plant germplasm of the NPGS. In August, 1992, the USDA dedicated a \$12 million expanded and remodeled NSSL, which quadrupled the storage area of the facility and added modern research and processing laboratories. The expanded



storage space features quality cold-storage conditions for conventional seed storage and cryopreservation storage capacity for seeds, pollen, and vegetatively propagated germplasm. Germplasm storage is at about -18°C for conventional refrigeration and at about -160°C for liquid nitrogen vapor phase. Accessions are stored in moisture-resistant containers for conventional storage and plastic tubes for cryostorage. The NSSL can store over one million samples and is expected to meet long-term storage needs in the USA for many years to come.

Upon receipt at NSSL, seed accessions are temporarily stored in an environmentally controlled room maintained at about 35% relative humidity and 5°C. Accessions are dried in an equilibration room at about 35% RH and 15°C. When at equilibrium, accessions are moved to temporary sub-zero storage while in queue for germination tests. Prior to germination testing, seed is moved to an equilibration room at about 25% RH and 5°C. Equilibration against a specific RH results in an optimum moisture content for seed storage that is independent of species or accession and obviates the need for testing all accessions for moisture content. The optimum RH varies with storage temperature, and current research indicates that 25% RH at 5°C produces a near optimum seed moisture for storage at subzero temperatures. Moisture contents are determined on a few random samples to ensure quality control. After reaching equilibrium during the germination tests, each accession is sealed in a moisture-resistant container (for conventional storage) or plastic tube (for cryostorage) and placed in long-term storage.

NSSL has two vaults for conventional storage with a combined shelf space of 3,645 m<sup>2</sup>. Two vaults for cryopreservation have a capacity of 200 tanks. Currently, 18 tanks are in use.

Proposals for storage of plant materials from foreign governments or international agencies are reviewed by the Director of NSSL and the National Program Leader for Germplasm. Long-term storage of security backup materials by NSSL requires a Memorandum of Understanding between the ARS and the requesting organization. Security backup materials are stored at about -18°C. NSSL does not conduct seed germination tests on these materials except in certain situations in response to a request by the donor with concurrence from the NSSL Director. Security backup materials are not available for distribution. Collections for temporary or emergency storage may be accepted by NSSL under terms specified in an exchange of letters between ARS and the requester. Agreements are in place or in progress with some international centers and national programs.

The base collection of the NSSL is not duplicated in its entirety in any other genebank. However, other genebanks hold many of the same accessions as NPGS. For example, the NPGS sugarcane (*Saccharum*) collection is mostly



duplicated in the sugarcane collections of India and Brazil. Most of the NPGS *Phaseolus* accessions are also present in the CIAT collection. The NPGS small grains collection has many duplicates in the collections of Canada, Russia, and the EU.

The National Germplasm Repositories maintain the active collections of the NPGS. Seed at the larger germplasm repositories is stored in temperature and humidity controlled rooms at about 25% RH and 4°C. Each is increasing its capacity to store sensitive, small, or little-used accessions in -18°C storage to reduce losses and regeneration costs.

The clonal repositories maintain active collections of crops that, for a variety of reasons, are not usually held in active collections as seeds. For most material held in such collections, long-term storage in the past was not feasible, so duplicate materials were often maintained in field and greenhouse or screenhouse collections to provide some backup protection. As cryopreservation becomes feasible for more of these species, more will be maintained in long-term storage.

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### 3.4 DOCUMENTATION

Data on the NPGS collections are maintained in the GRIN database. GRIN is a centralized computer database that includes all passport, inventory, evaluation and order processing records for the NPGS. All available passport data are included in GRIN for accessions that entered the NPGS after 1979. For accessions that entered the system prior to 1979, some of the passport data have not been fully transferred into GRIN, but exist in published Plant Inventory Records. Passport information exists for all germplasm accessions, but is typically more complete for germplasm acquired in recent years.

Most accessions have at least some characterization or evaluation data associated with them. Responsibility for entering data and reviewing data quality on accessions rests with the curators of the germplasm collections. In many cases, Crop Germplasm Committees (CGCs) associated with particular crops assist the curators in establishing descriptors, evaluation priorities, and assessing the validity of the evaluation data.

The amount of evaluation and characterization data available varies considerably from accession to accession and from species to species, but tends to be greater for those of greatest economic importance. Crops that have been



most extensively evaluated include wheat, barley, oats, rice, alfalfa, clover, sorghum, maize, potato, sugarbeet, sunflower, soybean, cucumber, and melons.

The amount of indigenous knowledge about the germplasm accessions in the U.S. collection is very limited. When such knowledge exists, it is included as a part of the collectors' notes in the passport area of GRIN.

The NPGS collections include few breeding lines from either publicly or privately supported breeding programs. Including these would result in thousands of additional accessions, the vast majority of which would be of little or no value because they would not add genetic diversity to the collection. Breeding lines that are included are usually documented with the important descriptive and pedigree information that led to the decision to include them in the collection. Efforts are made to secure and preserve parental material that has unique traits not known to otherwise exist in the germplasm collection.

In many cases, there is a relationship between the amount of characterization and evaluation data and the number of requests for individual accessions, although there are many exceptions to this.

Information about germplasm accessions is provided to users in several formats. A menu-driven microcomputer version of GRIN data (pcGRIN) is available which allows all information on a species, genus, group of genera, etc. to be loaded onto a personal computer. As of April 1995, this method of data distribution had been used to provide information to over 550 scientists in 46 countries. Direct access to the GRIN database is also available through Internet from anywhere in the world. Hard copies of data are also provided to anyone on request. The published Plant Inventory Records are another source of information about the germplasm collections. These annual publications are provided to libraries, genebanks and individual scientists free of charge.

The NPGS routinely exchanges data on its germplasm collections with scientists in the USA and elsewhere, with other national programs, and with regional and international centers. NPGS computer specialists are assisting many countries with developing their own genetic resources information systems. Examples include the Vavilov Institute in Russia, the Indian National Bureau for Plant Genetic Resources, and CENARGEN in Brazil. The Internet/World Wide Web will undoubtedly become more important in linking together genebanks and genetic resources programs around the world.



There are numerous accessions in the NPGS, mainly wild crop relatives, that are known to be or are likely to be incorrectly identified to the species level. There are also accessions that have not yet been assigned a species name. The effort to correctly identify all material in the collections is ongoing. For most genera, the collection curators possess the knowledge to correctly identify the accessions. However, when they do not, they seek the expertise of taxonomic specialists from within the USA and abroad. There is a national need for increased effort in the area of plant taxonomy, and a portion of this is needed for direct support of the NPGS.

The GRIN database is regularly backed-up or duplicated. Besides at least three complete sets of all records where the GRIN minicomputer resides in Beltsville, Maryland, another set of records is kept in a fireproof safe, yet another set is housed in a separate building, and a complete set of the database is sent to NSSL every six months.

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### 3.5 EVALUATION AND CHARACTERIZATION

In the NPGS, the term evaluation is generally used in the broad sense to cover its efforts to describe the germplasm in the collections. Although the term characterization is not frequently used, in reality there is a distinction made between characterization and evaluation. Characterization, the recording of those characters which are highly heritable, can be seen by the eye, and are expressed in all environments, is usually carried out by the curators during the first seed increase and subsequent grow-outs. CGCs help establish evaluation plans for the germplasm in the NPGS working collection for the crop(s) of concern to them. Such a plan first involves the CGC identifying the priority traits to be evaluated and then identifying where the specific expertise, interest and facilities reside to carry out the evaluations. Funds are earmarked each year to support germplasm evaluation and a call for proposals is made to the scientific community. Evaluation projects may be conducted by the staff at the NPGS germplasm maintenance site or by specialists at a university, government laboratory, or private institution. Data generated are provided to the appropriate crop curator for entry into the GRIN database.

Evaluation data may also be generated and provided to the curators by users who have requested and received germplasm. A concern that often exists with data generated in this way regards the uniformity and comparability of the data obtained and whether the data should be entered into GRIN. For example, information may be lacking on the specific conditions under which a test was conducted, check cultivars included in the tests, race of a pathogen used, etc.



Experience has shown that even though germplasm recipients are encouraged to return evaluation results, as well as information on the uses made of the germplasm, it should not be made a condition for receiving germplasm.

The descriptors used for the various species have been developed by the CGCs. In most cases in which there are existing IBPGR/IPGRI descriptors, these have been used at least as a starting point for the development of NPGS descriptors. In some cases, significant modifications have been made by the CGCs to the IBPGR/IPGRI descriptors; in other cases, they are very similar or identical.

A collection can never be considered fully evaluated. It is only possible to evaluate for known traits. However, history shows that one of the greatest values of plant germplasm collections is the discovery of new or unknown traits (i.e., resistance to a new disease or a new race of a disease, a gene controlling a quality trait needed for a new processed product, etc.). Of 80 of the most important crop plants in the NPGS, 41 have been evaluated for between 1 and 20 traits, 31 have been evaluated for between 21 and 49 traits, and 8 have been evaluated for between 50 and 90 traits. The evaluations include reactions to numerous biotic and abiotic stresses, biochemical composition, environmental adaptation, etc. All of the characterization and evaluation data entered into the GRIN database are freely available to everyone via Internet, telephone connection, diskettes, printouts, or pcGRIN (see Documentation section above).

Evaluation data can help in the establishment of plans for future plant collecting or exchange with other genetic resources programs. For example, if evaluations for a certain important trait reveal that there is little or no genetic variation in the existing collection it may be important to attempt to broaden the genetic base of the collection.

Because of the limited funds available for evaluating the germplasm collections, efforts are made to prioritize among the many species represented in the collection and to select only the most critical traits for evaluation. Expenditures for evaluation can be justified and an expanded effort is needed in the future. Experience shows that the accessions most likely to be requested or used are those for which at least some evaluation data are available.

