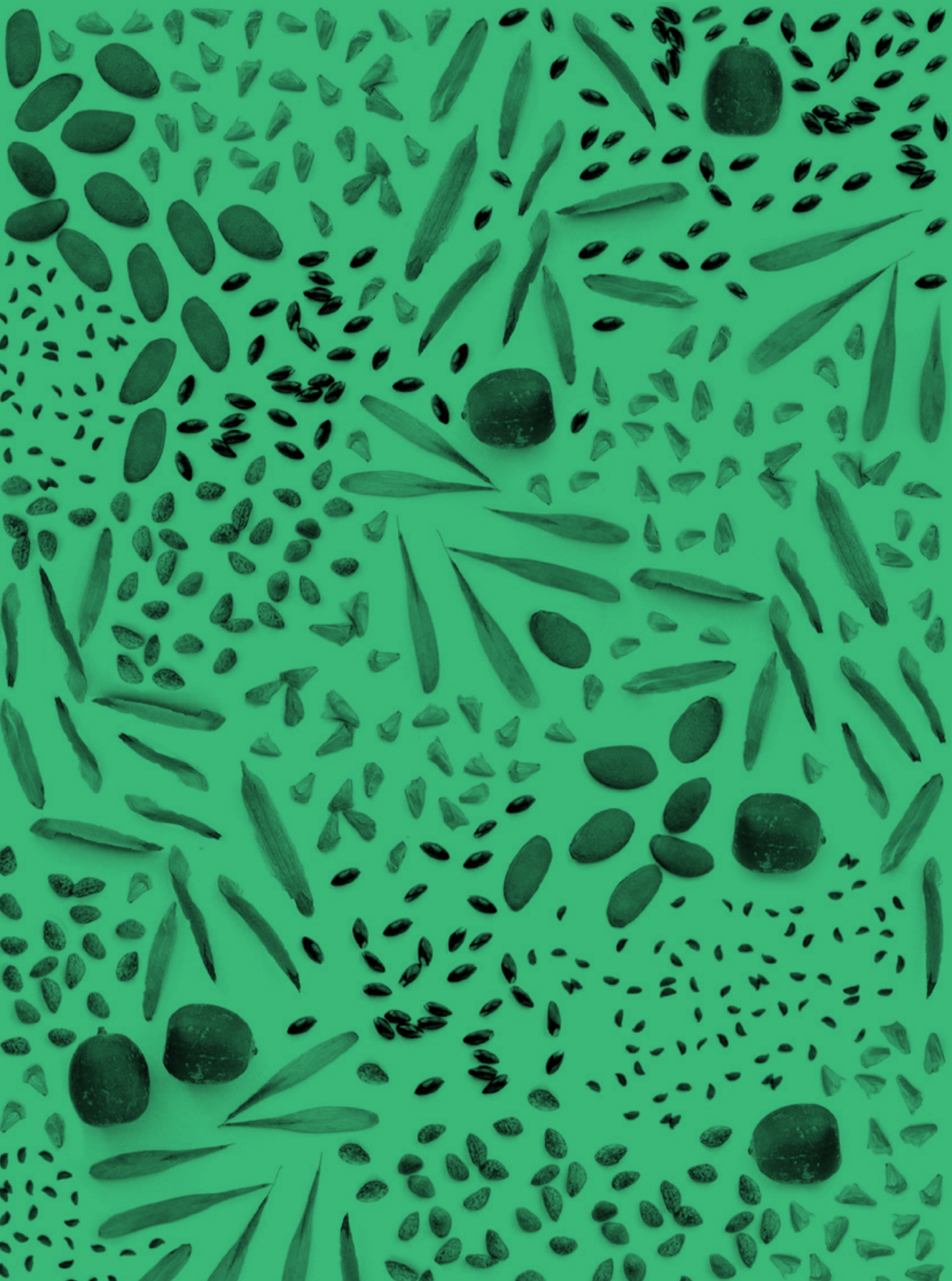
National Seed Laboratory Report 2005–2009



National Seed Laboratory Report 2005–2009

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United States
Department of
Agriculture

