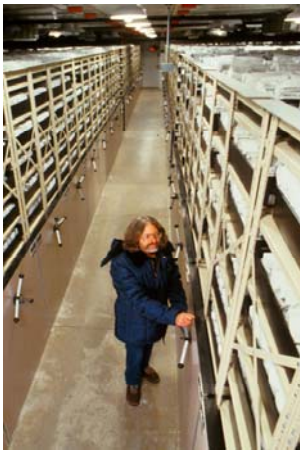
PLANT GENETIC RESOURCES PRESERVATION PROGRAM

2005 ANNUAL REPORT

PRESERVATION AND QUALITY ASSESSMENT OF PLANT SEED GENETIC RESOURCES



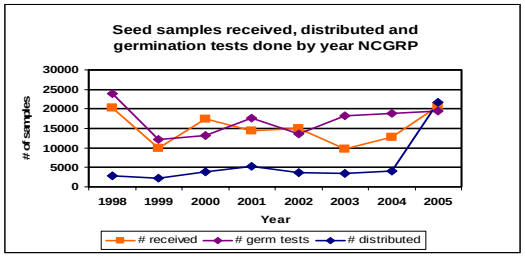
NCGRP Seed storage vault

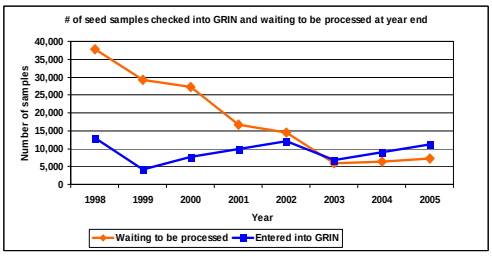
Problem: U.S. agriculture continually encounters new challenges for crop improvement. Exotic pests and diseases, increasing salinity, drought, as well as other pressures for land use and societal preferences, greatly impact and challenge crop improvement programs. The need for diverse genetic resources from widely distributed centers of origin throughout the world has underpinned US agriculture and is of growing importance today. Genetic diversity is critical to provide the basic building blocks for plant breeders to overcome these challenges. However, the centers of origin for most of our major crops are in fragile areas due to stresses for alternative land use and changing environmental conditions. Access to the wild relatives of crops is increasingly more limited due to international trade restrictions and depletion of the genetic resource as farmers switch to modern cultivars. It is imperative that diverse genetic resources be acquired, documented, preserved, and multiplied for those crops that are beneficial to mankind. The National Center for Genetic Resources Preservation (NCGRP) maintains replicates of the genetic resources of the National Plant Germplasm System (NPGS) active sites and preserves this base collection in long-term storage. Genetic resources in the form of seed are utilized by plant breeders and molecular biologists to identify genes necessary to overcome the problems mentioned above. Clearly, long-term storage and maintenance of genetically diverse germplasm are essential.

Findings: The NCGRP received 20,637 new seed accessions between Jan 1, 2005 and December 31, 2005. This is higher than in past years yet it reflects a large shipment of 8,100 samples from the Small Grains Center in Aberdeen, ID. The Unit tested 7519 seed accessions for viability this year and placed these accessions into long-term storage at -18 ^{o}C or in the vapor of liquid nitrogen. Monitor tests, to confirm viability of seed previously stored, held steady at 11,958 samples. 21,786 samples were distributed by the PGRPP in 2005 to 127 scientists from 16 different countries. This number of distributed samples is ~5X higher than normal due to a duplicate request for 8,000 NSSL-only sorghum accessions. The storage of safety back-up samples from International Gene Banks, State and Federal entities and NGOs remains an active storage activity for the Program. Dave Ellis was appointed curator of the Program in November 2005.

Personnel in Plant Genetic Resources Preservation Program (PGRPP)

Interpretations and Recommendations: The PGRPP continues to successfully maintain secure long-term storage of genetic germplasm for the use of future generations and to assure that genetic resources remain available for the welfare and survival of not only the US, but of the world's, population. The National Center for Genetic Resources Preservation's mission (see page 2) is to store and provide genetic resources for crop improvement. Long-term preservation of genetic resources is our main responsibility and as of December 31, 2005 we had 362,418 seed accessions in our base collection.





- D. Ellis

PERPETUAL SEED STUDY

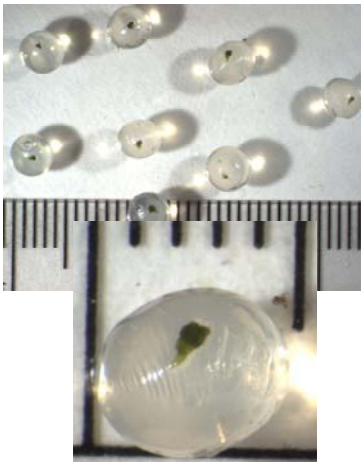
Problem: The mission of the SVSRU is *to effectively document, preserve and maintain viable seed and propagules of diverse plant germplasm in long-term storage*. To achieve this mission, it is prudent to continually evaluate the storage conditions and seed handling procedures to ensure that viable seed is maintained in long-term storage. However, since long-term seed storage is over 10's to 100's of years, present-day scientists must look into the future to predict how we might set up experiments and provide materials and tools to help future scientists and seed bank curators decades or centuries from now. The *Perpetual Seed Study* is one such project. Seed from diverse species were subjected to three pretreatments (immediate storage; 6 months at 5^{o}C; 1 year at room temperature) prior to placement of the seed in three long-term storage environments (-18^{o}C; LN2 vapor; LN2 liquid). Enough seed was included in each treatment to extend the testing period beyond 50 years.

