

Partnerships Promoting the Conservation of Fruit Genetic Resources

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Abstract

Limited human and fiscal resources require that partnerships be formed for the conservation, documentation, and evaluation of fruit and nut plant genetic resources. Plant exploration and exchange efforts have always required diplomacy and collaboration. The Foreign Seed and Plant Introduction Section of the United States Department of Agriculture was the precedent for the present National Plant Germplasm System. Current genetic resource partnerships involve international, governmental, educational, and private institutions as well as consortia. The future of continued global exchange of plant germplasm conservation rests in diplomacy and bilateral agreements.

INTRODUCTION

Plant germplasm is essential to the long-term welfare and survival of humanity. This natural resource is the foundation for development of food and fiber crops and is equivalent in importance to our soil, water, and air. Nations now realize the need to protect and manage sovereign plant genetic resources. To this end the United States (USA) has established the National Plant Germplasm System (NPGS), including facilities which specialize in the preservation of clonally propagated fruit and nut crops. I will discuss past, present, and future partnerships from the perspective of a genetic resource curator.

Early Partnerships

By the late 1890's scientists and administrators in the USA and Russia realized that global access to diverse wild and cultivated germplasm was requisite for significant agricultural advances. The USA had resources appropriated by Congress and strong support of President Theodore Roosevelt, a champion for conservation of natural resources. David Fairchild, a plant scientist of the United States Department of Agriculture (U.S. Dept. Agr.), Bureau of Plant Industry, was instrumental in encouraging the USA Congress to establish the Section of Seed and Plant Introduction in 1898 (Cunningham, 1984). This unit, predecessor of the present-day NPGS, emphasized acquisition and utilization of the best plants from all over the world.

Fairchild recruited a young Dutch plant explorer, Frank N. Meyer, to collect plants throughout Europe and Asia. Meyer's creed was, 'I will do all I can to enrich the United States of America with good things for her people' (Cunningham, 1984). In deed he devoted his life towards his creed and introduced more than 2,500 agronomic and horticultural crops, including numerous fruits, nuts, and ornamental trees and shrubs, to the USA. One example of the value of his collections is the 'Bradford' ornamental pear (*Pyrus calleryana* Decne.), that was derived from pears originally collected by Meyer in China, and is now found on streets throughout the USA.

N.I. Vavilov (1997) noted in his book, 'Five Continents', that although the Russians were a 'supplier' of plants, it was evident that they needed a 'broad approach toward systematic mobilization of plant resources for the purpose of regular utilization to improve existing crops and varieties'. According to Vavilov, 'A large number of scientists from the All-Union Institute of Plant Industry took part in expeditions ... almost all the agricultural areas of the world were visited, and an enormous amount of plant material was collected'. The Russian collections were based on Vavilov's hypothesis about phytogeography,

evolution, and the origin of cultivated plants. This was in sharp contrast, from Vavilov's point of view, to the 'eclectic and haphazard routes of American and European collectors'.

Partnerships were as integral to plant exploration then as now. Exploration was no easy task. Wars were raging, brigands were plundering, and diseases were rampant. Explorers frequently had to wait, with great patience, to obtain approval from their own country, to obtain visas to enter other countries, or to arrange for interpreters, bodyguards, porters, or shipping. The explorers were diplomats who negotiated mini-trade agreements in exchange for plant material.

PRESENT PARTNERSHIPS

The U.S. Dept. Agr., Agricultural Research Service, National Clonal Germplasm Repository at Corvallis, Oregon (NCGR-Cor) has benefited greatly from partnerships since its establishment in 1981. These partnerships include collaborations with international, governmental, educational, and private research institutions, as well as consortia and non-governmental organizations. A few examples will be described in detail for each type of partnership.

While the mandate of international agricultural research centers does not generally include fruit and nut crops, national genebanks have provided excellent opportunities for exchange and cooperation. During the last 10 years, the U.S. Dept. Agr. has sponsored more than 120 plant collecting expeditions to 47 countries. Twelve of the expeditions were specifically for collecting temperate fruit and nuts.

Grants from the U.S. Dept. Agr., Foreign Agricultural Service have enabled scientists from foreign countries to study in the USA, fostering germplasm exchange. During the late 1980's and 1990's, India received a grant for the development of the National Bureau of Plant Genetic Resources, a system modeled after the NPGS. A base seed storage laboratory was constructed in New Dehli, and working collections were established, including the Shimla Experimental Station for preservation of temperate fruit, nut, and other agronomically important resources. More than 100 scientists received training in the USA in the management of plant genetic resources. Additional funding from USA Public Law - 480 projects provided resources for the Indians to collect fruit and nut germplasm from the Himalayan hills.