For certain species, international collaboration could unquestionably help to achieve better results than a strictly U.S.-based evaluation and regeneration program. Such collaboration is probably most effective if handled with a crop-specific approach. There are initial efforts underway with some crops (i.e., *Solanum*, *Pisum*, *Hordeum*, *Beta*). Leadership for such efforts is and should be provided by working groups of scientists involved with individual species or



crops. Since none of the NPGS collections are currently deliberately being maintained *in situ*, there is no *in situ* evaluation being attempted.

### 3.6 REGENERATION

Because of the large numbers of species and accessions preserved and the large number of accessions distributed annually, seed regeneration is a major concern for the NPGS. It is the policy of the NPGS to regenerate accessions when the supply of seed held in the active collection drops below the amount needed for distribution, or when the viability of the seed sample stored at the base collection drops below 85%. species whose germination characteristically does not exceed 85% necessitate exception. There is a long-standing backlog of accessions requiring regeneration and new accessions are being added to the system continually. Presently 19% of the 348,517 accessions in the active seed collections are unavailable for distribution (Table 7). The 65,454 seed accessions that are unavailable need to be regenerated before they can be distributed. In addition, there are 60,628 accessions that are currently held only in the base collection and need to be increased before they can be put in the active collections and made available for distribution.

**Table 7. Summary of Availability of NPGS Seed Accessions**

Germplasm Repository Location	Seed Accessions	
	Total	Available for distribution
Ames, Iowa	40,079	22,101
Geneva, New York	14,180	11,556
Griffin, Georgia	82,277	63,412
Pullman, Washington	60,276	50,614
Aberdeen, Idaho	119,775	107,873
Sturgeon Bay, Wisconsin (potato)	5,360	4,485
Urbana, Illinois (soybean)	15,733	13,847
College Station, Texas (cotton)	6,098	4,680
Fargo, North Dakota (flax)	2,659	2,640
Oxford, North Carolina (tobacco)	2,080	1,855
<b>TOTAL</b>	<b>348,517</b>	<b>283,063 (81%)</b>



The facilities for regeneration of most species are adequate, but there are notable limitations for others. A problem for regenerating some species is that the environmental growing conditions at the genebank or maintenance site are less than ideal for the production of good yields of high quality seed. In some cases, arrangements are made to have seed regenerated at other locations. The NPGS has for many years sought to have a grow-out or regeneration site located in an arid region with a long growing season. Attempts are being made to establish such a site. If this can be accomplished and the site provided with adequate personnel and equipment, it will increase the NPGS's capacity to regenerate quality seed and reduce the backlog.

In addition to field grow-out facilities, there are limitations on greenhouse and screenhouse facilities for regenerating those species or accessions that need extra care or precisely controlled conditions. Another limitation often encountered is the availability of an adequate number of field cages for controlled pollination of open-pollinating species. Also, there are some species, or in some cases individual accessions, that are unusually difficult to increase (i.e., those that are naturally slow-growing, in which flowering is difficult-to-induce, or that require extraordinary temperature, light, humidity, etc.). However, the biggest single limitation for germplasm regeneration is the number of permanent employees and seasonal laborers to manage and carry out the necessary field and greenhouse activities.

Each of the germplasm maintenance sites has written standard operating procedures for regeneration of the species for which they are responsible. The procedures detail the minimum number of plants to be grown, isolation requirements, special cultural practices, etc. It is generally felt that current regeneration procedures are adequate for maintaining the genetic character of the accessions. Occasionally, there are situations where less-than-ideal practices have to be followed, such as when the supply of viable seed available for the increase is limited, that make some "genetic bottlenecking" inevitable. There is always a chance that pollen contamination could occur, but the likelihood of this is very small. The possibility of genetic drift occurring during grow-outs is recognized and efforts are made to prevent or minimize it. However, genetic drift is likely to be very subtle and may go unrecognized.

Details of regeneration history are recorded in the GRIN database and are thus available to users of the material. For accessions that have been in the NPGS for a long time, there are cases where some of the records are incomplete or inaccurate. It is common for there to be more than one generation of an accession in storage. When this is the case, the different generations or increases are managed separately and not mixed.



### 3.7 OTHER CONSERVATION PROGRAMS

In addition to the National Program, in 1985, the University of California established a Genetic Resources Conservation Program (GRCP) to identify genetic resources important for the State of California and to address related issues. The Program sponsors projects in the collection, inventory, maintenance, preservation, and utilization of genetic resources important for the State of California as well as research and education in conservation biology. A grants program provides small, but critical financial support to endangered collections of genetic resources. The GRCP activities take place on the several campuses of the University of California with funds provided by the State of California.



# CHAPTER 4

## In-Country Uses of Plant Genetic Resources

### 4.1 USE OF PGR COLLECTIONS

As of April 1, 1995, the NPGS collections included over 449,000 accessions representing 8,720 species. From 1992 to 1994, requests were received for germplasm of 3057 (35%) of the species. Table 8 summarizes the number of accessions distributed and the number of users for the 10 most requested species during this time period. Table 9 shows the percentage of the total number of accessions of each crop that were used domestically during the same three years.

**Table 8. Ten Most Requested Crops Distributed to Domestic Users**

CROP	1992		1993		1994	
	# Acc.	# Users	# Acc.	# Users	# Acc.	# Users
<i>Triticum aestivum</i>	4,142	76	1,675	68	12,532	70
<i>Glycine max</i>	5,838	196	10,356	183	6,002	74
<i>Hordeum vulgare</i>	1,505	45	3,590	43	16,018	43
<i>Oryza sativa</i>	6,711	33	5,005	31	3,021	28
<i>Zea mays</i>	2,694	85	1,172	95	1,664	97
<i>Phaseolus vulgaris</i>	1,078	35	1,398	18	2,086	19
<i>Sorghum bicolor</i>	6,702	50	9,59	28	9,492	26
<i>Gossypium hirsutum</i>	1,107	142	1,107	71	8,66	71
<i>Pisum sativum</i>	1,817	12	2,021	19	27,71	23
<i>Cucumis melo</i>	9,21	19	2,663	18	8,09	23



**Table 9. Ten Most Requested Crops - Percent of Collection Distributed to Domestic Users**

CROP	1992	1993	1994
<i>Triticum aestivum</i>	12	5	37
<i>Glycine max</i>	39	69	40
<i>Hordeum vulgare</i>	6	14	63
<i>Oryza sativa</i>	40	30	18
<i>Zea mays</i>	20	9	12
<i>Phaseolus vulgaris</i>	10	13	19
<i>Sorghum bicolor</i>	23	3	33
<i>Gossypium hirsutum</i>	27	27	21
<i>Pisum sativum</i>	62	68	94
<i>Cucumis melo</i>	31	90	27

It is impossible to know what portion of the genetic resources used in U.S. commercial plant improvement programs come from the NPGS collections. Private programs, like publicly supported programs, have their own working collections of germplasm. These working collections are usually acquired over long periods of time and through a variety of means. Distribution of germplasm from the NPGS to U.S. private companies has averaged 12,988 accessions per year for each year from 1992 through 1994. This represented 16% of the total distributions to U.S. scientists and 11% of the distributions to all scientists.

From 1992 to 1994, germplasm of 5,663 of the 8,720 species (65%) in the NPGS collection was not distributed. Although it is not possible to predict whether there will be requests for any of those 5,663 species in the future, two factors that may provoke interest in the other species are 1) searches for potential new crops, and 2) emerging technologies that are making it possible to combine genes from species that were previously too distantly related.

Germplasm maintained by the NPGS is available for research, teaching, and breeding purposes, but is not normally requested by farmers. Because the germplasm collections include mainly wild crop relatives, landraces and obsolete cultivars, U.S. farmers have little or no interest in direct access to the material.

There are numerous organizations in the USA composed of hobbyists, amateur gardeners, etc. that maintain and distribute heirloom varieties of agronomic crops, fruits and vegetables. These include the Seed Savers Exchange, Native Seeds/SEARCH, and the North American Fruit Explorers.



## 4.2 CROP IMPROVEMENT PROGRAMS AND SEED DISTRIBUTION

During the past decade there have been several surveys made of the public and private plant breeding programs in the USA. These surveys attempted to determine the level of plant breeding inputs being provided by the public and private sectors, whether adequate plant breeding attention was being devoted to "minor crops", the future availability of newly trained plant breeders to meet demands, and the effects of increased public funding for biotechnology-oriented programs on the educational opportunities for traditional plant breeding students. Although national needs are currently being met by plant breeding conducted by public and private institutions, the consensus of administrators and scientists is that periodic monitoring of plant breeding programs is important.

In 1989, there were reported to be 665 Federal and State supported plant breeding programs in the USA involving 417 breeder/geneticist full time equivalents (FTEs). Twenty-two percent of the programs and 32% of the FTEs were supported by federal funds and 78% of the programs and 68% of the FTEs were supported by state funds. Also in 1989, 157 private companies reported spending \$272 million in support of plant breeding.

Farmers in the USA are rarely involved directly in the breeding of new cultivars. They do, however, have opportunities to communicate their needs through various types of local and state grower meetings; contacts with research and extension personnel; and contacts with representatives of seed, or processing companies, etc. Also, farmers periodically cooperate with public and private breeding programs by participating in the testing of advanced generation breeding lines and serve in varying capacities on boards of directors and advisory committees of private companies and State universities.

U.S. plant breeding programs have many goals and are diverse in their approaches. They conduct research on all of the major crops grown in the country as well as on most minor crops. Specific procedures employed vary depending on the plant species under consideration and the specific objectives of the project.

The objectives of breeding research range from the introduction of a specific gene or trait into a locally adapted cultivar to the development of a totally new crop plant. The latter usually involves a lengthy and complicated series of crosses and selections of diverse germplasm. A common focus of many of the programs is identifying and incorporating resistance to biotic and abiotic stresses, such as disease and insect resistance and adaptation to a



range of different soil and climatic conditions. Emphasis is also usually placed on improving yield potential and quality, taking into account the intended use of new cultivars (i.e., export markets, fresh market, specific processed products, etc.).

