

## Ornamental Plant Germplasm Exploration in Tropical Forests of Puerto Rico

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In May 2005, an ornamental plant exploration trip was conducted in remnant forests of Puerto Rico. The main focus of this collection trip was *Tabebuia haemantha*, a rare Puerto Rican endemic that has many features of interest to horticulture industry. It is a small-statured tree, evergreen, red-flowered, and is largely unknown in cultivation. Also of interest and worth looking for were improved forms of *Tabebuia heterophylla*, the common pink *Tabebuia*. This species, widely produced and planted in southern Florida, has suffered from a great deal of inbreeding, as local seed sources are continuously used for the production. The species is also currently negatively impacted by a new thrips species. It was hypothesized that new germplasm from offshore populations of *T. heterophylla* might show variable resistance to this pest. Also collected were seeds and cuttings of other genera (including *Coccoloba*, *Poitea*, *Simarouba*, *Hillia*, *Turnera*, and *Polygala*) for evaluation as potentially new tropical and subtropical ornamentals in southern Florida. A number of these endemic Puerto Rican plants are threatened or endangered in their natural habitats.

One of the roles of the ornamental plant germplasm program at the USDA Subtropical Horticulture Research Station (SHRS) is the evaluation of new plant introductions for their potential as ornamentals. The National Germplasm Repository located in Miami, FL, has been active in the collection of ornamental plants for the last decade. Collecting has intensified in the last few years via collaborations with worldwide contacts who are directly involved in the identification, collection, and importation of superior selections of ornamental plants.

Puerto Rico is a natural place to turn to for ornamental germplasm suitable for cultivation in the mainland subtropics of the United States (Schubert, 1979). As part of the United States, collection of material is free of the constraints imposed by the Convention on Biological Diversity (CBD, 1992), as would be the case with collections from other Caribbean nations. A status report of the Woody Landscape Plant Crop Germplasm Committee (WLPCGC) (2004) identified Puerto Rico as a geographic priority for exploration. In 2005, an exploration grant for a plant collecting trip to Puerto Rico from the Plant Exploration Office, which is part of the National Plant Germplasm System, was successfully obtained. The main focus of this plant exploration (collection) trip was to identify seed sources of *Tabebuia haemantha*, a rare Puerto Rican endemic with many traits of interest as an ornamental (Little et al., 1974; Walter and Gillet, 1997).

The nearly four million people that inhabit the island of Puerto Rico make it one of the most densely populated areas in the world, with >445 inhabitants/km<sup>2</sup> (U.S. Census Bureau, 2006). As land-use pattern changes due to economic pressure for development,

native vegetation will likely face new threats from both urban sprawl and the modernization of agricultural practices. A survey of the Germplasm Resources Information Network (GRIN) database (<<http://www.ars-grin.gov>>), and U.S. arboreta and botanical gardens indicated that ornamental germplasm from Puerto Rico was underrepresented in these collections.

Collaboration and collection agreements between SHRS in Miami, FL, the Tropical Agriculture Research Station (TARS) in Mayaguez, P.R., and the Puerto Rican Department of Agriculture, Natural Resources Division, led our team to conduct the exploration in 2005. Collectively, an itinerary was developed for exploration to sample a broad range of sites in the west, north, south, and east quadrants of the island. These quadrants ranged from dry forest vegetation within the arid southwest to wet rain forest in the east. Sites focused on the targeted species identified by the WLPCGC and current needs for southern Florida climatic conditions, botanical gardens, and the NPGS.

### Materials and Methods

A number of plants of ornamental interest were collected in Puerto Rico from 3 May to 18 May 2005 (Table 1). The route taken during exploration is shown on the map (Fig. 1). Using past experience and knowledge of the areas, efforts concentrated in six major areas, which included the main commonwealth national forests of Maricao (Maricao, P.R.), Susua (Sabana Grande, P.R.), Guanica Dry Forest (Guanica, P.R.), Toro Negro Forest (Villalba, P.R.), the Southern Region (Ponce, P.R., and adjacent towns) and Luquillo National Forest (Luquillo, P.R.).

The collecting expedition was funded by the USDA, Agricultural Research Service, Plant Exploration Office, and endorsed by the WLPCGC. The TARS served as our base, with excursions to the west and southwest. The first excursion went northwest through Maricao towards Sabana Grande (Susua Forest) and

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Table 1. List of species collected in Puerto Rico.

