Project Number: S-009

Project Title: Plant Genetic Resources Conservation and Utilization

Period Covered: 07/2019 through 8/2020

Date of this Report: October 5, 2020

Annual Meeting Dates: August 26, 2020

Participants and Minutes:

https://www.ars.usda.gov/sp2UserFiles/Place/60460500/Documents/minutes/s9min2020.pdf

Accomplishments and Impacts

A large and highly diverse set of plant germplasm was preserved and distributed to scientists, educators, and plant breeders. A total of 100,081 accessions of 1602 plant species representing 286 genera were maintained in the Griffin plant genetic resources collection. Over 86% of these accessions were available for distribution to users and over 97% were backed up for security at a second location. A total of 16,275 seed and clonal accessions were distributed upon request to scientists and educators worldwide between October 1, 2019 and August 4, 2020. Sorghum, cowpea, peanut and pepper were the most distributed crops. Clonal collections were continually maintained and distributed to stakeholders. Clonal collections include warm-season grasses, bamboo, Chinese water chestnut, perennial peanut, and sweet potato. Preservation methods include tissue culture, field plots, greenhouse plants, and hydroponics. All of these activities ensure that the crop genetic resources at the Griffin location are safeguarded for future use in developing new cultivars and identifying novel traits and uses in our food and fiber crops.

Newly increased seed from a variety of crops in the collection were harvested, cleaned, and added to the collection to ensure high quality, viable seed samples continue to be available for distribution for scientific studies and breeding. During this process, valuable characterization data was collected in the field and greenhouse. Vegetable crops were regenerated in collaboration with USDA/ARS Parlier, CA, Rijk Zwaan, HM Clause, Bayer and the World Vegetable Center (Taiwan and Thailand). Peanut and cowpea were regenerated on site and digital images of peanut pods and seeds were captured. Numerous legume species, industrial crops, and warm-season grasses were regenerated on site as well. Sorghum was regenerated by USDA, ARS, Puerto Rico and received for cleaning and processing on site. Several sweet potato wild species were regenerated in greenhouses.

Collaboration continues with ARS Charleston (and CucCAP team) regarding evaluation of *Citrullus* and *Cucurbita* germplasm. Portions of the pepper collection are being screened for the presence of Pospiviroids and Tobamoviruses. Collaborative studies continue in an effort to examine genetic evolution in pepper by examining genome structure in collaboration with Baylor College of Medicine. Loofah fruit are edible and provide the well-known loofah sponge. Collaborative efforts have identified disease-resistant loofah and work is underway to examine genetic diversity in a loofah germplasm collection.

First year multi-location analysis of jute and basella for flavonol, cyanidin, and protein variability was completed. Significant location and accession effects were observed for quercetin and protein concentrations while only significant accession effects were found for kaempferol and cyanidin concentrations. Quercetin was negatively correlated with kaempferol and kaempferol was also negatively correlated with protein. Analysis of flower color, % germination, 100 seed weight, total seed weight, seed number, and origin for 26 butterfly pea accessions was completed. Flower color and origin were shown to be correlated. Butterfly pea germplasm was divided into five seed production groups. The information from these studies will provide plant breeders and scientists valuable biochemical variability in jute and basella as well as morphological and seed trait variation in butterfly pea for variety development.

Biochemical characterization of a wide variety of germplasm was conducted. In peanut, protein was measured to verify the role of location grown on this trait. The variation of oil content and fatty acid composition among six botanical varieties of peanut was measured to determine variation among botanical varieties. Flavonoids were measured in peanut root nodules to determine if flavonoids play a role in the development of root nodules in peanut as has been shown previously in soybean. Sugar content and flavonoids were measured in peanut sprouts to assess nutritive values. Protein content and flavonoid content of jute were measured to assess nutritive value in different germplasm populations. Genetic markers for the high oleic acid trait were used to determine if the high oleic trait is correlated with germination rate in peanut. In total, the molecular lab measured 172 samples for protein content, 700 samples for oil content, 740 samples for fatty acid composition, 60 samples for sugars, and 90 samples for flavonoids. DNA were extracted from 350 samples and genotyping was performed on 500 samples.

