

Forest Service Access to and Use of the Germplasm Information Network (GRIN-Global) Database and Security Backup at the National Laboratory for Genetic Resource Preservation¹

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Abstract

The U.S. Department of Agriculture Forest Service (USDA FS) National Seed Laboratory (NSL) began long term seed storage for genetic conservation, in 2005, for USDA FS units and cooperators. This program requires secure storage of both seeds and the data documenting the identification of the seeds. The Agricultural Research Service (ARS) has provided both of these services to the USDA FS through the NSL. Security backup, of all samples, is provided at the ARS National Laboratory for Genetic Resource Preservation. Forest Service seed sample data is stored in the Germplasm Resource Information Network (GRIN-Global).

Introduction

Successful genetic conservation of native trees through most of United States history has been through care of the natural forest and by maintaining broadly adapted sources for reforestation seedlings. In recent decades, that strategy has been stressed by catastrophic wild fires, climate change, and exotic invasive pests and diseases such as emerald ash borer (*Agrilus planipennis*) and white pine blister rust (*Cronartium ribicola*). Now, the World Conservation Union estimates that one in three plant species in the United States is threatened with extinction. Because losses of genetic resources were occurring faster than could be addressed by ongoing programs, conservation strategies have been expanded to include long term seed storage. This approach permitted for a relatively rapid response to changing conditions as long as species possessed seeds that met the requirements for long term storage and a seed crop was available. Fortunately, most North American trees and other native plants meet these requirements and do have seeds that are desiccation tolerant and are capable, following an adequate drying period, of remaining alive in freezer storage for decades. The administration of a long term seed storage program requires a seed laboratory facility which can test the seeds for viability prior to storage and at periodic intervals during storage to make sure the resource is remaining alive and to determine when stored seeds might need replacement or regeneration. The U.S. Department of Agriculture Forest Service (USDA FS) National Seed Laboratory (NSL) is the only national facility in the USDA FS with capability to perform this work. Therefore, long term seed storage for genetic conservation was formally added to the NSL mission by the Chief of the USDA FS, in 2005. As part of that mission, it was necessary to partner with the USDA Agricultural Research Service (ARS), National Plant Germplasm System (NPGS) for access to the National Laboratory for Genetic Resource Preservation (NLGRP) security backup of seed collections and the Genetic Resources Information Network (GRIN-Global) database in which all the conserved seed collections could be documented and displayed for potential users of the seed lots. This paper describes how samples can be submitted at the NSL, what data is entered into the GRIN-Global data base, and how to access information on samples held in the USDA FS collection. All USDA FS units and cooperators can submit samples for preservation. A material transfer agreement, renewable at 5 year intervals, defines

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the relationship of the NSL and the NLGRP. Seed samples remain the property of the USDA FS or the cooperator even though they are entered into the GRIN-Global database and a security backup sample is placed in the ARS storage vaults. The NSL is responsible for all maintenance activities such as periodic testing, sample distribution, and any increase of seeds in the event that viability begins to decrease.

Organization

The NPGS is part of the ARS in the USDA. It is composed of over 25 clonal and seed repositories and maintains over 500,000 accessions. These materials are made available for research and breeding on crop plants. As all crop plants have relatives in the wild, wild plants are also an important part of these collections. The efforts are a cooperative work among state, federal, and private organizations. To document the collections of plant materials and communicate the status and availability of the collections, the GRIN-Global was created. This database is the primary vehicle through which the NPGS interacts with the international germplasm community and the scientific public.

The collection of plant resources is divided into two parts. The first is working collections from which propagules are distributed to breeders and researchers. The second mirrors the working collection by holding a duplicate of what is in the working collections in secure facilities. This second part is called the security backup. This security backup is held at the National Laboratory for Genetic Resource Preservation at Fort Collins, Colorado.

The USDA FS has access to the database and the security backup facility and in turn makes them available to conservation communities. The USDA FS brings to the partnership an extensive network of contacts as well as the unique expertise and capacity of the NSL for quality testing of wild plant seeds and preparing them for storage. The NSL also has extensive history in sharing forest tree germplasm, having been a central point of contact to distribute seeds to international forest scientists since 1972. The USDA FS manages and conserves approximately 780,000 km² (193 million ac) of wild plants and assists in managing many millions more of private forests. Therefore, the agency brings an enormous working collection of plant material to the NPGS.