Genus species	Location	Latitude	Longitude	Elevation
<i>Areca macrocarpa</i>	Mayaguez-USDA TARS	N18°12.801'	W67°08.10'	10.3 m
<i>Calyptronomia rivalis</i>	Cambalache State Forest nursery	N18°27.151'	W66°35.832'	34.0 m
<i>Cassia javanica</i>	Mayaguez-USDA TARS	N18°12.801'	W67°08.10'	10.0 m
<i>Cassia polyphilla</i>	Cambalache State Forest nursery	N18°27.151'	W66°35.832'	34.0 m
<i>Cavanillesia platanifolia</i>	Mayaguez-USDA TARS	N18°12.801'	W67°08.10'	10.3 m
<i>Coccoloba pubescens</i>	Cambalache State Forest nursery	N18°27.381'	W66°35.162'	34.5 m
<i>Coccoloba rugosa</i>	Botanical Garden, Rio Piedras P.R.	N18°23.495'	W66°03.319'	17.1 m
<i>Coccoloba sintenisii</i>	Bosque Maricao, Hwy 120, dirt trail	N18°09.710'	W66°59.782'	632.0 m
<i>Coccoloba sintenisii</i>	Bosque Susua, Sabana Grande, P.R.	N18°04.277'	W66°54.488'	172.0 m
<i>Coccoloba sintenisii</i>	Maricao, Km 16.5	N18°09.710'	W66°59.782'	632.0 m
<i>Coccoloba sintenisii</i>	Maricao, Km 16.4	N18°09.710'	W66°59.782'	632.0 m
<i>Coccoloba sintenisii</i>	Carr. 120, Km 15.3 Maricao	N18°09.710'	W66°59.782'	632.0 m
<i>Coccoloba sintenisii</i>	Carr. 120, Km 13.0 Maricao	N18°08.460'	W66°58.261'	807.7 m
<i>Forsteronia portoricensis</i>	San German near Tomas's House	N18°08.704'	W67°01.405'	356.6 m
<i>Forsteronia portoricensis</i>	Luquillo National Forest, 1st Km on Toro Negro trail from Road 186	N18°18.752'	W65°49.338'	606.0 m
<i>Gaussia attenuata</i>	Cambalache State Forest nursery	N18°27.955'	W66°35'.530'	034.5 m
<i>Hillia parasitica</i>	Bosque Maricao	N18°08.994'	W66°59.426'	837.0 m
<i>Hirtella rugosa</i>	unmarked road off of Road 186 that leads to Rio Espiritu Santo, El Yunque National Forest	N18°18.752'	W65°49.338'	530.0 m
<i>Hymenaea courbaril</i>	2 Km from P.R.-2, Rt. 119	N18°08.704'	W67°01.405'	356.6 m
<i>Hymenaea courbaril</i>	Cambalache State Forest	N18°27.151'	W66°35.832'	034.5 m
<i>Hymenocallis</i> sp.	Quebradillas, "El Tunel"	N18°29.741'	W66°57.545'	003.1 m
<i>Inga</i> sp.	Guilarte forest	N18°08.678'	W66°46.056'	342.0 m
<i>Ipomaea repanda</i>	Guilarte forest /Ruta 7740, Km 6.6	N18°06.098'	W66°01.951'	342.0 m
<i>Lagostromia speciosa</i>	Mayaguez, near TARS station, street planting	N18°12.801'	W67°08.100'	10.0 m
<i>Chionanthus holdridgii</i>	dryer slopes Bosque Maricao, Hwy 120, dirt trail	N 18°10.12'	W66°16.566'	632.0 m
<i>Chionanthus holdridgii</i>	Carr. 120, Km 15.0 Maricao	N18°08.976'	W66°59.169'	850.7 m
<i>Magnolia portoricensis</i>	Bosque Maricao, Hwy 120,	N18°09.048'	W66°59.874'	838.5 m
<i>Magnolia portoricensis</i>	Carr. 120, Km 13.5 Maricao	N18°08.605'	W66°58.626'	845.5 m
<i>Magnolia portoricensis</i>	Carr. 120, Km 15.7 Maricao	N18°09.036'	W66°59.435'	838.2 m
<i>Mammea americana</i>	Mayaguez-USDA TARS	N18°12.801'	W67°08.10'	010.0 m
<i>Manilkara bidentata</i>	Cambalache State Forest nursery	N18°27.151'	W66°35.832'	009.0 m
<i>Persea urbaniana</i>	San German, P.R. near Tomas House	N18°08.704'	W67°01.405'	356.6 m
<i>Plumeria obtusa</i>	San German, P.R. near Tomas House	N18°08.704'	W67°01.405'	356.6 m
<i>Plumeria obtusa</i>	dryer slopes Bosque Maricao, Hwy 120, dirt trail	N18°10.125'	W66°16.566'	632.0 m
<i>Plumeria alba</i>	Peñuelas, P.R.	N17°59.617'	W66°42.364'	122.0 m
<i>Polygala cowellii</i> (Britton) Blake	Cambalache state forest nursery	N18°27.380'	W66°35.166'	33.93 m
<i>Posoqueria latifolia</i>	Mayaguez-USDA TARS	N18°12.801'	W67°08.10'	010.0 m
<i>Pouteria multiflora</i>	Luquillo National Forest, Vereda de La Coca	N18°18.928'	W65°46.251'	476.0 m
<i>Prestoea montana</i>	Bosque Maricao, at old observation structure	N18°06.672'	W66°58.802'	900.0 m
<i>Prestoea montana</i>	Luquillo National Forest, 1st Km on Toro Negro trail from Road 186	N18°18.752'	W65°49.338'	606.0 m
<i>Ravenia urbanii</i>	Unmarked road off of Road 186 that leads to Rio Espiritu Santo	N18°18.752'	W65°49.338'	533.4 m
<i>Renalmia jamaicensis</i>	Bosque Carite	N18°06.599'	W66°03.372'	342.0 m
<i>Renalmia occidentalis</i>	Carr. 120, Km 11.7 Maricao	N18°08.719'	W66°57.723'	733.3 m
<i>Sabinea florida</i>	Luquillo National Forest, Quebrada Sontodoria off Ruta 186, Km 20	N18°19.444'	W65°49.203'	243.0 m
<i>Sabinea punicea</i>	Bosque Maricao, Hwy 120, dirt trail	N18°09.710'	W66°59.782'	632.0 m
<i>Sabinea</i> sp.	Guanica Dry Forest, Guanica, P.R.	N17°58.284'	W66°52.133'	122.0 m
<i>Simarouba tulae</i>	Carr. 120, Km 11.7 Maricao	N18°08.719'	W66°57.723'	733.3 m

