ENH1155

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Natural Area Weeds: Mexican Petunia (*Ruellia tweediana*)[1]

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Introduction

Ruellia tweediana (Mexican bluebell, Mexican petunia or Britton's wild petunia) is an herbaceous perennial (USDA Hardiness Zone 8–11) in the family Acanthaceae. Five species of *Ruellia* are native to Florida, and three non-native species are listed as naturalized in the state, including *R. tweediana* (Wunderlin and Hansen, 2009). There has been some confusion about the name of this species, with seven listed by Wunderlin and Hansen (2006), who favor the name *Ruellia tweediana* Griseb. It is also commonly referred to as *Ruellia brittoniana, Ruellia coerulea, or Ruellia malacosperma* (USDA NRCS, 2008). Ezcurra and Daniel (2007) report that *Ruellia simplex* was the name used when this species was first described from Cuba in 1870, and therefore has priority. The name *Ruellia tweediana* is the most commonly used in the horticultural trade; therefore it will be used in this publication.

Description

Named in 1879 by the German botanist, August Grisebach, this South American species is characterized by linear to lanceolate leaves 3 to 7 inches long with very prominent veins. Leaves are oppositely arranged along the stem. Green to purple stems have prominent nodal swellings and vary in color with exposure to light and fertilizer levels. The purple, pedunculate flowers are funnel-shaped and have five petals that are either solitary or in a few-flowered cymes arising where the leaves attach to the stem. Cleistogamy (self-fertilization without flower opening) is known to occur (Khoshoo et al., 1969) and is characterized by small, tubular greenish brown flowers that do not open but form fruits from self-pollination. Growers note flower production from June to October, but flowering has been recorded throughout the year in natural areas (FDEP, 1998). Under natural daylength, greatest flowering has been observed between the end of May to early November in central Florida landscapes (R. Freyre, personal communication). It is possible that the quantity of blossoms is related to the amount of light the plant receives. Plants in more direct sunlight have been observed to produce more flowers. The fruit is a longitudinal capsule up to 1 inch long containing about 20 circular but flattened seeds. As they mature, the fruit dry and release the seeds explosively. When exposed to moisture, the seeds exude a mucous-like

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gel. Flower and fruit stages alternate year-round in Florida.

The ornamental features of Mexican petunia, its ability to grow in a wide range of conditions, and the numerous cultivars available in the nursery and landscape industry (Table 1), explain its popularity among consumers, landscapers and growers (Hammer, 2002; Gilman, 1999; Wirth et al., 2004).

Preferred Habitat

In natural areas, Mexican petunia escapes to marshy/wet areas and often forms small, localized, vegetative colonies (Turner, 1991; Figure 1). It typically has been observed in wet, disturbed sites including drainage ditches, shores of ponds or lakes, and moist to wet wooded areas (Godfrey and Wooten, 1981), with some populations noticeably expanding within a few years (St. Johns River Water Management District, personal communication). However, it has considerable drought tolerance and survives in drier sites with full sun. Wilson et al. (2004) compared growth and reproduction of plants grown in wet and dry conditions and found that seed pod production was three times greater in wet conditions compared to dry conditions. They also found that stem length and shoot dry weights were 1.4 times greater in wet conditions.

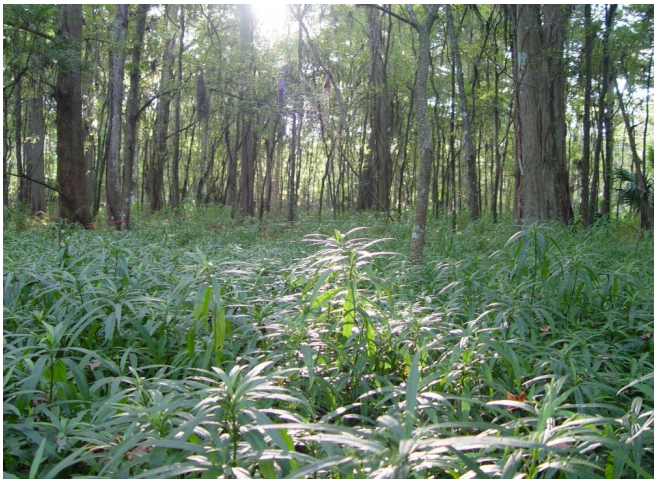

Figure 1. Monoculture of Mexican petunia (Ruellia tweediana) located in Payne's Prairie Preserve State Park, Alachua County.

