Project Number: S-009

Project Title: Plant Genetic Resources Conservation and Utilization

Period Covered: 08/2010 through 8/2011

Date of this Report: September 27, 2011

Annual Meeting Dates: August 2-3, 2011

Participants: www.ars.usda.gov/Main/docs.htm?docid=9514

Minutes: www.ars.usda.gov/Main/docs.htm?docid=9514

Accomplishments and Impacts:

USDA – Plant Genetic Resources Conservation Unit

Plant genetic resources collected or obtained from throughout the world are valuable sources of genetic diversity for use in agronomic and horticultural crop improvement programs in the U.S. This project forms part of a comprehensive nationwide program, National Plant Germplasm System, to preserve plant genetic resources for use today and for use by future generations. The primary objectives of this project are 1). To conserve genetic resources and associated information for a broad spectrum of crops and related species; 2). To develop and apply new or improved evaluation procedures and marker-based approaches to assess diversity of genetic resources in the collections and evaluate materials for useful traits; and 3). To transfer technology to researchers and plant breeders in the Southern Region and worldwide in the form of plant genetic resources and associated information. Seed and clonal genetic resources acquired, maintained, characterized, evaluated, documented, and distributed by this project will provide researchers with a broad range of clearly-identified crop genetic diversity to utilize. This broad genetic diversity enables research programs to efficiently produce new cultivars, develop new knowledge, discover value-added uses, and preserve food security for the general public.

The germplasm collection at Griffin, Georgia has increased to 90,942 accessions of 255 genera and 1,534 species. In 2010, a total of 28,308 seed, tissue culture, and clonal accessions were distributed to researchers and educators at universities, private companies, agricultural and medical research foundations, seed conservatories, federal agencies, farmer-owned cooperatives, and foreign universities and companies. All accessions were requested from the Griffin location directly by researchers and distributed in 925 orders to users in 49 states and 47 foreign countries. Genetic resources maintained at the Griffin location are in great demand by the research community and provide a valuable resource for crop improvement research. The quantity and quality of plant genetic resources maintained at Griffin makes this location one of the leaders in the National Plant Germplasm System.

Biosecurity and availability of plant genetic resources are of major concern to the U.S. agricultural research community. Backing up germplasm by maintaining accessions at two sites reduces the risk of losing valuable germplasm. In the last year, 97.1% of the accessions are backed up at the National Center for Genetic Resource Preservation, Ft. Collins, CO and 87.7% of the accessions are available for use by the research community. Additionally, 8% of the
collection is also backed up at the Global Seed Bank in Svalbard, Norway. Backing up safely secures these plant genetic resources for future use by researchers and good availability provides users with a wide array of currently available germplasm.

**Vigna:**
Roy Pittman, Plant Genetic Resources Conservation Unit, served as the Vigna curator. Cowpea regeneration was conducted in the field and greenhouse in 2010. A total of 30 lines were increased in the greenhouse in Griffin, 49 lines were increased in the field, and 52 lines were increased in Puerto Rico. Digital images of seeds and flowers were taken on regeneration plants. These images are posted on GRIN for use by breeders and other researchers.

**Peanut:**
Seed increases were conducted for 299 cultivated peanut accessions by Noelle Barkley, Plant Genetic Resources Conservation Unit, grown for regeneration at three locations in Georgia and Florida. About 270 clonal accessions of 38 *Arachis* species were maintained in the greenhouse. The high oleic trait in peanut is an important seed quality trait caused by two key mutations in the ahFAD2 gene. The nine genotypes that can be produced by crossing normal oleic to high oleic peanuts have never been characterized because there was not a method developed to track all possible genotypes and link them to each phenotype. Therefore, a method was developed to detect all genotypes and the resulting phenotype (fatty acid composition) of each possible genotype was quantified in 500 individuals. Being able to detect all possible genotypes can now expedite the breeding process by allowing unwanted characteristics to be purged from the population at early stages and only maintaining and evaluating the plants with the desired traits. Additional studies demonstrated that high quality DNA can be obtained from non-viable seeds in wild and cultivated peanuts. The extracted DNA can be successfully used to reveal differences among individuals. This study showed that non-viable seed can be successfully used in molecular research.

**Grasses:**
The warm-season grass germplasm collection was improved over the past year by Melanie Harrison-Dunn, Plant Genetic Resources Conservation Unit mainly through acquisition, regeneration, and characterization efforts. A total of 46 accessions representing 27 species of warm-season grasses were successfully regenerated. Descriptor data was collected and uploaded to GRIN for all regenerated accessions. Flower image data was collected and added to GRIN for the warm-season grass clonal collection including St. Augustine and zoysia grasses. Plant breeders need to know the number of chromosome sets or ploidy level of accessions in order to produce fertile or sterile progeny. The ploidy level and salt tolerance of the entire U.S. seashore paspalum collection of 64 accessions was determined. The ploidy level and salt tolerance data will enable plant breeders to efficiently use the proper accessions within their breeding program. The clonal collection of 348 accessions was maintained in the greenhouse.

**Clovers, New Crops, Misc. Legumes, and Misc. Crops:**
A total of 218 self-pollinated legumes, 37 cross-pollinated legumes, and 47 castor, sesame, and other misc. crops were regenerated in the field at Griffin by Brad Morris, Plant Genetic Resources Conservation Unit. An additional 40 winged bean and Leucaena accessions were increased in St. Croix. A total of 25 self-pollinated legumes and 11 Hibiscus accessions
were regenerated in the greenhouse. A total of 41 self-pollinated and 27 cross-pollinated annual clover accessions were regenerated in the field in Byron, GA, and 30 self-pollinated annual clover accessions were regenerated in the greenhouse by Gary Pederson, Plant Genetic Resources Conservation Unit.

Plant accessions need to have not only high oil content, but proper fatty acid content to be utilized for biodiesel production. Oil content had previously been determined for the entire U.S. sesame and castor bean collections. ARS researchers at Griffin, GA, identified a sesame accession with both high oil and high oleic acid content, and a castor bean accession with high oil content and desirable fatty acid composition. These accessions will be useful for researchers developing crop cultivars suitable for biodiesel production from these plant species.

Regeneration of *Neonotonia wightii* and *Teramnus labialis* was conducted in a greenhouse due to their photoperiod sensitivities. A total of 19 *N. wightii* and *T. labialis* accessions were successfully regenerated in a greenhouse during the offseason (November – April). Quality seed are now available for customers to use in their research projects.

Little data regarding flavonol, mineral, anthocyanin index, and fatty acid variability in the U.S. horsegram, roselle, and velvetleaf collections are available. Significant variation for several flavonols, fatty acids, minerals, and anthocyanin indexes were found in 18 horsegram, 13 roselle, and 42 velvetleaf accessions. These accessions can now be used by breeders or other scientists in the development of new products containing these flavonols, fatty acids, minerals, and anthocyanin indexes.

**Sorghum:**

Gary Pederson is currently serving as acting sorghum curator. Regeneration of sorghum accessions in St. Croix and Puerto Rico continued in coordination with ARS cooperators, Ricardo Goenaga and Alfredo Quiles. A total of 1,680 accessions were sent to St. Croix for regeneration in 2010 and seed from regenerations of 1,661 accessions has been sent to Griffin. In addition, a total of 90 boxes of sorghum seed from past regenerations conducted by John Erpelding in Puerto Rico was shipped to Griffin for incorporation into the sorghum germplasm collection. These seeds came from low germination or low seed number accessions that could not be regenerated under normal field conditions in St. Croix or Puerto Rico as well as sorghum accessions that John utilized in his research program. These materials are under evaluation and will be added to the sorghum collection if needed.

**Vegetable Crops:**

Bob Jarret, Plant Genetic Resources Conservation Unit, regenerated 60 accessions of the *Capsicum* spp. (chile pepper) germplasm collection in the field and greenhouse and characterized an additional 120 chile pepper accessions. Also, 30 accessions of other vegetable crops were regenerated. More than 750 accessions of sweetpotato were maintained in tissue culture.

Watermelon (*Citrullus* spp.) is cultivated primarily in Africa for its use as an oil seed crop with oil having industrial and nutritional value. Evaluations were conducted on more than 1,000 accessions of various watermelon species for total oil content using nuclear magnetic resonance (NMR). Data indicated that total oil content varied from approximately 14% to >40%. Seed of egusi-type melons were notably higher in oil content than other types. This information will enable researchers to select watermelon accessions with potential for use as an oil seed crop.

