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

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Introduction

Ruellia simplex (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 nonnative species are listed as naturalized in the state, including *R. simplex* (Wunderlin et al. 2016). There has been some confusion about the name of this species, commonly referred to as *Ruellia brittoniana, Ruellia coerulea, Ruellia tweediana,* or *Ruellia malacosperma* (USDA NRCS 2023; Wunderlin et al. 2016). *Ruellia simplex* C. Wright was the name used when this species was first described in Cuba in 1870; therefore, it has taxonomic priority (Ezcurra and Daniel 2007). This name is now widely used in the horticultural trade and amongst state agencies and will therefore be used in this publication.

Description

Ruellia simplex is native to southern North America, southern South America, and the Antilles (Ezcurra and Daniel 2007). It is characterized by linear to lanceolate leaves 3 to 7 inches long with very prominent veins, 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 appear in 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 day length, greatest flowering has been observed between the end of May to early November in central Florida landscapes (Freyre et al. 2012a). 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 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; Wirth et al. 2004; Bechtloff et al. 2019).

Preferred Habitat

In natural areas, Mexican petunia escapes to marshy/wet areas and often forms small, localized, vegetative colonies (Turner 1991; Figures 1 and 2). It typically has been observed in wet, disturbed sites, including drainage ditches, shores of ponds or lakes, and moist-to-wet wooded

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areas (Godfrey and Wooten 1981), with some populations noticeably expanding within a few years. 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 seedpod 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 (*R. simplex*) located in Payne's Prairie Preserve State Park, Alachua County.

Figure 2. Monoculture of flowering Mexican petunia (*R. simplex*) located at the Lake Jesup Conservation Area in Seminole 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 a high germination rate occurring over a broad range of temperatures (Smith et al. 2015) 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).

Literature describing the reproductive behavior of this species in natural areas is very limited. However, plants in the Acanthaceae have an explosive mechanism of seed dispersal. This helps Mexican petunia achieve seed dispersal up to 8–10 feet (Witzum and Schulgasser 1995). The mucus-like gel produced by these seeds when wet glues them to the soil surface when it dries (Gutterman et al. 1973), and can also help them stick to animals' fur or birds' feathers, helping their dispersal. Previous research found that seeds are not buoyant (Seitz 2015), but this characteristic does not inhibit dispersal. Seitz (2015) found that approximately 30,000 seeds/year and 10,000 stems/year are dispersed through streams during major stormwater events.

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 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. simplex* 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. simplex* to Florida native *R. caroliniensis* is negligible (Freyre and Tripp 2014).

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 released by Ball Seed. A bicolored 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 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 × 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) (Freyre, personal communication). Tetraploid cultivars can play an important role for crossing with diploids to produce triploid cultivars (three sets of chromosomes) with reduced fertility. The University of Florida Ornamental Breeding Program in Gainesville has released to date seven new cultivars with highly reduced (or nondetectable) fertility, named Mayan Purple™, Mayan White™, Mayan Pink™, and Mayan Compact Purple™, Aztec Pink/White™, Aztec Pink™, and Aztec Purple™ (Freyre et al. 2012a; Freyre et al. 2012b; Freyre and Wilson 2014; Freyre et al. 2016). These cultivars were subjected to the Infraspecific Taxon Protocol by the UF/IFAS Invasive Plant Working Group and are now patented and in commercial production.

Invasive Status and Distribution in Natural Areas

Since its introduction sometime before 1940, Mexican petunia has naturalized in disturbed uplands and wetlands of 8 states (from South Carolina west to Texas, as well as Hawaii), the US Virgin Islands, and Puerto Rico (USDA-NRCS 2023). In Florida, it has formed naturalized populations in 35 counties throughout the state (Wunderlin et al. 2023). Herbarium samples of escaped Mexican petunia exist from counties extending from the northwestern tip of Florida all the way to the southern tip (Wunderlin et al. 2023; Table 2), suggesting the likelihood of its existence throughout the entire state.

In 2001, the Florida Exotic Pest Plant Council (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 2019). 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. For example, a dense population of Mexican petunia can be found along the Sweetwater Branch Tributary in Paynes Prairie Preserve State Park in Alachua County. This population is exposed to frequent inundation in light and shade conditions. It can also be found growing in narrow zones along the edge of water ways at Hogtown Creek and other smaller creek beds in Alachua County. In Seminole County at Lake Jesup, Mexican petunia has become one large monoculture in a wetland under the cabbage palm hammock, even in the presence of grazing and trampling cows (Smith et al. 2016). 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 56 of Florida's 67 counties (Wunderlin et al. 2023). 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.