State Reports Submitted in 2020

Alabama

Charles Chen, University of Alabama

According to records provided by S-009, a total of 1021 accessions were mailed to Alabama from 2016 to 2019. In 2019, the requested germplasm covered 8 genera. They are Okra, Peanut, Peppers, Watermelon, Cucumber, Legume, Eggplant, and Cowpea. The most requested crop was peanuts by Tuskegee University (Table 1). The recipients of required germplasm were university scientists, consultants, seed companies, gardeners and citizens of Alabama (Table2). The largest number of accessions was requested by Dr. Guohao He at Tuskegee University for peanuts (328 accessions), following by Dr. Juan Liu from Dr. Charles Chen lab at Auburn University for peanuts (102 accessions), and Dr. Chiou from the University of Alabama for peppers (51 accessions). Four individuals in AL required germplasm. Blount County Learning Center and Rutledge Gardens required peppers, cucumber, eggplant, cowpea, okra and watermelon.
In addition to the records provided by S-009, the peanut breeding program by Dr. Charles Chen at Auburn University is maintaining the purified accessions of the U.S. peanut mini-core collection (104 accessions). Dr. Chen distributed the seeds of the U.S. peanut mini-core collection to Dr. Naveen Puppala at New Mexico State University, Agricultural Science Center at Clovis, NM 88101 for phenotyping of drought tolerance in field in 2019.

Table 1. Required Accessions by Genus in 2019

CROP	GENUS	TOTAL
Okra	*Abelmoschus*	3
Peanut	*Arachis*	64
Peppers	*Capsicum*	422
Watermelon	*Citrullus*	4
Cucumber	*Cucurbita*	3
Legume	*Pueraria*	1

Eggplant	*Solanum*	10
Cowpea	*Vigna*	12

Table 2. Required Accessions by Recipients

Year	University	Public Service/Primary Education	Private Sector	Total
2016	65	2	21	*88*
2017	267	1	10	*278*
2018	103	1	32	*136*
2019	483	5	31	*519*
Sub-Total	*918*	*9*	*94*	*1021*

Florida
Kevin Kenworthy, University of Florida

The state of Florida was very active in 2019 for plant genetic resources distribution. According to records provided by S-9, 33 different individuals requested materials from 15 different genera of plants and a total of 564 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.

Alan Chambers, University of Florida, Tropical Research and Extension Center reported the following: My lab has requested and continues to leverage plant genetic resources from the USDA GRIN collection. We have requested Vanilla from Hilo. They only had one accession available being an ornamental vanilla growing outside the USDA building. I am interested in providing genotyped vanilla accessions to GRIN. I ordered around 15 accessions of tropical raspberry from Corvallis to trial these types in southern Florida. We also regularly access the mango collection at SHRS in Miami for both genetics and fruit quality research. I have also requested two rice accessions from germplasm collection. The material is usually in good condition, though the GRIN system generally lacks the staff needed to process the volume of requests in a timely manner. Obtaining verified material is exceptionally valuable as anything available online comes in a “buyer beware” condition.

Jianjun Chen, University of Florida, Mid-Florida Research and Extension Center reported the following:

We placed an order from S9 for the following 23 Tephrosia PIs on the first of November 2019 and received 25 seeds per PI on the 18^{th} of November 2019.

Our initial plan was to collect as many Tephrosia PIs as possible to conduct a molecular analysis about their genetic relationships. Based on the relationships, select representatives for studying their symbiosis and other potential economic value. The seeds were germinated by two tests: first 10 seeds each and then the rests. Ten

PIs failed to germinate. Among the germinated 13, six had two plants with poor growth vigor.

We also received some seeds from DLEG, those also had germination problems. We are probably not going to run molecular analysis due to the low numbers of collection. At this time, we try to grow them to see how many could survive in Florida.

Gokhan Hacisalihoglu, Florida A&M University reported the following: As lockdowns and campus/lab closures forced to postpone our research plans in 2020, there is no progress report available about the germplasm at the moment.