Dispersal

Seeds lack dormancy mechanisms and are ready to germinate almost immediately after leaving the capsule. With no requirement for a cold treatment or seed coat damage scarification or stratification, seeds have high germination rate occurring over a broad range of temperatures with and without light (Wilson and Mecca, 2003). In seed burial studies, environmental conditions of the soil inhibited germination of some seeds, but seeds germinated once placed in ideal conditions (Hupp, 2007). Persistent seed banks can last for more than one year in areas where Mexican petunia exists (Hupp, 2007).

Literature describing the reproductive behavior of this species in natural areas is very limited. However, it is known that plants in the Acanthaceae have an explosive mechanism of seed dispersal. Witzum and Schulgasser (1995) report that elastic energy is stored in the two halves of the capsule after drying and is converted to kinetic energy (movement) when the seam joining the two halves splits. This action helps Mexican petunia achieve seed dispersal up to 8–10 feet (Witzum and Schulgasser, 1995). The mucus-like gel produced by these seeds when wetted allows the seeds to stay buoyant in water, and the gel also glues the seed to the soil surface when it dries (Gutterman et al., 1973).

Mexican petunia is commercially propagated by seed or cuttings. Cuttings root readily without being treated with auxin. Mexican petunia is also capable of spreading vegetatively. Horizontal stems, both above and underground, root where the leaves are attached, giving rise to new plants.

Hybridization Between *Ruellia* Species

Extensive artificial hybridizations were conducted in the genus *Ruellia* in the 1960s and 1970s to understand genetic relationships between species for taxonomic purposes (Long, 1966; Long 1974; Khoshoo et al., 1969). Natural hybrids between *R. caroliniensis, R. strepens, R. pedunculata*, and *R. purshiana* were reported (Long, 1974). Additionally, *R. caroliniensis* produced artificial hybrids after hand pollination with *R. geminiflora, R. harveyana, R.*

humilis, and *R. pedunculata*. Artificial hybridization between R. caroliniensis and R. tweediana was reportedly not successful (Long, 1974). However, the same cross recently yielded a few interspecific hybrids, all of which were extremely weak and sterile. Therefore, it appears that the risk of gene flow from the invasive *R. tweediana* to Florida native *R. caroliniensis* is negligible (R. Freyre, personal communication).

Cultivars

The wild type form of Mexican petunia is ornamentally inferior to the cultivated forms and is rarely offered for sale. Currently, there are eight known cultivars that have been selected commercially for pink, purple, or white flowers as well as tall and dwarf forms, none of which are patented (Table 1). They are easily propagated by cuttings or seed. Seed-propagated cultivars of dwarf forms have been recently released by Ball Seed. A bi-colored form with white petals and a purple corolla tube has been identified in a landscape but is not in production (S. Wilson, personal communication). The cultivars reportedly are weedy in cultivation with some seedlings having the typical growth form and flower color of the species (Hammer, 2002). Wilson and Mecca (2003) evaluated a wild type selection of Mexican petunia and eight cultivars ('Chi Chi', 'Morado Chi', 'Katie Variegated', 'Purple Showers', 'Snow White', 'Katie Pink', 'Katie Purple', and 'Katie White') and found that seed production, germination, and relative growth rate were highly variable among cultivars. Their study revealed that the cultivar 'Purple Showers' did not set any seed, whereas at least two other cultivars ('Morado Chi' and 'Chi Chi') set as much or more seed than the wild type form with greater germination and viability. Other insightful data from their study revealed: (1) seeds germinated under a wide range of temperature conditions with significant cultivar x light interactions (2) after 6–12 months of storage at room temperature, seeds showed reduced rates of germination, and (3) dwarf cultivars were not true to type. Through flow cytometry analysis, the wild type form of Mexican petunia and cultivars 'Chi Chi', 'Katie Pink', 'Katie Purple', 'Katie White', and 'McKee' appear to be diploids (with two sets of chromosomes), and 'Snow White' and 'Purple Showers' appear to be tetraploids (four sets of chromosomes) (Deng, personal communication). However this still needs to be confirmed by chromosome counts. Tetraploid cultivars can play an important role for crossing with diploids to produce sterile triploid cultivars (three sets of chromosomes). The University of Florida Ornamental Breeding Program in Gainesville is developing sterile or almost sterile hybrids, some of which are currently being evaluated in several locations for ornamental potential and fruit production (R. Freyre, personal communication).