The sensory attributes (chemical composition) of vegetables can be an important factor in determining consumer acceptance and demand. The genetic basis for the preferential synthesis
of capsiate rather than capsaicin was investigated in a mutant line of chile pepper (*Capsicum annuum*). Capsiate is a non-pungent analog of capsaicin with documented medicinal properties. Data indicated that the mutation is inherited as a single recessive gene. Portions of the gene were sequenced and the mutate allele characterized. This information will be of benefit to those developing pepper lines or varieties enhanced for either of these compounds.

**Molecular and Analytical Evaluations:**

Ming Li Wang, Noelle Barkley, and others, Plant Genetic Resources Conservation Unit, developed a genotyping assay using a real-time polymerase chain reaction to detect alleles relating to the high oleic acid trait in peanuts. This assay enables breeders to test seed or leaf tissue in initial crosses without using chemical analysis of ground up seeds. Development of this rapid assay will help identify key genotypes linked to important agronomic traits, improve breeding efficiency by eliminating undesirable plants, and expedite the process of developing improved peanut cultivars by decreasing the time and effort to characterize all of the generated progeny.

In collaboration with National Peanut Research Laboratory (USDA-ARS), a total of 84 DNA markers have been used for genotyping the U.S. peanut mini-core collection. Seeds from two years of the mini-core collection have been analyzed for flavonoids, resveratrol, fatty acids and oil content. Data for morphological traits (including disease resistance, botanical descriptors and pod-market type) have been collected for two years. The data for association analysis is in progress and results will be reported.

Okra (*Abelmoschus* spp.) is an oil seed crop that is known to produce oil yields with chemical properties similar to those of cotton seed. More than 1,200 accessions of various okra species were evaluated for total oil content using nuclear magnetic resonance (NMR). Data indicated that total oil content varied from approximately 4% to >21% and that it was loosely correlated with seed weight. This information will enable researchers to select okra accessions with potential for use as an oil seed crop.

Oil content for biodiesel production among the castor bean accessions in the U.S. collection is unknown. Significant variation in oil content (ranging from 37 to 61%) was found in 1,033 castor bean accessions. Selected castor bean accessions with high oil content can now be used in variety development for use as a biodiesel crop.

**Germplasm Maintenance:**

Prior to 2002, seed samples of over 84,000 accessions of plant genetic resources maintained at the Griffin location had not been tested for germination and the quality of seed distributed to researchers was not known. A concentrated effort was made to conduct germination tests on this large collection. Currently germination tests have been completed for almost 70,000 accessions including almost all accessions of pepper, watermelon, eggplant, mung bean, sesame, pearl millet, and castor bean and 48-86% of all accessions of sorghum, okra, annual clovers, peanuts, and misc. legumes. This germination testing enables curators to properly identify accessions with poor quality seed that need to be regenerated resulting in better quality seed being distributed to researchers upon request.

In 2010, a total of 3,023 accessions were sent for safety back up to Ft. Collins and 2,158 accessions were sent to the global safety backup vaults at Svalbard, Norway. The program continued to split seed samples of all accessions at Griffin with a small distribution sample maintained at 5 C and the bulk of each sample maintained at -18 C to maximize seed longevity.
Currently, almost 75% (almost 67,000 accessions) of the entire collection has at least one sample in -18 C storage.

Two breeders’ germplasm collections were obtained recently and are currently being evaluated for possible addition to the Griffin collection. The University of Kentucky donated Dr. Norman Taylor’s clover collection to NPGS as a special collection and the annual clovers in this collection will be added to the Griffin collection. The University of Florida donated Dr. Al Kretschmer’s tropical legume collection to NPGS. This collection contains tropical legumes, Vigna, and clover accessions that will be added to the Griffin collection.

Alabama

Legumes: Forage and Cover Crops
Current work focuses on evaluation, utilization and breeding of sunn hemp and sericea lespedeza species. Sunn hemp germplasm has been used for development of cultivars for the continental US. These cultivars can be used as fodder and as cover crops. Sericea lespedeza is being evaluated for control of gastrointestinal parasites in ruminants and for condensed tannin content. A new low-growing sericea lespedeza will be evaluated for road-side use. Evaluations are being done in cooperation with colleagues at Auburn, GA, LS, AR, and USDA at several locations.

Upland cotton
Current work focuses on evaluation, utilization and breeding of upland cotton. Cotton accessions continue to be evaluated for resistance to heat and drought. We have fine-tuned our evaluation process, and have been able to get repeatable results for increased resistance to heat at vegetative stages. We have begun to generate advanced lines from crosses between putative heat tolerant accessions and adapted germplasm for further study. We are also conducting a study on the impact of exotic germplasm introgression on cotton yield and fiber quality traits.

Soybean
We are cooperating in a USDA-sponsored evaluation of soybean germplasm for resistance to Asian soybean rust. We evaluate about 300 accessions per year under natural conditions near the gulf coast of Alabama.

Florida

The state of Florida was very active in 2010 for plant genetic resources distribution. According to records provided by S-9, 31 different individuals requested materials from 18 different genera of plants and a total of 1,230 unique PIs distributed. Affiliation of individuals obtaining materials included University of Florida scientists, USDA scientists, private research organizations, private citizens, and public schools. Most individuals who responded to a request for information indicated a high level of satisfaction with materials provided and appreciation for the availability of the germplasm. Listed below are reports submitted by cooperators.

Dr. Ann Blount, NFREC, Marianna, FL provided this report regarding her use of plant genetic resources in the past year. **Bahiagrass evaluation:** Bahiagrass (*Paspalum notatum*) germplasm evaluation with approximately 50 plant introductions from NPGS-GRIN, Australia, Uruguay and Argentina in multi-year and multi-location trials. Several species have been identified as having
superior winter growth and better seasonal forage distribution compared to bahiagrass (i.e. *P. cromyorhizon*, *P. guaraniticum*, *P. nicorae*). Evaluation includes winter survival, frost tolerance, forage yield, forage quality, seasonal forage distribution, turf characteristics, seed production aspects, and persistence under clipping. NPGS-GRIN germplasm in this evaluation includes *P. notatum*, *P. nicorae*, *P. quadrifarium* and *P. guaraniticum* (*P. nicorae* - PIs 202044, 209983, 276248, 276249, 283020, 284171, 304004, 310131, 404469, 404471, 404859, 462273, 477103, 490363, 490364, 508818, 508819, 508820, 508821; *P. quadrifarium* - 404880, 404881, 404882, 462302, 462295, 462298, 508942, 508947; *P. guaraniticum* – 404449). Several plant introductions have persisted at droughty sites, particularly at Live Oak and Brooksville, FL. These lines have been planted at Marianna in plots to increase seed production for the next level of field trial evaluation. Seed harvest has begun this summer, 2011.

**Hemarthria evaluation:** Plant introductions of *Hemarthria* were planted under non-irrigated conditions at the North Florida Research and Education Center at Marianna, FL and include: PIs 299039, 299993, 299994, 299995, 349750, 349751, 349752, 349754, 349796, 364861, 364863, 364865, 364867, 364869, 364871, 364874, 364875, 364876, 364877, 364878, 364881, 364882, 364884, 364885, 364890, 364891, 365145, 379613, 383331, 409751, 410128, 410129, 410131, 410132, 410133, 410134, 410137, 410138, 410139, 410140, 413186, 508606. BYDV has been documented on the limpograss PIs at that site. Novel hybrids of limpograss resulting from crossing PIs are being evaluated for cold tolerance, improved forage quality and nutrient removal efficiency at several Florida locations and this work is on-going.

**Gamagrass evaluation:** Twenty eight Florida gamagrass (*Tripsacum dactyloides*) selections collected by NRCS and forage breeders at University of Florida are under evaluation at the NFREC. These include NRCS nos. 9055975, 9056065, 9056073, 9059196, 9059199, 9059203, 9059215, 9059232, 9059245, 9059267, 9059269, 9059272, 9059280, 9059281, 9059282, 9059283, 9059285, 9059286, 9059287, 9059290, 9059294, 9059338, and NFREC ecotypes Joe Budd, Rancher, Pine Acres, Woodruff Dam, Marianna and Savannah. New NRCS gamagrass experimental lines were established at the NFREC-Marianna in 2008-2009 and seed increases of these have been made annually. Additionally, NRCS 9059266 was planted in 2009 and 2010 in seed increase plots at the NFREC-Marianna site. Seed of NRCS 9059266 is currently in progress summer, 2011.

**Aristida stricta collection:** A southeastern collection of wiregrass (GA, FL and AL) is being planted at the NFREC-Marianna as part of a cooperative arrangement with Northwest Water Management District-FL, NPGS-Griffin, NRCS-PMC-Brooksville and NFREC-Marianna to collect and evaluate populations of wiregrass and submit new germplasm to NPGS-GRIN. Seed harvest in 2010 was poor due to weather issues and seed harvest is slated for fall 2011.