The products of publicly and privately funded crop improvement programs are made available to farmers, gardeners, etc. through an extensive national network of seed company marketing people, farm and garden stores, cooperatives, etc. Cultivars developed by public sector breeding programs may be released to all interested seed companies to produce and market or released exclusively to a single company. Companies generally want an exclusive license before getting involved in order to ensure a suitable market. Seed companies generally produce a sufficient quantity of seed of new cultivars to meet the expected demand by the time it is made available for sale. Off-season production in South America has been regularly used to speed increases of new parental lines, and even hybrids. All farmers, regardless of the crops they grow and the size of their farming operation, benefit from the use of well-adapted, high-yielding, pest-resistant, high-quality cultivars.

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#### **4.3 BENEFITS DERIVED FROM THE STORAGE OF RESEARCH ON AND USE OF PGR**

In its active collections, the NPGS does not maintain germplasm of species mainly or wholly for foreign use. However, the policy of the NPGS is to freely exchange all material preserved with scientists from any country. The average annual distribution of germplasm to foreign scientists by the NPGS has been over 40,000 accessions per year for the last 14 years.

Separate from the germplasm maintained in the active collections and the duplicate samples maintained in the base collection, the NPGS, as a courtesy to a limited number of foreign counterparts, provides cold storage security backup space for their germplasm collections. Depending on the agreement, the packages containing the accessions may be kept sealed during their storage or the material may be used by U.S. scientists.

Of the over 449,000 accessions in the NPGS collection, over 85,000 (19%) originated in the USA. Much of this indigenous germplasm is regularly used by U.S. researchers. Examples of frequently used genera include many native range grasses and forages, *Helianthus*, *Fragaria*, *Juglans*, and *Prunus*. As is the case with all of the germplasm in the NPGS, the germplasm of native U.S. species is freely available to foreign scientists for breeding or other research.



Sunflower (*Helianthus*) is an example of a crop native to the USA and grown by native American Indians. Early European explorers of North America took germplasm home with them and sunflower subsequently became an important crop in Europe because of its high quality oil and protein content. Sunflower cultivars developed in Europe were later introduced into North America where they became commercially important.

As stated above, approximately 81% of the germplasm held in the NPGS is originally from foreign sources. The countries of origin, as well as all other countries, have benefited from having the germplasm securely maintained for future generations, and at the same time having it available for research. At its 1989 and 1990 annual meetings, the Crop Science Society of America sponsored symposia on the uses of plant introductions in cultivar development. The presentations and subsequent publications documented in detail how germplasm has been used to improve 16 of the world's most important agronomic crops or crop groups. The improved germplasm resulting from decades of U.S. breeding research has been and continues to be used widely around the world.

Moreover, whole collections have been repatriated to countries developing national genebanks and requesting samples. In addition, everyone has access to improved germplasm that results from research without having to develop and support expensive germplasm enhancement and breeding programs.

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#### 4.4 IMPROVING PGR UTILIZATION

Plant genetic resources activities have for many decades contributed significantly to the development of improved cultivars that are high yielding, responsive to improved cultural practices, have acceptable quality for food, feed or fiber uses, and possess resistance to disease and insect pests and to environmental stresses. Plant breeding research and farmers' utilization of improved cultivars and hybrids have contributed greatly to the fact that the average U.S. family now spends only 8% of its income for food. Although it is not possible to assign a value to the contribution that plant genetic resources and their use in the USA for developing improved cultivars has made to the populations of other countries, it has without question been highly significant. For example, ARS scientists provided the breakthrough crosses in wheat that led to the broad use of the Norin 10 dwarf genes in both spring and winter miracle wheats.



The relationship between the germplasm preservation program in the USA and the utilization system is generally satisfactory. Demand often exceeds the capacity of the system to respond (note the number of unavailable accessions in Table 7). Greater evaluation of the preserved germplasm, through conventional and molecular methods, would likely result in more efficient utilization of the germplasm. However, financial constraints limit the ability to more fully evaluate major portions of the NPGS collections. It must be recognized that it is not always possible to predict what traits might be important in the future. Such traits might be resistance to new diseases or insects or a new race of a disease or biotype of an insect; unique qualities that will allow a cultivar to fit a niche in a domestic or foreign market; plant characters that make use of new cultural practices; or reduction of genetic vulnerability. This points out perhaps the greatest reason for maintaining collections of genetically diverse material, that is, the ability to respond to new crises and needs as they arise.

Plant genetic resource collections are expected to be at least as important in the future as in the past. This is because of the likelihood that there will be new or unanticipated needs and the fact that new techniques are being developed and refined that will make it possible to transfer genes between species or genera that were previously incompatible.

Probably the greatest factor hampering more effective utilization of genetic resources is limited enhancement or prebreeding research with many of the crop gene pools. Such programs are needed to identify useful traits possessed by germplasm of crop species or their wild relatives and to conduct initial studies to understand the inheritance of the genes controlling those traits and to transfer them into adapted germplasm. Thus, enhancement or prebreeding makes it easier and more likely that the useful genes will be incorporated into applied plant breeding programs. The level of financial support is presently the principal factor that limits enhancement efforts.



# CHAPTER 5

## National Goals, Policies, Programs and Legislation

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### 5.1 NATIONAL PROGRAMS

In 1990, the U.S. Congress passed legislation (P.L. 101-624) that authorized establishment of a National Genetic Resources Program (NGRP) to acquire, characterize, preserve, document, and distribute to scientist users, germplasm of all lifeforms important for food and agricultural production. The ARS was assigned the responsibility to administer the program. Within the ARS, the Associate Deputy Administrator for Genetic Resources heads the NGRP. This position has equal rank within the ARS to the Associate Deputy Administrators for Plant Sciences, Animal Sciences, Natural Resources and Systems, and Agriproducts and Human Nutrition Sciences. The legislation specified the NPGS as a part of the NGRP. Funding for the NPGS comes from Federal appropriations and State contributions that include land, laboratory and office space, scientists and support services. Private industry underwrites selected projects relative to germplasm maintenance and evaluation. Industry also plays a major role in the development and transfer of germplasm in the form of hybrids and cultivars to farmers and other consumers, both from its own and from the public research system programs.

Plant germplasm is used by numerous publicly and privately supported research programs. No single agency or organization coordinates the use of genetic resources within the country. There are close working ties on a commodity basis between public and private sector breeders which provide the coordination on selected activities of current mutual interest.

Collaboration exists with many NGOs on matters relative to plant germplasm. These include the National Council of Commercial Plant Breeders of the American Seed Trade Association, the American Association of Botanical Gardens and Arboreta, the Center for Plant Conservation (CPC), the Nature Conservancy, the Seed Savers Exchange, and Native Seeds/SEARCH. An example of how the NPGS collaborates is illustrated by work with the CPC, an organization that focuses on the conservation of endangered native plants of the USA. The NPGS provides the CPC with access to seed storage facilities at



the NSSL and conducts research on the storage of seed of threatened or endangered species in which they are interested.

Expansion of the capabilities for preserving, evaluating, and enhancing plant germplasm has been identified as a high priority national need and objective by the U.S. Department of Agriculture, a Committee on Managing Global Genetic Resources established by the National Research Council, and by scientific societies such as the Crop Science Society of America and the American Society for Horticultural Science. Collecting, classifying, evaluating, preserving, and distributing plant germplasm and assessing its potential for meeting agricultural and industrial needs is identified as an objective of the ARS strategic plan.

The 1990 legislation that authorized the NGRP also authorized a National Genetic Resources Advisory Council to provide oversight to the entire genetic resources program. The National Program Leader for Plant Germplasm, a member of the ARS National Program Staff, is charged with planning for the NPGS. This individual has responsibility for budgets and programs and offers management recommendations to individual components of the NPGS.

The Plant Germplasm Operations Committee (PGOC), an ad hoc committee of site managers, curators and service unit heads, develops uniform protocols for managing the day-to-day activities of the NPGS. Forty Crop Germplasm Committees composed of federal, state, and private-sector scientists and administrators representing commodities or commodity groups help assess and prioritize germplasm activities relating to their specific interests.

The USDA, with input from the individual agencies involved (ARS, Cooperative State Research Education and Extension Service, and Animal and Plant Health Inspection Service), approves and submits to the U.S. Congress the budget for plant genetic resources. The contributions from the State Agricultural Experiment Stations result from the appropriation process in the individual states.

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## 5.2 TRAINING

The scientific and support staff of the NPGS is fully trained to carry out its mission. Virtually all of the managers and scientific staff have Ph.D. degrees awarded by U.S. universities. The specific areas of training vary, but include all disciplines related to the plant sciences including genetics, plant breeding,



agronomy, horticulture, plant pathology, plant physiology, plant taxonomy, computer science, and entomology. None of these staff members have degrees specifically in plant genetic resources management. Most members of the support staff at the NPGS sites have B.S. or M.S. degrees from U.S. universities.

Although some U.S. Land Grant universities offer specific courses on genetic resource management, none offer a degree in the subject. However, the training that is offered by many U.S. universities is adequately meeting the needs of the NPGS. Most people with undergraduate or graduate degrees in one of the agricultural disciplines have taken one or more courses in most of the subjects pertinent to plant genetic resource management. As specific needs for training are identified for NPGS personnel, arrangements are made for on-the-job training at another site or at courses offered by universities or private companies.

There is, and probably always will be, a need to inform policy makers and the general public who lack training in agriculture or science, about the need for and importance of plant genetic resources programs. Within the management of the federal agencies that have responsibility for the national program, there is a good understanding of and support for a genetic resources program.