Invasive Status and Distribution in Natural Areas

Since its introduction sometime before 1940, Mexican petunia has naturalized in disturbed uplands and wetlands of 9 states (from South Carolina west to Texas), the Virgin Islands, and Puerto Rico (USDA-NRCS, 2008). In Florida, it has formed naturalized populations in 28 counties throughout the state (Wunderlin and Hansen, 2009). Herbarium samples of escaped Mexican petunia exist from counties extending from the northwestern tip of Florida all the way to the southern tip (Table 2; Wunderlin and Hansen, 2009), suggesting the likelihood of its existence throughout the entire state.

The Florida Exotic Pest Plant Council Distribution Database (FLEPPC, 2007a), reported Mexican petunia in 19 different natural areas in five different community types: 1) pine flatwoods, prairies, 2) hardwood (hammocks, tree islands, etc.), 3) freshwater marshes, 4) rivers, springs and 5) salt marsh. In 2001, FLEPPC upgraded Mexican petunia from a Category II (potential problem) to Category I due to "altering native plant communities by displacing native species, changing community structures or ecological functions, or hybridizing with natives" and its status has not changed since (FLEPPC, 2007b). The Institute for Regional Conservation's database (IRC), "The Floristic Inventory of South Florida Database Online" contains distribution records of more than 2,400 species of plants in south Florida conservation areas. Mexican petunia is listed in 18 conservation areas in south Florida (Gann et al., 2008).

Mexican petunia has been observed in many natural areas across Florida. An example was at Backwater Creek in Hillsborough County, where the population of Mexican petunia was a very dense monoculture in the swampy area next to the creek. While it was not growing in the permanent water ways, it was growing on exposed sandbars in the flowing water. It was commonly found growing in narrow zones along the edge of water ways, for example at Frog Creek in Manatee County (L. Huey, UF, personal communication), Hogtown Creek and Payne's Prairie Preserve State Park in Alachua County, Ocklawaha River in Marion County (L. Huey, UF, personal communication), and The North Fork Buffer Preserve in St. Lucie County. At Fakahatchee Strand State Park in Collier County, Mexican petunia was growing along the side of the lime-rock road down to the swamp edge on well-traveled, dry roads. Where the swamp had flooded into the road, Mexican petunia could be found growing in the middle of the road. At Tradewinds Park in Broward County, a population of Mexican petunia was growing along the side of a horse trail in an old dry stream bed that did not flow any longer. At Long Key Natural Area in Broward County, it was persisting under the canopy of trees of an old abandoned home. In Seminole County at Lake Jessup, Mexican petunia had become one large monoculture under the cabbage palm hammock even in the presence of grazing and trampling by cows. Thus, most populations in natural areas were associated with water, and upland populations seemed likely to have persisted after deliberate planting and cultivation, or from populations that were established under wetter conditions (Hupp, 2007).

In comparison, the native species *R. caroliniensis* grows in 50 of Florida's 67 counties (Wunderlin and Hansen 2009). Despite having a widespread distribution, it is typically found as only a few scattered plants at a time, not in dense monocultures. It does not show the narrow zonal distribution associated with water that is exhibited by Mexican petunia, though it is known to show similar habitat tolerances under cultivation.

