

Natural Area Weeds: Invasive *Solanum* spp. in Florida¹

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Introduction

The Florida Exotic Pest Plant Council's (FLEPPC) 2007 List of Invasive Plant Species includes two Category I and three Category II *Solanum* species (Solanaceae) (FLEPPC 2007). Category I *Solanum* species identified by the Council are *S. tampicense* Dunal (wetland nightshade, aquatic soda apple) and *S. viarum* Dunal (tropical soda apple). Category II *Solanum* species identified by the Council are the following: *S. diphyllum* L. (twoleaf nightshade), *S. jamaicense* Mill. (Jamaican nightshade), and *S. torvum* Sw. (turkeyberry).

Category I invasive exotics are defined by the FLEPPC as those plants that alter native plant communities by displacing native species, changing community structure or ecological functions, or hybridizing with natives. The FLEPPC defines Category II invasive exotics are those that have increased in abundance or frequency, but have not yet altered Florida plant communities to the extent shown by Category I species.

As members of the same genus, the *Solanum* species identified by the FLEPPC as invasive share certain morphological features. These similarities can

lead to misidentification. This publication provides a guide to differentiate the invasive *Solanum* species, along with information about the ecology and management of each species. Also included is information on another relatively common species, *Solanum capsicoides* All., which can easily be confused with some of the invasive *Solanum* species.


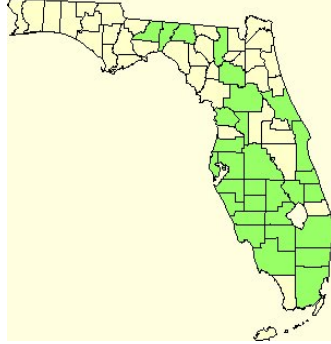

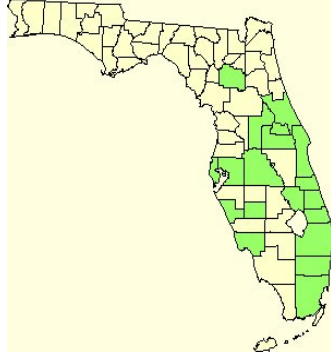
Identification and Florida distribution


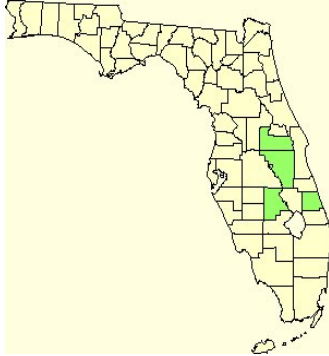

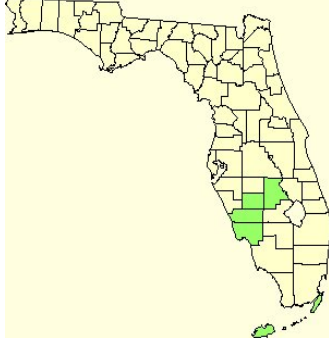
The five *Solanum* spp. on the FLEPPC's 2007 List of Invasive Plant Species can be identified using morphological characters and also by the habitat in which they are found. For example, wetland nightshade (*S. tampicense*) is found in wetlands, whereas the other four species are typically found in more upland, and often disturbed, habitats. Tropical soda apple is found both in open areas with full sun (often in pastures), but also in wooded hammocks. In contrast, Jamaican nightshade is found almost exclusively in or nearby wooded areas.


