

## **Planning Conference to Develop Strategies for Training the Next Generation of U.S. Plant Genebank Managers**

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**Co-PD:** Gayle Volk, USDA-ARS, Fort Collins, CO

### **Project Summary**

The U.S. plant genetic resource (PGR) management community is experiencing an unprecedented generational change in personnel, with as many as one-third of the U.S. National Plant Germplasm System's scientific and curatorial staff potentially retiring between now and 2020. To our knowledge, U.S. universities do not currently offer PGR management courses or degree programs that could serve as a foundation for training the next generation of U.S. PGR managers. This proposal recognizes the urgent need to develop educational resources through a joint effort between land-grant universities and USDA-ARS. Funding is requested to support a conference among selected U.S. and international PGR experts to design and develop a strategy for providing the needed training, which may include semester-long classes delivered through distance-learning, short courses at genebanks, or workshops at scientific meetings. The conference will be held in Fort Collins, Colorado, in April, 2018 for 3 days, co-hosted by Colorado State University and the USDA-ARS National Laboratory for Genetic Resources Preservation. Objectives for the meeting are 1) to identify the pedagogical options, logistics, and curriculum topics for a U.S. plant genetic resource management training effort, with major emphasis on a distance-learning course; and 2) to design a strategy to develop, deliver, and sustain a plant genetic resource management training program. Proposed conference attendees include representatives from USDA-ARS, land grant universities, and State Agricultural Experiment Stations; members of the plant breeding, genetics, and genomics communities; experts in delivering distance-learning courses; and potential international partners. This conference proposal is directly relevant to Plant Health and Production and Plant Products, Program priority area: Plant Breeding for Agricultural Production. The specific priorities addressed are "Pre-breeding and germplasm enhancement" and "Cultivar development".

## **Project Narrative**

### **Introduction**

A. The U.S. plant genetic resource management community is currently experiencing an unprecedented generational change in personnel, with as many as one third of the U.S. National Plant Germplasm System's scientific and curatorial staff potentially retiring between now and 2020 (P.K. Bretting, USDA-ARS, personal communication). To our knowledge, U.S. universities do not currently offer plant genetic resource management classes or degree programs that could serve as a foundation for training the next generation of U.S. plant genetic resource managers. This proposal recognizes the urgent need to develop educational resources through a joint effort between land-grant universities and USDA-ARS. The long term goal of this effort is to establish and sustain appropriate training opportunities in plant genetic resource management for university students and plant germplasm curators and managers.

This particular proposal focuses on support for organizing a conference/workshop to discuss the scope, focus, format, and demand for such a plant genetic resource management training effort. The specific objectives are to

- 1) Host a conference to identify the pedagogical options, logistics, and curriculum topics for a U.S. plant genetic resource management training effort, with major emphasis on a distance-learning course.
- 2) Design a strategy to develop, deliver, and sustain a plant genetic resource management training program.

The U.S. National Plant Germplasm System (NPGS) is among the world's largest collection of plant genetic resources, maintained by approximately 120 USDA-ARS and land-grant university curators, research leaders, and key support staff members at 20 locations throughout the U.S. The NPGS conserves 579,894 accessions representing over 15,000 species, and is the largest distributor of plant genetic resources in the world. Skilled genetic resource managers are needed to ensure that NPGS germplasm remains accessible and available for the long-term. At this time, no known U.S. academic courses are available for plant genetic resource management. Training classes and workshops in this general area are sometimes available internationally, but they often focus on relatively narrow aspects of European or International Agriculture Research Center facilities, approaches, and regulations. A single international online series of educational modules regarding plant genetic resource management is available through the internet ([http://cropgenebank.sgrp.cgiar.org/index.php?option=com\\_content&view=article&id=319&Itemid=455&lang=English](http://cropgenebank.sgrp.cgiar.org/index.php?option=com_content&view=article&id=319&Itemid=455&lang=English)) but it is limited in its coverage of key topics, not focused on the U.S. genebank system, and is not updated regularly.

#### ***Significant ongoing or recently completed activities.***

Co-PIs Byrne and Volk recently coordinated, co-authored, and submitted a manuscript to the journal *Crop Science* titled "Sustaining the future of plant breeding: The critical role of the USDA-ARS National Plant Germplasm System". This review of the current and future roles of

the NPGS in plant breeding recognized and emphasized the need for training the next generation of plant genetic resource managers and users.