Finding: Since 2002, we have received 60 seed samples representing 27 genera for this study. In 2005, 13 seed samples from 3 genera and 9 species were received and incorporated into the Perpetual Seed Study. All active seed sites, as well as several International collaborators, have cooperated in this study. After seed has received the pre-storage conditioning it is split among the three long-term storage conditions. Viability of the seed during storage is evaluated by seed germination assays. All seed is germinated before it is placed in the long-term storage temperatures. Germination tests are repeated after one year, and periodically thereafter. As of 2005, all seed for the study has been received and initial germination tests have been completed. Approximately half of the seed accessions in the Perpetual Seed Study have been processed through the first year of post-storage testing.

Interpretations and Recommendations: Continual refinement and/or confirmation of optimum conditions for long-term seed storage are critical to the preservation of germplasm for centuries. Anticipating questions that might be asked 50 years from now is difficult, if not impossible; yet, as custodians of this germplasm, we must endeavor to provide the tools needed by future generations to answer questions regarding the consequences of long-term storage of germplasm. The Perpetual Seed Study is one such effort to provide the needed tools to the next generation.

- L. Wiesner
- D. Ellis

PRESERVATION OF VEGETATIVELY-PROPAGATED CROPS



Problem: While the primary focus of the PGRPP is the long-term preservation of crop diversity via seed, there is a large group of valuable crops which are maintained through vegetative propagation and not by seed. These crops include most fruit, nut and berry crops. These vegetatively-propagated crops are primarily maintained as field plantings that are not only very costly, but also make these crop collections very susceptible to biotic and abiotic stresses. Two methods to preserve these crops for the long-term which are not subject to the risks inherent in field plantings are to store them either in vitro as tissue cultured plants or in liquid nitrogen as cryopreserved specimens. Unfortunately, such methods have only been developed for a handful of genotypes from a few crop species. Where this initial work has been done, it allows an inroad into the long-term cryopreservation of these crops. In other cases, low temperature-subfreezing, shorter-term (6-36 month) storage methods have been developed for the safety back-up of other vegetatively-propagated crops in vitro.

Finding: PGRPP currently has 3,965 accessions of vegetatively propagated plants in storage. These include accessions both in liquid nitrogen and in shorter-term subfreezing storage. Those species in the later group of shorter-term storage include *Ipomea, Corylus, Fragaria, Humulus, Mentha, Pycanthemum, Pyrus, Ribes, Rubus* and *Vaccinium*. Active research in the liquid nitrogen storage of species continues with *Pyrus, Ribes, Rubus*, *Allium, Ipomoea*, and *Fragaria* with 72 new accessions from these species being successfully preserved in liquid nitrogen in 2005. In addition 63 *Malus* accessions were successfully placed into storage as dormant buds from field material. Finally, over 70 *Vitis* accessions are being maintained as shoot cultures and in 2005 the PGRPP had initial success with the survival of cryopreserved *Vitis* buds.

Interpretations and Recommendations: The PGRPP is making great strides in the preservation of vegetatively-propagated crops, due mostly to the continued improvement in expertise by the members of the group. As the cost of maintaining field-based repositories increases, so does the need to continue work into alternative storage methods. Although very labor intensive until preserved, these accessions need very little expense to maintain them. While the cryopreservation of these crops is important, it is viewed as a safety back-up and not a replacement for field-based collections.

- D. Ellis

PUBLICATIONS FOR PGRPP

1. Lippert, D., J. Zhuang, S. Ralph, D.D. Ellis, M. Gilbert, R. Olafson, K. Ritland, B. Ellis, C. Douglas and J. Bohlmann. 2005. Proteome analysis of early somatic embryogenesis in *Picea glauca*. Molecular and Cellular Proteomics 5:461-473.

2. Robinson, A.R., R. Gheneim, R.A. Kozak, D.D. Ellis and S.D. Mansfield. 2005. The potential of metabolite profiling as a selection tool for genotype discrimination in Populus. Journal of Experimental Botany 56:2807-2819.

3. Coleman, H.D., D.D. Ellis, M. Gilbert and S.D. Mansfield. 2006. Up-regulation of sucrose synthase and UDP-Glucose pyrophosphorylase impacts plant growth and metabolism. Plant Biotechnology Journal. (In press).