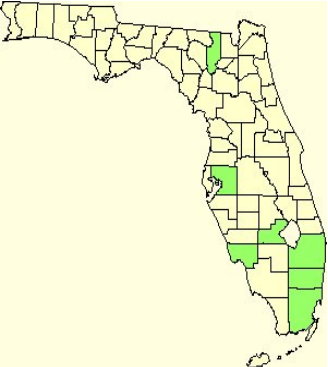

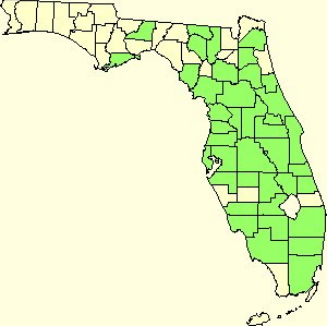
The following table provides some of the key characters that can be used to differentiate the species, as well as information on the habitats in which the species are found and the counties where herbaria specimens have been collected.

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1. This document is SS AGR 312, one of a series of the Agronomy Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date, November 2008. Visit the EDIS Web Site at <http://edis.ifas.ufl.edu>.
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Table 1. Identifying characteristics of FLEPPC Category I and Category II Solanum spp. and *S. capsicoides*

Scientific name Common name(s)	Habitat	Distribution in Florida*	Key characteristics
<p><i>S. viarum</i> Dunal tropical soda apple sodom apple</p>  <p>Photo: John J. Mullahey</p>	<p>Common in pastures, and ruderal/disturbed sites. Troublesome in pastures, ditch banks, citrus groves, sugarcane fields, wet areas of rangelands; and becoming more frequent in pinelands and hammocks (Mullahey 2003).</p>		<p>Broad-based, straight, prickles found on stems and leaves (ONLY); leaves with smooth, clear petiole, but surface covered with fine, soft, hairs that exude sticky fluid, making the leaves "clammy" to touch; mature berry 2-3 cm (0.8-1.2 in) wide and light yellow, immature fruit to 3cm and similar to colors of watermelon.</p>
<p><i>S. diphyllum</i> L. twoleaf nightshade twinleaf nightshade</p>  <p>Photo: Kenneth A. Langeland</p>	<p>Disturbed uplands (e.g., roadsides, agricultural fields, and/or thickets), floodplain forests (floodplain with substrate of sand, silt, clay or organic soil; seasonally flooded; temperate; oaks, palmetto, cane, mixed hardwood), maritime hammocks.</p>		<p>Lack of prickles on otherwise smooth branches and stems (dark maroon brown to white); on more established plants, the presence of well defined leaf pairs with one leaf of pair notably larger than the other; leaf edges smooth, entire, elliptic; major leaves widest at the center; major leaves to 4.7-6.8 cm (1.8-2.6 in) x 2.2 cm (0.89 in), minor leaves ovate to obovate and range up to 2.5 cm x 1.4 cm (0.98 in x 0.55 in); flowers white (immature) to whitish-lavender (mature); fruit a globose berry, to 1.2 cm in diameter and bright orange and fleshy when ripe.</p>

Scientific name Common name(s)	Habitat	Distribution in Florida*	Key characteristics
<p><i>S. jamaicense</i> Mill. Jamaican nightshade</p>  <p>Photo: William A. Overholt</p>	<p>Most common in ruderal/disturbed areas (roadsides, agricultural fields, thickets, pastures and/or ecotone of neighboring hammocks). Several sources note plant as “noxious weed” and troublesome in Central Florida near cypress swamps, lake edges berms, pastures, ditch banks, and wooded areas.</p>		<p>Angularly lobed, sessile (or nearly sessile) leaves (attached directly at the base, without a stalk). Apart from 2-3 prickles at base of leaf stems, along lower midribs leaves are free of prickles and densely pubescent (soft trichomes, hairs); stems are flexuous (zig-zag form), pubescent, and contain short, recurved prickles that are very narrow at the base. Fruit is globose berry that, at maturity, is red and glossy, to 0.8 cm (0.3 in) across, with seeds to 2 mm (0.08 in) across).</p>
<p><i>S. tampicense</i> Dunal wetland nightshade aquatic soda apple</p>  <p>Photo: Allison M. Fox</p>	<p>Riparian zones and wetlands; in relatively undisturbed wetlands, such as cypress swamps and river margins; grows in full shade to full sunlight; age-dependent tolerance to regional flooding (mature plants can tolerate several weeks of submersion).</p>		<p>Clambering, vine-like growth habit over the tops of surrounding vegetation; deeply sinuate (wavy margin) leaves; clusters of up to 11 pea-sized berries that are bright red at maturity; pubescence of stellate (star-shaped) hairs ONLY; straight prickles on veins on upper surfaces of leaves and curved prickles underneath and on stem.</p>