**Arachis glabrata evaluation:** Approximately 100 perennial peanut PI cuttings were obtained from Roy Pittman, USDA-ARS-Griffin in 2009. These plant introductions were established in the field/greenhouse in 2009-2010. Evaluation of these PIs will include winter survival, frost tolerance, foliage yield, seasonal foliage growth, turf or forage classification, flowering aspects, shade tolerance, and persistence under clipping. Twelve lines were selected for advancing into replicated research trials in 2012.

Dr. Huangjun Lu, EREC, Belle Glade, FL, University of Florida provided this update on his use of germplasm in his lettuce breeding program. The lettuce breeding program at the University of Florida resumed breeding project in 2010 after 6 years of discontinuation (2004-2010). Only about 80 of the germplasm lines that were stored in the seed storage room of the Everglades
Research and Education Center, Belle Glade, FL were found to be viable based on seed germination tests. An additional 10 cultivars currently used in the Florida lettuce production were collected and added to the germplasm pool. All germplasm lines were planted in the field in fall 2010 and were used for observation of yield performance and other traits such as disease resistance. Two lines (70096 and 60185) were found to be resistant to banded cucumber beetles. The resistance in these lines has been confirmed in no-choice test in the insectarium room and therefore can be used for development of new varieties resistant to the insect. Based on field performance, about 100 plants were selected and moved to greenhouse for crosses. A total of 48 crosses were made.

Mr. Jeffery Hubbard, graduate student, Botany Department, University of Florida provided this report. The following PIs were requested, Grif 1613 Capsicum pubescens, PI 419058 Basella alba, and PI 276655 Canavalia ensiformis. These selections have been utilized over the past year in undergraduate and graduate instruction by the Biology Department at the University of Florida. Specifically; Botany 2710 – Practical Plant Taxonomy, Botany 2800 – Plants in Human Affairs, and Botany 5725 Taxonomy of Vascular Plants.

Mr. Eliezer Zuckerbraun, Gold Seed Co. LLC provided this report stating that he has been back crossing his proprietary breeding lines with material from the USDA for resistance to BLS (Xanthamonas) in bell peppers.

Dr. Ken Quesenberry, Department of Agronomy, University of Florida, provided this report on use of plant genetic resources. His graduate student Dr. Bunmi Aina, has completed her research with perennial Arachis spp. She evaluated tissue culture regeneration of Arachis paraguayensis PIs 262842, 468155, 468176, 468180, 468362, 468365, 468370, 604836, 604837. She achieved both organogeneic and somatic embryogenic regeneration of plantlets from these accessions, with only limited effects of genotype using the protocols she developed. Additionally, she has developed in vitro methods for ploidy manipulation to produce tetraploid Arachis papraguariensis plants. These plants may now be used in potential crosses with common peanut. She also developed a protocol for tissue culture regeneration of Arachis glabrata. Dr. Quesenberry, also reports that he is completing career long research with Arachis glabrata, Hemarthria altissima, Trifolium pratense, T. repens, and Paspalum notatum. During 2010 he made grower planting material distributions of the new cultivars ‘UF Peace’ (PI 658214) and ‘UF Tito’ (PI 2628260 to growers who will increase these new cultivars for commercial planting. The second year of field evaluations of new A. glabrata introductions from Paraguay (GRIF numbers 15054, 15058, 15062, 15067, 15068, 15072, 15075, 15212, 15214, 15216, 15221, 15223, 15227 was completed in 2010. The first year of an experiment to evaluate response to grazing defoliation of eight selected superior F1 hybrids of from H. altissima crosses of PI 299995 (Bigalta) and PI 364888 (Floralta) was completed in 2010 and is continuing in 2011 with the goal of identifying one or more superior line for potential release. Certified seed of a new mid-dormant, RKN resistant red clover cultivar, ‘Barduro’, was available for producers in fall 2010. This is the only known red clover cultivar with intermediate spring dormancy and high levels of RKN resistance. Seed of a new RKN resistant white clover cultivar, Ocoee, was also first available in fall 2010. Dr. Quesenberry is continuing evaluations of new apomictic forage bahiagrass hybrids and of other bahiagrass accessions that may have potential as utility turfgrass.
Drs. Bala Rathinasabapathi and Carlene Chase provided the following report on their use of plant genetic resources. A nonprotein amino acid, 5-hydroxynorleucine, isolated from seeds of sunn hemp (*Crotalaria juncea* L.) (Pant and Fales 1974) was reported to be phytotoxic to lettuce (Wilson and Bell 1979). Adler and Chase (2007) provided evidence that aqueous extracts of sunn hemp leaves resulted in suppressed radicle elongation in livid amaranth and bell pepper. We hypothesized that 5-hydroxyleucine also occurs in other parts of the sunn hemp plant in addition to the seeds, and may explain the phytotoxicity of foliar extracts. In 2010, we obtained 14 accessions of sunn hemp from the USDA-ARS Plant Genetic Resources Conservation Unit in Griffin, GA. The allelopathic potential of the accessions was compared using a bioassay that exposed lettuce seeds to aqueous foliar extracts from the 14 accessions. The two accessions resulting in the greatest suppression of lettuce growth and the two accessions with the lowest suppression were further evaluated for their suppression of germination of large crabgrass and lambsquarters. HPLC/MS analyses will be conducted in summer 2011 on extracts from each of the 14 accessions to detect and quantify 5-hydroxynorleucine. The results will aid in the selection of sunn hemp accessions for use as weed-suppressive cover crops in the southeastern USA.

Dr. Barry Tillman, NFREC, University of Florida, Marianna, FL provided this report on the peanut breeding program’s use of plant genetic resources. In 2010, 93 advanced breeding lines (F7 and greater) in the University of Florida peanut breeding program had at least one Plant Introduction (PI) in their pedigree. A total of 130 early stage breeding lines (F4-F5) had one parent that had a PI in its pedigree. There were 22 intermediate stage breeding lines (F5-F6) which had one PI as a parent. Two F2 populations containing one PI parent were grown and evaluated in 2010. Additionally, we are working with the USDA-NPGS in Griffin, GA to provide quarantine facilities for 47 tetraploid introductions from Bolivia being grown during 2011 and in winter 2010-11 we grew 21 tetraploid introductions in the greenhouse in Marianna, FL.

Mr. Robert Beiriger, EREC, University of Florida, Belle Glade Florida, provided this update on the use of PIs. We are evaluating the sweet sorghum lines for disease resistance and agronomic traits in south Florida. So far, two lines have shown good disease resistance but have not produced the sugar levels as indicated in the GRIN description. Two other of these lines had a unique photoperiod response. We will look at the lines again this fall and hope to be able to use lines to produce a sorghum that will grow and yield well in the fall and winter in south Florida. The lines with good disease resistance we be used in crossing with several of our sweet sorghum lines.

Dr. Kevin Kenworthy, Department of Agronomy, University of Florida has utilized material from plant genetic resources in some of his research. Argentine (PI 148996) and Wilmington (PI 434189) bahiagrass were exposed to different types of mutagens to generate > 1,000 putative mutant lines of bahiagrass. These lines have been evaluated and approximately 50 lines have been selected for further study for their turf potential. Common bermudagrass PI 289922 has shown some different drought responses and will be included in new research efforts that will more effectively tie together water use efficiency and root morphology in turfgrass. Several bermudagrass PIs (PI 289922, PI 290868, PI 290872, PI 290895, and PI 291590) were evaluated along with several other experimental bermudagrass for their response to sting nematodes.
Indications are that PI 291590 has improved tolerance to sting nematodes in comparison to Tifway bermudagrass.

Drs. Ana Saballos and Wilfred Vermerris, Department of Agronomy, University of Florida provided this report on their use of plant genetic resources. The sorghum program at the University of Florida is focused on developing sorghum lines adapted to the Southeastern US. The germplasm we have requested has been used for field evaluations in measures of disease resistance, agronomic traits and biomass and sugar production, as well as genetic and physiological studies on genes involved in lignin biosynthesis and drought tolerance. Lines with promising traits have been used in crosses with other grain and sweet sorghum lines to introgress beneficial traits such as disease resistance and high yield. The lines that have served as parents for segregant populations from which selections are being made are shown in the table below.