Training programs are available equally for men and women and all ethnic groups. The U.S. Department of Agriculture prohibits discrimination in its programs on the basis of race, color, national origin, sex, religion, age, disability, political beliefs, and marital or family status.

The NPGS staff has a low turnover rate, so investments in training pay off. The turnover rate, among other things, reflects the interest and dedication of those involved in the plant genetic resources program to the NPGS mission.

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## 5.3 NATIONAL LEGISLATION

Federal quarantine regulations governing the movement of plants into the USA are written and administered by the Animal and Plant Health Inspection Service (APHIS), an agency of the U.S. Department of Agriculture. There are three categories of quarantine that affect the movement of plant germplasm into the USA. These are:

- 1. Restricted** - An inspection at the port of entry satisfies the quarantine requirement for most species in this category. Most forage, vegetable, and flower species are in the restricted category.



**2. Postentry** - Specific conditions are required for handling species that fall into this category. Usually inspections during two active growing seasons are required. Also, a postentry permit allows individuals to observe germplasm, but not to distribute it until formally released by quarantine officials.

**3. Prohibited** - This is the most restricted quarantine category. Federal permits are required for the introduction of any plant species in this category. The restrictions vary widely depending on the species, the plant parts being imported, and the source location. Researchers with proper expertise and facilities can obtain import permits for certain species in this category, but other species must be held in a quarantine facility and tested for pathogens by quarantine officials.

Quarantine regulations can delay the movement of genetic resources into the USA if the species involved are included in one of the above quarantine categories. The quarantine laws only restrict the planting of plant genetic resources when the imported material is found to be infected with an exotic pathogen and the material cannot be freed of the pathogen using one of the available therapy procedures (i.e., heat or cold therapy, chemical therapy, meristem tipping, etc.). The movement of *in vitro* plants is governed by the same rules as other vegetative material. The exportation of plant material from the USA is governed by the regulations and declarations required by the receiving country. The existing quarantine laws are adequate to protect U.S. agriculture, yet allow for the movement of plant material into and out of the country.

The U.S. government does not provide incentives to farmers to conserve traditional cultivars. However, numerous NGOs and the NPGS curators in cooperation with the CGCs are concerned with and attempt to ensure that obsolete cultivars are preserved. Those that possess unique traits are incorporated into the national collection.

Open market forces govern the sale and distribution of seeds and other propagules to farmers. The Federal Seed Act and state seed laws govern various aspects of the sale and distribution of seeds. However, there are no legal requirements in the USA for the certification of seed.

From a farmer's perspective, the incentive for purchasing certified seed is the assurance that the seed is labeled properly and that it is genetically pure. Major seed companies generally stand behind their products. The incentive for small seed companies to sell certified seed is increased profit and the benefits that result from a good reputation for selling high quality products.



There are five main categories of Intellectual Property Rights (IPR) protection covering plant material in the USA. These are: trade secrets, contracts, the Plant Patent Act, the Plant Variety Protection Act (PVPA), and utility patents. IPR legislation has encouraged more private sector investment in plant genetic resources in the USA. The PVPA has a research exemption such that the materials protected by plant and utility patents can be used for research, but not for developing new commercial products. The USA has recently brought its PVPA into conformity with the International Convention for the Protection of New Varieties of Plants (UPOV91) and is expected to ratify the UPOV91 Treaty in the near future.

The effects of IPR legislation are generally understood by the scientific community, including the managers and others working in the NPGS. As new regulations or new interpretations are made, efforts are made to communicate the appropriate information in a timely manner to affected people. The NPGS could benefit from knowing about changes in foreign legislation concerning plant genetic resources. The U.S. Patent and Trademark Office is willing to assist other countries in establishing an IPR system.

The U.S. policy is to provide all bona fide users free access to public germplasm held in the NPGS genebanks. Requesters are referred to owners when intellectual property laws such as patents, plant variety protection, and trade secrets apply. Because the U.S. policy has always been one of free exchange, the individual collection sites and curators are not faced with making decisions about whether germplasm can be exported. The only exception to immediate access is when accessions are temporarily unavailable pending a seed increase or completion of quarantine pathogen testing.

A requirement of foreign plant collecting trips supported by the NPGS is that they be conducted in full cooperation with the government and scientists of the host country. U.S. collectors are expected to abide by any restrictions imposed by the host country including IPRs agreed to by the two countries. Also, any plant germplasm collected by the scientists of the two countries is divided appropriately. Foreign plant explorers often participate with U.S. scientists collecting germplasm in the USA and collected materials are divided. Any restrictions imposed on U.S. collectors (i.e., collecting in protected reserves or private property, collecting endangered species, etc.) also apply to foreign collectors.



## 5.4 OTHER POLICIES

Plant Genetic Resources experts or staff are not likely to be involved in the planning of major agricultural development projects. However, during the planning for any major development projects, environmental impact assessments are required which must address any possible issues related to conservation of plant genetic resources.



# CHAPTER 6

## International Collaboration

### 6.1 INTERNATIONAL AGRICULTURAL RESEARCH CENTERS (IARCS) AND THE CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH (CGIAR)

The USA continues to support the Core Programs of the IARCs but may consider targeted funding through IARCs to help fund projects in the Global Plan of Action (GPA) of the FAO's International Technical Conference. If the IARCs have a comparative advantage on a priority activity, the USA may feel that advantage should be exploited for the efficiency it would bring. This would be particularly important on regional multilateral or cross-regional projects.

The USA is convinced that regional and global approaches offer an especially efficient means of conserving and sustainably using plant genetic resources for food and agriculture, since actual genetic resources, their use and conservation needs frequently transcend national and even regional boundaries. The USA believes the IARC mechanism, which usually involves collaborative linkages with national partners, lends itself well to the efficient and effective accomplishment of FAO CPGR goals.

Although the USA provides substantial financial support to the CGIAR centers, collaborative scientific activities with U.S. institutions proceed largely on an informal, needs-determined basis. Much of the collaboration between NPGS and the CGIAR system reflects the availability of specific expertise, complementary or functional redundancy in conservation objectives and collection make-up, and specific short or long-term program needs. U.S. scientists are active participants in efforts to screen IARC germplasm for pests and diseases. A case in point is the screening of wheat and maize germplasm as a joint activity between U.S. researchers and counterparts at the International Maize and Wheat Improvement Center (CIMMYT).

The exchange of materials between U.S. collections and researchers and the CGIAR system goes beyond screening for disease or pest resistance, or other information. Differing agro-climatic conditions usually mean that finished



varieties from the centers or from U.S. programs rarely are used directly for agricultural production in the areas they serve. Instead, the exchange of materials can provide additional variability that, when combined with other strains, results in genetic combinations advantageous to a particular region's needs. CIMMYT germplasm has been used extensively in developing varieties important to U.S. wheat production; similarly, U.S. crosses and lines incorporating semi-dwarf genes were critical to advances made at CIMMYT in developing the high-yielding wheats that powered the green revolution. There are many other cases where U.S. technological advances in the form of improved germplasm have been incorporated in center collections. U.S. lines have been used to further progress in IARC breeding programs in groundnuts, lentil, sorghum and other important crops of the tropics and subtropics.

Exchange of germplasm between the IARCs of the CGIAR and the USA is very much a two-way street. A number of the CGIAR collections, especially those of crop species also grown in the United States, were established with significant infusions of germplasm from existing U.S. collections. In other cases, U.S. collections took on formal responsibility for safety duplication of collections of certain species developed by individual centers. IPGR (now IPGRI) was a leader in ensuring conservation of important germplasm collections at multiple sites, always with the assurance that materials would remain freely available. In some cases, U.S. collections which predated IARCs contributed substantially to the establishment of the latter; many of the *Phaseolus* lines in the International Center for Tropical Agriculture (CIAT) collections were originally obtained in this way. A two-way flow of materials between IARCs and NPGS continues; in the last three years, an average of 1,235 accessions per year were sent to the IARCs, while the USA received major collections of sorghum, potato and groundnut.

The NPGS does not receive support from the CGIAR Centers nor have any of the NPGS staff received training from the Centers. There are no programs currently being carried out by the CGIAR Centers that should logically be transferred to the U.S. program. Likewise, there are no functions of the U.S. national program that should be transferred to a CGIAR Center.

The USA has worked with IPGRI in the development of coordinated databases and shared its data and database with the Centers. The USA has tried to coordinate with IPGRI in the area of plant collecting and has participated in several joint collecting trips. Likewise, the USA has hosted collecting trips involving staff from NARS and CGIAR Centers.

The U.S. Agency for International Development (USAID) and the USDA's ARS have worked closely with the CGIAR, IPGRI and the World Bank in providing assistance to the N.I. Vavilov Research Institute and other Former



Soviet Union institutions with plant germplasm collections. The USA has contributed to the fund to improve the genebanks and provided expertise and training in establishing a database for the St. Petersburg collection.

In their personal capacities, many U.S. scientists assist the CGIAR Centers on panels and program reviews. The USA and all countries will benefit from a full implementation of the recent CGIAR Technical Advisory Committee's Stripe Report on Genetic Resources. The USA did have participation on the Committee in a personal capacity. An important initiative for the CGIAR Centers to undertake is the development of a coordinated database program, System-wide Information Network for Genetic Resources (SINGER), to provide ready access to the information about the CGIAR genetic resources collections.

Communication between NPGS and the CGIAR Centers is most frequently on a scientist-to-scientist or curator-to-curator basis. NPGS staff and other Americans serve on occasional reviews of individual center or CGIAR system-wide programs, and thus gain the opportunity to see programs first hand and participate in strategic planning. NPGS also works closely with USAID, which represents the USA in the CGIAR donor forum and relevant CGIAR committees. In some cases, U.S. scientists serve on center boards in their individual capacities, but help bring about program linkages and further scientist contacts by virtue of their involvement. USAID and USDA jointly sponsor a program of scientific liaison with the IARCs, and several USDA and NPGS researchers have served to help strengthen overall research linkages.