Scientific name Common name(s)	Habitat	Distribution in Florida*	Key characteristics
<p><i>S. torvum</i> Sw. turkeyberry susumber gully-bean Thai eggplant devil's fig</p>  <p>Photo: Forest and Kim Starr</p>	<p>Disturbed uplands (roadsides, agricultural fields, pastures, and/or thickets) and swamps; noted by some sources to currently have become a nuisance species in some areas where the plant has been documented to form impenetrable thickets in pastures, preventing animals from grazing (www.lucidcentral.org). In its native range (Mexico to Peru and Venezuela, and in Bermuda and the West Indies), the plant grows in woodland clearings, dry brushy plains, wet thickets, and on rocky hillsides (Langeland and Craddock-Burks 1998).</p>		<p>One of the largest of the prickly <i>Solanum</i> spp., reaching heights close to 5 m (16 ft); fruits are numerous, erect (fruits of other prickly <i>Solanum</i> spp. typically droop or hang towards the ground), a subglobose berry that is yellow and grape-sized at maturity (to 0.6 in); prickles stout, wide at base, and slightly curved (occasionally straight); flowers are vivid white, to 2.5 cm (1 in), and are many per group in branched clusters with glandular hair on axes; leaves are large, to 25 cm (10 in) long, with blades oval to elliptic and tips notably pointed; leaves are distinctly petioled and have a dense covering of stellate (star-shaped) hairs on the undersurface.</p>
<p><i>S. capsicoides</i> soda apple red soda apple cockroach berry</p>  <p>Photo: William A. Overholt</p>	<p>Moist, disturbed sites. Often seen co-occurring in pastures with tropical soda apple.</p>		<p>Short-lived shrubs up to 1 m tall with prickles on most parts, up to 12 mm long. Leaves entire, alternate, broadly ovate, up to 11 cm long and 10 cm wide, margins with 5-7 lobes divided 1/2 or less to midrib, petioles ca. 5 cm long. Leaves appear shiny when compared to those of tropical soda apple. Flowers in clusters of 2-4 on short peduncles 3-4 mm long. Fruits are bright red when mature and 2-3.5 cm in diameter. Seeds are numerous, flattened, bordered by a distinct narrow wing ca. 1.5 mm wide, 4-5 mm in diameter.</p>

Native Distribution

The five *Solanum* spp. on the FLEPPC 2007 List of Invasive Plant Species are native to Mexico, Central America, South America, and/or the Caribbean.

Experts do not agree on the native range of *S. capsicoides*. Some consider the plant to be a native in Florida (Wunderlin and Hansen 2008) while others believe it is native to the Caribbean (D'Arcy 1974) or to eastern Brazil (Wagner et al. 1999). Regardless of the origin of *S. capsicoides*, it is not considered to be invasive in Florida. Native and exotic ranges for the invasive species are indicated in Table 2.

newly germinated plants may be necessary (Langeland and Stocker 2001).

***Solanum viarum*.** Based on research conducted by Ferrell and Mullahey (2006), heavy infestations of tropical soda apple are best controlled by herbicides, such as Milestone or ForeFront. Aminopyralid is the active ingredient for both of these. Field research has shown that herbicides containing this particular active ingredient have been successful at not only postemergence control of tropical soda apple, but preemergence control of germinating seedlings more than six months after the initial application.