Another important collaboration involves Kazakhstan and Russian scientists. The USA is supporting the training of former weapons scientists to work on projects of humanitarian benefit. Laboratories that previously produced biological weapons are now engaged in agricultural science - including plant genetic resource preservation.

Dr. Barbara Reed of the NCGR-Cor, is collaborating with Dr. Ned Garvey of the U.S. Dept. Agr., Plant Exchange Office and horticulturist Dr. Irina Kovalchuk of the Kazakh Research Institute of Horticulture and Viniculture to study in vitro culture and cryogenic preservation of fruits. Black currants are one of the crops of common interest. The Kazakhstan Plant Physiology Institute is also involved in this project.

Governmental

The NCGR-Cor works closely with many sister federal agencies for plant importation and exportation, conservation, genetic resource evaluation, and documentation. The U.S. Dept. Agr., Animal and Plant Health Inspection Service (APHIS) collaborates on the importation and exportation of plant genetic resources. Plant disease and pest problems tend to be continentally or regionally based and specific to particular crops. Quarantine and plant importation regulations are written by APHIS according to country of origin and specific plant material. The NCGR-Cor has been granted an APHIS Departmental Permit for strawberry importation and for restricted, or post-entry, nursery stock. Imported items that are prohibited, such as pomes, including apples and pears, must be processed through National Plant Germplasm Quarantine Office in Beltsville, Maryland.

The NCGR-Cor ships 2,000 to 3,000 germplasm accessions to requesters each year. Approximately 25% of the requests are international. Filling these requests requires coordinating the regulations of the importing country with pathogen testing and phyto-

sanitary certification. This certification is coordinated with APHIS and inspectors from the Oregon Department of Agriculture who provide third-party review of our pathogen testing results.

The NCGR-Cor works with the USA Department of Interior, National Park Service (NPS), to preserve fruit and nut trees. Many heritage orchards exist within various national parks. For example, in Michigan, the Sleeping Bear Dunes National Lakeshore, Lake Michigan, includes many old farmsteads containing heritage fruit orchards. Another park, the Manzanar Relocation Center on the edge of the Sierra Mountains in California, also contains heritage fruit orchards. The Manzanar Center was a Japanese internment site during World War II. Manzanar, which means 'little orchard' in Spanish, was an orchard prior to becoming a relocation center and the orchards provided work and food for the occupants during internment. We are working with NPS personnel to date and identify trees, and determine the best course of action for preservation of the germplasm. Unusual clones are added to the NCGR-Cor collection and the NPS is prepared to preserve the orchards within the parks.

Another project with the NPS involves the preservation and re-establishment of a fruit orchard at Ft. Vancouver, Washington. This park is where the first fort was established by the Hudson Bay Company of England in the early 1800's for trading purposes in the Pacific Northwest. The oldest apple tree in the Pacific Northwest exists at this site and Joseph Postman of the NCGR-Cor, working with Susan Dolan, NPS, have collected scion wood and seed of this tree. A replacement orchard for the Ft. Vancouver Park is being propagated from this original germplasm.

Record documentation is an aspect of germplasm conservation. Joseph Postman, NCGR-Cor pear curator, is working with the U.S. Dept. Agr., National Agricultural Library to display a set of original watercolor paintings of heritage fruit cultivars prepared in the early 1900's. These paintings were scanned and made available for research and public use through the NCGR-Cor website. Images include apples (*Malus domestica* Borkh.), pears (*Pyrus communis* L.), strawberries (*Fragaria × ananassa* Duchesne), raspberries (*Rubus idaeus* L.), blackberries (*Rubus* sp.), currants, and gooseberries (*Ribes* L.).

Educational

1. Universities. The NCGR-Cor collaborates with many agricultural experiment stations throughout the USA. In some cases specific cooperative agreements support research efforts on evaluation of genetic resources. We also have Research Support Agreements with several departments at Oregon State University. We are working with Dr. Maxine Thompson, Emeritus Professor, concerning the evaluation of a potential new crop, edible-fruited honeysuckle, *Lonicera cerulea* L. Germplasm of this species was obtained from native locations in Russia, China, and Japan. Developed clones are being compared with seedling selections.

Visiting scientists often spend their sabbatical leave studying the living fruit collections at the NCGR-Cor. Dr. Richard Moyer, from King's College, Tennessee, analyzed the anthocyanin content and antioxidant properties of clones of black raspberries (*Rubus occidentalis* L), blackberries (*Rubus* sp.), blueberries (*Vaccinium corymbosum* L), and black currants (*Ribes nigrum* L.). He observed that antioxidant compounds are complex in these crops and that black raspberries had the highest oxygen radical absorbance capacity (ORAC) of the fruits. 'Marionberry' had the highest ORAC of the cultivated blackberries, and wild rabbiteye blueberries (*Vaccinium ashei* Reade) had the highest ORAC of the tested blueberries, much higher than those in present cultivated types.

