Registration of ‘UF Tito’ and ‘UF Peace’ Rhizoma Peanut Cultivars with High Dry Matter Yields, Persistence, and Disease Tolerance

Kenneth H. Quesenberry,* Ann R. Blount, Paul Mislevy, Edwin C. French, Mary J. Williams, and Gordon M. Prine

ABSTRACT

‘UF Tito’ (Reg. No. CV-107, PI 262826) and ‘UF Peace’ (Reg. No. CV-108, PI 658214) rhizoma perennial peanut (RP; Arachis glabrata Benth.) cultivars were released by the University of Florida in 2008. After introduction into the United States in 1936 from Brazil, evaluations showed RP to be well adapted to the U.S. Gulf Coastal Plains region. UF Tito originated from Paraguay and was collected in 1959. This plant introduction resembles the plant type of ‘Florigraze’. It was identified as having high dry matter yields, highest percent pure peanut, and greatest vigor based on the amount of spread in a 10-yr evaluation experiment. In subsequent multilocation experiments over a 5-yr period, yields were generally equal to or higher than Florigraze. UF Peace was received in Florida in 1986 from Charles Simpson at the Texas AgriLife Research Center at Stephenville, TX, as collection no. P-2352. The ID numbers when the material was received trace it to PI 262839, an introduction subsequently released as the germplasm Arblick. Amplified fragment length polymorphism evaluation indicates that the molecular profile of this line is different from Arblick and all other known A. glabrata germplasm. It resembles the plant type of Florigraze, and its dry matter yields and competitiveness with weedy bermudagrass [Cynodon dactylon (L.) Pers.] are comparable. UF Peace appears to have better adaptability to the upper Coastal Plains. Both cultivars show improved field tolerance to peanut stunt virus compared with Florigraze.

The genus Arachis is most prominently known worldwide for the edible peanut (A. hypogaea L.). One of the novel and distinguishing features of this genus is the presence of aboveground flowers that after pollination develop specialized peg structures that carry the developing seed and pod underground. In their revision of the taxonomy of the genus Arachis, Krapovickas and Gregory (1994) indicated that the most significant characters for Arachis taxonomy were the underground structures including fruits, rhizomatous stems, root systems, and hypocotyls. This taxonomic treatment divided the genus into nine sections and 69 total recognized species.

Section VIII Rhizomatosae Series Rhizomatosae is composed of only two tetraploid species, A. pseudovillosa (Chodat & Hassl.) Krapov. & W.C. Gregory and A. glabrata Benth. The first record of introduction of A. glabrata as a plant introduction into the United States was an addition to the USDA National Plant Germplasm System in 1936 when a collection from Matto Grosso, Brazil, became PI 118457. This introduction was later given the experimental name Arb by the USDA Soil Conservation Service (now Natural Resources Conservation Service) but was never officially released. Nine other A. glabrata accessions were added before 1960. As the result of major collection efforts, 50 were added in the 1960s and 24 in the 1980s (USDA–ARS National Genetic Resources Program, 2009).

Beginning in the mid-1960s, forage potential evaluation research was initiated in Florida with A. glabrata. From this research, an off-type line, assumed to be a chance hybrid, was identified as superior to the available introductions and was released as the cultivar Florigraze (PI 421707) (Prine et al., 1981). The common name of rhizoma peanut (RP) was suggested to distinguish this species from other perennial, but stoloniferous, Arachis spp. such as A. pintoi Krapov. & W. C. Greg. The cultivar Arbrook (PI 262817), also originated from germplasm collected in Paraguay and introduced to

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Abbreviations: AFRU, Agronomy Forage Research Unit; CP, crude protein; DM, dry matter; IVOMD, in vitro organic matter disappearance; NFREC, North Florida Research and Education Center; PSV, peanut stunt virus; RP, rhizoma peanut; TDN, total digestible nutrient.
the United States in 1960, was released by Prine et al. (1986, 1990) as being better adapted to the deep droughty sands of the Florida ridge area. An accession introduced in the 1950s was PI 262839 collected by W.C. Gregory in Paraguay near the Brazil–Paraguay border 8 km from Arroyo Mangaba, along the Ponta Pora–Bela Vista road near the town of Bela Vista, Brazil (USDA–ARS National Genetic Resources Program, 2009). This accession was given the experimental name Arblick by the USDA Soil Conservation Service and was included in several of the early evaluation experiments. This accession was recently released as a germplasm by the Florida Agricultural Experiment Station under the name ‘Arblick’ (Prine et al., 2010). A second accession from this collection, PI 262840, is documented as being collected in Bella Vista, Brazil, not far from where Arblick was collected (USDA–ARS National Genetic Resources Program, 2009). This accession was also recently released as the germplasm ‘Ecoturf’ intended for ornamental groundcover (Prine et al., 2010).