Table 2. Native ranges of each of the five invasive *Solanum* spp. and current locations of establishment. (Information from Langeland and Craddock-Burks 1998, USDA/ARS 2008)

Species	Native Distribution	Exotic Range
<i>S. tampicense</i> Dunal	West Indies, Caribbean, Mexico, Belize, Central America	North America: U.S. (FL, OK, SC)
<i>S. viarum</i> Dunal	Argentina, central Brazil	North America: U.S. (AR, AZ, FL, GA, PR, SC, TN, TX), Mexico; Africa , naturalized in certain tropical regions; and Asia , naturalized in various temperate and tropical regions
<i>S. diphyllum</i> L.	Mexico, Central America	North America: U.S. (FL, TX)
<i>S. jamaicense</i> Mill.	West Indies, Central American and northern South America	North America: U.S. (FL)
<i>S. torvum</i> Sw.	West Indies, Antilles, Bermuda, Mexico, Peru, Venezuela	North America: U.S. (AL, FL, HI)

Control Measures

Prior to taking action to control a suspected invasive plant, verify that the plant is an invasive and not a native species. Species verification can be obtained from a local Florida Cooperative Extension Service office (<http://solutionsforyourlife.ufl.edu/map/>).

Chemical

***Solanum tampicense*.** Herbicides that have shown the most promise in controlling this species include glyphosate, 2,4-D, and triclopyr. Seeds buried in the soil have been found to maintain their viability for as long as five years. As such, follow-up site scouting of treated areas and additional treatments of

The following application rates for each herbicide are label rates for rangeland/pasture/open space with dense infestations: 1) Milestone, 5-7 oz./acre in at least 20 gallons of water per acre; 2) ForeFront R&P, 2-2.6 pints/acre in at least 20 gallons of water per acre.

A mowing regiment is not required when using these herbicides, but best results are obtained with the use of a non-ionic surfactant (0.25% v/v) in the spray mix. Herbicides effective for spot spraying include Remedy or Forefront, mixed at a 0.5% solution, or Milestone at 0.5 to 0.8 oz per 2.5 gal (15 - 20 ml per 2.5 gal). Consider adding 0.25% non-ionic surfactant and a color marker to the herbicide solution to help identify plants that have been treated. It is also recommended that application of sprays is before

budding/early flowering if possible.

For more, see EDIS Publication SS-AGR-77, Tropical Soda Apple: Biology, Ecology and Management of a Noxious Weed in Florida, <http://edis.ifas.ufl.edu/UW097>.

A triclopyr formulation labeled for tropical soda apple is Remedy Ultra. Mowing is required to obtain best control of tropical soda apple in Florida when using this herbicide. Old infestations and/or newly germinating patches must be mowed regularly (every 50-60 days through April) to control budding and flowering. A broadcast treatment of 1 quart in 40 gallons of water/acre is recommended 50-60 days after the April mowing (late May-June). Follow-up with spot treatments (1-1 1/2 gallons of Remedy Ultra in 100 gallons of total spray mixture) of remaining plants or newly germinated plants.

Solanum jamaicense/Solanum diphylum. No research has been conducted on chemical control methods for either of these plants. Control methods developed for tropical soda apple (*Solanum viarum*) may be tried (see above) on these plants.

Solanum torvum. Control of turkeyberry has been achieved chemically on the Hawaiian Islands, where the plant has been found to be susceptible to translocated herbicides, such as glyphosate (Swarbrick 1997).

Biological

Solanum viarum. In early 2003, the South American beetle, *Gratiana boliviana* (Coleoptera: Chrysomelidae) was released in Florida for biological control of tropical soda apple. Since then, more than 128,000 beetles have been released in 19 counties in Florida. In addition, this beetle has been released in Georgia, Alabama, South Carolina and Texas. The beetles are well established in Florida and causing considerable damage to tropical soda apple populations (20-100% defoliation). Beetles move from 1 - 10 miles each year, depending on available food source and initial population size (Medal et al. 2006)

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