During the next decade, the most important function for IPGRI is to provide effective leadership for better coordination and management of the CGIAR System-wide Program on Genetic Resources. IARCs and national collections in foreign countries have a privileged status in respect to access to the GRIN database for the U.S. collection. Faced with further shortfalls of funding, the CGIAR must focus on the basics of germplasm, training, and high-return research. The System-wide Program on Genetic Resources should be implemented so as to provide an open, coordinated genebank system.

## 6.2 REGIONAL INTERGOVERNMENTAL INITIATIVES

As is the case with the CGIAR Centers, the NPGS does not have any special relationship with any of the regional research centers. Again, the interactions or relationships are on a scientist-to-scientist basis. From the standpoint of



cooperation on matters relative to genetic resources and database access, the regional centers are treated the same as the IARCs.

Genetic resources activities generally cross borders and solutions may come only from a multilateral approach to a multinational activity. If there is an appropriate regional body with the comparative advantage to carry out the task, the USA would support that approach. If the CGIAR also has the capacity, the U.S. Government would look favorably on the CGIAR's leadership in this area.

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### 6.3 BILATERAL INTERGOVERNMENTAL INITIATIVES

The U.S. Government provides support and funding for a number of binational cooperative projects in genetic resources. Those have been: single exchange projects; single reciprocal exchanges; multiple exchange projects; technical assistance and evaluation; plant collection and preservation; database development and documentation; and various crop research and crop network activities.

The USDA's ARS has a number of bilateral agreements with other countries to promote collaborative research and the sharing of plant genetic resources and benefits. The ARS is interested in such collaboration with other countries having similar interests.



## CHAPTER 7

# National Needs and Opportunities

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The NPGS has many needs and opportunities that it hopes to be able to address in the coming years. Addressing these needs will contribute significantly to the effectiveness of the NPGS and the global effort to conserve and utilize plant genetic resources. Specific needs and opportunities include:

- Identify and fill outstanding gaps in current germplasm collections through additional exchanges and collecting;
- Eliminate the backlog of characterization and evaluation of germplasm in the NPGS collection;
- Update and improve the quality of data available in the GRIN database;
- Develop a core subset for each major crop in the NPGS collection;
- Accelerate the development of molecular technology on quarantinable diseases for quicker and more accurate identification;
- Increase taxonomic support for the NPGS to produce and store herbarium specimens, and to deal with incompletely or incorrectly identified samples;
- Increase the rate of seed growout to accommodate the backlog of accessions that are new, are not replicated outside the base collection, have reduced germinability, or are of difficult to increase species;
- Accelerate research on difficult orthodox and recalcitrant seeds, and develop alternative storage techniques for clonal collections in order to reduce costs and ensure a secure backup;
- Formalize and support crop genetic stock collections and reconcile genetic maps with molecular maps through the Plant Genome Research Program;
- Increase involvement with *in situ* conservation, including rare and endangered species, recognizing that future biotechnologies may provide means to utilize almost any genetic source for gene transformations;
- Establish permanent programs for *in situ* conservation of crop genetic resources native to the USA;
- Promote dissemination of information generated by the NPGS;



- Strengthen international collaboration with plant genetic resources (PGR) researchers and national programs in germplasm donor nations to facilitate the reciprocal exchange of technology, information, and materials;
- Pursue opportunities for cooperation with private groups to preserve plant germplasm.



# APPENDIX A

## U.S. Native Plant Genetic Resources

**Table A-1. Wild Relatives of Grain and Cereal Crops in the USA**

Genus	Crop	# of species	Species
<i>Amaranthus</i>	Amaranth	19	<i>albus, arenicola, australis, bigelovii, brownii, californicus, cannabinus, fimbriatus, floridanus, greggii, hypochondriacus, palmeri, powellii, pumilus, rudis, scleropoides, spinosus, tuberculatus, wrightii</i>
<i>Chenopodium</i>	Quinoa	29	<i>albescens, album, atrovirens, berlandieri, californicum, capitatum, carnosulum, cycloides, desiccatum, foggii, fremontii, graveolens, hians, humile, incanum, leptophyllum, neomexicanum, nevadense, oahuense, overi, pallescens, rubrum, salinum, simplex, standleyanum, strictum, subglabrum, urbiculum, watsonii</i>
<i>Hordeum</i>	Barley	6	<i>arizonicum, brachyantherum, californicum, depressum, jubatum, pusillum</i>
<i>Zizania</i>	Wild Rice	3	<i>aquatica, palustris, texana</i>



Table A-2. Wild Relatives of Fruit Crops in the USA

Genus	Crop	# of species	Species
<i>Annona</i>	Custard apple	3	<i>glabra, montana, reticulata</i>
<i>Asimina</i>	Pawpaw	8	<i>angustifolia, incana, obovata, parviflora, pygmaea, reticulata, tetraptera, triloba</i>
<i>Diospyros</i>	Persimmon	6	<i>hillebrandii, revoluta, sandwicensis, sintenisii, texana, virginiana</i>
<i>Fragaria</i>	Strawberry	3	<i>chiloensis, vesca, virginiana</i>
<i>Malus</i>	Apple	4	<i>angustifolia, coronaria, fusca, ioensis</i>
<i>Morus</i>	Mulberry	2	<i>microphylla, rubra</i>
<i>Passiflora</i>	Passion-fruit	19	<i>affinis, anadenia, bilobata, bryonioides, filipes, foetida, laurifolia, lutea, maliformis, mexicana, morifolia, multiflora, murucuja, pallens, rubra, serratodigitata, sexflora, tenuiloba, tulae</i>
<i>Prunus</i>	Stone Fruits	30	<i>alleghaniensis, americana, andersonii, angustifolia, caroliniana, emarginata, fasciculata, fremontii, geniculata, gracilis, harvardii, hortulana, ilicifolia, lyonii, maritima, mexicana, minutiflora, munsoniana, murrayana, myrtifolia, nigra, occidentalis, pensylvanica, pumila, rivularis, serotina, subcordata, texana, umbellata, virginiana</i>
<i>Ribes</i>	Currant, Gooseberry	49	<i>amarum, americanum, aureum, binominatum, bracteosum, californicum, canthariforme, cereum, coloradense, cruentum, curvatum, cynosbati, divaricatum, echinellum, erythrocarpum, glandulosum, hirtellum, hudsonianum, indecorum, inerme, lacustre, lasianthum, laxiflorum, leptanthum, lobbii, malvaceum, marshallii, menziesii, mescalerium, missouriense, montigenum, nevadense, niveum, oxyacanthoides, pinetorum, queretorum, roezlii, rotundifolium, sanguineum, sericeum, speciosum, triste, tularensis, velutinum, viburnifolium, victoris, viscosissimum, watsonianum, wolfii</i>
<i>Rubus</i>	Raspberry, Blackberry	188	<i>aboriginum, aculiferus, adjacens, alaskensis, aliciae, allegheniensis,</i>



Genus	Crop	# of species	Species
Rubus (cont.)	Raspberry, Blackberry	188	<i>alter, alumnus, amnicola, andrewsianus, apogaeus, aptatus, arcticus, arenicola, arizonensis, argutus, arvensis, audax, baileyanus, bartonianus, belllobatus, bicknellii, biformispinus, bigelovianus, boyntonii, burnhamii, bushii, canadensis, celer, centralis, chamaemorus, clarus, concameratus, coronarius, cubitans, cuneifolius, curtipes, deamii, deliciosus, densissimus, depavitus, dissimilis, elegantulus, exsularis, exter, fecundus, felix, flagellaris, flavinanus, floricomus, florulentus, fraternalis, frondisentis, frondosus, fryei, furtivus, glandicaulis, glaucifolius, gnarus, grimesii, gulosus, hancinianus, harmonicus, hawaiensis, heterophyllus, hispidoides, hispidus, huttonii, hypolasius, ictus, idaeus, immanis, impar, injunctus, insons, insulanus, invisus, ithacanus, jacens, jugosus, junceus, kelloggii, kennedyanus, largus, lasiococcus, laudatus, lawrencei, leggii, leucodermis, leviculus, libratus, longii, lucidus, macraei, macvaughii, maniseensis, meracus, michiganensis, mirus, missouicus, mollior, montensis, multifer, multiformis, multispinus, mundus, navus, nefrens, meomexicanus, nigerrimus, nivalis, notatus, noveboracus, obsessus, occidentalis, odoratus, oklahomus, orarius, originalis, ortivus, ostryifolius, paganus, parlinii, particeps, parviflorus, pascuus, pedatus, pensylvanicus, pergratus, permixtus, persistens, perspicuus, pervarius, philadelphicus, plicatifolius, plus, porteri, prestonensis, probabilis, probativus, probus, profusiflorus, provincialis, pubescens, pubifolius, pugnax, racemiger, randolphiorum, recurvans, recurvicaulis, regionalis, riograndis, roribaccus, rosa, rossbergianus, russeus, scambens, sceleratus, schoolcraftianus, segnis, semisetosus, setosus, severus, signatus, sons, spectabilis, spectatus, steelei, stipulatus,</i>



Genus	Crop	# of species	Species
<i>Rubus</i> (cont)	Raspberry, Blackberry	188	<i>subtractus, suus, tardatus, tholiformis,</i> <i>trifrons, trivialis, trux, tygartensis,</i> <i>ucetanus, uniformis, ursinus, uvidus,</i> <i>vagus, varus, vermontanus, vigoratus,</i> <i>vitifolius, wheeleri, wisconsinensis</i>
<i>Vaccinium</i>	Blueberry, Cranberry	34	<i>angustifolium, arboreum, boreale,</i> <i>caesariense, calycinum, cespitosum,</i> <i>corymbosum, crassifolium, darrowii,</i> <i>deliciosum, dentatum, elliottii,</i> <i>erythrocarpum, formosum, fuscatum,</i> <i>geminiflorum, hirsutum, macrocarpon,</i> <i>membranaceum, myrsinoides,</i> <i>myrtilloides, myrtillus, ovalifolium,</i> <i>ovatum, oxycoccus, pallidum,</i> <i>parvifolium, reticulatum, scoparium,</i> <i>simulatum, stamineum, tenellum,</i> <i>virgatum, vitis-idaea</i>
<i>Vitis</i>	Grape	16	<i>acerifolia, aestivalis, arizonica,</i> <i>californica, cinerea, girdiana, labrusca,</i> <i>monticola, mustangensis, palmata,</i> <i>riparia, rotundifolia, rupestris,</i> <i>shuttleworthii, tiliifolia, vulpina</i>