Most of the research with RP over the past two decades has focused on methods for improved establishment (Canudas et al., 1989; Kelly and Quesenberry, 1993; Williams et al., 1997), utilization under grazing (Ortega-S. et al., 1992), and evaluation of new germplasm accessions (Freire et al., 2000; Mislevy et al., 2007; Ruttinger-Lamperti, 1989; Williams et al., 2008). The early research (Prine et al., 1981) showed that most accessions of RP produce very small amounts of seed. Consequently, large-scale field establishment of this species will likely be only by vegetative propagation using rhizomes. The cultivar Florigraze has dominated large commercial plantings of RP with the target use being production of high-quality hay for dairy and equine rations. It is estimated that between 10,000 to 12,000 ha of RP are currently grown in Florida (French et al., 2006).

‘UF Tito’ (Reg. No. CV-107, PI 262826) and ‘UF Peace’ (Reg. No. CV-108, PI 658214) are two RP cultivars that were released in 2008 by the Florida Agricultural Experiment Station on the basis of consistent high dry matter (DM) yields, good persistence, competitive ability to invasion by weedy grasses, and field tolerance to virus diseases. These releases culminate from a 20-yr program of evaluations at multiple locations in Florida and Georgia. Release of these cultivars to producers should begin to alleviate the potential genetic vulnerability that currently exists with over 90% of current production planted to the cultivar Florigraze.

Methods

In 1987 a collection of approximately 100 plant introductions of RP was planted in replicated small plots at the Agronomy Forage Research Unit (AFRU) located near Gainesville, FL. All vegetative planting materials for this evaluation had been maintained by C.E. Simpson, Texas Agricultural Experiment Station, Stephenville, TX, and were brought to Florida as vegetative cuttings collected from specimens at Stephenville. In some instances, apparent phenotypic variants within his source materials were identified as Variants a., b., and so on, within a given PI number. The materials were vegetatively propagated in a greenhouse in Florida before planting in spring 1987 at the AFRU. The introductions were evaluated for rate of spread and coverage for 2 yr (Ruttinger-Lamperti, 1989). In 1990 15 superior lines were selected from this experiment and planted in a second replicated experiment at the AFRU. In addition to the 15 selections, the cultivars Florigraze and Arbrook were planted in this experiment. This experiment was harvested for four growing seasons after establishment (Kelly, 1994). After this time, the experiment was not harvested for 5 yr, but weeds and forage were removed once annually. The plots were harvested again in 1999, and from the results of this 10-yr experiment, two lines (UF Tito and UF Peace) were selected for evaluation at multiple locations in Florida and Georgia (Freire et al., 2000).

Plots were planted at Marianna, FL, at the Range Cattle Research and Education Center at Ona, FL, and at Fort Valley State University at Fort Valley, GA, in February 2000. An additional location was planted at the Plant Science Research and Education Unit at Citra, near Gainesville, FL, in summer 2001. In addition to the newly selected lines, the cultivars Florigraze and Arbrook and the germplasm Ecoturf were included for comparison. Plots were evaluated for general agronomic attributes and DM yields. At Marianna, plots were harvested in 2002 through 2006. At the Gainesville–Citra location, plots were harvested in 2003 through 2006. At Ona, plots were harvested in 2000 through 2003. At Fort Valley, plots were evaluated for percentage lateral spread in 2001 and 2002. Forage nutritive data (crude protein [CP]) and digestibility as either total digestible nutrient (TDN) or in vitro organic matter disappearance (IVOMD) was determined from DM samples at Marianna in 2006, at Citra in 2005, and at Ona in 2000, 2001, and 2002. Marianna samples were analyzed by Waters Laboratory, Camilla, GA, and those from Citra and Ona were analyzed by the University of Florida, Institute of Food and Agricultural Sciences Forage Evaluation Support Laboratory.

The experimental planting at the AFRU near Gainesville reported by Freire et al. (2000), from which UF Tito was identified as a superior line, was sampled in spring 2002 for the presence of peanut stunt cucumovirus (PSV) in top growth. These plots had been established for 12 yr at the time of sampling. Plots at the North Florida Research and Education Center (NFREC), Marianna, were also sampled in October 2002, three growing seasons after establishment in winter 2000. The ELISA assays were conducted by the Plant Pathology Unit, Division of Plant Industry, Florida Department of Agriculture and Consumer Services, Gainesville, FL.