United States
Forest Service

All photos credited to the National Seed Laboratory

Introduction

History

The Forest Service National Seed Laboratory (NSL) has its roots in the early days of forest restoration. CCC crews planted conifer seedlings on millions of acres of abandoned farmland in the 1930's. Phil Wakely, a scientist at the Forest Service (FS) research station at New Orleans LA, wrote a seminal book on the germination of the seed used to grow these seedlings. WWII interrupted the work but it was resumed at the FS nursery in Brooklyn MS in 1952 using Wakely's methods. In the fall of 1954, the laboratory moved to the Georgia Forestry Commission (GFC) campus in Macon GA under a cooperative agreement with the GFC. This was the first of many close associations with user groups that proved essential to restoration efforts. FS silviculture and genetics research also came to the same location, resulting in a strong technical center for forest restoration.

In 1958, the soil bank, another major conservation program, required an additional expansion of the laboratory. The need for seed technology services and the lack of them from any other source resulted in continued growth of the laboratory. In 1964 the name of the laboratory changed from the Region 8 Seed Laboratory to the Eastern Tree Seed Laboratory (ETSL), because clients were now coming from the whole Eastern half of the nation. International seed exchange was added to the duties of the ETSL in 1972 as a service to FS research. Assistance to western nurseries led to sharp increases in testing and the laboratory evolved into the National Tree Seed Laboratory in 1979. Manual direction and funding at the national level by all Forest Service branches began in 1981. Additionally laboratory staff actively participated in international organizations (International Seed Testing Association, International Union of Forest Research Organizations) and received many international visitors and trainees. The laboratory was firmly established as a nationally and internationally recognized facility for global reforestation by 1980.

Tree planting reached all time historical highs through the 1980's because of the conservation reserve program and a strong timber program on the National Forests. Through providing seed technology, the laboratory assisted in reforestation throughout the United States.

Present

Interest in non-timber native plants and hardwoods began to grow in the 1990's. Following these increasing demands in ecological restoration, the lab began to work with non-timber native plants. A 2004 review of the lab led to a new mission from the Chief of the Forest Service. The mission is to provide seed technology to restore all native plants on our forests and rangelands. The name of the lab was changed to the Forest Service National Seed Laboratory to reflect the wider mission.

There are 4 major parts to the mission:

1. **technology transfer and technical assistance,**
2. **development of seed handling protocols,**
3. **testing seeds for nurseries and seed dealers,**
4. **conservation of natural genetic resources through long term seed storage.**

An advisory group was formed in 2005 to assist the lab in implementing this new mission. The group provided 4 main points and assisted in writing a strategic plan. The four main points are:

- The NSL needs to become more relevant to all appropriate FS personnel and partners.
- The future role for the advisory group needs further definition
- The NSL should provide leadership in international seed exchange and genetic conservation.
- The NSL needs to provide leadership in seed technology development and transfer.

The strategic plan contained 6 primary points or drivers for seed lab activities.

- Develop seed technology protocols required for restoration.
- Assist the organization and execution of gene conservation and species recovery plans.
- Provide transfer of seed technology to native seed and plant producers.
- Collaborate with other Forest Service offices, federal agencies, state agencies, NGO's, other entities engaged in restoration.
- Address international seed issues.
- Develop and Execute Operating Guidelines (for the laboratory).

IMG. 1: EQUILIBRIUM RELATIVE HUMIDITY TESTING TO PRESERVE SEED VIABILITY IS ONE OF THE LATEST TECHNOLOGIES BEING DEVELOPED AND TRANSFERRED BY THE NSL.

IMG. 2: NSL PRESENTS MANY HANDS-ON WORKSHOPS WHERE SEED WORKERS CAN LEARN HOW TO PROPERLY HANDLE NATIVE PLANT SEED.

Mission Accomplishments

Technology Transfer and Technology Assistance

The NSL is well known as a source of both group and individual training. Hands-on seed workshops are provided from 2 to 8 times per year at various locations throughout the US. The lab staff actively participates at professional meetings and regularly publishes technical articles to provide needed information on seeds. From 2005 through 2009 22 workshops were presented, 18 persons received individual training, 12 oral and poster presentations were made at meetings, 65 meetings were attended to establish contacts and plan work, and the Woody Plant Seed Manual (USDA Agricultural Handbook 727) was completed. A website is also maintained to provide seed lab specific resources (http://www.nsl.fs.fed.