Table 1 continued on next page.

Table 1. List of species collected in Puerto Rico (*continued from previous page*).

Genus species	Location	Latitude	Longitude	Elevation
<i>Simarouba tulae</i>	Unmarked road off of 186 that leads to Rio Espirito Santo, El Yunque Nacional Forest	N18°18.752'	W65°49.338'	530.0 m
<i>Tabebuia chrysotricha</i>	Mayaguez-USDA TARS	N18°12.801'	W67°08.108'	010.0 m
<i>Tabebuia haemantha</i>	San German, base of Maricao State Forest	N18°09.908'	W67°00.776'	430.0 m
<i>Tabebuia haemantha</i>	Bosque Maricao, Hwy 120	N18°10.120'	W66°16.566'	632.0 m
<i>Tabebuia haemantha</i>	SE of Susua State Forest, 2.3 miles from P.R.-18	N18°04.437'	W66°55.656'	210.0 m
<i>Tabebuia heterophylla</i>	Peñuelas, P.R.	N17°59.617'	W66°42.364'	122.0 m
<i>Tabebuia heterophylla</i>	Bosque Rio Abajo	N18°19.998'	W66°40.250'	330.0 m
<i>Tabebuia heterophylla</i>	Bosque Carite	N18°06.599'	W66°03.372'	342.0 m
<i>Tabebuia rosea</i>	Naguabo (downtown) P.R.	N18°12.140'	W65°43.650'	021.0 m
<i>Tabebuia schumaniana</i>	Ruta 7740, Km 6.6, bosque Carite	N18°06.098'	W66°01.951'	342.0 m
<i>Tabebuia schumaniana</i>	Bosque Maricao, Hwy 120	N18°09.048'	W66°59.450'	838.5 m
<i>Thespesia grandiflora</i>	Quebradillas, "El Tunel"	N18°29.741'	W66°57.540'	003.1 m
<i>Thespesia grandiflora</i>	Ruta 621 urban zone in Rio Abajo forest	N18°19.694'	W66°41.934'	342.0 m
<i>Thespesia grandiflora</i>	Lago Dos Bocas, Utuado, P.R.	N18°20.550'	W66°39.840'	100.0 m
<i>Turnera diffusa</i>	Peñuelas, P.R	N17°59.617'	W66°42.364'	122.0 m
<i>Zamia amblyphyllidia</i>	Morovis P.R. Route 155	N18°24.771'	W66°25.166'	121.0 m
<i>Zamia amblyphyllidia</i>	Morovis P.R. Route 155	N18°24.764'	W66°25.176'	134.1 m
<i>Zamia amblyphyllidia</i>	Morovis P.R. Route 155	N18°24.775'	W66°25.171'	138.4 m
<i>Zamia amblyphyllidia</i>	Morovis P.R. Route 155	N18°24.773'	W66°25.167'	132.0 m
<i>Zamia amblyphyllidia</i>	Morovis P.R. Route 155	N18°24.766'	W66°25.194'	139.9 m
<i>Zamia amblyphyllidia</i>	Morovis P.R. Route 155	N18°24.492'	W66°25.107'	140.5 m
<i>Zamia amblyphyllidia</i>	Cambalache State Forest	N18°26.947'	W66°35.829	045.7 m
<i>Zamia amblyphyllidia</i>	Cambalache State Forest	N18°26.750'	W66°35.979	068.3 m
<i>Zamia amblyphyllidia</i>	Cambalache State Forest	N18°26.7480'	W66°36.01	027.1 m
<i>Zamia portoricensis</i>	Bosque Susua, Sabana Grande, P.R.	N18°04.277'	W66°54.488'	167.6 m
<i>Zamia portoricensis</i>	Bosque Susua, Sabana Grande, P.R.	N18°04.277'	W66°54.493'	172.0 m