Heqiang (Alfred) Huo, University of Florida, Mid-Florida Research and Extension Center reported the following: My group frequently use this system and request some ornamental plant germplasms. I noticed that the plant materials or seeds from USDA ornamental plant germplasm center (OPGC) are not in high quality and delivered very slow, presumably because of tight budget compared to other field crops or cash crops. In the past three years, we have requested 70 different begonias ordered from OPGC, and received 33 of them. In addition, we have ordered seeds of 29 snapdragon germplasms, some of them have poor viability.

Sam Hutton, University of Florida, Gulf Coast Research and Extension Center reported the following:

Tomato is a little interesting, as we have two germplasm repositories: the USDA ARS tomato collection at the Plant Genetic Resource Unit in Geneva, NY; and also the tomato collection at the Tomato Genetic Resources Center in Davis, CA. I believe both are supported to some extent by the USDA.

Kurt Perez, Elementary School Teacher reported the following: My students planted all sample seeds in the Elementary School Garden this year. Thank you so much.

Heather Martin, Hyldemoer Farms reported the following: In the fall of 2019 I ordered 50 seeds each of 5 varieties of *Hibiscus sabdariffa*. The shipment arrived swiftly and in good order. We were looking for unique varieties that we could compare to more commercially available varieties and then further to utilize those less commercially available varieties to augment several value added fresh from farm products that we produce.

We finally planted those ordered seeds about 3 weeks ago. We were skeptical given the age of some of the seeds, but the seeds received from GRIN all germinated and have outgrown commercial varieties planted at the same time.

Jimmy Webb, University of Florida, Environmental Horticulture reported the following: In 2019 we received a sample of the USDA GRIN's entire collection of Hibiscus cannabinus. Our purpose in obtaining this collection is that it is the most complete collection that we could obtain in order to move forward with our research. We are a group under the direction of Dr. Dave Clark a plant breeder at the University of Florida. We are currently screening the kenaf collection to determine which variety currently has the greatest potential for pulp production as a replacement for tree production in the southeastern United States. As much of the timber areas in Florida were devastated in hurricanes over the last few years the timber industry has been set back for decades. The seeds are currently sown out and planted in research fields at the University of Florida's, Citra location, to determine total fiber production, time of flowering and days till harvest. At the end of this trial we will have selected down to around 10 cultivars that we will then add to our breeding program in order to maximize the fiber production and growth cycle of these cultivars. These cultivars will be used to aid timber producers as well as pulp plants to have a steady supply of a fiber crop that can be ground in about 120 days as opposed to a timber crop that takes 30 years to mature.

Georgia
Soraya Leal-Bertioli, University of Georgia

In the state of Georgia, 161 requests for plant germplasm were made to in 2019/2020. As a result of these requests, S-009 provided 1,408 plant accessions. The recipients were University scientists (187 accessions/3,231 accessions in previous reporting period), USDA scientists (1187/186 in previous reporting period), privately owned seed companies/farmers (22/8 in previous reporting period), schools (9), community service entity (2) and citizens of Georgia (1). The most requested crops were peanut/wild peanut (451 accessions), sorghum (422) and Capsicum (398).

The University of Georgia maintains strong emphasis on plant breeding and continues to expand its advanced molecular biology programs. The Institute of Plant Breeding, Genetics, and Genomics at UGA currently has 48 total faculty members, being 29 full faculty from the departments of Crop and Soils Science, Plant Pathology and Horticulture, six adjunct faculty, seven affiliated members from the USDA and three emeritus members. The main mission of the Institute is to develop improved plant cultivars from agronomic and horticultural species of importance to Georgia, the U.S., and worldwide. UGA currently has active cultivar development programs in soybean, peanut, small grains, cotton, turfgrass, forages, blueberry, pecan, grape, pepper, peach, watermelon, and numerous ornamental crops that frequently utilize the plant genetic resource collections. These cultivar development programs released 11 cultivars during Aug 2019-Jul 20 (Table 1).

Table 1. Cultivar and Germplasm Releases from UGA Breeding Programs in 2019-2020.

