

**National Agricultural Research, Extension,
Education and Economics (NAREEE) Advisory Board**

“The National Genetic Resources Program”

**Report and Recommendations from a Focus Session on this Topic Conducted at the
NABREE Advisory Meeting held in Washington D.C.
March, 2006**

Executive Summary

The United States Department of Agriculture (USDA) National Plant Germplasm System (NPGS) had its origin in the 1943 National Research Council report that recommended a series of plant introduction stations to receive plants of potential value to the United States. Authorizing legislation in the 1946 Agricultural Marketing Act led to the establishment of the regional plant introduction stations and the inter-regional potato introduction station that still exists today.

Legislation in 1990 (Public Law 101-624, Title XVI) authorized the Secretary of Agriculture to provide for a National Genetic Resources Program (NGRP) whose purpose was “maintaining and enhancing a program providing for the collection, preservation, and dissemination of genetic material of importance to American food and agriculture production.” These materials were considered critical national assets of the United States because they underpin the U.S. and even global food security. Today, these materials are even more critically important in protecting the nation’s and world’s agriculture base because of the threats of bio-terrorism and numerous other challenges.

The National Agriculture Research, Extension, Education and Economics (NAREEE) Advisory Board was briefed at its Spring, 2006 meeting on the current status of the National Genetic Resources Program. This program is largely supported by the United States Department of Agriculture in cooperation with its Land Grant University and Agriculture Experiment Station partners. Presentations were made by USDA staff and stakeholders of the program. The presentations and review focused primarily on the status and operations of the program since it was not possible to do a fully comprehensive review within the allotted time.

While the NGRP has made important strides in some areas since its authorization, the effect has been only a fraction of what Congress envisioned. It is disappointing that funding has not been made available for the animal, insect, microbes, silviculture and aquatic species programs. The USDA has internally reallocated some funds to begin the collection and preservation of animal germplasm in view of the urgency of some major animal disease problems. However, the overall program is so critically under funded that even the important research and operations of the National Seed Storage Laboratory, a primary facility of the USDA and a part of the NGRP, have lagged in programmatic work and research staffing has been reduced.

The NGRP is a model system, but adequate resources have not been provided to fully implement and maintain its operations. The NAREEE Board believes that the USDA should embrace the NGRP in the strongest ways possible and provide leadership for both the programmatic operations and securing budgetary support for its full and complete implementation. This is especially important today with the current state of the many uncertain externalities associated with world food and national securities.

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Introduction

The National Agricultural Research, Extension, Education and Economics (NAREEE) Advisory Board was briefed in March, 2006 on the current status of the National Genetic Resources Program (NGRP) supported in part by United States Department of Agriculture (USDA). The NAREEE Advisory Board had the opportunity to review and analyze this complex system that supports the NGRP and reports its findings accordingly.

Legislation in 1990 authorized the United States Department of Agriculture to establish and operate the NGRP to acquire, characterize, preserve and distribute important genetic resources of plants, animals, insects, microbes, trees and aquatic species of importance to food and agriculture. These are considered critical national assets because they underpin this nation's and even global food security. These assets are especially important for providing and protecting the nation's agricultural base at a time when threats of bioterrorism and other challenges abound.

Since the authorizing legislation, the United States Department of Agriculture through its Agricultural Research Service (ARS) has provided the primary program leadership for the NGRP. This effort has been in cooperation with the Cooperative State Research and Extension Service (CSREES) and the State Agricultural Experiment Stations. While the program has made significant strides in some areas, the effort has been short of what Congress envisioned.

It is disappointing that significant development and funding of the programs for animal, insects, microbes, silvicultural and aquatic species have not occurred. The ARS reallocated internal funds to establish the National Animal Germplasm Program (NAGP) in 1999, but no additional funds have been available for continued development of the other life forms

The insect species collection is of great value to agriculture. Many of our flowering plants and over 40 billion dollars in crop production in the United States each year depend on pollination by insects. Other important insect contributions include nitrogen volatilization, reduction of parasite habitats, reduction of insect pests by beneficial insects and food for wildlife, including fish, birds and small mammals. Animal germplasm is the most recent addition to the collection and it is the smallest. It includes livestock, birds and fish. This new collection is facing many problems not found in the other collections; therefore, it will take time and new resources to build this collection to fulfill the national needs. Many plant and animal food sources depend on microbes to be successful, and all are potential victims of microbial pathogens. There are several microbial species and cultural collections available in the United States; however, they urgently need to be further developed.

It is clear that having an integrated system with dispersed locations for the preservation of the nation's germplasm collections is critical to our ability to sustain or improve the current level of agricultural productivity and to provide appropriate assistance to our world-wide partners. The collaborative activities and partnerships of the USDA's Cooperative State Research, Education and Extension Service (CSREES) and the Agricultural Research Service (ARS) with the State Agricultural Experiment Stations are vital to the program.

Among our most valued biological organisms are those that provide food, fiber and the potential to provide useful bio-materials. Ensuring the future availability and viability of these collections is critical to the nation's future and to the scientists that depend on this resource in their efforts to understand and improve biological systems. Scientific efforts to continue to improve the productivity and sustainability of United States and world food and cropping systems are of utmost importance.