Fig. 1. Map of Puerto Rico indicating route transverse during plant exploration trip: 1) southwest region, 2) north-south corridor, and 3) east-northeast corridor).

then to the southeast toward Guanica and Peñuelas. A second excursion involved traveling to the north coast (Quebradillas, Guajataca, Arecibo, Morovis, Vega Alta), through the center of the island (Utua, Jayuya, Villalba), and finally returning south to Ponce. A third excursion involved traveling east through Patillas (Guavate and Carite State Forests) to San Lorenzo, south through Las Piedras to Humacao, and returning northeast to Luquillo (El Yunque National Forest).

Road maps, topological, U.S. Forest Service maps of each forest in 1:200,000 scale, and forest information sheets were helpful in locating natural forests, potentially interesting topographic features, and navigating through both the cities and countryside. Exact locations for collection sites were verified by the use of a Global Positioning System (GPS) receiver (Brunton Atlas GPS, Brunton, Riverton, Wyo.) and occasional comparisons of elevation contours within the maps. Positional data were also verified upon return to the U.S. by comparison with coordinates held by the U.S. Geological Survey and Google Earth servers.

### Results and Discussion

Interesting ornamental plant genetic resources were found in the investigated region. Figure 1 shows the route traversed during the plant exploration trip. Collecting was concentrated in those regions where material of interest had been previously reported. Collecting was done in natural habitats including valleys, trails, mountain slopes, and uncultivated land; samples were gathered within the inner areas of forests, botanical gardens, nurseries, and on roadsides of the traversed route. Table 1 shows the genus and species, location, latitude, longitude, and elevation of the collected samples. A total of 46 species and 84 accessions were collected from 72 sites during the trip. Accessions were collected as cuttings, budwood or scions, seed, and seedlings. The level of seed ripeness varied within species and sites. Collecting of some species, such as *Simarouba tulae*, *Leandra krugii*, *Ravenia urbanii*, *Coccoloba sintenesii*, and *Zamia* sp., were limited as it was early in the year and trees had not set seed. We were fortunate to find seed (seedlings) of *P. cowellii* (violet tree) *C. rugosa*, *Gaussia attenuata*, and *Calyptrotrichia rivalis* from the Cambalache State Forest nursery, as it was late in the year and seed set had passed. *Simarouba tulae* (aceitillo), an endangered species, was collected in two different regions—at the Maricao and Luquillo National forests.

Several potential sites were identified where future plant germplasm exploration trips could yield important non-ornamental accessions. Collections from several area forests and local regions may yield useful accessions of tropical fruit and nut germplasm in the genera *Mangifera*, *Persea*, as well as genera in the Sapotaceae family. These potentially new fruit accessions could prove useful sources of traits for adaptation to southern Florida and other subtropical environments.

Following the trip, seed samples were shared with botanical gardens and nurseries as well and have now been accessioned into the NPGS through the National Germplasm repository in Miami, FL. Accessions have also been shared with appropriate American Public Garden Association sites for maintenance. Herbarium vouchers were collected and prepared for several of the species collected. Many of the seed collections have been propagated for long-term evaluation and are undergoing field trials at the SHRS ornamental plant program. It is anticipated that many of the accessions collected will possess superior genetic adaptation to the climatic and edaphic stresses in south Florida and other subtropical regions.

### Conclusions

Potentially important new ornamental plant genetic resources were found in the investigated areas. Much of the germplasm collected during the expedition will be used for initial field trials and release. The collections are maintained at the National Germplasm repository in Miami, FL, and will be available to scientists, botanical gardens, and nurseries. Selections from the collected material will be introduced as new ornamental cultivars for the southern areas of Florida. Duplicate collections will be developed of the collected selections and placed with local institutions where there is sufficient interest and resources available for the long term upkeep of living collections.

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