Cultivar Registration	Main Breeder	Date of Release
Peanut		
Spear-shaped leaf	N Brown and W Branch	August 19
Albino-virescent leaf	N Brown and W Branch	August 19
Revolute Leaf	N Brown and W Branch	August 19
GA 132724	W Branch	Sept 19
132724	W Branch	Sept 19
Artemisia annua		
C1, C10, B6, P137	H Wetzstein	Sept 19
Soybean		
G11-7013	Zenglu Li	August 19
Wheat		
09377-16LE18	M Mergoum	Sept 2019
09436-16LE12	M Mergoum	Sept 2019
071518-16E39	M Mergoum	Sept 2019
09129-16E55	M Mergoum	Sept 2019

Faculty is also engaged in training graduate students and the graduate program currently has 39 students (17 MS and 22 PhD), and post-docs involved in various aspects of plant improvement. 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. The 42 publications produced in the period 2019-2020 (listed below) demonstrate the importance of this germplasm for education and advancement of science. In addition, five patents were registered involving uses and methodology for watermelon, *Capsicum* and *Hibiscus*.

Research programs in crop science, horticulture, plant pathology, entomology, molecular biology 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 and U.S. agriculture. The S-009 unit remains a critical component of our research, cultivar development, innovation and student training programs in Georgia.

Guam

Mari Marutani, University of Guam

a. Progress Report:

1. Evaluation of germplasm adaptation to Guam's climate

Phenotypic data of roselle (Hibiscus sabdariffa) germlines from the field experiment of March 27 – December 3, 2018 were summarized in 2019 at University of Guam Horticulture laboratory. The aim of the field trial was to discover the morphological differences of ten cultivars, to determine adaptability of cultivars suited to grow in Guam's climate, and to quantitatively measure differences in anthocyanin contents of calyxes for each cultivar. Morphological characters studied at the field included plant height, canopy form, leaf color and calyx color.

Three cultivars of commercial pickled cucumbers (Cucumis sativa) were studied for their field performance in Guam, 'Excelsior,' 'Adam Gherkin F1,' and 'Northern Picking.' Melon fly (Bactrocera cucurbitae) was the major pest, puncturing young fruits to lay eggs. A fungal disease, anthracnose (Colletotrichum orbiculare), caused severe infection on fruits. The majority of fruits became unmarketable. Cultivar 'Excelsior' showed some degree of resistance; however, the results were inconclusive.

Phytochemical analysis focusing on capsaicinoids in local chili peppers (Capsicum spp.) and anthocyanins in roselle (Hibiscus sabdariffa) were conducted. A local line of Capsicum frutescens showed a high concentration of capsaicin and dihydrocapsaicin. A preliminary study of anthocyanins in roselle calyxes of accessions showed differences in the total contents of anthocyanins in calyxes of cultivars, and identification of individual anthocyanins is being investigated.

2. Acquisition and conservation of plant germplasms

2.1 Sweetpotato, Ipomoea batatas:

Sixteen (16) in-vitro sweetpotato (Ipomoea batatas) germlines have been maintained in tissue culture laboratory of Horticulture Unit at the University of Guam: PI 531122 (Jewel, Peru), PI 531126 (Vilca, Romero, Peru), PI 531131 (Camote Morado-1, Peru), PI 531149 (Amarilo local, Peru), PI 531150 (Lurin, Peru), PI 531154 (Corazon de Huarango, Peru), PI 531168 (Morado de Cante), PI 538289 (Morado, Peru), PI 566613 (Beauregard, US, Louisiana), PI 573322 (85016-100 Tonga). PI 645582 (Okinawa Purple), '15-0001,' 'Liberty.' 'SP16-0003,' 'SP16-0004,' and 'Stokes.'

2.2 Chili pepper (Capsicum spp.)

Local lines of chili peppers were collected from local growers for seed production and characterization study at Guam Agricultural Experiment Station.

2.3. Eggplant (Solanum melongena)

Local lines of chili peppers were collected from local growers for seed production and characterization study at Guam Agricultural Experiment Station.

b. Outcomes / Impact:

The search for new germlines and commercial cultivars with heat tolerance and pest resistance will assist growers in choosing locally adapted vegetable crops to promote their farming operation in Guam.