**Table A-3. Wild Relatives of Nut Crops in the USA**

Genus	Crop	# of species	Species
<i>Carya</i>	Pecan, Hickory	10	<i>alba, aquatica, carolinae-</i> <i>septentrionalis, cordiformis, glabra,</i> <i>illinoiensis, laciniosa, ovata, pallida,</i> <i>texana</i>
<i>Castanea</i>	Chestnut	2	<i>dentata, pumila</i>
<i>Corylus</i>	Hazelnut	2	<i>americana, cornuta</i>
<i>Juglans</i> <i>jamaicensis,</i>	Walnut	6	<i>californica, cinerea, hindsii,</i> <i>microcarpa, nigra</i>
<i>Pistacia</i>	Pistachio	1	<i>texana</i>



Table A-4. Wild Relatives of Vegetable Crops in the USA

Genus	Crop	# of species	Species
Allium	Onion	79	<i>aaseae, acuminatum, amplexens, anceps, atrorubens, bigelovii, biceptrum, bolanderi, brandegei, brevistylum, burlewii, campanulatum, canadense, cernuum, columbianum, constrictum, coryi, cratericola, crenulatum, crispum, cuthbertii, dichlamydeum, dictuon, douglasii, drummondii, elmendorfii, falcifolium, fibrillum, fimbriatum, geyeri, glandulosum, gooddingii, haematochiton, hickmanii, hoffmanii, howellii, hyalinum, jepsonii, kunthii, lacunosum, lemmontii, macropetalum, macrum, madidum, membranaceum, monticola, munzii, nevadense, nevii, obtusum, parishii, parryi, parvum, passeyi, peninsulare, perdulce, platycaule, pleianthum, plummerae, praecox, punctum, robinsonii, runyonii, sanbornii, schoenoprasum, scilloides, scorodoprasum, serra, simillimum, siskiyouense, stellatum, textile, tolmiei, tribracteatum, tricoccum, tuolumnense, unifolium, validum, yosemitense</i>
Apium	Celery	1	<i>nodiflorum</i>
Capsicum	Pepper	1	<i>annuum</i>
Cucurbita	Squash	5	<i>digitata, foetidissima, okeechobeensis, palmata, texana</i>
Dioscorea	Yam	7	<i>floridana, pentaphylla, pilosiuscula, polygonoides, quaternata, rotundata, villosa</i>
Ipomoea	Sweet Potato	39	<i>barbatisepala, batatas, calantha, capillacea, cardiophylla, cordatotriloba, costellata, cristulata, eggersiana, hederacea, hederifolia, horsfalliae, imperati, krugii, lacunosa, leptophylla, leptotoma, lindheimeri, longifolia, macrorhiza, meyeri, microdactyla, ochroleuca, pandurata, pes-caprae, plummerae, repanda, rupicola, sagittata, setifera, shumardiana, steudelii, tenuiloba, tenuissima, thurberi, tiliacea, trifida, tuboides, violacea</i>
Lactuca	Lettuce	6	<i>biennis, floridana, graminifolia, hirsuta, ludoviciana, tatarica</i>



Genus	Crop	# of species	Species
<i>Lepidium</i>	Pepperwort	28	<i>alyssoides, arbuscula, austrinum,</i> <i>barnebyanum, bidentatum,</i> <i>bourgeauanum, davisii, densiflorum,</i> <i>dictyotum, flavum, fremontii,</i> <i>heterophyllum, integrifolium, jaredii,</i> <i>lasiocarpum, latipes, montanum,</i> <i>nanum, nitidum, oblongum, ostleri,</i> <i>oxycarpum, pinnatisectum,</i> <i>ramosissimum, serra, sordidum,</i> <i>thurberi, virginicum</i>
<i>Manihot</i>	Cassava, Tapioca	3	<i>angustiloba, davisiae, walkerae</i>
<i>Phaseolus</i>	Bean	8	<i>acutifolius, angustissimus, filiformis,</i> <i>grayanus, maculatus, parvulus,</i> <i>polystachios, ritensis</i>
<i>Raphanus</i>	Radish	1	<i>sativus</i>
<i>Rorippa</i>	Watercress	19	<i>alpina, barbareifolia, calycina,</i> <i>coloradensis, columbiae, curvipes,</i> <i>curvisiliqua, gambelii, microtis,</i> <i>palustris, portoricensis, ramosa,</i> <i>sessiliflora, sinuata, sphaerocarpa,</i> <i>subumbellata, tenerrima, teres, truncata</i>
<i>Solanum</i>	Potato	2	<i>fendleri, jamesii</i>



Table A-5. Wild Relatives of Forage and Turf Grass Crops in the USA

Genus	Crop	# of species	Species
<i>Andropogon</i>	Bluestem	13	<i>arctatus, bicornis, brachystachyus, floridanus, gerardii, glomeratus, gyrans, hallii, leucostachys, longiberbis, ternarius, tracyi, virginicus</i>
<i>Bromus</i>	Brome grass	20	<i>arizonicus, carinatus, cilatus, grandis, inermis, laevipes, latiglumis, marginatus, maritimus, mucroglumis, nottowayanus, orcuttianus, pacificus, polyanthus, pseudolaevipes, pubescens, sitchensis, suksdorffii, texensis, vulgaris</i>
<i>Bouteloua</i>	Gramagrass	20	<i>americana, aristidoides, barbata, breviseta, chondrosioides, curtipendula, eriopoda, gracilis, hirsuta, juncea, kayi, parryi, pectinata, radicosa, repens, rigidiseta, simplex, trifida, uniflora, warnockii</i>
<i>Buchloe</i>	Buffalograss	1	<i>dactyloides</i>
<i>Cenchrus</i>	Buffelgrass	7	<i>agrimonioides, carolinianus, echinatus, gracillimus, longispinus, myosuroides, tribuloides</i>
<i>Dactylis</i>	Orchardgrass	1	<i>glomerata</i>
<i>Echinochloa</i>		5	<i>muricata, paludigena, polystachya, spectabilis, walteri</i>
<i>Elymus</i>	Wild rye	24	<i>alaskanus, arizonicus, bakeri, californicus, canadensis, elymoides, glaucus, hirsutus, hordeoides, hystrix, interruptus, kronokensis, lanceolatus, macrourus, multisetus, riparius, sajanensis, scribneri, sierrus, stebbinsii, trachycaulus, villosus, virginicus, vulpinus</i>
<i>Festuca</i>	Fescue	23	<i>altaica, arizonica, baffinensis, brachyphylla, californica, campestris, dasyclada, elmeri, hawaiiensis, idahoensis, kingii, lenensis, ligulata, occidentalis, ovina, paradoxa, rubra, sororia, subulata, subuliflora, subverticillata, thurberi, versuta, viridula</i>
<i>Lathyrus</i>	Vetchling	27	<i>bijugatus, brachycalyx, delnorticus, eucosmus, graminifolius, hitchcockianus, holochlorus, japonicus, jepsonii, laetivirens, lanszwertii, littoralis, nevadensis, ochroleucus, odoratus, palustris, pauciflorus, polymorphus, polyphyllus, pusillus, rigidus, splendens, sulphureus, sylvestris, torreyi, venosus, vestitus</i>



Genus	Crop	# of species	Species
<i>Lupinus</i>	Lupine	143	<i>abramsii, adsurgens, affinis, agardhianus, albicaulis, albifrons, alpicola, ammophilus, amphibius, andersonii, angustifolius, antoninus, apertus, arboreus, arbustus, arcticus, argenteus, aridus, arizonicus, bakeri, barbigeri, benthamii, bicolor, bingenensis, brevicaulis, brevior, breweri, burkei, caespitosus, caudatus, cervinus, chamissonis, citrinus, concinnus, confertus, congdonii, covillei, crassus, croceus, culbertsonii, cusickii, dalesiae, densiflorus, depressus, diffusus, duranii, elatus, elmeri, evermannii, excubitus, fissicalyx, flavoculatus, formosus, fulcratus, garfieldensis, gormanii, gracilentus, grayi, guadalupensis, hartmannii, harvardii, hillii, hirsutissimus, holmgrenianus, holosericeus, horizontalis, huachucanus, hyacinthinus, johannis-howellii, jonesii, kingii, klamathensis, lapidicola, latifolius, lemmontii, lepidus, leucophyllum, littoralis, longifolius, ludovicianus, luteolus, lutescens, lyallii, maculatus, magnificus, malacophyllum, meionanthus, minimus, mollis, monticola, nanus, neomexicanus, nevadensis, nootkatensis, obtusilobus, odoratus, onustus, oreganus, ornatus, pachylobus, padre-crowleyi, pallidus, palmeri, parviflorus, peirsonii, perennis, plattensis, polycarpus, polyphyllus, pratensis, prunophilus, punto-reyesensis, pusillus, rivularis, roseolus, ruber, sabinianus, saxosus, sellulus, sericatus, sericeus, shockleyi, sierrae-blancae, sparsiflorus, spectabilis, stiversii, subcarnosus, sublanatus, subvexus, succulentus, suksdorffii, sulphureus, texensis, tidestromii, tracyi, truncatus, uncialis, vallicola, versicolor, villosus, volutans, westianus, wyethii, abscissum, amarum, anceps, beecheysi, brachanthum, bulbosum, capillare,</i>
<i>Panicum</i>	Switchgrass	47	