The germplasm collections that are maintained for the Nation through support from the USDA and the State Agricultural Experiment Stations have incalculable value. While it is improbable that we can place a precise value on every collection, their net worth to the nation and the world would be increased measurably with a thorough and systemic effort to further characterize and evaluate the material so that its usefulness to all types of agricultural scientists worldwide would be enhanced. At the present time, those who curate the collections have insufficient time or resources to become involved to any significant degree with characterization of the material and looking for unique genes and/or gene sequences. Significant increases to the funds already appropriated to the collections should be made and directed specifically at characterization efforts.

Background

An explosion of new genetic discoveries over the last 30 years will become crucial tools for competitive advantage and agricultural security in the future. The NGRP must incorporate regularly this new, relevant science and technology to fulfill its mandate. The program will be required to incorporate rapidly new knowledge and techniques that are developed, and there will be need for an even better utilization of the genetic material in the collections, both in the US and internationally.

Because of the high strategic importance of these collections, it is in the national interest for USDA and its partners (e.g., the Land Grant Universities, State Agricultural Experiment Stations, and others) to ensure that we remain the world leader in collection, preservation, understanding and utilization of the resources in these collections. Future success of these programs requires continuous incorporation of new tools used in synthetic biology, gene regulation, proteomics and bioinformatics, and the development of more and more sophisticated genomic databases, so that the collections will have even more impact and value when coupled to programs that focus on future rapid genetic enhancement and plant breeding.

The USDA supports numerous programs to carry out the NRGP legislation. ARS National Program (NP) 301 collects and preserves germplasm from plants, microbes and insects in over 30 gene banks (Appendix 1 lists the National Plant Germplasm Centers), while NP101 handles animal germplasm at 12 regional centers, with a central repository at Fort Collins, Colorado. Additionally, the State Agricultural Experiment Stations, in collaboration with ARS and CSREES, maintain four regional centers that house over 40% of the plant collections. The Economic Research Service (ERS) of the REE mission area has periodically studied the

economic significance both of the crops maintained in the National Plant Germplasm System (NPGS) and of the collections themselves. The U.S. Forest Service conducts similar research, funded by the Department of the Interior, aimed at collecting and breeding forest and orchard trees with superior productivity and disease resistance. In addition, it should not be overlooked that the State Agricultural Experiment Stations, through the National Research Support Projects (NRSP), provide support for NRSP-6, *The Inter-Regional Potato Introduction Project: Acquisition, classification, preservation, evaluation and distribution of potato (Solanum) germplasm*.

Even though the NGRP has made remarkable progress in the last 15 years, it seems apparent that future strategic leadership will be required to ensure that we remain competitive. Furthermore, the program will require that as new knowledge and techniques are developed there will be need for an even greater utilization of the genetic material in the collections, both in the US and internationally.

In NP 301, USDA has focused its efforts on crop research, but increasingly has incorporated research on several beneficial microbial genetic resource projects. Emphasis in NP 301 continues to focus on developing and maintaining scientific infrastructure e.g., the collection, databases and genebanks, along with significant applied research that focuses on genetic improvements of specific crops in the collections. The stated vision for efforts carried out within NP 301 is to furnish genetic and bio-informational tools, genomic information, and genetic materials to enhance U.S. agricultural productivity and to ensure a high quality, safe supply of agricultural products. To achieve this vision, ARS employs an integrated approach to the research agenda on plant genetic resources that focuses on building extensive collaborations (nationally and internationally) along with partnerships that exploit the untapped plant and microbial genetic diversity in the NPGS collections. When coupled with efforts in proteomics and bioinformatics, and the development of more and more sophisticated genomic databases, the collections will have even greater impact and value to programs that focus on genetic enhancement and plant breeding.

Within NP301 there are three research components of note:

- Genetic Resource Management
- Genetic Characterization and Genetic Improvement
- Genomic Databases.

The national effort to support NP 301 initiatives is funded principally by ARS, with support from CSREES and the State Agricultural Experiment Station system.

It is clear that conserving genetic resources is a high impact and high priority area of research for USDA and the State Agricultural Experiment Stations. Given the priority, it seems apparent that efforts are required within USDA to develop strategies, in concert with its partners to ensure that germplasm facilities are aligned with conservation of the collections that will both ensure the health and safety of the accessions in the collections and the genetic integrity of the material. In addition, efforts need to be given priority to expand the molecular evaluation capabilities of the collections at each of the germplasm facilities and projects, and to expand the collaborative efforts to characterize the accessions in the collections so that scientists will have better knowledge of the genes that are present in the material, thus increasing the usefulness of the collections in the future.

Lastly, the agency must not forgo its commitment and strong support for basic research in genetics and genomic theory which focus on areas that often receive little attention. With the broad area of genetic characterization and genetic improvement, USDA and its partners need to expand efforts to discover and develop new genetic tools that will aid in the characterization of the collections. Crop breeders, for example, provide clear goals for genomic characterization that are tied to crop improvement needs - focus on abiotic stress and continuing strong programs in biotic stress alongside the various crop improvement strategies. Ensuring support for the genomic databases, their interconnectivity, and evolving data storage are high priorities to ensure usefulness of the databases well into the future. USDA must expand its commitment to and strong support for basic research in genetics and genomic frontiers which is focused and strengthened by expanded collaborations with scientists in the Land Grant Universities, the REE agencies, and the State Agricultural Experiment Stations system.