Louisiana
Don LaBonte, Louisiana State University

Sweetpotato germplasm requests from the S-9 repository serve two purposes: 1) in search of a source of resistance to specific diseases, and 2) to evaluate resistance to diseases of germplasm in the collection to assist the curator in expanding the information in the characterization database. Specifically, we have requested germplasm to search for a source of resistance to the reniform nematode, *Rotylenchulus reniformis*, for which we do not yet have a good source, for the recently re-emerged black rot pathogen, *Ceratocystis fimbriata*, and for the recently introduced guava root-knot nematode, *Meloidogyne enterolobii*. USDA-APHIS-PPQ has a significant number of requested accessions now being processed for ultimate release. Other Louisiana germplasm requests for 2019 were for evaluation only.

Mississippi
Brian Baldwin, Mississippi State University

Germplasm requested from GRIN during 2019-202019 were used for various personal, research and extension activities. During this period only eight requests were made from the S-009 Unit by five entities in Mississippi. Of the eight requests, two were made for personal use.

Dr. Barickman is located at Verona Branch Station and is working on evaluating Vigna species as a summer cover crop. Dr. Flecher of USDA-ARS is working in conjunction with Dr. Barickman.

USDA-ARS at Poplarville makes requests annually. Sorghum bicolor was requested as a control for cytology and polypoidy studies using flow cytometry.

Plant Variety Protection examiners have approved the lowland switchgrass variety ‘Expresso’ (syn ‘Espresso’), and issuance of the PVP (#201800200) is immanent. Breeder’s seed of the five entries has been delivered to Roundstone Native Seed, LLC. (Upton, KY and Live Oak, FL). Foundation fields have been established. Spring, 2020 will initiate the generation of registered seed increase.

‘Tusca’ is a cultivar of lowland switchgrass selected from ‘Alamo’ (USDA NRCS, Knox City, TX) for resistance to the herbicide imazapic. Plant patent has had its final assessment from the patent examiner, but is still listed as pending (https://patents.google.com/patent/US20190014734A1/en). Additional screening to determine if selection for Tusca conferred cross-resistance to similar ALS-inhibiting herbicides was conducted. Five ALS-inhibiting herbicides including; imazapic (IPIC), imazamox (IMOX), imazapyr (IPYR), imazethapyr (ITHR), and metsulfuron methyl (MSUM), were tested.

Copian, sun tolerant germplasm of southeastern wildrye (Elymus glabriflorous) has been transferred to Roundstone Native Seed, LLC. (Upton, KY and Live Oak, FL). Protection is being applied for.

Oklahoma
Yanqi Wu, Oklahoma State University

A total of 981 plant accessions maintained at the USDA ARS Plant Genetic Resources Conservation Unit at Griffin, GA were distributed to organizations and individuals in Oklahoma in this reporting period. The requested plant germplasm included peanuts (*Arachis* spp.*),* clovers *(Triforlium* spp.*),* sorghum (*Sorghum* spp.*),* perennial grasses (*Axonopus compressus, Brachiaria* spp.*,* and *Zoysia matrella*)*,* okra (*Abelmoschus esculentus*), cowpea (*Vigna* spp.), watermelon (*Citrullus lanatus*), pepper (*Capsicum annuum*), switchgrass (*Panicum virgatum*), white morning glory (*Ipomoea* spp.), Korean clover (*Kummerowia stipulacea*), guar (*Cyamopsis* spp.), and Sesbania legumes (*Sesbania* spp.). Receivers of the plant accessions include researchers at USDA-ARS laboratories, Oklahoma State University, Noble Research Institute, and residents in the state.

Puerto Rico
Vivian Carro-Figueroa, University of Puerto Rico

<u>Legumes</u>

Pigeonpea [*Cajanus cajan* (L.) Mill.] cultivar 'Lazaro' was released. The seed-yield averages varied from 338 to 1,091 kg ha^{-1} in Puerto Rico, and over 3,300 kg ha^{-1} in California. Also, the agronomic performance of 20 common bean (*Phaseolus vulgaris* L.), and 3 tepary bean (*P. acutifolius* A. Gray) and their response to ashy stem blight (ASB), caused by the fungus *Macrophomina phaseolina* (Tassi) Goidanich, were evaluated. Tepary beans PI 313488, PI 462025, and PI 477037; and common bean TARS-MST-1 had the highest seed-yield (345-512 kg ha^{-1}) in Lajas where higher ASB pressure was observed. However, only PI 313488 and TARS-MST-1 had lower ASB severity with mean scores values of 4.0 and 3.0, respectively.