***Role of stakeholders in problem identification, planning, implementation, and evaluation.***

The need for a training course in plant genetic resource management was recognized by the members of the National Plant Germplasm Coordinating Committee (NPGCC) during their most recent meeting held in Geneva, NY in early June 2017 (for more information about the NPGCC see the website <http://www.escop.info/ViewCommittees.cfm?comid=41>). The NPGCC concluded that the ongoing challenge for training NPGS curators, research leaders, and support staff will become more acute as the current wave of retirements continues and grows during the next 5-10 years. Subsequent discussions among university and ARS leadership teams confirmed the urgent need for the development of the proposed training program. The participants in the proposed conference (see list of participants on p. 5-8 and attached set of letters) represent a broad range of stakeholders, including land-grant university scientists and administrators, NPGS curators, private sector seed companies, and non-governmental organizations. The disciplines represented by the participants include plant breeding, genetics, and genomics, plant pathology, seed science, germplasm conservation, distance education, and computer applications. These experts have been strongly supportive of the need for a training effort in plant genetic resources management. Thus, the conference itself will serve as a venue for gathering input from relevant stakeholder groups. If this proposal is funded, the participants will be queried to further refine the conference agenda and organization.

**Reasons for performing the work at the proposed institution**

The proposal co-PIs, Dr. Byrne and Dr. Volk, are co-located in Fort Collins, Colorado. Dr. Byrne is a Professor in the Soil and Crop Sciences Department at Colorado State University (CSU) and has experience using plant genetic resources in his wheat genetics research program, as well as developing and teaching distance-learning classes. Dr. Volk is a Plant Physiologist at the USDA-ARS National Laboratory for Genetic Resources Preservation (NLGRP), with a research program aimed at improving the security and efficiency of genebanking efforts. The proposed conference will be co-hosted by NLGRP and CSU. Conference attendees will also have the benefit of conferring with CSU and NLGRP faculty, students, and staff with interests and expertise regarding this topic, and touring the NLGRP facility during their visit.

**B. Rationale and Significance**

Access to high quality plant genetic resources is critical to the future of worldwide plant breeding. In the words of the Plant Breeding Coordinating Committee's 2015 Renewal Document, "genetic diversity serves as the basis for development of locally adapted, high yielding cultivars that are critical for providing livelihood resilience and food and nutritional security. Therefore, it is essential that the U.S. and international communities conserve, characterize, and provide access to diverse germplasm for plant breeding."

(<https://www.nimss.org/projects/view/mrp/outline/17576>).

The NPGS plays an important role in U.S. agriculture by distributing 250,000 germplasm accessions annually to university, industry, and federal researchers in the U.S. and abroad. Many

of these accessions are provided to the plant breeding, genetics, and genomics community for developing and identifying cultivars with improved resistance to biotic and abiotic threats, higher quality, and improved yields. It is critical that qualified, trained personnel maintain the extremely diverse collections of the NPGS using the latest and most effective management techniques to ensure that materials are healthy, true-to-type, well-documented, and available. Thus, this proposed conference to discuss developing training opportunities in plant genetic resource management, is directly relevant to Plant Health and Production and Plant Products, Program priority area: Plant Breeding for Agricultural Production. The specific priorities addressed are “Pre-breeding and germplasm enhancement” and “Cultivar development”.

We believe that an accredited online distance education course offered through a land-grant university will be a key part of the proposed training program. Distance courses have the advantages of reaching a geographically dispersed group of students and drawing upon subject matter experts from throughout the country (or even worldwide) as instructors. Distance education instructional platforms have improved markedly in recent years, and can easily provide lessons that include videos, animations, reading materials, synchronous and non-synchronous discussions, assignment submission, quizzes, and exams. A course taken for academic credit meets the needs of university students and has a built-in quality control mechanism through the university’s curriculum approval process.