Characteristics

Origin and Source of UF-Tito and UF-Peace

UF Tito originated as a plant introduction from Paraguay. It was collected in January 1959 by W.C. Gregory as Collection No. 9587 and assigned PI 262826 in May 1960. Two samples of PI 262826 were originally received from Dr. Simpson, and the material for this release traces to Sample (a). This plant introduction resembles the plant type of Florigraze, and it was selected as 1 of 15 accessions from the research of Ruttinger-Lamperti (1989) for further evaluation. It was identified by Freire et al. (2000) as the top line out of a 10-yr evaluation experiment originally established by Kelly (1994) at the AFRU near Gainesville, FL. In addition to having high DM yields in this 10-yr evaluation experiment, UF Tito had the highest percent pure peanut (lowest invasion by weedy
common bermudagrass [Cynodon dactylon (L.) Pers.] and the
greatest amount of spread at the AFRU (Freire et al., 2000).
This line is named in honor of the late Dr. Edwin C. “Tito”
French, associate professor of agronomy, University of Flor-
da, and an avid researcher and proponent for RP.
UF Peace also originated as a plant introduction from
Paraguay. It was received from Dr. Simpson as Plant 2 from
Gregory’s January 1959 Collection No. 9642 that became
USDA PI 262839. Other material that has been main-
maintained since the 1960s in Florida as PI 262839 was given
the name Arblick by the USDA Soil Conservation Service
and released in 2008 as germplasm (Prine et al., 2010).
Recent amplified fragment length polymorphism evalu-
ations indicated that the plant material we received from
Simpson and have evaluated is different from Arblick and
all other A. glabrata germplasm tested (Maas et al., 2010).
Like UF Tito, it resembles the plant type of Florigraze, and
it also was one of 15 superior accessions identified for
further evaluation from the work of Ruttinger-Lamperti
(1989). In the summary report by Freire et al. (2000), DM
yields were similar to UF Tito, but competitiveness with
weedy bermudagrass was inferior to that of UF Tito. This
line is named in honor of the late Mr. Caroll Peace, of Val-
dosta, GA, long-time advocate and commercial producer
of RP hay and planting materials.

Dry Matter Yields
In multilocation experiments over a 5-yr period, yields of
UF Tito were generally equal to or higher than Florigraze.
Although some genotype x location interactions effects are
evident in the data, the results of the multilocation evalu-
ations (Tables 1–3) validate the conclusions of Freire et al.
(2000) that UF Tito has excellent yield potential and is
competitive against weedy grasses. At Ona, UF Tito gener-
ally was not different in DM yield from most other entries
in the test. Yields at this location were relatively consistent
over the experiment, with only a slight decrease in DM
yields over the period of the experiment, whereas other
selections decreased in persistence and yield (Mislevy et
al., 2007). At Citra, UF Tito generally had greater DM yield
than Florigraze and Ecoturf but was not different from
Arbrook and UF Peace. Four-year-average total seasonal DM
yield among all entries ranged from 8300 to 12,000 kg ha–1
(Tables 1 and 2). Over the five harvest years at Marianna,
UF Tito was not significantly different from Florigraze but
yielded less than Arbrook (Table 3).

Dry matter yields of UF Peace were similar to UF Tito
in trials at Citra, Marianna, and at Ona (Tables 1–3, Mislevy et al., 2007). In some
individual years and locations, yields of UF Peace were not statistically different
from Florigraze, but the 4-yr summary data from Citra (Table 2) show that UF
Peace had greater DM yields than Flori-
graze and was not different from Arbrook.
In the 5-yr summary data from Marianna
(Table 3), yield of UF Peace was not
different from those of UF Tito or Flori-
graze and was less than that of Arbrook.

Table 1. Dry matter yield of rhizoma peanut at the Plant
Science Research and Education Unit, Citra, FL, 2004.

<table>
<thead>
<tr>
<th>Identification</th>
<th>Harvest 1</th>
<th>Harvest 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecoturf</td>
<td>2980 a†</td>
<td>5380 a</td>
<td>8,360 ab</td>
</tr>
<tr>
<td>UF Tito</td>
<td>4800 ab</td>
<td>7830 a</td>
<td>12,650 a</td>
</tr>
<tr>
<td>UF Peace</td>
<td>4080 ab</td>
<td>8000 a</td>
<td>12,070 ab</td>
</tr>
<tr>
<td>Florigraze</td>
<td>3190 b</td>
<td>5970 a</td>
<td>9,160 b</td>
</tr>
<tr>
<td>Arbrook</td>
<td>3830 ab</td>
<td>6320 a</td>
<td>10,150 ab</td>
</tr>
<tr>
<td>CV</td>
<td>36</td>
<td>28</td>
<td>28</td>
</tr>
</tbody>
</table>

†Means followed by the same letter are not significantly different (P = 0.05), Duncan’s Multiple Range Test.