<u>Forages</u>

A field study (Fall 2019) assessed six determinate type cowpea's [524B and CB 27, CB 46 (California lines), Mouride (Senegal improved line), IFE brown (Nigeria improved line) and the commercial variety Iron clay effects on forage dry matter yield (DMY; flowering stage and pre-pod stage), nutritional value and seed yield in Puerto Rico. Higher DMY was observed on 524B line (2.4 and 2.0 Mg/ha, for flowering stage and pre-pod stage, respectively) and also higher seed yield (1.4 Mg/ha) compared to other cowpea lines. Iron clay crude protein (two percent units higher), neutral (58%) and acid detergent fiber (44%) maintained superior nutritional value at both growth stages because of continued vegetative growth, but seed yield was lower (0.5 Mg/ha) than other lines. Line 524B shows potential for commercial forage and seed production in Puerto Rico, requiring further assessment before release.

<u>Fruits</u>

<u>*Passiflora*</u>

Passion fruit (*Passiflora edulis*) accessions (named PP, M, and E) have grown well in Puerto Rico, but with differences among accessions. In Adjuntas, M has been the most vigorous accession, with thicker and longer vines, larger and darker individual leaves, greater plant leaf area, and less lateral branching. In accession E, plants are about 35% smaller and have twice the number of branches than M plants. M and E were selected by the PI from western PR. PP is considered the check accession, as it was obtained from the largest passion fruit farm in the island. In PP, overall plant size is about 25% smaller than in M, and

PP vine branching is 5x the amount of M and 2.5 x the amount of E. During the vegetative stage, M has required less lateral branch pruning, hence lower labor costs, which is important for growers.

Citrus

The AES has been evaluating combinations of different scions and rootstocks to see their potential at different locations (i.e. with different soil, climate and elevation). At present, we are evaluating three citrus varieties (Mexican lime (ML), fine clementine mandarin (FCM) and Campbell Valencia orange (CVO) in three rootstocks (Swingle, HRS 812 and HRS 897) under fertigation practices in Isabela-AES. At 29 months after planting, ML exhibited significant difference for canopy volume, fruit production and tree efficiency. The HRS 897 rootstock had higher canopy volume (6.9 m3), fruit per tree (#11) and tree efficiency (1.65#/m3) versus Swingle and HRS 812 (~6.45 m3, 6 and 0.94 #/m3, respectively). FCM had significant difference for rootstock/scion ratio canopy volume and tree efficiency. Lower rootstock/scion ratio was observed in Swingle (42.6) versus the other two rootstocks (~47.2). HRS 897 had higher tree canopy (8.3 m3) than Swingle and HRS 812 (~7.65 m3). However, HRS 812 had higher tree efficiency (10.3 #/m3) than the other two rootstocks (3.25 #/m3). In CVO significant difference was found for height, rootstock/scion ratio, tree canopy and tree efficiency. HRS 812 had less tree efficiency (0.98 #/m3) and rootstock/scion ratio (51.5%) than Swingle and HRS 812 (~1.48 #/m3 and 54.7 %, respectively). However, HRS 897 had higher height (1.84 m) than HRS 812 (1.72 m) and Swingle (1.28 m). In addition, HRS 897 had higher tree efficiency (8.3#/m3) than the other two rootstocks (7.65 #/m3). In terms of CG, 49 % of the trees were positive to CG (ML: 9-HRS 812, 5-Swingle, 3-HRS 897; MCF: 6-HRS 812, 5-HRS 897, 5-Swingle; CVC: 8-HRS 812, 5-HRS 897, and 7-Swingle) and there were two dead trees (1ML and 1CVO both grafted in Swingle).