IFAS Assessment

Conclusions from the "Institute for Food and Agricultural Science (IFAS) Assessment of the Status of Non-Native Plants in Florida's Natural Areas" state that Mexican petunia is invasive and not recommended for use in the north and central parts of Florida. In southern Florida, this species should be used with caution and managed to prevent its escape (Fox et al., 2008). Professional experts consulted by the IFAS Assessment team indicated that Mexican petunia coverage constituted 50% of the infested stratum in several areas and that it was changing community structure by adding a new stratum or increasing plant density in the stratum by 5-fold. It is likely altering the hydrology within a community. On a statewide basis, this species is considered difficult to manage and has a high economic value. To see if any exceptions for specified and limited use have been approved since publication of this article, check the IFAS Assessment Conclusions table at: http://plants.ifas.ufl.edu/assessment.html.

Control

Eradication of this species may prove to be extremely difficult. Hand pulling of this species can be difficult due to underground rhizomes, and all vegetative material must be removed to prevent vegetative re-growth. This species is believed to have a persistent seed bank in the soil. This allows seedlings to germinate for years after adult species have been fully removed.

There are many safe and effective herbicides available to the homeowner for control of unwanted vegetation, and four of these products have been tested for effectiveness in controlling Mexican petunia. Tested products were all available at local hardware and home improvement stores, and they were all "ready-to-use" products, meaning they came in an applicator bottle, and no mixing or diluting was required. It is important to note that product names often change, and the only way to be sure to purchase the same product that was used in this study is to compare the type and amount of active ingredient. This information is provided on the product label. The tested products are listed in Table 3. Follow all safety, application, and disposal requirements indicated on the product label.

These ready-to-use products are applied to the entire plant, covering as much of the upper and lower surfaces of the leaves and stems as possible, but stopping before herbicide drips off the plant. Because different products have different susceptibility to reduction in effectiveness from rainfall, effort should be made to apply herbicides during a period when rainfall is not expected for 24 hours. This can be difficult in many parts of Florida during the summer.

Mexican petunia plants are killed back to the ground by these products within about two months, but because of significant re-growth, a second application of herbicide will probably be necessary. This second application is made in exactly the same manner as the first, and may be much easier, and require less herbicide, if the first application has reduced Mexican petunia size and coverage significantly. Almost 100% kill should result about two months after the second herbicide application. There was no difference in effectiveness among the four products tested.

Follow-up is an important component of any plant control project, and individual sprouts or small amounts of scattered regrowth may require additional treatment. Rarely is every stem of every target plant killed in one application of herbicide to a stand of Mexican petunia plants. Because long-term control studies have not been conducted, it is not possible to state definitively when monitoring for new or re-growth can be stopped.

In one field study, initial (two months after application) control of Mexican petunia was better in shaded areas than in sunny areas, although the plants were about the same size in both areas. It is possible that the unshaded plants were under water stress, and it is important to remember that plants best absorb herbicide when well watered and not subject to moisture stress. This effect of location disappeared after two more months, and the final high levels of control were the same for both shaded and sunny areas.

If the first herbicide application does not kill the plants entirely, regrowth will come from either the tips of underground stems (rhizomes), or from sprouts along the bigger stems, near the base of the plant. Plants sprayed with Roundup exhibit regrowth almost exclusively from the bases of dead (treated) stems. Applications of other products usually also result in some regrowth from underground stems.

The effect of these products on other vegetation depends on many factors, such as which plant species are currently present and how tolerant of any particular product those species are. In one field study, the products, in increasing damage to non-Mexican petunia plant species, were Lawn Weed Killer, Weed-B-Gon, Roundup, and Brush-B-Gon Poison Ivy Killer. In plots where Mexican petunia comprised more than 75% of the ground cover, within six months after herbicide application as much as 50% of the ground cover was non-Mexican petunia vegetation. Non-Mexican petunia vegetation was present in higher amounts after six months in sunny areas than in shaded areas.