UF/IFAS Assessment

Conclusions from the "University of Florida Institute for Food and Agricultural Science (UF/IFAS) Assessment of the Status of Non-native Plants in Florida's Natural Areas" state that the wild type of Mexican petunia is invasive and not recommended for use in any region of Florida (UF/IFAS Invasive Plant Working Group 2023). However, the abovementioned Mayan and Aztec cultivars were evaluated through their Infraspecific Taxon Protocol and approved

for release and use with caution in all areas in Florida. More information can be found on the UF/IFAS Assessment page at http://assessment.ifas.ufl.edu/assessments/ruellia-simplex/.

Control

Eradication of this species may prove to be extremely difficult. Hand-pulling of this species can be effective for small areas or individual plants; however, all vegetative material must be removed to prevent vegetative regrowth from the underground rhizomes (Reinhardt Adams, Wiese, Lee et al. 2014). Mexican petunia seeds do not persist in the seedbank; this suggests that seeds germinate readily once released from the parent plant (Reinhardt Adams et al. 2015). Native seeds persist in the seedbank, but it is still unclear why native species are unable to recolonize after Mexican petunia control (Reinhardt Adams et al. 2015).

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, but the most commonly used and readily available product is Roundup (glyphosate) (Reinhardt Adams, Wiese, Lee et al. 2014). 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.

For natural areas, a single application of herbicide, specifically Roundup, applied in the fall or spring is enough to initially control Mexican petunia (Reinhardt Adams, Wiese, and Cobb 2014). A follow-up application may be needed after 3–6 months, depending on regrowth (Reinhardt Adams, Wiese, Lee et al. 2014). 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.

One field study showed that unassisted recolonization (i.e., plots where Mexican petunia was sprayed with herbicide but not planted or seeded with native species) did not result in Mexican petunia control and native plant establishment. In fact, even when planted seedlings of native species had adequate survival (2%–57% depending on species), reinvasion of Mexican petunia was not prevented (Smith et al. 2016). Smith et al. (2016) noted that Mexican petunia regrowth was primarily from rhizomes, not seed germination. More research is needed to determine effective herbicide methods that target rhizome growth, as well as refined revegetation approaches on both small- and large-scale invasions in the longer term.

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.

Prevention

Prevention of Mexican petunia in yards and landscapes is an important approach to avoid costly control measures in the future. The IFAS assessment is updated on a regular basis and can be used to identify the most up-to-date invasive outcomes. In addition, a review of ornamental invasives in Florida and evidence-based recommendations for alternatives was recently published by Wilson and Deng (2023).

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 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. A guidebook to assist with identifying this species and others is now available that includes native alternatives as well as sterile cultivars (Parrish et al. 2023).

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Table 1. Botanical description, origin, and alternative names of wild-type Mexican petunia (*R. simplex*) and twelve cultivars.

Cultivar/species	Similar cultivars	Botanical description and origin if known
Wild type		2–3 feet, upright growth, 1.4-inch-diameter purple flowers, narrower leaves than 'Purple Showers' and wider than 'Morado Chi'; designated as a Category I invasive plant by the Florida Exotic Pest Plant Council (FLEPPC 2019).
'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. simplex* (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'.
'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.simplex* but may be a distinct species.
Mayan Purple™		Up to 3 feet, upright and full growth habit, 1.8 inch-diameter purple flowers, wide leaves, less tall and prone to lodging than 'Purple Showers'; University of Florida release.
Mayan White™		Up to 3 feet, upright and full growth habit, 1.8 inch-diameter white flowers, wide leaves; University of Florida release.
Mayan Pink™		1–2 feet, upright growth, 1.5 inch-diameter pink flowers, narrow leaves. Some fruits may be present; University of Florida release.
Mayan Compact Purple™		1–2 feet, upright and full growth habit, 1.8 inch-diameter pink flowers, very wide leaves; University of Florida release.
Aztec Pink/White™		White flowers with pink center. University of Florida release.
Aztec Pink™		Pink flowers with dark-pink center. University of Florida release.
Aztec Purple™		Purple flowers with dark-purple center. University of Florida release.

Table 2. Florida counties in which Mexican petunia (*R. simplex*) has been documented (Wunderlin et al. 2023).

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

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

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%
Ortho 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%