Genus	Crop	# of species	Species
<i>Panicum</i> (cont)	Switchgrass	47	<i>capillarioides, dichotomiflorum, diffusum, elephantipes, fauriei, flexile, gattingeri, ghiesbreghtii, glutinosum, hallii, havardii, hemitomon, hillmanii, hirsutum, hirticaule, konaense, laxum, lepidulum, lithophilum, nephelophilum, niihauense, obtusum, pampinosum, parvifolium, pellitum, philadelphicum, ramosius, rigidulum, schiffneri, sonorum, stevensianum, stramineum, tenerum, tenuifolium, torridum, trichanthum, urvilleanum, verrucosum, virgatum, xerophilum</i>
<i>Paspalum</i>	Bahiagrass	40	<i>acuminatum, alnum, bifidum, blodgettii, boscianum, caespitosum, clavuliferum, decumbens, densum, dissectum, distichum, floridanum, fluitans, hartwegianum, hydrophylum, laeve, langei, laxum, lividum, millegrana, molle, monostachyum, orbiculatum, paniculatum, parviflorum, paucispicatum, pleostachyum, plicatulum, praecox, pubiflorum, rupestre, sagetii, scrobiculatum, secans, separatum, setaceum, unispicatum, vaginatum, virgatum, virletii</i>
<i>Phalaris</i>	Reed	5	<i>angusta, arundinacea, californica, caroliniana, lemmontii</i>
	canarygrass		
<i>Phleum</i>	Timothy	1	<i>alpinum</i>
<i>Poa</i>	Bluegrass	54	<i>abbreviata, alpina, alsodes, rachnifera, arctica, arida, atropurpurea, autumnalis, bigelovii, bolanderi, chapmaniana, confinis, curta, curtifolia, cuspidata, douglasii, eminens, eyerdamii, fendleriana, fernaldiana, fibrata, glauca, interior, kelloggii, laxiflora, leibergii, leptocoma, lettermanii, macrocalyx, macroclada, malacantha, mannii, marcida, apensis, nemoralis, nervosa, occidentalis, paludigena, palustris, pringlei, pseudoabbreviata, reflexa, rhizomata, saltuensis, sandvicensis, secunda, siphonoglossa, stenantha, strictiramea, sylvestris, tolmatchewii, tracyi, unilateralis, wolfii</i>



Genus	Crop	# of species	Species
<i>Pseudoroegneria</i>	Bluebunch wheatgrass	1	<i>spicata</i>
<i>Setaria</i>	Millet	22	<i>adhaerens, arizonica, chapmanii, corrugata, firmula, grisebachii, liebmannii, leucopila, macrosperma, macrostachya, magna, parviflora, pradana, ramiseta, reverchonii, scheelei, setosa, tenacissima, texana, utowanaea, villosissima, vulpiseta</i>
<i>Sorghastrum</i>	Indiangrass	5	<i>elliottii, nutans, secundum, setosum, stipoides</i>
<i>Stipa</i>	Needlegrass	26	<i>arida, californica, comata, coronata, curtiseta, curvifolia, diegoensis, eminens, hendersonii, latiglumis, lemmontii, lettermanii, lobata, nelsonii, neomexicana, nevadensis, occidentalis, pinetorum, richardsonii, robusta, scribneri, spartea, speciosa, stillmanii, thurberiana, webbweri</i>
<i>Trifolium</i>	Clover	56	<i>amabile, amoenum, andersonii, andinum, attenuatum, barbigerum, beckwithii, bejariense, bifidum, bolanderi, brandegeei, breweri, carolinianum, ciliolatum, cyathiferum, dasypodium, dedeckerae, depauperatum, dichotomum, douglasii, eriocephalum, fucatum, gracilentum, gymnocarpon, haydenii, howellii, kingii, latifolium, leibergii, lemmontii, longipes, macraei, macrocephalum, microcephalum, microdon, monanthum, nanum, neurophyllum, obtusiflorum, oliganthum, olivaceum, owyheense, parryi, pinetorum, plumosum, polyodon, productum, rollinsii, siskiyouense, stoloniferum, thompsonii, trichocalyx, variegatum, virginicum, willdenowii, wormskioeldii</i>
<i>Tripsacum</i>	Gamagrass	3	<i>dactyloides, floridanum, lanceolatum</i>
<i>Vicia</i>	Vetch	12	<i>acutifolia, americana, caroliniana, cracca, floridana, hassei, leucophaea, ludoviciana, menziesii, minutiflora, nigricans, pulchella</i>
<i>Cuphea</i>	Cuphea	5	<i>aspera, micrantha, parsonsia, viscosissima, wrightii</i>



Table A-6. Wild Relatives of Industrial Crops in the USA

Genus	Crop	# of species	Species
<i>Gossypium</i>	Cotton	3	<i>hirsutum, thurberi, tomentosum</i>
<i>Helianthus</i>	Sunflower	49	<i>agrestis, angustifolius, annuus, anomalus, argophyllus, arizonicensis, atrorubens, bolanderi, californicus, carnosus, ciliaris, cusickii, debilis, decapetalus, deserticola, divaricatus, eggertii, floridanus, giganteus, glaucophyllus, gracilentus, grosseserratus, heterophyllus, hirsutus, laciniatus, laevigatus, longifolius, maximiliani, microcephalus, mollis, neglectus, niveus, nuttallii, occidentalis, paradoxus, pauciflorus, petiolaris, porteri, praecox, pumilus, radula, resinosus, salicifolius, schweinitzii, silphioides, simulans, smithii, strumosus, tuberosus</i>
<i>Humulus</i>	Hop	1	<i>lupulus</i>
<i>Lesquerella</i>	Bladder-pod	59	<i>alpina, angustifolia, artica, arenosa, argyraea, arizonica, aurea, auriculata, calcicola, carinata, cinerea, condensata, cordiformis, densiflora, densipila, douglasii, engelmannii, fendleri, filiformis, fremontii, garrettii, globosa, gooddingii, gordonii, gracilis, grandiflora, hitchcockii, intermedia, kingii, lasiocarpa, lata, lescurii, lindheimeri, ludoviciana, lyrata, macrocarpa, mcvaghiana, montana, multiceps, occidentalis, ovalifolia, parviflora, paysonii, perforata, pinetorum, prostrata, pruinosa, purpurea, rectipes, recurvata, rubicundula, sessilis, stonensis, subumbellata, tenella, thamnophila, utahensis, valida, wardii</i>
<i>Linum</i>	Flax	30	<i>alatum, arenicola, aristatum, australe, berlandieri, carteri, catharticum, compactum, elongatum, floridanum, hudsonioides, imbricatum, intercursum, kingii, lewisii, lundellii, medium, neomexicanum, perenne, pratense, puberulum, rigidum, rupestre, schiedeanum, striatum, subteres, sulcatum, vernale, virginianum, westii</i>
<i>Nicotiana</i>	Tobacco	5	<i>attenuata, clevelandii, quadrivalvis, repanda, trigonophylla</i>



# APPENDIX B

## Acquisition Policy for the National Plant Germplasm System

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### Introduction

Plant germplasm is a natural resource of the same magnitude of importance to our long-term welfare and survival as soil, water and air. It is incumbent on all nations to protect and manage this resource to the benefit of current and future generations. For agriculture, we presently use only a small fraction of the quarter million known species of plants but advancing biotechnology may greatly expand the number that have utility. The number of samples or accessions of each crop necessary to provide adequate representation of the available genetic diversity is not precisely known, but it is likely to be several thousands. The magnitude of the task of collecting, evaluating, utilizing, and preserving sufficient accessions of all species of interest could become overwhelming and excessively costly unless controlled. Efficient and economical methods to manage and preserve this valuable resource for current and future crop improvement must be developed and adopted. Development of a rational acquisition policy for germplasm entering our national collections is a necessary first step to good management of the National Plant Germplasm System (NPGS).

### Goal

To assure the enduring availability of a broad range of genetic diversity of crop plants and their wild relatives for present and future needs of Agriculture.

### Objective

Acquisition and preservation of plant germplasm to provide the maximum amount of genetic diversity within a minimum number of accessions of each species of interest to the United States shall be the objective of the NPGS. Collected and preserved genetic diversity should include not only genes for traits of current interest, but also include diversity for future, unknown needs.



## Categories of Germplasm

- 1. Cultivars:** New non-patented cultivars will be preserved at the time of their release to ensure genetic purity and healthy seed in storage for future needs. Obsolete cultivars will be preserved as they can be acquired. A low priority should be given to acquiring cultivars for which known parents of that cultivar are already in the NPGS. Acquisition of heirloom germplasm, domestic or foreign, should be given the same consideration and judged by the same criteria or uniqueness and potential utility as obsolete cultivars, landraces and primitive cultivars.
- 2. Germplasm releases and genetic stock collections:** Breeders and Crop Germplasm Committees (CGCs) should mutually decide what is truly unique and needs to be preserved. Germplasm releases which are direct parents or descendants of obsolete or modern cultivars already maintained in the NPGS should be given much lower priority than those developed from more exotic sources. Genetic stocks are highly specialized, costly to develop and maintain and should be maintained in long-term storage by the NPGS. An acceptable plan is needed to provide for their multiplication, and maintenance of an appropriate working collection.
- 3. Landraces and primitive cultivars:** Acquire and preserve well-documented accessions of all crops of interest. Whenever possible, priority should be to preserve well documented accessions known to come from the primary geographic or ethnic source of the cultivar (i.e., an accession of the "Tir" wheat from Turkey, its source, should have priority over acquisition of "Tir" wheat without documentation from a collection in Argentina). In some cases, accessions with the same name but from different sources should be grown side by side, compared, and bulked, as appropriate. Original variety may have been a "bulk" and each selecteur has developed a unique subline. It should not be assumed that the total genetic diversity of a landrace is represented by one accession.
- 4. Wild relatives:** Acquire the greatest coverage of genetic diversity in the closest relatives of each crop and acquire lesser coverage of the genetic diversity in more distant relatives employing a gene pool concept. Greatest priority should be to acquire population samples of the progenitors of each crop from across their ecogeographic distribution range. Accessions should be maintained of all close wild relatives for each crop. A sampling of congeneric species representative of variation in the genus should be maintained for each crop. Wild crop relatives indigenous to the United States should be given the same preference as foreign species in germplasm preservation. However, the NPGS should consider the possibility and utility of maintaining genetic diversity of these species *in situ*. For native



wild species, whenever possible, it is preferable to have *in situ* preservation complement *ex situ* preservation. The NPGS should be aware of and collaborate in the activities of other Federal agencies and nongovernmental conservation organizations to preserve germplasm of native species.