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<tr>
<td>PI 482769</td>
<td>Umkumbe</td>
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<td>PI 146890</td>
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Additional forage lines carrying two lignin biosynthetic genes are in the process to be evaluated for their agronomic characteristics. Based on this evaluation, they may be included in the crossing program for the development of new lines. The lines currently under evaluation are:

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One accession, PI 602899, served as the source for the mutant allele of the Bmr2-ref gene. This line was used in genetic and compositional analyses to discover and characterize the gene underlying the bmr2 phenotype. Bm2 is involved in lignin biosynthesis. It is expected that this gene will be deployed in the production of bioenergy lines with improved processing characteristics. The research article describing the findings, “Brown midrib2 (Bmr2) encodes the major 4-coumarate: Coenzyme A ligase involved in lignin biosynthesis in sorghum (Sorghum bicolor (L.) Moench” has been submitted to “The Plant Journal”.
Seven lines from NPGS/GRIN are currently included in a panel to evaluate the range of variation for drought stress tolerance and water use efficiency of sorghum genotypes. The results of this study will help select the best parental lines to confer high drought and improved water use efficiency to bioenergy sorghum lines. It is expected that this study will also provide insights into the mechanisms of drought tolerance in sorghum. The knowledge gained will serve to improve the drought tolerance of not only sorghum, but also related crops such as sugarcane and maize. The NPGS/GRIN lines included in this study are:

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<th>Line Number</th>
<th>Accession</th>
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**Georgia**

During 2010, thirty-one different requests for plant germplasm were made to the S-009 unit by citizens of Georgia. As a result of these requests, 332 plant accessions were supplied to University scientists, USDA scientists, consultants, seed companies, gardeners, and citizens of Georgia. The most requested crops were peanut, warm-season grasses, sorghum, and watermelon.

The University of Georgia maintains strong emphasis on plant breeding and continues to expand its advanced molecular biology programs. The recently formed Institute of Plant Breeding, Genetics, and Genomics currently has 22 faculty members, 10 M.S. students, and 13 Ph.D. students. These programs supply new crop cultivars and associated technologies to our agricultural sector and rely heavily upon the plant materials maintained within the S-009 unit.

UGA currently has active cultivar development programs in soybean, peanut, small grains, turf grasses, forages, blueberries, pecan, grape, and numerous ornamental crops that frequently utilize the plant genetic resource collections. These cultivar development programs have released 13 cultivars since the beginning of 2010 (Table 1).

In addition, research programs in crop science, horticulture, plant pathology, entomology and other disciplines continue to utilize the genetic resources of the S-009 unit in both basic and applied research projects designed to address the needs of Georgia agriculture.

For example, the entire available seashore paspalum collection was screened for salt tolerance in 2010 and work is underway to develop molecular markers that could be used by breeding programs to improve salt tolerance in grasses. Also, many accessions of the warm-season collection are currently being evaluated through DNA sequencing of the ACCase gene for the presence of mutations known to confer resistance to ACCase inhibiting herbicides. This work could lead to the discovery of new mutations useful in developing herbicide resistance systems for turfgrass.
In summary, the S-009 unit remains a critical component of our research and cultivar development programs in Georgia.

Table 1. Cultivar Releases from UGA Breeding Programs in 2010-2011

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Type</th>
<th>Breeder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tift 8</td>
<td>Ornamental Pennisetum</td>
<td>Wayne Hanna</td>
</tr>
<tr>
<td><em>Callistemon rigidus</em> 6-10</td>
<td>Stiff bottlebrush</td>
<td>John Ruter</td>
</tr>
<tr>
<td>GA 031238-7E34</td>
<td>Wheat</td>
<td>Jerry Johnson</td>
</tr>
<tr>
<td>T-959</td>
<td>Rabbiteye Blueberry</td>
<td>Scott NeSmith</td>
</tr>
<tr>
<td>Selection no. 72 ‘Tanner’</td>
<td>Pecan</td>
<td>Darrel Sparks</td>
</tr>
<tr>
<td>GA 052529</td>
<td>Peanut</td>
<td>William Branch</td>
</tr>
<tr>
<td>G03036 D3 ‘Auld’</td>
<td>Canola</td>
<td>Paul Raymer</td>
</tr>
<tr>
<td><em>Ilex cernata</em> x <em>I. maximowicziana</em> 2-5</td>
<td>Ornamental Ilex</td>
<td>John Ruter</td>
</tr>
<tr>
<td>Ga. 5-1-54 Grape</td>
<td><em>Vitis rotundifolia</em> x <em>Muscadinia rotundifolia</em></td>
<td>Patrick Conner</td>
</tr>
<tr>
<td>GA 001138-8E36</td>
<td>Wheat</td>
<td>Jerry Johnson</td>
</tr>
<tr>
<td>UGA31</td>
<td>Seashore Paspalum (Turf)</td>
<td>Paul Raymer</td>
</tr>
<tr>
<td>G04-2215RR</td>
<td>Soybean</td>
<td>Roger Boerma</td>
</tr>
<tr>
<td>G04-1618RR</td>
<td>Soybean</td>
<td>Roger Boerma</td>
</tr>
</tbody>
</table>

Guam

Plant collection, conservation and distribution
Local selections of sweetpotato (*Ipomoea batatas*) and chili pepper (*Capsicum annuum*) were maintained at University of Guam. Local field corn (*Zea mays*) seeds were distributed to a farmer for seed production. Eggplant (*Solanum melongena*) Nitta x Waimanalo hybrid was provided to a farmer for an on-farm trial.

An accession of *Crotalaria juncea* (PI652939 SD, Texas 374) planted for seed collection resulted in either flower/bud drops or production of pods without seeds when planted 2010 in November. Observations continue to find out why no seed formation occurred. Hand pollination was attempted with no success.

Evaluation of germplasm adaptation to Guam’s climate
A total of 16 accessions of sunnhemp (*Crotalaria juncea*) including 15 obtained from USDA/ARS/PGRCU Griffin GA, and a local check (a Taiwan variety commonly used in Guam) were tested for their field performance in calcareous Guam cobbly clay soil (pH 7.8, RCB, 8 plant/plot; 2 replications) from 7/16/10 to 9/27/10. The germination rate determined on 8/9/10 ranged from 37% to 93%. Plant maturation rate and dry biomass production differed among germlines. The majority reached the reproductive stage at 72 days after planting except three accessions, PI468956SD, PI561720SD, and PI234771SD. Early maturation was observed with four accessions of PI20765703SD, PI39156701SD, PI25048703SD, and PI32237703SD. ‘Tropic Sun’ developed in Hawaii was a late maturing cultivar that produced the greatest biomass at harvest (Table 1).
An on-farm trial of nine oriental-type cucumber (Cucumis sativus) cultivars was conducted at a pesticide-free farm. Cvs. Soarer, Summer Dance, and Summer Top showed tolerance to anthracnose.

Outcomes / Impact
Conservation and evaluation of important tropical plant germplines will support development of sustainable agriculture in the region. Searching for new germplines and commercial cultivars with heat tolerance and pest resistance will assist growers to choose locally adapted vegetables and green manure plants to sustain their manageable farming operation in Guam.

Table 1. Dry biomass (leaves + stems), germination rate and the stage of plant development formation at harvest of 16 sunnhemp (Crotalaria juncea) accessions grown in calcareous Guam cobbly clay soil (pH=7.8) in Guam from July 16 to September 27, 2010.

<table>
<thead>
<tr>
<th>Accession</th>
<th>Average dry biomass (g/plant) on 9/27/10</th>
<th>Average germination rate (%) on 8/9/10</th>
<th>Stage of plant development on 9/27/10</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI 468956 02 SD (Tropic Sun)</td>
<td>38.0  a</td>
<td>81.3</td>
<td>Vegetative</td>
</tr>
<tr>
<td>PI 207657 03 SD</td>
<td>30.6  ab</td>
<td>81.3</td>
<td>Pod formation</td>
</tr>
<tr>
<td>PI 426626 01 SD (Sanni)</td>
<td>27.7  b</td>
<td>62.5</td>
<td>Flowering</td>
</tr>
<tr>
<td>PI 391567 01 SD (T’ai-yang-ma)</td>
<td>25.9  b</td>
<td>56.3</td>
<td>Flowering</td>
</tr>
<tr>
<td>PI 652939 01 SD (TEXAS 374)</td>
<td>21.3  bc</td>
<td>43.8</td>
<td>Flowering</td>
</tr>
<tr>
<td>PI 561720 01 SD (IAC-1)</td>
<td>14.8  cd</td>
<td>50.0</td>
<td>Vegetative</td>
</tr>
<tr>
<td>PI 250487 03 SD (K681)</td>
<td>14.5  cd</td>
<td>50.0</td>
<td>Pod formation</td>
</tr>
<tr>
<td>PI 337080 03 SD</td>
<td>11.3  cde</td>
<td>37.5</td>
<td>Flowering</td>
</tr>
<tr>
<td>PI 219717 04 SD</td>
<td>10.5  de</td>
<td>75.0</td>
<td>Flowering</td>
</tr>
<tr>
<td>PI 234771 01 SD</td>
<td>8.2   de</td>
<td>68.8</td>
<td>Vegetative</td>
</tr>
<tr>
<td>PI 250486 03 SD (K680)</td>
<td>5.8   de</td>
<td>68.8</td>
<td>Flowering</td>
</tr>
<tr>
<td>PI 314239 03 SD (COL NO524)</td>
<td>5.3   de</td>
<td>93.8</td>
<td>Flowering</td>
</tr>
<tr>
<td>Taiwan Variety</td>
<td>5.3   de</td>
<td>81.3</td>
<td>Flowering</td>
</tr>
<tr>
<td>PI 346297 02 SD</td>
<td>5.0   de</td>
<td>78.8</td>
<td>Flowering</td>
</tr>
<tr>
<td>PI 322377 03 SD (IRI 2473)</td>
<td>4.3   e</td>
<td>81.3</td>
<td>Pod formation</td>
</tr>
<tr>
<td>PI 250485 05 SD (K679)</td>
<td>4.2   e</td>
<td>75.0</td>
<td>Flowering</td>
</tr>
</tbody>
</table>