Table 2. Dry matter yield of rhizoma peanut at the Plant
Science Research and Education Unit, Citra, FL, 2006
and means over years.

<table>
<thead>
<tr>
<th>Identification</th>
<th>2006</th>
<th>4-yr mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvest 1</td>
<td>Harvest 2</td>
<td>2003–2006</td>
</tr>
<tr>
<td>Ecoturf</td>
<td>2250 a†</td>
<td>4870 a</td>
</tr>
<tr>
<td>UF Tito</td>
<td>3000 a</td>
<td>6260 a</td>
</tr>
<tr>
<td>UF Peace</td>
<td>3090 a</td>
<td>5350 ab</td>
</tr>
<tr>
<td>Florigraze</td>
<td>2870 a</td>
<td>4160 b</td>
</tr>
<tr>
<td>Arbrook</td>
<td>2680 a</td>
<td>5440 ab</td>
</tr>
<tr>
<td>CV</td>
<td>49</td>
<td>24</td>
</tr>
</tbody>
</table>

†Means followed by the same letter are not significantly different (P = 0.05), Duncan’s Multiple Range Test.

Table 3. Total dry matter yield of rhizoma peanut at the North Florida

<table>
<thead>
<tr>
<th>Identification</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>5-yr avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kg ha–1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ecoturf</td>
<td>6,850 c†</td>
<td>8,150 c</td>
<td>6,850 d</td>
<td>9,980 d</td>
<td>9,720 b</td>
<td>8,310 c</td>
</tr>
<tr>
<td>UF Tito</td>
<td>10,390 b</td>
<td>13,270 ab</td>
<td>10,380 b</td>
<td>14,440 ab</td>
<td>10,620 b</td>
<td>11,820 b</td>
</tr>
<tr>
<td>UF Peace</td>
<td>10,160 b</td>
<td>11,540 b</td>
<td>10,090 bc</td>
<td>13,460 bc</td>
<td>11,090 b</td>
<td>11,270 b</td>
</tr>
<tr>
<td>Florigraze</td>
<td>8,670 bc</td>
<td>11,220 b</td>
<td>8,150 b</td>
<td>11,650 cd</td>
<td>10,530 b</td>
<td>10,590 bc</td>
</tr>
<tr>
<td>Arbrook</td>
<td>13,050 a</td>
<td>14,180 a</td>
<td>12,150 a</td>
<td>16,050 a</td>
<td>13,240 a</td>
<td>13,730 a</td>
</tr>
</tbody>
</table>

†Means followed by the same letter are not significantly different (P = 0.05), Duncan’s Multiple Range Test.
The TDN analyses of the 2006 harvest at Marianna ranged from 510 g kg\(^{-1}\) (Arbrook) to 570 g kg\(^{-1}\) (Ecoturf), and the values for UF Tito and UF Peace were 550 g kg\(^{-1}\) and 550 g kg\(^{-1}\) respectively (Table 4). At the second harvest in 2005 at Citra, IVOMD values ranged from 621 g kg\(^{-1}\) (Arbrook) to 667 g kg\(^{-1}\) (Ecoturf). UF Tito and UF Peace IVOMD values (638 g kg\(^{-1}\) and 647 g kg\(^{-1}\), respectively) were not different from Florigraze or Ecoturf, but were higher than Arbrook (Table 5). Values for UF Tito and UF Peace at the June and October 2002 harvests at Ona were also intermediate between Ecoturf and Arbrook (Mislevy et al., 2007). These IVOMD values likely reflect differences in plant type, with Ecoturf being a lower growing type with smaller stems and a higher leaf to stem ratio, whereas Arbrook is more upright with a lower leaf to stem ratio and UF Tito and UF Peace intermediate in plant type and subsequent nutritive values.

Values for total ash, Ca, P, and the amino acids lysine and methionine were similar to those of alfalfa at similar stages of maturity. In general, RP nutritive values were similar to alfalfa at comparable stages of maturity and not a limiting factor in livestock nutrition.