Genetic Resource Information Network (GRIN-Global)

GRIN-Global is a flexible, open source information management system designed to enable genebanks to store and manage germplasm information and deliver that information globally. The USDA ARS Database Management Unit at Beltsville, Maryland maintains and enhances the GRIN-Global.

The flexibility of GRIN-Global allows genebanks to tailor the system for optimum performance. The system is made up of multiple tables. Each table has required fields but you can add as much optional information as needed to adequately describe your accession. Typically, the USDA FS stores taxonomy data, collection id, material type, origin of sample, latitude and longitude, habitat, cooperator data, viability and inventory (number of seeds).

The Public Website - Requesting Seeds

Many types of information are available from the GRIN-Global public website, including a wealth of information on taxonomy, rare and endangered plants, and noxious weeds. It is also here that queries are made to find what materials are being curated in the NPGS. Simple searches allow the user to enter search criterion, such as a species name, in the search box. To view materials curated by the NSL it is necessary to check the block for “historic” and “unavailable.” More complex searches can be used to restrict the query by more than one criterion. Again, it is necessary to check the block for “historic” and “unavailable” in order to view materials curated by the NSL. The link to the query page is: <https://npgsweb.ars-grin.gov/gringlobal/search.aspx>? To perform a complex search follow the “Advanced Search Criterion” link found on the simple search page. Contact the NSL at 478-751-3552 for information on entering material into GRIN-Global or assistance in searching the GRIN-Global database.

Accession Information

As of December 31, 2016, the NSL long term seed storage program list 7,600 accessions, 37 genera, 107 taxa of 103 species. The full list of the accessions can be viewed at <https://npgsweb.ars-grin.gov/gringlobal/site.aspx?id=32>. Figure 1 shows five at-risk genera preserved in the program, and for each genus, its proportion of the total.

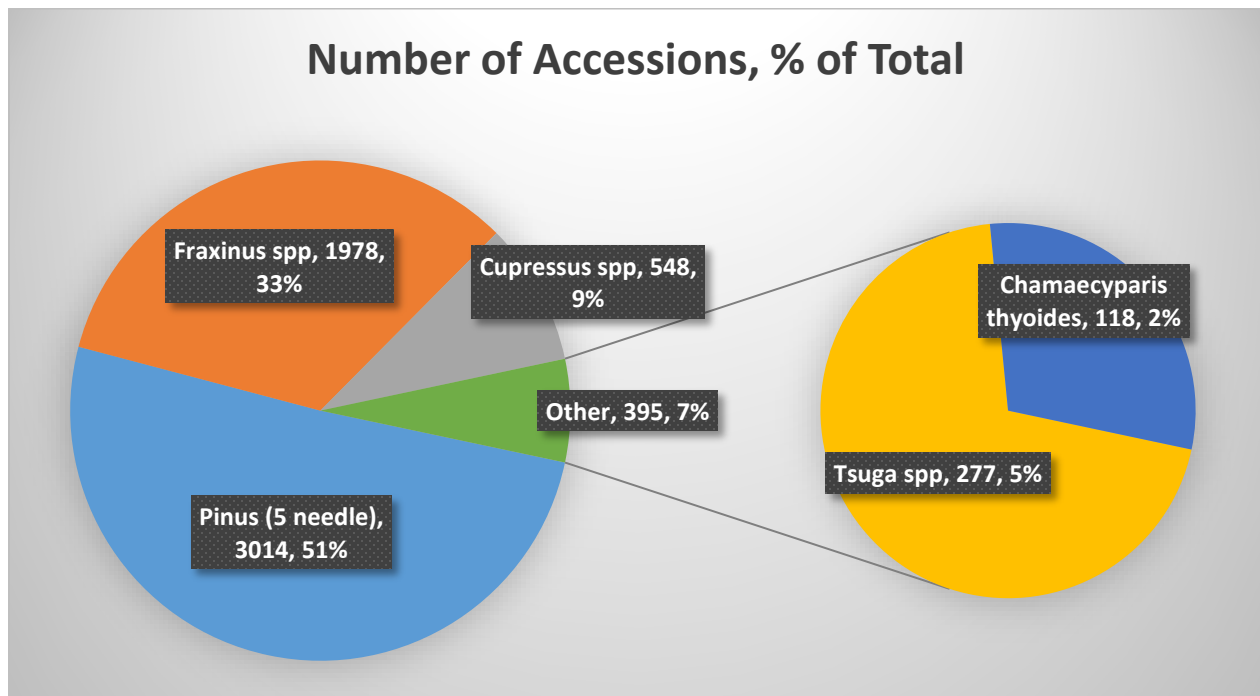


Figure 1—The five most collected genera in the National Seed Laboratory long term seed storage program.