Melicoccus bijugatus (Quenepa)

Physicochemical and fruit quality characteristics of 18 quenepa clones is being carried out to culminate the evaluation of clones in the Juana Diaz AES collection. Samples were obtained from two harvests during July and September 2019. Seventeen clones were evaluated for size, color, pH, titrable acidity and total soluble solids. Range for fruit size was: weight 9.7 to 19.5 g, length 28.3 to 39.6 mm, width 23.7 to 56.6 mm. The weight of the seed and the peel of fruit varied from 1.5 to 5.8 g and 2.1 to 4.8 g, respectively. The pulp color varied from pale orange yellow to strong orange. The quantity of total soluble solids varied between 17.4 to 25.2 °Brix. Acidity ranged from 0.71 to 2.03% citric acid. The pH ranged from 3.11 to 3.79. These results are from a partial analysis of the data. The data on titratable acidity, Brix, and pH will still be analyzed until September 30. Due to the quarantine imposed by COVID-19, theses analyze were interrupted.

Banana and Plantain

The plantain (AAB) collection was renovated in June 2020, with 18 accessions, including two new entries, Curare and FHIA20. These two new entries were introduced in Puerto Rico by tissue culture plantlets from a private producer and their agronomic performance is being evaluated. The banana (AAA) collection was renovated in June 2020 with 26 varieties. The variety FHIA02, a Black Sigatoka resistant variety, is being evaluated for its response to nematodes.

Root Crops

The sweet potato (*Ipomoea batatas*) collection at Corozal will be renovated in August 2020 with a new introduction for a total of 30 accessions. Two varieties developed at the PRAES, 04-006 and 04-180, are under agronomic evaluation for potential release to farmers. Integrated management practices for the production of commercial quality sweet potatoes are also being evaluated by a graduate student.

The tanier (*Xanthosoma sagittifolium*) collection at Isabela was renovated in June 2020. Two varieties developed at the AES, Nazareno and a Vinola segregating variety, are under agronomic evaluation for potential release to farmers. The Yam (*Dioscorea* spp.) collection was renovated in June 2020, including a new introduction, for a total of 22 entries. The Cassava (*Manihot esculenta*) collection was also renovated with two new introductions for a total of 29 accessions. The AES-Adjuntas apio (*Arracacia xanthorrhiza*) collection, with 4 varieties adapted in Puerto Rico, was established to evaluate their response to an irrigated system.

Propagation material from the plantain, banana and root crops collections were distributed to local farmers from over 19 municipalities in Puerto Rico. In 2019, until September, there were 38 records of germplasm requests by farmers from the Corozal AES collections. Sweetpotato requests account for 55% of this total.

Coffee

The genotyping of Limani and Fronton, two coffee leaf rust-resistant cultivars at Adjuntas AES, is being performed by Single Nucleotide Polymorphisms (SNPs) markers using 140 entries from a total of 600, from each variety, and using genomic DNA extraction of youngest leaves. We are currently waiting for the SNPs analysis results.

South Carolina
Richard Boyles, Clemson University

I. Germplasm Received from the Plant Genetic Resources Conservation Unit, Southern Regional Plant Introduction Station, Griffin, GA**:**

The following list of germplasm was received, representing 17 different researchers or individuals in SC during the 2019.

Genus	**# of accessions**
Andropogon	3
Arachis	19
Capsicum	219
Citrullus	345
Hibiscus	14
Sorghum	133
Urochloa	3
Total	**736**

II. Germplasm Uses

Nearly half of the 2019 GRIN requests to the S-009 unit represented the *Citrullus* genus. Efforts in melon continue toward improving watermelon for disease and pest resistance, including resistance to Fusarium wilt, gummy stem blight, papaya ring spot virus and whiteflies. Following melon, there was an increase in the amount of *Capsicum* accessions sourced to screen for potential resistance to the invasive root-knot nematode species *Meloidogyne enterolobii*. Several accessions with possible sources of resistance to this pest were identified, but this work is still in progress, with planned publications to follow. In addition to research, diverse peppers were requested by an organic and conventional farm operations to evaluate for adaptability and end-use traits for potential production and distribution to restaurants and other food providers. Much of this effort was reduced due to the COVID-19 pandemic. As typical, a significant number (n=133) of sorghum accessions were requested from GRIN that represented four different researchers. Sorghum traits under evaluation by these researchers included malting potential, abiotic stress, and various quality traits. A small number of peanut accessions were solicited to screen them for abiotic stress tolerance, primarily heat stress.