Specific Recommendations

- Funding from USDA for the NGRP, while significant, needs to be greatly increased in the future if this material is to be appropriately maintained, characterized and utilized for genetic improvement purposes.
- USDA and its partners who provide funds supporting these collections must develop a strategic plan for the future of the collections. Decisions need to be made regarding further building of the collections and increasing efforts to better understand the inherent value of the collections, that is, what genes of economic value do these collections hold that have yet to be characterized.
- It is critical in the development of a strategic plan for the nation's germplasm collections that USDA work with other federal and state partners to determine what and where the gaps are in the collections and to proceed toward obtaining critical germplasm that may hold the answer to future agricultural, energy and human health concerns.
- We encourage USDA to continue to partner with the Department of Energy (DOE), the National Science Foundation (NSF) and the National Institutes of Health (NIH) to leverage funds for support and characterization of the unique material in these collections. NIH should have significant interest in the collections as a source of new and unique pharmaceuticals and medical products. DOE would be interested in materials in the collections that would have utility for biomass production and its conversion to biofuels and bioproducts as a significant portion of the economy is transformed to biobased. Clearly, both of these agencies should be approached for funds in a supporting role, as the collections held in the USDA National Plant Germplasm system are invaluable resources to all.
- Both USDA and the nation would be well-served to obtain and commit significant funding to focus on characterization of specific materials that are of national importance in the collections, so that genetic maps and identifiable genes of importance are available to researchers.
- Funding should be provided to support, enhance or initiate major efforts for germplasm collection and preservation for animals, insects, microbes, silviculture, aquatic species and specialty crops.

- The USDA and the State Agricultural Experiment Stations should be encouraged to look toward mining these collections for material that would accelerate the nation's efforts to move toward a bio-based economy. While the plant germplasm collections have been most often utilized for efforts to increase yields, and/or to find genes and traits usable in increasing specific disease and insect resistance, it is clear the collections harbor material that would be valuable as sources of material for biomass, bio-products and bio-energy production.
- REE should communicate more frequently and effectively to the public on significant success stories that have emerged from scientists having access and using the collections as a component part of their research programs. In any such effort it should be made clear the irreplaceable value of these collections and what would be lost if these programs were to disappear. Efforts could be pursued to develop scenarios that would demonstrate the value of the nation's germplasm banks in reversing the damage resulting from climate change, a global epidemic or a bioterrorist attack.

Appendix 1: National Plant Germplasm Centers

1. Barley Genetic Stock Center (GSHO), Aberdeen, ID
2. C.M. Rick Tomato Genetics Resources Center, Davis, CA
3. Desert Legume Program, Tucson, AZ
4. Genetic Stocks – Oryza (GSOR) Collection, Stuttgart, AR
5. G.A. Marx Pea Genetic Stock Center (GSPI), Pullman, WA
6. Maize genetics Cooperative Stock Center (GSZE), Urbana, IL
7. National Arid Land Plant Genetic Resources Unit (PARL), Parlier, CA
8. National Clonal Germplasm Repository (COR), Corvallis, OR
9. National Clonal Germplasm Repository for Citrus and Dates (RIV),
10. Riverside, CA
11. National Clonal Germplasm Repository for Tree Fruit/Nut Crops and Grapes
(DAV), Davis, CA
12. National Clonal Germplasm Repository (NGRL), Beltsville, MD
13. National Center for Genetic Resources Preservation (NCGRP), Fort Collins, CO
14. National Small Grains Collections (NSGC), Aberdeen, ID
15. National Temperate Forage Legume Genetic Resources Unit, Prosser, WA
16. North Central Regional Plant Introduction Station (NC-7), Ames, IA
17. Ornamental Plant Germplasm Center (OPGC), Columbus, OH
18. Pecan Breeding and Genetics, Brownwood and Somerville, TX
19. Plant Genetic Resources Conservation Unit (S-9), Griffin, GA
20. Plant Genetic Resources Unit (NE-9), Geneva, NY
21. Plant Germplasm Quarantine Center (PGQC), Beltsville, MD
22. Soybean/Maize Germplasm, Pathology and Genetics Research Unit, Urbana, IL
23. Subtropical Horticulture Research Station (MIA), Miami, FL
24. Tropical Agricultural Research Station (TARS), Mayaguez, Puerto Rico
25. Tropical Plant Genetic Resources Management Unit (HILO), Hilo, HI
26. United States Potato Genebank (NRSP-6), Sturgeon Bay, WI
27. Western Regional Plant Introduction Station, (W-6), Pullman, WA
28. Wheat Genetic Stock Center (GSTR), Aberdeen, ID
29. Woody Landscape Plant Germplasm Repository, Washington, DC

Appendix 2: Work Group for the National Genetic Resources Program

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