### Emergence, Spread, and Competitiveness

UF Tito has proven to be more competitive with common bermudagrass than are other lines and cultivars that were evaluated at multiple locations, with a rating of 91% pure RP 10 yr after establishment (Freire et al., 2000). These data also showed that UF Tito had the highest spread rating among 18 entries in the experiment. UF Peace was similar to Florigraze in competition with common bermudagrass with percentage pure RP of 71 and 76, respectively. At the AFRU, UF Peace and Florigraze had similar spread ratings of 3.5 and 3.8, respectively.

UF Peace may have better adaptability in the upper Coastal Plains as indicated by its performance at Ft. Valley, GA (Terrill et al., 2003). In this experiment, it had higher (\(P < 0.10\)) percentage emergence than all other entries except Arbrook. In year two of the experiment, UF Peace had greater lateral spread than all other entries. The authors reported that UF Peace had the best combination of percent emergence, survival, and lateral spread of all of the rizoma peanut lines tested. This finding of rapid emergence, spread, and plot infill may be responsible for the first-year harvest data at Citra, where UF Peace was superior to Florigraze and UF Tito.

### Peanut Stunt Virus Incidence

In recent years, the identification of PSV in commercial fields of Florigraze has raised concerns about genetic vulnerability because Florigraze dominates the planted hectarage and is essentially a monoculture (Blount et al., 2006). Long-term field exposure to viruses should be an indicator of field tolerance or resistance to the virus. Samples from the planting described by Freire et al. (2000) taken 12 yr after establishment were tested by ELISA for PSV. All four replications of Florigraze and Arbrook tested positive for PSV, whereas all four reps of UF Tito were negative for PSV. UF Tito showed none of the visual yellowing and mosaic symptoms shown in all four replicates of Florigraze.
In this same experiment, only one of four replications of UF Peace tested positive for PSV (Table 6). The one positive replicate of UF Peace showed minor visual yellowing and mosaic symptoms. Similar results were obtained at the NFREC Marianna where after three growing seasons, samples from three out of four field replications of Florigraze and Arbrook tested positive for PSV, but no replications of UF Tito and two of UF Peace were positive. Although these data are not from a controlled study attempting to inoculate PSV onto RP, they do indicate that UF Tito may have field resistance to PSV and that UF Peace may have an intermediate level of resistance compared with Florigraze and Arbrook. The 12-yr exposure of entries in the AFRU experiment may be a good indicator of “field tolerance.”

Availability

UF-Tito and UF-Peace will be maintained by the Agronomy Department, Florida Agricultural Experiment Station, University of Florida, Gainesville, FL, 32611, as vegetative planting material. Small quantities are available on written request to the corresponding author. No intellectual property protections will be pursued on these releases. Initial distributions of producer quantities of vegetative planting material will be available spring 2011 or as containerized plants in 2009. UF Tito had existed as a numbered plant introduction in the USDA NPGS GRIN database since 1960, and vegetative materials of UF Peace from plots maintained by the corresponding author were supplied to the Plant Genetics Resources Conservation Unit, Griffin, GA, as a source for PI 658214.

Conclusions

UF Tito and UF Peace RP should benefit producers by providing superior yields and more aggressive rhizoma peanut cultivars available for planting. Probably as important is that these new releases provide growers the ability to diversify the rhizoma peanut plantings with other genotypes of *A. glabrata* to avoid the monoculture of Florigraze that currently exists throughout much of the growing area of the southeastern United States. UF Tito has shown a high level of field tolerance to PSV and UF Peace an intermediate level of resistance compared with the more susceptible Florigraze and Arbrook. On the basis of data from Ft. Valley, GA, UF Peace appears to have better adaptability to the upper Coastal Plains. On the basis of results by Mislevy et al. (2007) UF Tito appears to be more persistent than Arbrook on the better-drained flatwoods soils of south Florida.

Table 6. Results of ELISA screening for presence of peanut stunt virus (PSV) in various rhizoma peanut lines at the North Florida Research and Education Center (NFREC), Marianna, FL, and the Agronomy Forage Research Unit (AFRU), Gainesville, FL.

<table>
<thead>
<tr>
<th>Cultivar or germplasm</th>
<th>No. of replicates out of four testing positive by ELISA for PSV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NFREC</td>
</tr>
<tr>
<td>Ecoturf</td>
<td>0</td>
</tr>
<tr>
<td>UF Tito</td>
<td>0</td>
</tr>
<tr>
<td>UF Peace</td>
<td>2</td>
</tr>
<tr>
<td>Florigraze</td>
<td>3</td>
</tr>
<tr>
<td>Arbrook</td>
<td>3</td>
</tr>
</tbody>
</table>


References