Tennessee
Virginia R. Sykes, University of Tennessee

Over the past four years (2016-2019), 69 requests for GRIN germplasm were made from Tennessee (2016: 28 requests, 2017: 13 requests, 2018: 11 requests, 2019: 17 requests). These requests came from 33 entities representing individuals (13), as well as public (10) and private institutions (10). Germplasm were obtained from the following genera: Abelmoschus, Capsicum, Chloris, Citrullus, Cucurbita, Digitaria, Eleusine, Hibiscus, Indigofera, Ipomoea, Melothria, Sesamum, Solanum, Sorghum, Strophostyles, Trifolium, and Vigna. Reports were received from three scientists in Tennessee who utilized germplasm from the GRIN collection for active research projects in 2019. These projects resulted in three publications, two cultivar releases, and one germplasm release.

Texas
Gerald R. Smith, Texas A&M University

Guar, lablab bean and quinoa accessions were evaluated for salinity and heat tolerance in growth chamber and greenhouse experiments. No salinity tolerance was noted in the lablab bean. Guar accessions were also used to optimize gene editing techniques using CRISPR/Cas9 technology with the ultimate goal of increasing guar gum production potential.

Multiple private seed companies evaluated sorghum germplasm for disease and insect tolerance, forage production, forage quality and other traits. The USDA sorghum breeding program in Lubbock, TX evaluated sorghum accessions for drought tolerance and adaptation to the Southern Great Plains. Maize, sorghum and setaria germplasm was characterized for their ability to respond to pathogen signals and develop host immune responses.

Sorghum germplasm was evaluated in Dr. Magill's lab (TAMU Plant Pathology) to determine response to *Colletotrichum sublineola* and to identify host plant resistance. A Genome Wide Association Mapping study identified 8 genes that may contribute resistance or tolerance.

Peanut germplasm was evaluated at Lubbock, TX for resistance to *A. flavus* and to identify resistance mechanisms.

Evaluation and breeding continues on forage and multi-use cowpea for Texas. Ace is a small seeded cultivar of forage cowpea (*Vigna unguiculata* [L.] Walp.) that was developed by Texas A&M AgriLife Research at Overton, TX. Ace is intended for use in wildlife supplemental plantings, cover cropping systems and hay production systems. In other experiments, sixteen forage cowpea plant introduction lines were evaluated for agronomic traits and pest resistance to enhance double cropping and cover crop rotation systems in northeast Texas and the southeastern U.S. Several PI lines were identified with improved biomass and seed production and one PI line and one breeding line with resistance to the southern root-knot nematode.

Virginia
Bastiaan Bargmann, Virginia Tech

Several institutions in Virginia have used germplasm provided by the S-009 project over the last five years for educational purposes as well as differing lines of research, some with promising results that are expected to lead to publications in the near future. Moreover, four articles were reported to have been published in the last year, listed below. Dr. Balota's group at Virginia Tech used sorghum germplasm obtained from the S-009 project for an association panel to phenotype for disease susceptibility and temperature base for germination. Dr. Bhardwaj's group at Virginia State University used germplasm obtained from the S-009 project in field evaluation studies for preliminary production potential and identification of adapted lines for future breeding. Dr. Collakova's group at Virginia Tech used peanut germplasm obtained from the S-009 project to study oil production and gather preliminary results for grant submissions. Andre Diatta at Virginia Tech used mungbean germplasm obtained from the S-009 project in greenhouse and field studies in Blacksburg, VA and Senegal. The Heights Homeschool used peanut, cucumber, and pepper germplasm obtained from the S-009 project for education purposes. Dr. Mehl at Virginia Tech used sorghum germplasm obtained from the S-009 project to screen for resistance to fungal diseases and mycotoxins. MountainRose Vineyards used Catharanthus germplasm obtained from the S-009 project to develop grafting procedures and perform location studies. Dr. Zhang's group at Virginia Tech used soybean germplasm obtained from the S-009 project to make crosses to improve agronomic and quality traits. Dr. Zhao's group at Virginia Tech used germplasm obtained from the S-009 project to evaluate bacterial leaf spot disease resistance and the bacterial fruit blotch disease resistance in pepper and melon, respectively. There were multiple users for whom the recorded contact information was no longer valid and attempts at communication were not successful.

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