Seeds were sown on 7/16/10 having 8 plants/plot with two replications. Average biomass amounts followed by same letter are not significantly different at the 0.05 level (Student’s t test). Nodulation was observed in all plants on 9/27/10.

Hawaii

USDA/ARS, Hilo-Germplasm Unit.
The team of seven continued to manage 14 tropical fruit and nut crops at the clonal repository in Hilo Hawaii (approx. 1000 accessions). The collection represents a diverse economically important collection of tropical fruit and nut crops such as pineapple, macadamia, guava, papaya, pili nut, peach palm, breadfruit, lychee and longan, carambola and their relatives. The living collection is maintained as 30 acres of field plantings, some germplasm such as Vasconcellea (papaya relatives) are isolated and cared for as potted plant in a screen house because of the
Papaya Ringspot virus. The pineapple, ohelo, tea, breadfruit, ginger and selected passion fruit germplasm are maintained as tissue culture for the ease of distribution and to prevent escape into the wild. Preliminary tests were initiated on tissue culture storage of rambutan, pulasan and Canarium germplasm. Older field plantings such as the Carambola are being replanted using air-layering, this is to eliminate the potential of rootstock overgrown of the germplasm collections. A shipment of avocado scions was received in 2010 and again in June, 2011 from Fort Detrick to Hilo after the quarantine monitoring. These scions were grafted and kept in our quarantine house for six months before moving into the greenhouse; the next set of avocado root stocks are being produced for additional scion transfer.  Grin database management continued and collection information is undated by unit staffs. Germplasm introductions were 32 and distributions 34 comprised of 240 items.

Evaluation activities included: 1) guava germplasm tolerance to the Oriental fruit fly using cage inoculation of fruits at different maturities.  2) Kapoho solo seeds regenerated at our PRSV free field in Paauilo are planted out in a commercial papaya field at Ophihii kau, this is to select for and maintain a uniform source of the Kapoho papaya germplasm.  3) Observations of growth and production of ohelo at three locations continued and completed for the SCRI project: Ohelo: a specialty crop from Hawaii. Results included: a) release of three clonal selections for berry and ornamental potted plants production. b) Two extension articles on propagation, culture and management of ohelo.  c) Tissue culture plugs of two ohelo selections are made available to the public by repository distributions and through a commercial laboratory for larger quantities.  d) Project leaders at Corvallis repository published SSR marker finger printing and cryopreservation research of 3 ohelo accessions. e) Cost of production, timing of production and plant sale information were gathered and preliminary economic analysis of ohelo as an ornamental potted plant conducted.

The repository continue to cultivate good relationship with stake holders including: senior citizen (24 ) (5/16/11); Hawaiian farmers on ohelo ornamental production at Volcano (8)(10/5/10); Hilo business community representatives on tea and ohelo project at the Volcano station (10) (1/7/11); Tropical Fruit Grower Association members (50) (2/16/11); a Hilo business and science group at Volcano for the ohelo and tea project (12)(3/1/11); University of Hawaii, CTAHR fruit crop production class (12) (3/24/11). Continue working with the S.W. Forestry University in Yunnan and two representatives from Hainan China to plan for future plant germplasm exchanges.

**Louisiana**

*Hibiscus sabdariffa* germplasm seeds were screened to select early maturing hibiscus accessions for Louisiana climatic conditions. Out of 17 accessions, one failed to germinate. One accession from South Africa showed promise. Seed of *Desmanthus illinoensis* received from the NPGS will be combined with other native materials and used for variety development. Malvaceae family species are being screened for odd-chain unsaturated fatty acids in their seed oils. These fatty acids were identified in the initial accessions and additional accessions will be screened. Research on *Ipomoea* accessions include evolutionary ecology, molecular evolution and population genetics of genes involved in flower color, as well as the phylogenetic systematics of morning glories (species of the tribe Ipomoeae). Rice and red rice lines were used to investigate the genetics of photoperiodic flowering response.
North Carolina

Faculty in the Crop Science and Horticultural Science Departments at NC State University conduct research on strawberry, blueberry, brambles, tree crops, ornamentals, maize, soybean, peanut, cotton, tobacco, small grains, turfgrasses, sweet potato, cucurbits, and other crops. Priorities are on incorporating disease and insect resistance, abiotic stress resistance, and quality factors into improved breeding lines and cultivars. Plant introductions are critical components of plant improvement programs, and NCSU scientists make use of germplasm maintained in the National Plant Germplasm System (NPGS). During the past year, 18 individuals received 115 entries that were being introduced to NC from the Southern Regional Plant Introduction Station, including species of *Arachis*, *Sorghum*, *Capsicum*, *Citrullus*, *Eremochloa*, and *Ipomoea*. In addition, the Plant Breeding Center is supporting a large group of plant breeding graduate students, many of whom are involved with plant germplasm collections.

The U.S. collection of cultivated and wild *Nicotiana* species is maintained at NCSU and numerous seed requests are filled annually both to U.S. and international individuals and organizations. The tobacco breeding program is developing hybrids for both the flue-cured and burley markets with enhanced disease and virus resistances.

Collections of *Arachis* cultivars are being maintained by the peanut breeder. Three plant breeders and geneticists are working with the cultivated and wild species of peanut. An attempt is being made to create a duplicate collection of the *Arachis* species and there are currently 405 of the 607 accessions in the USDA collection at NC State University. In addition, the peanut curator sent accessions of cultivated and wild *Arachis* species for seed regeneration in North Carolina. We are also attempting to document the numbers of wild peanut accessions being maintained at Texas A&M University, at CENARGEN in Brazil, and at the International Crops Research Institute for the Semi-Arid Tropics. Plant breeding efforts are being made to pyramid genes for disease resistances into single genotypes, investigate the inheritance of Sclerotinia blight and tomato spotted wilt virus resistances, develop drought resistant genotypes, and higher yields. Both cultivated and wild species are being utilized in the breeding program, and the most advanced breeding lines have a significant amount of wild species germplasm in their pedigrees that are thought to be supplying genes for high levels of disease resistances. During the past year, ‘Bailey’ was released as a large-seeded Virginia market type cultivar.

The soybean breeding program has one state-supported and two USDA scientists who are concentrating on utilizing exotic germplasm to improve drought resistance. Significant progress has been made during recent years to increase yields of non-GMO cultivars. One germplasm line ‘N6202’ was released with high protein, favorable yield potential, and large seed; and two cultivars were released: ‘NC-Tinius’ and ‘NC-Burton’.

The maize breeding program has one state-supported and two USDA scientists. The maize breeding program released six lines last year (NC512 - 522, even numbers only), with increased disease resistance. The GEM program is continuing to incorporate Southern germplasm into the US corn belt types. The GEM site at Iowa State, the Panzea site at Cornell, and the maize genetics site at Cornell all have data from the maize program at NC State University.
The Wheat Breeding program is utilizing wild species to introgress genes for scab and other diseases into the cultivated species. The Eastern Regional Small Grains Genotyping Laboratory at NCSU is involved in use of markers to characterize germplasm and deployment of genes/QTL by marker-assisted selection.