However, we recognize that other groups of learners may have other training needs or preferences. For example, not everyone will require academic credit for a course. Some learners would prefer an intensive, non-credit, hands-on training experience rather than an extended semester-long course. In some cases, a focused 1-day workshop on a specific topic may meet a learner’s needs. Therefore, although the proposed conference will have in mind the design of a distance-learning curriculum, we will also address the broader strategy of meeting diverse educational needs.

### **C. Approach**

#### ***Justification for the meeting***

The U.S. NPGS is experiencing a challenging level of personnel turnover, with as many as one third of the NPGS scientists and curators potentially retiring by 2020. This significant loss of long-term institutional knowledge and expertise will have tremendous impacts on the sustainability and success of the NPGS. With current USDA and land-grant university budgetary constraints, it is rarely possible to hire a replacement prior to the departure of the incumbent, thus making it very difficult to provide on-the-job training opportunities for new hires.

The proposed planning conference will convene experts to identify training needs and to develop plans for a distance-learning semester-long course in plant genetic resource management for the next generation of NPGS genebank personnel, and students and researchers interested in this topic. It will capture, document, and make available existing knowledge and expertise for the upcoming generation of plant genetic resource managers, researchers, and students. Other types of training will also be explored, for example, holding 1- or 2-week short courses at one of

USDA’s germplasm facilities, or day-long focused workshops in conjunction with annual meetings of relevant scientific societies.

At least a month prior to the conference, relevant readings will be distributed to the participants so that they can read and reflect on the subject matter and be ready to discuss the issues at the meeting. Certain participants will be asked to give short presentations or lead the discussion of topics in which they have expertise. For each topic, we will attempt to reach a consensus decision or agree to table a decision pending further research. A summary document will be drafted by the co-PD’s and distributed to the participants for comment.

***Recent meetings on the same subject with dates and locations***

To our knowledge, there have not been any meetings held recently to discuss training needs for PGR management.

***Names and organizational affiliations of the chair and other members of the organizing committee***

Co-chair: Pat Byrne, Soil and Crop Sciences, Colorado State University. 970-491-6985  
patrick.byrne@colostate.edu

Co-chair: Gayle Volk, USDA-ARS, National Center for Genetic Resources Preservation, 1111 S. Mason St., Fort Collins, CO 80521 970-492-7607 Gayle.Volk@ars.usda.gov

**Proposed Agenda for the Conference (subject to modification)**

<b>Date</b>	<b>Time</b>	<b>Topic</b>
April 23		Travel day
April 24	9:00	Arrive. Optional NLGRP tour
	11:00	Welcome and Introductions
	11:30	Justification for the development of a PGR management training course
	12:00	Lunch
	13:00	Presentation and discussion of training options, including distance-ed courses, face-to-face short courses, and workshops at national meetings
	14:00	Presentation and discussion of distance-learning concepts and logistics
	14:45	Training curriculum topics for PGR management basics
	15:30	Break
	15:45	Training curriculum topics for committee involvement (Crop Germplasm Committees, Regional Technical Advisory Committee, Plant Germplasm Operations Committee, etc.)
	16:15	Training curriculum topics for customer service and germplasm use, including phenotypic and genotypic evaluation and pre-breeding

	17:30	Adjourn
April 25	8:00	Training curriculum topics for PGR management of seed-based crops
	10:00	Break
	10:15	Additional curriculum topics for PGR management of clonally-based crops
	12:00	Lunch
	13:00	Training curriculum topics for developing and meeting PGR management standards
	14:00	Training curriculum topics for seed viability and regeneration
	15:00	Break
	15:15	Training curriculum topics for regulations/explorations/APHIS
	16:00	Training curriculum topics for Intellectual Property issues
	16:30	Training curriculum topics for GMOs
	17:00	Training curriculum topics for GRIN-Global
	17:30	Adjourn
April 26	8:00	Training curriculum topics for genetic/genomic data
	10:00	Break
	10:15	Training curriculum topics for crop wild relatives and in situ conservation
	11:30	Revisit training format/content discussion (length, locations, dates, promotion)
	12:00	Review follow-up responsibilities and timelines
	12:30	Lunch
	1:30	Adjourn
	1:30	Optional NLGRP tour. Afternoon flights should be made for no earlier than 5 p.m.