IMAGE 1

IMAGE 2

us). When new technologies for seed emerge they are tested and introduced to the native plant community. Many NSL innovations can be found in native seed cleaning facilities across the country. The most recent example is the use of equilibrium relative humidity (ERH) for managing seed moisture in native seeds for storage. It is inexpensive, fast, easy to use, more versatile than previous methods, and non destructive. Seed at high moisture can die or decrease in germination and consequently value within a few months. Therefore, the native seed trade is eagerly adopting this technology to manage the seed inventories and protect their investment and increase the profitability of their businesses. Seed inventories worth many millions of dollars are at risk without good moisture management.

Protocol Development

New technologies and new species for restoration necessitate development of new protocols. Most native plants are produced from seed. Therefore the collection, cleaning, germination, and storage protocols have to be determined before seed can be provided and used for seeding or seedling production. Preliminary protocols have been developed for 37 understory species from the longleaf ecosystem, 15 species from the great basin ecosystem, and 6 from the tall grass prairie ecosystem. These protocols can now be used to guide development work in seed source studies, seed increase, and pilot scale restoration work. Ultimately, official rules will be introduced into the Association of Official Seed Analysts Rules for Testing Seeds. These rules are used for the orderly marketing of seeds within the United States and are indispensible to developing a profitable native seed industry.

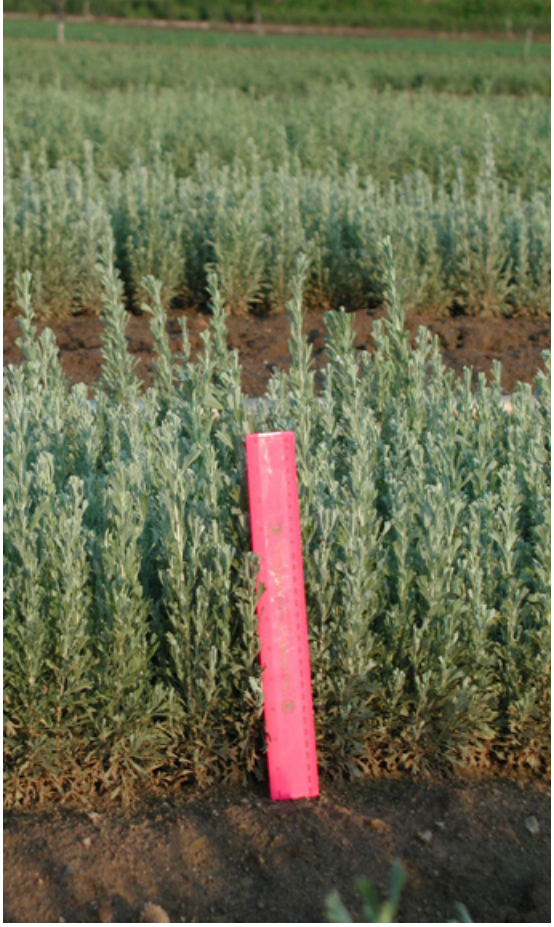

IMAGE 3

IMAGE 4

SEEDLINGS OF WYOMING BIG SAGEBRUSH (ARTEMISIA TRIDENTATE NUTT. SSP. WYOMINGENSIS BEETLE & YOUNG) (IMG. 3) ARE RAISED FROM SEEDS (IMG. 4). SEEDLING PHOTO CREDIT NANCY SHAW, USDA FOREST SERVICE BOISE, ID.

The collection, cleaning, germination, and storage protocols have to be determined before seed can be provided and used for seeding or seedling production.

Seed Testing Services

IMAGE 5

Fee for service seed testing is still important work at the NSL, especially to the tree and shrub sectors of the native plant industry. The impact of this service is an efficiently running seed industry and efficient more predictable production of seedlings for reforestation and restoration. Native seeds frequently sell for $100 to $200 per pound. The specific selling price is determined by the germination and purity test results. The impact of an inaccurate test can be seen in the following. A 10% underestimate of seed germination could cost the seed seller $10 to $20 per pound. In even a modest sale volume of 10,000 pounds this loss becomes $100,000 to $200,000. The losses could also occur to the buyer if the germination were overestimated. These are only the losses directly relating to seed costs. There would be further losses down the line in under stocked stands, lost site preparation costs, or insufficient seedling supplies. State and private labs test native plant seeds. However, the financial incentives are not strong enough to build sufficient capacity in these labs that would allow the NSL to totally withdraw from the testing service. This service also allows for a closer link with clients for technology transfer.