A turfgrass breeding program was initiated 2 years ago with the objective of improving cultivars in the cool-warm season transition zone of North Carolina. The turfgrass breeder is working to improve the sustainability and economic gain of the overall turfgrass industry in the state through the development of cultivars that require reduced inputs and that are capable of tolerating biotic and environmental stresses while still maintaining good quality and overall performance. Specific projects include breeding for drought tolerance in tall fescue; breeding for cold tolerance in St. Augustine grass, and bermudagrass; evaluation of St. Augustine grass germplasm for gray leaf spot resistance; (4) evaluation of zoysiagrass germplasm for large patch resistance; and developing EMS mutants in centipede grass. Research efforts are to utilize molecular markers to assess levels of molecular variability in different warm season grass species, improve selection methods for difficult/expensive to measure traits, and study the genetics of disease resistance in warm season grasses. In addition to the turfgrass breeding program, the turfgrass genetics program is working on improvement of genetic transformation efficiency of turfgrasses and bio-fuel crop (switchgrass), and the improvement of agronomic traits of various crops, including disease resistance in tall fescue, drought tolerance in cereals, and lignin reduction in switchgrass.

The tomato breeding program at NC State University aims to improve tomato for fruit quality, disease resistance and stress tolerance by conventional and molecular breeding methods. Current emphasis is to combine resistances for early blight, late blight, fusarium wilt, bacterial wilt, tomato spotted wilt virus, tomato mosaic virus and root knot nematode. In fruit quality, fruit smoothness, size and color are the traits of interest, which are in priority for improvement. Progress is being made to achieve these overall objectives as indicated by the release of following hybrids and breeding lines recently. One breeding line “NC 714” was released for its large size and smooth fruit quality. Two cultivars were released, including “Mountain Merit”, a hybrid tomato released for late blight resistance; and “Mountain Majesty” a hybrid tomato released for tomato spotted wilt virus resistance, and its large and smooth fruit quality.

A mountain landscape program released three cultivars of *Tutsans hypericum*, one mountain gordinia (‘Sweet Tea’) which is a rare intergeneric hybrid between *Franklinia* and *Gordonia*; one weigela (‘Sunset’), which is a deciduous shrub in the family *Caprifoliaceae*; and one pearl bush cultivar (‘Blizzard’).

Dr. Julia Kornegay rejoined the plant breeding faculty in the Department of Horticultural Science after being in administration for more than 5 years. NC State University has a comprehensive cut flower research program focusing on new cultivar evaluation, greenhouse and field production, and postharvest handling (www.ncsu.edu/project/cutflowers). Research is being significantly expanded for genetic improvement of zinnias and *Eucomis*, a new crop with potential for the Southeast. Research with zinnias is centered upon developing *Z. violacea* cultivars with powdery mildew.
resistance. Only a relatively small portion of the *Zinnia* germplasm has been exploited by breeders and work is underway to produce interspecific hybrids. Research with *Eucomis* is to increase and strengthen the flower racemes to reduce lodging.

Also in the Horticulture Department is research with *Buddleja* (butterfly bush) and efforts are being made to develop plants with compact and sterile flower clusters. Traditional cultivars are excessively vigorous and challenging to manage in a home landscape. Butterfly bush is potentially invasive in many parts of North America and the world, hence the development of sterile cultivars is important. The cultivar ‘Purple Haze’ was released as having both compact flower and it is female sterile. The cultivar 'Miss Molly' is a white flowered butterfly bush. Research with *Cercis canadensis* (redbud) is to develop a series of weeping forms and compact forms encompassing the range of leaf variants (purple leaf, variegated leaf, golden leaf) and flower color variants. Also, attempts are being made to introgress traits from eastern redbud into the Texas redbud to exploit the heat and drought tolerance of this subspecies. Three cultivars have been released during the past year, including: 'Ruby Falls', which demonstrates the unique combination of weeping growth habit and purple leaf color; 'Merlot' is the first purple leaf form of the Texas redbud; and 'Whitewater' is a unique weeping form with variegated foliage.

The cucumber breeding project at NC State has been working on the development of new hybrids of pickling type for use by North Carolina growers. We have just released 'NC-Eldorado', a type for use with our medium and long day cultivars. NC-Eldorado is also an excellent hybrid for use in areas needing a long harvest season provided by the monoecious type and it performs well in patio pots and containers. NC-25’ and ‘NC-75 were also released as cucumber inbreds.

**Oklahoma**

Plant germplasm distribution data received from S-9 indicate that 1,576 plant accessions maintained at the Plant Genetic Resources Conservation Unit at Griffin, GA were distributed to organizations or individuals in Oklahoma the last year, from August, 2010 through July, 2011. The number of distributed plants last year is the highest in recent years, if not a record. The accessions were distributed in 67 respective requests. Respective annual plant germplasm distribution numbers for 2006, 2007, 2008, and 2009 were 169, 295, 431 and 352. The requested plant species in 2010 included sorghum (*Sorghum bicolor*) (1,104 accessions), peanuts (136), Panicum (113), Guar (*Cyamopsis* sp.) (33), peppers (21), watermelon (20), Okra (4), squash (*Cucurbita* spp.) (6), vigna (*Vigna* spp.) (8), and Miscanthus (*Miscanthus* sp.) and other warm-season grasses (10), and other legumes (13). Receivers of the plant accessions represent researchers of Oklahoma State University, the Noble Foundation, USDA-ARS laboratories, and individual Oklahomans.

**Puerto Rico**

Eighteen quenepa (*Melicoccus bijugatus*) cultivars are in the sixth year of evaluation at Juana Diaz and Lajas. At Juana Diaz and Lajas, respectively, 48% and 22% of the trees fruited in 2009. Horticultural traits and fruit quality parameters (pH, TSS, acid, and TSS/acid ratio) were measured on the mandarin cultivars ‘Encore’, ‘Murcott’ and ‘Fallglo’ on five rootstocks in Corozal. The mandarin experiment at Isabela was eliminated due to high incidence of citrus
greening disease. At Isabela, a citrus germplasm collection was established in the screenhouse and citrus rootstocks are being propagated for new experiments to be established at Corozal and Adjuntas. Five hybrid and five open-pollinated Cubanelle-type pepper cultivars were evaluated from February to May. The best commercial yields were obtained by hybrids ‘Aruba’, ‘Key West’ and ‘HMX 6640’. Among the open-pollinated cultivars, the best performers were ‘Aconcagua’ and ‘Marconi Red’. Twelve “Mayagueziano-type” mango clones on ‘Banilejo’ dwarfing rootstock are being evaluated in the field at Lajas. A field planting of 14 guava accessions is being evaluated at Juana Diaz. ‘Estela’ hybrid tannier production was evaluated using planting material of different source and size. Marketable yield was increased by 27% when planting material from main corm sections was used, compared with crowns. The size of planting material has no effect in the marketable yield of tannier. ‘Cuerno de Arce’ plantain was evaluated with and without a chicken manure soil amendment. An increase in average bunch weight of 18% and a reduction of 32 days from planting to fruiting was observed with the addition of chicken manure. One hundred half-sib lines of ‘Suresweet’ sweet corn are being evaluated in a replicated performance trial. After the second cycle of mass selection has been completed, a manuscript will be prepared for the formal release of this sweet corn variety as ‘Suresweet 10’. Seed of ‘Suresweet’ is currently available for sale at Isabela. During January 2009, flowering was induced in ‘Cabezona’ pineapple clones HT1-N, HT2-N, I-A, I-B and I-C. Fruits were harvested in June 2009. Clones HT1-N, HT2-N and I-B showed the best fruit characteristics (size, weight and brix). Germplasm requests in Puerto Rico in 2010 include 5 Crootalaria sp. and 4 Mucuna sp. New crop germplasm projects in 2011 include evaluation of accessions of upland rice, breadfruit and achachairu (Garcinia sp.), screening of citrus rootstocks for Phytophthora resistance, and evaluation of traditional varieties produced by the Agricultural Experiment Station.

South Carolina

Germplasm Distribution
A total of 481 germplasm accessions were distributed by the Plant Genetic Resources Conservation Unit at Griffin, GA to the following individuals in South Carolina in 2010: Dr. Amnon Levi, USDA Vegetable Laboratory, Charleston, SC, 49 Citrullus, 14 Praecitrullus (watermelon), 9 gourd, and 1 Cucurbita accessions; Dr. H. Knap, Clemson University, 1 Pueraria (legume) accession; Dr. Ellis Caniglia, USDA Vegetable Laboratory, Charleston, SC, 2 Citrullus accessions; Dr. S. Kresovich, University of South Carolina, 383 Sorghum accessions; Dr. J. Bohac,, 20 Ipomoea (sweetpotato) accessions: K. Hazel,1 Vigna (cowpea) accession; Dr. M. Shepherd, Clemson University,1 Vigna accession.