### **Scheduled Participants**

**Pat Byrne**, Wheat Geneticist at Colorado State University (Fort Collins, CO). See Key Personnel section.

**Gayle Volk**, USDA-ARS Plant Physiologist at the National Laboratory for Genetic Resources Preservation (Fort Collins, CO). See Key Personnel section.

**David Bubeck**, Research Director at DuPont Pioneer (Des Moines, IA). American Seed Trade Association liaison to the National Association of Plant Breeders. His expertise is in using maize genetic resources for genetic enhancement and breeding.

**Debora Colbert**, Director of Professional Development at the Institute of Learning and Teaching at Colorado State University. She has extensive experience in developing high quality programs regarding teaching and learning theory and best practices for online learning.

**Clare Coyne**, USDA-ARS Curator of cool season legume crops at the USDA-ARS Western Regional Plant Introduction Station (Pullman, WA). She has expertise in NPGS crop curation and the use of genomic data to evaluate the collection and affect management decisions. Use of NPGS materials for evaluation, characterization, and use in plant breeding programs.

**Fernando de la Torre**, Director of the Centro Nacional de Recursos Genéticos, INIFAP (Tepetitlan, Mexico). His expertise is in leading curators and managing a large plant genebank in a developing nation.

**Axel Diederichsen**, Curator at the Agriculture and Agri-Food Canada's Plant Genetic Resources Canada genebank at the Saskatoon Research and Development Centre (Saskatoon, Canada). He acquires, maintains and distributes genetic resources of relevance to Canadian and international agriculture, consistent with Canada's commitments to implementing the FAO International Treaty on Plant Genetic Resources for Food and Agriculture.

**Candice Gardner**, USDA-ARS Research Leader of the Plant Introduction Research Station and Coordinator of the NC-7 Project, a Cooperative Multi-State Project (Ames, IA). Interests focus around development of resources and tools that improve the effective management of the germplasm collections and associated information, their availability and utility to researchers, and new uses of crops.

**Paul Gepts**, Geneticist/Breeder at the University of California, Davis (Davis, CA). His research focuses on the elucidation of the processes that have shaped the evolution of crop plants under cultivation, with an emphasis on beans; and the use of the NPGS collections in plant breeding.

**Mike Gore**, Molecular breeding and genetics for improving nutritional quality at Cornell University (Ithaca, NY). Combines quantitative genetics, genomics, analytical chemistry and remote sensing to elucidate the genetic basis of complex trait variation in various crops, including maize, oat, cassava, cotton, sorghum, industrial rapeseed, and guayule.

**Luigi Guarino**, Director of Science and Programs at the Global Crop Diversity Trust (Bonn, Germany). Oversees the Crop Trust's work in genetic resources management programs at the CGIAR Centers' genebanks.

**Mike Havey**, USDA-ARS Research Geneticist and Director of the Plant Breeding and Genetics Graduate Program at the University of Wisconsin. (Madison, WI). His research program is focused on the breeding, genetics, and genomics of the Alliums (onions, garlic) and cucurbits (cucumbers).

**Kim Hummer**, USDA-ARS Research leader and small fruits curator at the USDA National Clonal Germplasm Repository (Corvallis, OR). She is responsible for the collection, maintenance, distribution, evaluation, and documentation of clonal crops, including hazelnuts, berries and pears, and their wild relatives.

**Gary Kinard**, USDA-ARS Research leader and Plant Pathologist at the National Germplasm Resources Laboratory (Beltsville, MD). His responsibilities include the management of the GRIN-Global database, Plant Exchange Office, and Plant Disease Research Unit. He also serves as coordinator of the 42 Crop Germplasm Committees of the U.S. National Plant Germplasm System.

**Sarada Krishnan**, Director of Horticulture and Center for Global Initiatives at the Denver Botanic Gardens (Denver, CO). She helped develop the global strategy for the conservation of coffee genetic resources and serves on the USDA National Genetic Resources Advisory Council.

**Jan Leach**, Professor of Molecular Plant-Microbe Interactions and Research Associate Dean at Colorado State University (Fort Collins, CO). Her research emphasis is molecular characterization of the genes that control disease resistance and biomass accumulation.