Conclusion

Although Mexican petunia is an attractive and popular ornamental plant, the escape and establishment of this species in Florida's natural areas has had harmful, ecological impacts. It is hoped that sterile cultivars will not escape and thus may be recommended for use by UF-IFAS, if approved using the newly implemented IFAS infraspecific taxon protocol. The species can be controlled in yards using ready-to-use herbicides. However, repeated treatments may be needed and long term management of large escaped populations will be costly.

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Table 1. Botanical description, origin and alternative names of wild type Mexican petunia (*Ruellia tweediana*) and eight cultivars.

Cultivar/ species	Similar cultivars	Botanical description and origin if known	
Wild type		2–3 feet, upright growth, 1.4-inch-diameter purple flowers, leaves more narrow than 'Purple Showers' and less narrow than 'Morado Chi'; designated as a Category I invasive plant by the Florida Exotic Pest Plant Council (FLEPPC, 2007b).	
'Chi Chi'	'Pink Showers'	3–4 feet, upright growth, 2-inch-diameter pink flowers, narrow leaves	
'Katie Pink'	'Bonita Pink'™, 'Colobe Pink'PPAF, 'Compact Pink Ruffle'™, 'Pink Shorts Katie'™	6–12 inch compact form, 2-inch-diameter pink flowers, narrow leaves; Discovered by Greg Grant, who used 'Purple Katie' as the female parent to cross with the standard pink *R. tweediana* (Pickens, 1999)	
'Katie Purple'	'Compacta Katie', 'Dwarf Katie', 'Purple Katie'	6–12 inch compact form, 2-inch-diameter purple flowers, narrow leaves; discovered in Texas by employees Herbert Durand and Nolan Guillot (Lowrey, 1991).	
'Katie Variegated'	'Strawberries and Cream'	6–12 inch compact form with variegated foliage, 2-inch-diameter purple flowers, narrow leaves; discovered by Scott Reaves of Tree Search Farms in Texas in 1994 in a grouping of 'Katie' (Plant Delights Nursery, 2003).	
'Katie White'	'Clean White Katie'™, 'Clean White Shorts'™, 'Compact White Ruffle'™	6–12 inch compact form, 1.8-inch-diameter white flowers, narrow leaves.	
'Morado Chi'		3–4 feet, upright growth, 1.8-inch-diameter purple flowers, very narrow leaves.	
'Purple Showers'	'Purple Fountain'	3–4 feet, upright growth, 2.2-inch-diameter purple flowers, leaves wider than the wild type species.	
'Snow White'	'Snow Queen', 'White Snow'	3–4 feet, upright growth, 1.8-inch-diameter white flowers, rounded leaves; sold as *R. tweediana* but may be a distinct species.	

Table 2. Florida counties in which Mexican petunia (*Ruellia tweediana*) has been documented (FLEPPC, 2007a, Gann et al. 2008, and/or Wunderlin and Hansen, 2009).

Alachua	Manatee
Brevard	Marion
Broward	Miami-Dade
Charlotte	Monroe
Collier	Orange
Escambia	Palm Beach
Franklin	Pasco
Hendry	Pinellas
Highlands	Putnam
Hillsborough	Sarasota
Indian River	Seminole
Lake	St. Johns
Lee	St. Lucie
Leon	Sumter
Levy	Volusia

Table 3. Ready-to-use liquid (spray) herbicides tested for effectiveness in controlling Mexican petunia (*Ruellia tweediana*).

Product	Chemical	Concentration
Ortho Brush-B-Gon Poison Ivy Killer	Triclopyr triethylamine salt	0.7%
Ortho Weed B Gon Max	Mecoprop-p dimethylamine salt 2,4-D Dimethyl amine Dicamba	0.22% 0.12% 0.05%
Orth Basic Solutions Lawn Weed Killer	2,4-D Dimethylamine salt Mecoprop-p dimethylamine Dichloroprop-p dimethylamine	0.326% 0.163% 0.161%
Roundup	Glyphosate	2.0%