Soybean Germplasm Utilization and Evaluation
In 2010, twenty elite breeding lines and/or cultivars from the Clemson University soybean breeding program were tested in a greenhouse to determine their suitability as hosts for reniform nematode, Rotylenchulus reniformis, and identify resistant genotypes. Five pots containing plants of each genotype were inoculated with 2000 nematodes per pot. The test was conducted by Dr. R.T. Robbins at the University of Arkansas from May 26 to August 26. Elite lines SC98-1930, SC07-786, SC06-687, SC07-1490, and SC cultivar Motte had reproductive indices lower than the reniform resistant cultivar, Santee. The elite lines were also evaluated for resistance to southern root-knot nematode, Meloidogyne incognita, and concurrently in 2010 field tests for
agronomic traits and seed yield. Based on nematode resistance traits and performance in non-nematode infested field nurseries, SC07-786 and SC07-1490 will be further evaluated in 2011 Southern Regional Soybean Tests for potential cultivar release.

Participation in a multi-year, multi-state, cooperative research effort led by Dr. David Walker, USDA-ARS, has led to identification of 64 soybean plant introductions that show varying levels of resistance to soybean rust disease caused by the fungus *Phakopsora pachyrhizi*. While none of the accessions was immune in all environments, 64 were resistant in two or more locations each year that they were tested. Some accessions appeared to be more resistant in certain environments than in others. Of the original four *Rpp* genes described in the literature, *Rpp1* provided the highest level of resistance, and among the accessions with uncharacterized *Rpp* genes, PI 567104B had the highest overall resistance across environments. The plant introductions confirmed to be resistant in these evaluations should be useful sources of genes for resistance to North American populations of *P. pachyrhizi*. Results are published in Crop Science. 2011. 51:678-693.

**Tennessee**

The following projects are being conducted at the University of Tennessee in which plant introductions are being utilized in research.

**Biofuel Crop Alternatives: Switchgrass**

Project Title: Breeding improved synthetic varieties of Switchgrass
Personnel: Fred Allen, Professor; Virginia Sykes, Grad Research Assistant; and Hem Bhandari, Assistant Professor, Dept. of Plant Sciences, Univ. of Tennessee.
Objective: Development of improved varieties of Switchgrass
Approach: Three PI’s are being intercrossed with two experimental lines and two released cultivars for the purpose of developing new synthetic varieties of switchgrass. A polycross nursery was established in spring 2007. F1 half-sib families were established in the field in 2009 and have been evaluated for various agronomic traits in 2010 and 2011. New polycross set will be established from selected F1 plants in 2012 for the purpose of creating new synthetic varieties. Allen, F., V. Sykes, R. Johnson and J. Zale. 2011. An ideotype for selection among F1 half-sibs of switchgrass. Am. Soc. of Agronomy. Abstracts, CD.

**Row Crops: Corn**

Project Title: Cereal Breeding
Subtitle: Breeding maize lines with exotic/elite germplasm
Personnel: Dennis West, Univ Tenn
Collaborators: Major Goodman, NCSU
Objective: Develop improved maize germplasm for the southern region.
Approach: Early generation lines from the Germplasm Enhancement of Maize (GEM) project, expired PVP lines, and other germplasm obtained from the North Central Regional Plant Introduction station maize collection are crossed with elite adapted lines. Progeny from crosses are advanced by traditional breeding methods, to develop new maize parental lines. In 2011 we obtained the following maize germplasm from the NPGS for inclusion in our maize breeding project:

<table>
<thead>
<tr>
<th>PI/code</th>
<th>cultivar</th>
</tr>
</thead>
</table>
1. Lines from the GEM project;  
   - GEMS-0218  
   - GEMS-0219  
   - GEMS-0220  
   - GEMS-0221  
   - GEMS-0222  

2. Expired PVP lines;  
   - 559935  PHBA6  
   - 559944  PHP85  
   - 559954  PHWG5  
   - 548804  PHR55  
   - 555651  83IBI3  
   - 555462  F118  

3. Other lines;  
   - Ames 28940 MO501  
   - Ames 28941 MO502W  
   - Ames 28942 MO506W  
   - Ames 28943 MO508W  
   - Ames 28945 MO511W  

Soybean  
Project Title: Effects of Root/Leaflet Orientation Trait Combinations on Water-Use Efficiency in Soybean  
Personnel: Fred Allen, Professor; Richard Johnson, Res. Associate, Dept. of Plant Sciences, Univ. of Tennessee  
Objective: Determine the effects of combinations of fibrous root and leaflet orientation on water-use efficiency in soybeans.  
Approach: Recombinant inbred lines and Near-Isogenic lines were developed from a cross between a prolific rooting line, PI 416937, and a high leaflet orienting cultivar, USG 5601T. The goal was to develop lines that have low-orientation/normal root; low-orientation/prolific root; high-orientation/normal root; and high-orientation/prolific rooting trait combinations and compare their water-use relative to seed yield. F6, F7 and F8 generation lines have been evaluated via sap-flow instrumentation and high pressure flow meters to determine the water use and water use efficiency of the above trait combination lines. Leaflet orientation scores, root morphology, yield and water use efficiency have been determined for each of the different lines. A dissertation project will be completed on this study in the fall, 2011.  

Project Title: Stability of Oleic Acid Content in Germplasm Resources  
Personnel: Vince Pantalone, Professor; Ben Fallen, Research Associate, Catherine Nyinyi, Graduate Research Assistant, Dept. of Plant Sciences, Univ. of Tennessee  
Objective: To determine the stability of oleic acid concentration across environments for 15 high oleic plant introductions, and to determine biodiesel properties of elite lines derived from a mid-oleic germplasm source.  
Approach: 18 soybean genotypes including 15 high oleic plant introductions (PI) and three checks were planted 16 different environments across five locations during three years. Fatty acid composition from gas chromatography has been completed to identify specific PIs that may serve as sources to increase oleic acid concentration and maintain its stability over environments to provide an opportunity to develop a novel type of oil soybean that has increased oxidative stability for food and industrial uses. Biodiesel properties were evaluated for a commercial
soybean cultivar and a new recombinant inbred line whose parentage included a registered germplasm line.

Results: We identified MG II to MG V plant introductions with oleic acid concentrations significantly higher than normal soybean. The elite recombinant inbred line TN07-93RR had a fatty acid profile with elevated levels of monounsaturated fatty acid and was determined as the more desirable line for production of biodiesel.

Project Title: Development of edible vegetable soybean
Personnel: Carl Sams, Professor, and Vince Pantalone, Professor, Dept. of Plant Sciences, Univ. of Tennessee
Objective: To use traits (larger seed size, high protein) acquired through PI 416937 to develop edible vegetable soybean cultivars.
Approach: Experimental line TN03-349 is an F6-derived line from the cross TN93-99 x PI 416937. The female parent, TN93-99 is a germplasm released by Univ. of Tennessee and is maintained by the USDA active collection as GP-280. The male parent, PI 416937 is a plant introduction from Japan that exhibits drought and aluminum tolerance, increased nodulation by nitrogen fixing bacteria, larger seed size, and higher seed protein concentration. The experimental line TN03-349 was released as the new edible vegetable soybean cultivar, NUTRIVEG Soy6407 in fall 2007. That cultivar has been utilized as a crossing parent with other lines to develop superior new vegetable soybean lines. New experimental lines are being evaluated for potential release as new cultivars.

Texas

Daryl Morishige (TAMU) ordered the entire collection of the *Sorghum bicolor* BTx623*IS3620c Recombinant Inbred Population. Single rows of each RIL line and parents (430 lines) were planted in College Station, TX in spring 2011. The lines will be evaluated for "Days to Flowering" over the course of the summer. A BTx623*IS3620c genetic map will be generated from the population. The collected data will be used for QTL analysis to identify the genes controlling flowering time underlying the QTL.

MMR Genetics and USDA-ARS have a collaborative project (Re-Initiated Sorghum Conversion) funded by the National Sorghum Checkoff. This project has as its objectives (1) the identification of genomic regions associated with yield potential, and (2) conversion of these
materials to shorter heights and early maturity (removal of photoperiod sensitivity). Accessions stored at Griffin, GA from an Ethiopian Collection, Sudan Collection and Mali Collection were requested based on collector/breeder notes of superior breeding value. These materials have been grown in increase and crossing programs in Puerto Vallarta, Mexico and Vega, Texas. Each of the materials was crossed to a short height, photoperiod insensitive inbred line to facilitate conversion. Currently segregating populations are growing in Vega, Texas which will be selected for traits of interest. Each of the accessions has been evaluated with some 14,000 markers to determine genetic relationships and genomic similarity. This information will be used to assist in the location of genomic regions under selection for grain yield and to identify those accessions containing these yield blocks.