IMAGE 6

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IMG. 5: SEEDS OF LOMATIUM GRAYI (J.M. COULT. & ROSE) J.M. COULT & ROSE SPROUTING IN A GERMINATION PROTOCOL TRIAL.

IMG. 6: MANY NATIVE PLANT SEEDS ARE TOO SMALL TO SEE WITHOUT THE AID OF A MICROSCOPE.

Genetic Conservation

Many native plants are at risk of loss in the wild or having a significant amount of their genetic diversity lost. The causes of this are rarity of plants, climate change, or invasive exotic insects or diseases. One economical and effective strategy to preserve genetic resources of these plants is long term seed storage. Seeds placed in storage can then be used to do resistance breeding, study modes of resistance, develop propagation protocols, or be used directly in restoration of wild populations. The following groups are currently going into long term seed storage: 1) Ash from many of the populations most at risk from the emerald ash borer 2) Five needle pines being lost to blister rust, and 3) G1 and G2 plants from the National Forests. (Notes: G1 and G2 plants are the rarest plants globally as determined by the rating system of Nature Serve. Both the emerald ash borer and white pine blister rust are invasive exotics from Asia.) The species stored are selected by consulting with pathologists, entomologists, geneticists, and botanists. Seed is stored directly by the NSL for distribution and also with the Agricultural Research Service (ARS) National Center for Genetic Resource Preservation for security backup in the event that the working collections at the NSL should be lost. All seed lots are cataloged in the ARS Genetic Resource Information Network (GRIN). GRIN is a central database that lists all genetic resources protected and available from the federal government.

IMAGE 7

IMG. 7: THE SEEDS PRODUCED BY WILD FLOWERS ARE ALSO COLLECTED FOR GENETIC PRESERVATION.

IMG. 8: SEEDS OF WHITE ASH (FRAXINUS PENSYLVANICA MARSH.) COLLECTED FOR GENETIC PRESERVATION.

IMG. 9: CONES FROM 5 NEEDLE PINES, ALSO CALLED WHITE PINES, ARE COLLECTED TO EXTRACT SEEDS FOR GENETIC PRESERVATION.