The total number of tree accessions is 7437. The herbaceous accessions number 163. A tabulation of tree species and the number of accessions in the NSL long term seed storage program follows:

Species	Accessions		
		<i>Picea breweriana</i>	8
<i>Pinus albicaulis</i>	1032	<i>Pinus nigra</i>	8
<i>Fraxinus americana</i>	838	<i>Pinus peuce</i>	8
<i>Fraxinus pennsylvanica</i>	759	<i>Cupressus abramsiana</i> subsp.	6
<i>Pinus lambertiana</i>	732	<i>butanoensis</i>	
<i>Pinus longaeva</i>	441	<i>Pinus parviflora</i>	6
<i>Pinus sylvestris</i>	441	<i>Robinia pseudoacacia</i>	6
<i>Pinus flexilis</i>	429	<i>Pinus elliottii</i>	5
<i>Pinus ponderosa</i>	405	<i>Pinus strobus</i>	5
<i>Pinus pungens</i>	290	<i>Fraxinus</i> spp.	4
<i>Fraxinus nigra</i>	276	<i>Ulmus pumila</i>	4
<i>Tsuga canadensis</i>	222	<i>Juniperus</i> spp.	3
<i>Pinus monticola</i>	148	<i>Pinus densiflora</i>	3
<i>Pinus strobiformis</i>	147	<i>Pinus pumila</i>	3
<i>Chamaecyparis thyoides</i>	118	<i>Pinus virginiana</i>	3
<i>Cupressus macnabiana</i>	104	<i>Juniperus communis</i>	2
<i>Pinus balfouriana</i>	85	<i>Juniperus oxycedrus</i>	2
<i>Fraxinus profunda</i>	80	<i>Pinus ayacahuite</i>	2
<i>Juniperus scopulorum</i>	74	<i>Pinus hartwegii</i>	2
<i>Cupressus sargentii</i>	71	<i>Pinus nigra</i> subsp. <i>Laricio</i>	2
<i>Cupressus abramsiana</i>	70	<i>Pinus nigra</i> subsp. <i>Pallasiana</i>	2
<i>Pinus cembra</i>	66	<i>Juniperus macrocarpa</i>	1
<i>Cupressus guadalupensis</i> var. <i>forbesii</i>	60	<i>Juniperus phoenicea</i>	1
<i>Tsuga caroliniana</i>	55	<i>Pinus arizonica</i> var. <i>cooperi</i>	1
<i>Pinus palustris</i>	33	<i>Pinus douglasiana</i>	1
<i>Pinus echinata</i>	30	<i>Pinus engelmannii</i>	1
<i>Cupressus arizonica</i> var. <i>nevadensis</i>	29	<i>Pinus greggii</i>	1
<i>Fraxinus quadrangulata</i>	25	<i>Pinus nigra</i> subsp. <i>nigra</i>	1
<i>Cupressus pigmaea</i>	21	<i>Pinus patula</i>	1
<i>Pinus taeda</i>	18	<i>Pinus pseudostrobus</i>	1
<i>Juniperus virginiana</i>	16	<i>Pinus roxburghii</i>	1
<i>Pinus clausa</i>	10	<i>Pinus tabuliformis</i>	1
<i>Pinus rigida</i>	10	<i>Pinus teocote</i>	1
<i>Pinus resinosa</i>	9	<i>Taxodium distichum</i>	1

Conclusion

In the 11 years since the establishment of the NSL long term seed storage program, large numbers of seed lots have been placed into security backup and recorded in the GRIN-Global for centralized and accurate communication of the progress. The database is well-suited to the needs of the NSL and it is well maintained. Some distributions, to researchers, have already been made. The centralized nature of GRIN-Global has made data on conservation efforts very easy to share among USDA FS offices and users.