Dr. Bob Klein (USDA) has a research program to characterize the sorghum germplasm at a molecular level. The accessions are being evaluated at the molecular level for allelic variation in a key flowering time gene. There are no breeding activities taking place with this germplasm; just molecular characterization at this key flowering time locus.

Dr. Gary Peterson (TAMU, Lubbock) is evaluating grain sorghum response to salt stress in selected germplasm. Purpose of the program is to identify the response of a number of sorghum genotypes to salt stress at Pecos. If resistance/tolerance to salt stress is identified additional studies will be conducted in the field and greenhouse to further understand the response. In 2010, no sorghum genotypes exhibited susceptibility to salt stress. The lack of response was attributed to above normal rainfall at Pecos during the 2010 growing season. The trials will be repeated in 2011.

Dr. Tom Juenger, UT Austin, requested and received seed for two GRIN accessions of Panicum hallii. The accession codes were PI 229052 and PI 229051. They have recently started a number of projects developing Panicum hallii as a diploid model for genetic studies in Panicum grasses. Their interests are to use genetic mapping and gene expression studies to understand the genetic basis of abiotic stress responses, including drought tolerance, in these grasses.

Dr. Russell Jessup (TAMU) ordered accessions of Urochloa brizantha. These accessions are being used for comparison of candidate apomixis genes between Urochloa and Pennisetum spp. Dr. Jessup also ordered a single accession of Phragmites australis. This single accession has been propagated and utilized as a pollen donor in wide hybridizations with Saccharum complex spp. with biofuel potential. Initial efforts failed to produce hybrids, but a population of P. australis has since been developed and is being assessed for potential to overcome genotype specific effects.

Dr. Guy Hallman (USDA, Weslaco, TX) requested bell pepper (Capsicum annuum) germplasm to evaluate summer fruit set in extreme south Texas. The accessions were planted in the fall but winter freezes killed them 2 years in a row.

Dr. Mark Burow (TAMU) requested peanut germplasm was used for the following purposes: (1) As botanical type specimens for evaluation of the US peanut minicore collection. Three botanical types are not grown in the US, and the standards were requested as references for peruviana, equatoriana, and hirsuta types for comparison.
For parents to use for crossing to incorporate leafspot resistance.
As parents to use for crossing to incorporate early maturity and cold tolerance.

Virgin Islands

Virus-free sweet potato plantlets, obtained from the USDA Germplasm Repository are being grown in culture to supply clean plantlets to local growers. However, between requests for plant material a system was needed to control growth and increase the intervals between normal monthly transfers. Long-term in vitro maintenance, on MS medium containing 0-12% sucrose, was used by UVI student Noel Burnett to evaluate shoot growth over time on four sweet potato cultivars. Sucrose levels from 2-12% had no influence on controlling in vitro growth and development over time. Having no sucrose in the medium resulted in minimal growth but was lethal to 50% or more of the cultures. The rate of root growth and leaf development was greatly reduced on sucrose levels from 0.1-0.3%. These low sucrose levels controlled the rate of growth and extended the interval between transfers from monthly to yearly. Long-term maintenance for a year on low sucrose medium does not influence growth after transfer to fresh medium. Sweet potatoes can be successfully maintained for a year on low sucrose medium to reduce growth and revitalized on fresh medium with 3% sucrose to regain active growth for micropropagation.

Viruses in sweetpotatoes are a problem that reduces growth and production over time. Sweetpotatoes are propagated asexually by cutting or slips. However, if the sweetpotato plant is virus infected, the virus remains in the new plant. To determine the extent of sweetpotato virus infection, sweetpotato leaves were collected from local grower and the UVI field plot, that was started with virus free material, and evaluated through ELISA. Most of the 41 sweetpotato leaf samples on the island of St. Croix were positive for at least one virus. ELISA tests indicated that 15 samples were positive for Potyvirus, 12 samples were positive for Cucumber Mosaic Virus and 22 samples were positive for Zucchini Yellow Mosaic Virus. Of these results, 16 sweetpotato samples were infected with multiple viruses. Fifty percent of the originally clean UVI material had virus after 120 days.

There are multiple viruses that can potentially affect papaya varieties. Each one causes detrimental symptoms to the plant that weaken and ultimately kill it. Three viruses, Papaya Ring Spot Virus (PRSV), Papaya Mosaic Virus (PMV), and Cauliflower Mosaic Virus (CaMV) were tested for. This was done with ELISA kits and leaf tissue samples from the various trees. The results indicated that 100% contained PRSV, 30% CaMV and 18% PMV. Work at UVI-AES has been on going to develop papaya varieties that tolerate the virus and still be productive.

Sorrel (Hibiscus sabdariffa), is popular during the winter holiday season in the Caribbean for its colorful fleshy calyces during the Christmas Season. Sorrel is normally planted at two foot spacing during July and August. We evaluated late September sorrel planting and the influence of 8, 16 and 24 inches in-row spacing. The results indicated that the day-neutral variety can be grown from 8-24 inches with no effect on branching or production. However, 8 and 16 inches can result in taller plants and fewer branches on traditional red December bearing varieties. Planting sorrel in September at 16 inches can increase production per length of row.
Sorrel is sensitive to high pH calcareous soils found in areas of St Croix. A study was conducted to grow and evaluate 17 sorrel varieties, from the Caribbean and African origin, for tolerance on high pH caliche soils. For caliche tolerance, plant leaves were ranked from 1-5, with (5) being the normal healthy green and (1) being severely bleached white (chlorotic) and having dead (necrotic) leaf margins. Generally, the varieties from Africa had better tolerance to the high pH soil, ranked above 2.5, than the Caribbean varieties which were rated below 2. Five varieties appeared to be photoperiodically day neutral by producing flower buds and flowered in May and June. From these results, a breeding plan will be developed to combine tolerance to calcareous soils with a day neutral photoperiod to enhance year round production.

The sorrel is important to the culture of the Virgin Islands for its use in making a healthy red beverage from the calyx. The calyx of sorrel varies in the intensity of redness between cultivars. The concentration of the red pigment in the calyxes from fourteen sorrel cultivars was determined. Sorrel calyxes were ground 1/1 (w/v) in either ethanol or water. Following centrifugation, the solute was read in a spectrophotometer at 535 nm. Ethanol was found to be better for extracting the anthocyanin pigment. Paper chromatography, utilizing polar and nonpolar solvents, was used to separate the anthocyanin pigmented compounds. All pigments migrated with ethanol and water as the solvent, but chloroform inhibited all pigment migration while acetone inhibited a set of purplish pigments. Red and purple bands were observed in the paper chromatography which relates to cyanidines and delphinidines, respectively. These results indicate that sorrel has similar nutraceutical bioflavonoid compounds as found in cranberries and blueberries. Plant breeding has begun to increase the bioflavonoid content and develop a day-neutral caliche tolerant variety for year round production.

**Virginia**

Germplasm from S9 was acquired in Virginia by researchers at both Virginia Tech and Virginia State University. A joint project between Gregory Welbaum and Bingyu Zhou in the Department of Horticulture at Virginia Tech has been focused on screening Citrullus, Lageraria, and Preacitrullus accessions for resistance to the watermelon pathogen that causes fruit blotch, with the eventual objective of releasing blotch resistant cultivars. Although no complete resistance has been found, some resistance genes have been shown to interact with effector genes from the pathogen cloned into Escherichia coli. Dr. Zhao has also been studying host plant resistance in Panicum accessions to different bacterial pathogens. Sheena Friend, under the direction of Khidir Hilu, in the Department of Biology at Virginia Tech, has conducted a phylogenetic study on the genus Arachis using germplasm acquired from S9.

Two projects are ongoing at Virginia State University with S9 germplasm. The first is an evaluation of several accessions of three legume crops, Guar (Cluster bean – Cyamposis tetragonoloba), Sunn hemp (Crotalaria) and Lablab for potential production in Virginia. This effort, conducted by Harbans Bhardwaj, involved seed multiplication at Randolph Farm in 2010, followed by replicated field experiments with Guar and Lablab in 2011. Poor seed set of Sunn hemp prevented its inclusion in the replicated trials. In another study, Francoise Favi has been growing Cympogon accessions in the greenhouse of the Agriculture Research Station of Virginia State University to test volatiles and plants extracts on whitefly (Bemisia tabacci) and post-harvest insect pests.
Maria Virginia Sanchez Puerta, at the Universidad Nacional de Cuyo in Argentina, has used accessions of solanaceous species to test for resistance to root-knot nematode (*Meloidogyne* spp.).

These activities document the distribution and utilization of plant genetic resources, a primary objective of the regional project, in Virginia.
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**Plant Genetic Resources Conservation Unit**


Alabama


Florida


**Louisiana**


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Oklahoma


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