**5. Other Species:** Acquisition and preservation of species not even considered part of a tertiary gene pool of present crops need also to be considered as resources allow. These species have the potential to become new crops, contribute to genetics research of current crops or, as technology advances, become part of the tertiary gene pool of current crops.

## Implementation of Policy

Implementation of this acquisition policy requires a review of current NPGS collections to determine to what degree they meet acquisition criteria. The acquisition criteria should then be used to determine the need for continued preservation of many accessions and the manner in which they are preserved. Elimination or bulking of duplicate accessions within a collection will be a necessary part of the curating process, even if the redundant material has been given a P.I. number. Bulking of accessions during collecting explorations may also be feasible when multiple samples within the same species are collected in a similar habitat. When circumstances permit, controlling the number of accessions entering the collections will help control costs at every operational step in the preservation process, particularly in the regeneration phase.

To provide research scientists a broad genetic representation with minimum numbers of accessions, the core concept may be practical and more economical than traditional approaches. This core concept identifies a carefully selected small portion of the total collection to provide a statistically valid sample of the total genetic diversity. When the core has been selected and evaluated, it will indicate what diversity exists in a collection, and may suggest where gaps occur in our coverage of total genetic diversity. The core concept will be a method through which, by limited means, we can facilitate meeting our overall goal. Acquisition policy need not be directly affected by a core concept. NPGS goals, acquisition policy and core methodology are three different but interrelated topics.

Successful implementation will be dependent on informed participation by germplasm program leaders, curators, and scientists engaged in germplasm evaluation and crop improvement. Sound judgment will be required to rationally apply the acquisition policy to the diversity of species and types of germplasm to be preserved. Any acquisition policy will lack total precision and must rely on estimates and best judgment. At best it will provide reasonable



and consistent guidelines for the collection and preservation of representative and adequate genetic diversity for the future. We will always be faced with difficult choices of how much is enough under the constraints of limited resources.

For some species, with limited numbers of accessions, we should not delay in acquiring the best representative samples of their genetic diversity still available. As we establish national priorities for germplasm acquisition, we should remain aware of and take advantage of well-established collections existing in other countries to which we have reliable accessibility.

All seed samples entering the NPGS for short or long-term preservation, in so far as feasible, shall be received or regenerated free of disease or insect infestation and be of good quality. When practical, seed samples will be large enough to provide for increase without depleting the original sample. Seed samples will be provided to the P.I. Stations or other working collections. It will be the responsibility of the curators of working collections to ensure that adequate samples of all bonafide accessions will be made available to the National Seed Storage Laboratory at the earliest feasible time.

All ARS-supported plant explorations must provide samples of collected materials to the NPGS through appropriate P.I. Station, Clonal Repository, or National Plant Germplasm Quarantine Center. If insufficient seed is available for sharing between collector and the P.I. Station, mutually acceptable arrangements must be made for prompt increase of the accession(s).

All accessions entering the NPGS should be adequately identified and with sufficient passport data to be useful to the users and future collectors. Collectors should take maximum precautions to cross-reference collection numbers to host country shared samples. This and other useful information should be entered into Germplasm Resources Information Network (GRIN) upon receipt of the accessions and become a part of the permanent germplasm inventory.

All genetic materials entering the NPGS from outside the United States will comply with quarantine regulations. The Plant Exchange Office will be informed of all such entries. Permits for quarantined materials may also be obtained through the PEO.

This policy statement was approved by the Plant Germplasm Operations Committee at the September 6-7, 1989 meeting, BARC-West, Beltsville, Maryland. October 4, 1989.



# Acknowledgements

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## 1 Shands, H.L. and L.E. Weisner

(eds.). 1991. Use of Plant Introductions in Cultivar Development.  
Part 1. CSSA Spec. Publ. 17, ASA, Madison, WI.

## 2 Shands, H.L. and L.E. Weisner

(eds.). 1992. Use of Plant Introductions in Cultivar Development.  
Part 2. CSSA Special Publ. 20. ASA, Madison, WI.

## 3 National Research Council (NRC). 1991.

Managing Global Genetic Resources:  
The U.S. National Plant Germplasm System.  
Washington, D.C.: National Academy Press.

## 4 NRC. 1993.

Managing Global Genetic Resources:  
Agricultural Crop Issues and Policies.  
Washington, D.C.: National Academy Press.



## References

**Beckman, T.G. and W.R. Okie.** 1994. Native North American plum species potential for variety and rootstock development. *Acta Hortic.* 359:41-48.

**Dahl, K. and G.P. Nabhan.** 1992. From the grassroots up: the conservation of plant genetic resources by grassroots organizations -- "Latter-Day Noahs" of North America. *Diversity* 8(2):28-31.

**Eck, Paul.** 1990. *The American Cranberry.* Rutgers Univ. Press, New Brunswick.

**Hancock, J.F. and J.J. Luby.** 1993. Genetic resources at our doorstep: The wild strawberries. *BioScience* 43(3):141-147.

**Hayes, P.M., R.E. Stucker,** and G.G. Wandrey. 1989. The domestication of American wildrice (*Zizania palustris*, Poaceae). *Econ. Bot.* 43(2):203-214.

**Janick, J. and J.N. Moore** (eds.). 1975. *Advances in Fruit Breeding.* Purdue University Press, West Lafayette, IN.

**Janick, J. and J.E. Simon** (eds.). 1990. *Advances in New Crops.* Timber Press, Portland, OR.

**Janick, J. and J.E. Simon** (eds.). 1993. *New Crops.* John Wiley and Sons, Inc., New York.

**Kartesz, J.T. 1994.** A Synomized Checklist of the Vascular Flora of the United States, Canada, and Greenland. 2nd ed. Timber Press, Portland, OR.

**Miller, J.F., G.J. Seiler,** and C.C. Jan. 1992. Introduced germplasm use in sunflower inbred and hybrid development. *In* H.L. Shands and L.E. Weisner (eds.) *Use of Plant Introductions in Cultivar Development. Part 2.* CSSA Special Publ. 20. ASA, Madison, WI.

**Moore, J.N. and J.R. Ballington** (eds.). 1990. *Genetic Resources of Temperate Fruit and Nut Crops.* *Acta Hortic.* 290. ISHS, Wageningen, The Netherlands.



**Sauer, J.D.** 1993. Historical Geography of Crop Plants. CRC Press, Boca Raton, FL.

**Simmonds, N.W.** (ed.). 1976. Evolution of Crop Plants. Longman, London.

**VanderKloet, S.P.** 1988. The Genus *Vaccinium* in North America. Ag. Canada Publ. 1828. Ag. Canada, Ottawa, Canada.



# ABBREVIATIONS

<b>ARS</b>	USDA Agricultural Research Service
<b>CBD</b>	Convention on Biological Diversity
<b>CENARGEN</b>	National Center for Genetic Resources (Brazil)
<b>CGC</b>	Crop Germplasm Committee
<b>CGIAR</b>	Consultative Group on International Agricultural Research
<b>CIAT</b>	International Center for Tropical Agriculture
<b>CIMMYT</b>	International Center for the Improvement of Maize and Wheat
<b>CPC</b>	Center for Plant Conservation
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>FS</b>	USDA Forest Service
<b>FTE</b>	Full time equivalent
<b>FY</b>	Fiscal year
<b>GEF</b>	Global Environment Facility
<b>GPA</b>	Global Plan of Action
<b>GRIN</b>	Genetic Resources Information Network
<b>IARC</b>	International Agricultural Research Center
<b>IBPGR</b>	International Board for Plant Genetic Resources
<b>IPGRI</b>	International Plant Genetic Resources Institute
<b>IPR</b>	Intellectual property rights
<b>NARS</b>	National Agricultural Research Systems
<b>NGO</b>	Non-governmental organization
<b>NGRL</b>	National Germplasm Resources Laboratory
<b>NGRP</b>	National Germplasm Resources Program
<b>NPGS</b>	National Plant Germplasm System
<b>NSSL</b>	National Seed Storage Laboratory
<b>pcGRIN</b>	a version of GRIN for use on personal computers
<b>PGR</b>	Plant genetic resources
<b>PI</b>	Plant Introduction Number, Plant Inventory
<b>PVP</b>	Plant Variety Protection
<b>PVPA</b>	Plant Variety Protection Act
<b>RH</b>	Relative humidity
<b>RNA</b>	Research Natural Area
<b>SINGER</b>	System-wide Information Network for Genetic Resources
<b>TNC</b>	The Nature Conservancy
<b>UN</b>	United Nations
<b>UPOV</b>	International Convention for the Protection of New Varieties of Plants



<b>U.S.</b>	United States of America
<b>USA</b>	United States of America
<b>USDA</b>	United States Department of Agriculture
<b>UNCED</b>	United Nations Conference on Environment and Development
<b>UNDP</b>	United Nations Development Program
<b>UNEP</b>	United Nations Environment Program
<b>USAID</b>	United States Agency for International Development