**Steve Lommel**, Associate Dean and Director and Plant Pathologist at North Carolina State University (Raleigh, NC). His research expertise is in the molecular mechanisms of plant viral pathogenesis.

**Manjit Misra**, Director of the Seed Science Center and Seed Science Professor at Iowa State University (Ames, IA). He is active in the American Seed Trade Association and has specialties in computer vision systems and seed conditioning. The Seed Science Center has extensive distance learning programs.

**Margaret Smith**, Professor of Plant Breeding and Associate Director of the Agriculture Experiment Station at Cornell University (Ithaca, NY). Her research interests are to enhance understanding of corn adaptation to marginal environments and develop genetic materials that will improve corn productivity and sustainability in such environments. Teaching responsibilities include applied breeding, selection, variety testing, and seed issues.

**Wayne Smith**, Plant Breeding Professor and Associate Department head at Texas A&M (College Station, TX). Research duties include development of superior germplasm/cultivars which will enhance the productivity, improve the product quality, and/or decrease production costs associated with cotton production in Texas. Texas A&M has an extensive distance learning curriculum for plant breeding.

**Gan-Yuan Zhong**, USDA-ARS Research Leader of the Grape Genetics Research Unit and Plant Genetic Resources Unit (Geneva, NY). His expertise is in plant introduction station and clonal repository management and the use of genetic/genomic data to evaluate NPGS collections.

### **Proposed Informal Participants:**

**Marty Draper**, Professor and Head, Department of Plant Pathology, Kansas State University

**Peter Bretting**, National Program Leader, USDA-ARS Plant Genetic Resources, Genomics and Genetic Improvement, Beltsville, MD

From the USDA-ARS National Laboratory for Genetic Resources Preservation, Fort Collins:

**Stephanie Greene**, Plant Geneticist

**Colin Houry**, Research Associate

**Christopher Richards**, Plant Geneticist

**Christina Walters**, Plant Physiologist

### ***The method of announcement or invitation that will be used***

Invitation to the planning conference will be conducted by email. A follow-up discussion of the results of the conference supported by this grant will occur at the C-8 Division (Plant Genetic Resources) meeting of the Crop Science Society of America (CSSA) meetings in Baltimore, MD, in Nov. 2018.

The invitation to participate in the resulting training opportunities will be announced at relevant conferences, including, but not limited to:

- Seed Longevity Workshop, Fort Collins, CO, Summer 2018
- CSSA, C-8 Division Meeting, Baltimore, MD Nov. 4-7, 2018
- Plant and Animal Genome, Genomics for Genebank Workshop, Jan. 12-13, 2019
- National Association of Plant Breeders annual meeting, Summer 2019, Guelph, Ontario, Canada

Announcement of the training opportunities will also be made through newsletters, websites, Crop Germplasm Committee chair meetings, and email lists of organizations relevant to plant genetic resource management.

### **Expected results**

We expect that this focused conference will result in a defined, coordinated strategy for providing training for the next generation of plant genebank managers. This will include at least tentative agreement on the different types of training, topics to be covered, and potential instructors and institutional providers of the training. The discussion will be formalized in the form of a conference summary, which will be circulated to a wide audience, including at the C-8 Division meeting of CSSA in November, 2018. Relevant materials will be posted on a website established for this project. Follow-up activities may include a survey of training preferences of target groups, a comparison of different institutional providers, a compilation of potential instructors, and an implementation plan finalized.

## **Evaluation**

Shortly after the conference, an online evaluation will be conducted to assess the conference's organization, logistical arrangements, quality of discussion, and results achieved. The ultimate evaluation of the project will be based on the concrete results accomplished by the end of the year.

## **Project timetable (all dates are 2018)**

- Jan. 1      Funding begins.
- Jan. 10     Formal invitations sent to conference participants.
- Feb. 1      Begin online discussion among participants to refine conference agenda.
- March 1    Finalize meeting agenda. Distribute reading materials and assign roles to participants.
- April 24    Conference begins.
- April 26    Conference ends. Follow-up duties assigned.
- May 15     Conference summary finalized and distributed.
- June-Oct.   Follow-up activities underway.
- Nov. 4-7    Results presented and input solicited at Crop Science Society of America annual meeting.
- Dec. 31    Funding ends. Implementation plan finalized.