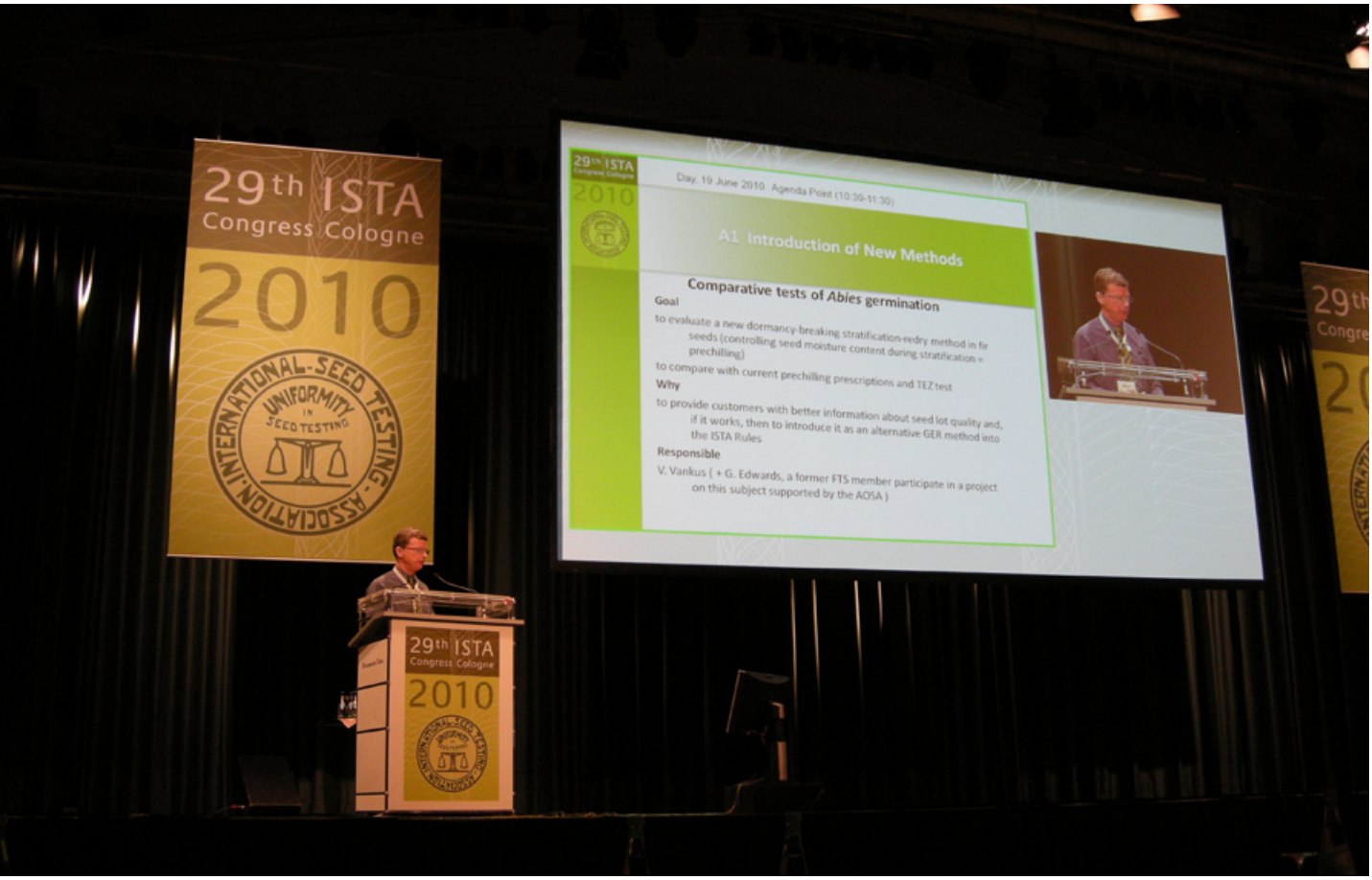
IMAGE 8

IMAGE 9

International Participation

The NSL represents the US government in two international forums. The first is the International Seed Testing Association (ISTA) and the second is the Forest Reproductive Materials Scheme in the Organization for Economic Cooperation and Development (OECD). When seeds are traded internationally they need to be tested for quality (e.g. germination). ISTA is the international forum for setting these rules. NSL participation in ISTA assures US interests are represented as these international standards are formulated and that US companies will be prepared to make international seed sales. ISTA is also a good source for learning of emerging seed technologies.

The OECD scheme establishes standards to guarantee the genetic identity of the seeds traded. **By ensuring the genetic identity of the seeds the buyers can be reasonably certain they are acquiring materials that will be adapted to the planting site.**



IMG. 10: LABORATORY DIRECTOR MAKING A PRESENTATION AT 29TH CONGRESS OF THE INTERNATIONAL SEED TESTING ASSOCIATION.

The Seed Analysis Workload Indiates a National Program

Seed analysis is the testing of seeds to determine their quality and suitability for various purposes. This involves geminating seeds, determining their purity, their weight, and so forth. All the functions of the NSL involve seed analysis and, therefore, the summary of seed testing work at the lab provides a good view of the status of the lab. Chart 1 shows that over the last 5 years the demand for protocol development and genetic conservation has grown to account for about 45% of all seed tests. According to the data in chart 2, a majority (about 65%) were for concerns in the south in 2005, but by 2009 the work was more balanced geographically with 30% of all tests from the north, 25% from the west, and 45% from the south. The same pattern is seen in the division among ownership sectors (chart 3). In 2005, 60% of all tests were for private concerns. In 2009, the private sector had reduced to 40% while the federal sector increased to about 50%; the state sector remained at about 10%. Taken together, these three charts show a program balanced in its service to ownership sectors and geographic regions with a growing demand for the new emphasis on protocol development and genetic conservation.