We collaborate with Kentucky State University to preserve pawpaw (*Asimina triloba* L.) genetic resources through a capacity building grant and participation in a regional variety trial. The pawpaw is the largest fruit native to North America and has potential for development as an orchard crop.

2. High Schools. The NCGR-Cor trains high school teachers and students in genetic resource preservation. We work with an Oregon program of Apprenticeships for Science and Engineering to provide a summer internship study for high school juniors. Each year students study in vitro culture, cryogenic preservation and pathogen-testing procedures at the repository.

Several high schools in the Corvallis area have horticultural therapy or vocational training programs for students with special needs. The Corvallis High School 'Wings' program has provided a team of students and a teacher-trainer who help maintain the NCGR-Cor strawberry collection. They pull weeds, remove runners and flowers, and perform other plant management tasks. The NCGR-Cor also works with Oregon Vocational Rehabilitation. Presently we have a blind individual that we have trained in optical scanning technology, who takes written plant information, scans it into a computer file, and then through a vocal system, edits the scan for computer read-errors.

Consortia and Groups

An effective collaboration exists with the Northwest Center for Small Fruit Research. This program is termed a virtual program in that it involves a coordinated effort from federal and state government, and universities throughout the region. Industry representatives have obtained congressionally appropriated funds for research on grapes, caneberries, strawberries, blueberries and other minor fruit crops. Scientists such as Dr. Chad Finn, evaluate the small fruit germplasm through support from this program.

Professional and amateur fruit growers collaborate with the NCGR-Cor. These groups include the North American Fruit Explorers (NAFEX), the California Rare Fruit Growers (CRFG), the Home Orchard Society and the Seed Saver's Exchange. Members of these large organizations are valuable contacts for unusual fruit genetic resources from all over the world. NAFEX includes more than 3,000 members through the USA and Canada. The CRFG is the largest amateur fruit-growing organization in the world, including members in 48 states and 30 countries. Through the assistance of Roger Meyer, a member of the CRFG, the NCGR-Cor obtained more than 30 diverse hardy kiwi fruit cultivars. The Home Orchard Society has a very effective scionwood exchange each year. The NCGR-Cor obtained new clones and provided plant material for multiple users through this group. The Seed Saver's Exchange, which preserves an orchard of heritage fruit cultivars, is attempting to obtain cuttings of every 19th century apple variety that still exists. The NCGR-Cor also worked with the Farmer's Cooperative Genome Project, Junction City, Oregon on a project funded by a federal Rural Development Grant to assist with the evaluation of NPGS plant genetic resources.

Another important group that the NCGR-Cor has begun to collaborate with are Native Americans. The Confederated Tribes at Warm Springs is interested in the conservation of huckleberries, which are a sacred food for their traditions. The NCGR-Cor would like to pursue additional collaborations to obtain ethno-botanical information about the native uses of USA fruit genetic resources.

Future Partnerships

Issues concerning intellectual property rights, farmer rights, and the ownership of native genetic resources have caused new ways of thinking about germplasm exchange. The Convention on Biological Diversity (CBD), a legally binding treaty administered by the United Nations Environmental Program, became effective in December 1993. The CBD impacts international germplasm exchange, as well as genetic resource conservation and sustainable use. Although the CBD has been ratified by most nations, the USA has signed, but not ratified it.

A second treaty, the International Treaty for Plant Genetic Resources for Food and Agriculture (IT), affecting germplasm exchange, conservation, and sustainable use, has also entered into effect. The IT is intended to facilitate the international exchange of germplasm of some plant genera preserved in ex-situ collections through a multilateral system. Future efforts to exchange germplasm of crops not covered by the IT, or to collect in situ germplasm, will require bilateral agreements.

CONCLUSIONS

While the plant distribution policy of the USA NPGS continually voices the ‘free exchange of genetic resources for crop improvement’, the global perspective has changed. Intellectual property rights and international treaties have brought plant collectors and genetic resource preservation into a new era. The concept of ‘sovereign ownership’ of germplasm within a country’s boundaries is international law. However, exchange and sharing of native genetic resources remains critical to crop improvement throughout the global system. We must all join together to work within our limited financial and germplasm resource base. Conservation of fruit and nut genetic resources must continue to be a global partnership at all levels.

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