Tests by Lab Function

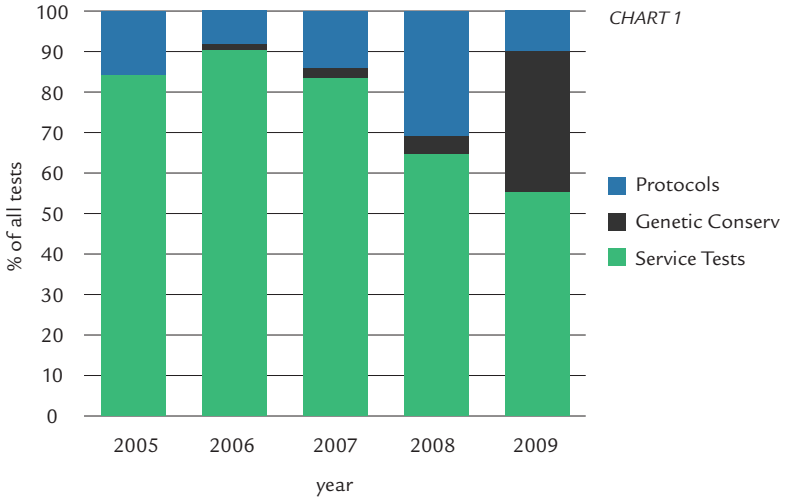


CHART 1

National Distribution of All Tests

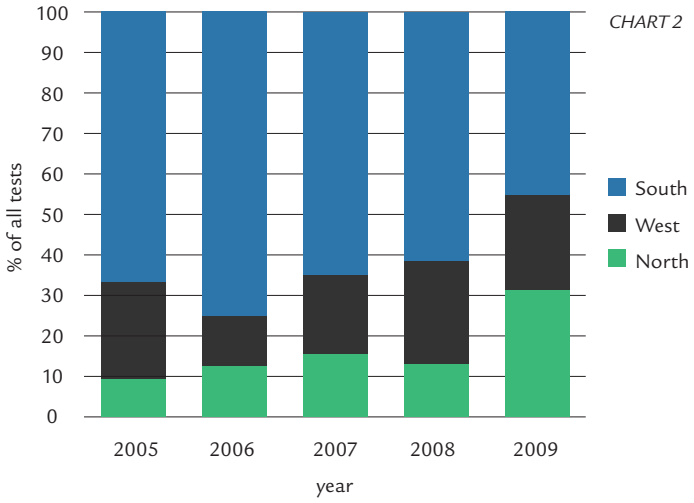


CHART 2

Distribution of Tests Among Sectors

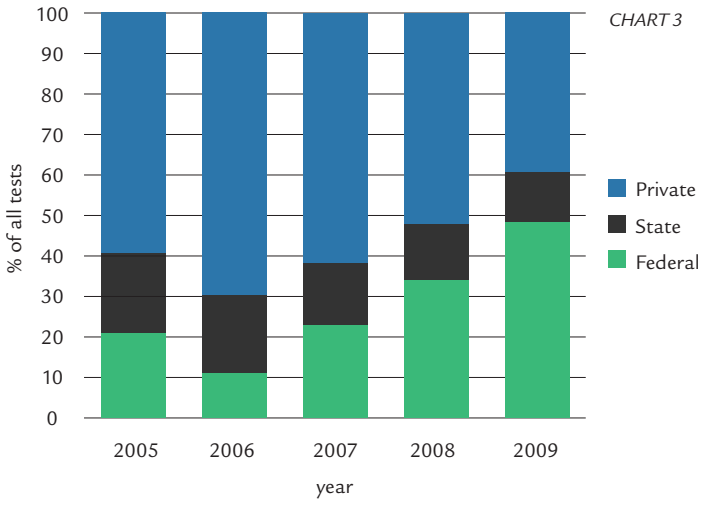


CHART 3

CHART 1: THE DIVISION OF SEED ANALYSIS AT THE NSL AMONG MISSION FUNCTIONS

CHART 2: THE DIVISION OF SEED ANALYSIS AT THE NSL AMONG GEOGRAPHIC REGIONS.

CHART 3: THE DIVISION OF SEED ANALYSIS AT THE NSL AMONG OWNERSHIP SECTORS.

USDA Nondiscrimination Statement