Natural Area Weeds: Invasive Solanum spp. in Florida

L. T. Markle, W. A. Overholt, and K. A. Langeland

Introduction
The Florida Exotic Pest Plant Council’s (FLEPPC) 2013 List of Invasive Plant Species includes two Category I and two 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 S. diphyllum L. (twoleaf nightshade) and S. torvum Sw. (turkeyberry). Solanum jamaicense Mill. (Jamaican nightshade), included in Category II in the 2009 FLEPPC list, was removed in 2011 because of a lack of occurrence data in natural areas.

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 as 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. We have also included information on Jamaican nightshade and another relatively common species, Solanum capsicoides All. (red soda apple), both of which can easily be confused with some of the invasive Solanum species.

Identification and Florida Distribution
The four Solanum spp. on the FLEPPC’s 2013 list and the two other species mentioned above 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.

Table 1. Identifying characteristics of FLEPPC Category I and Category II Solanum spp. and S. capsicoides
Table 1. Identifying characteristics of FLEPPC Category I and Category II *Solanum* spp. and *S. capsicoides*

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name(s)</th>
<th>Habitat</th>
<th>Distribution in Florida*</th>
<th>Key characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>S. viarum</em> Dunal</td>
<td>tropical soda apple</td>
<td>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).</td>
<td><img src="image" alt="Map" /></td>
<td>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.</td>
</tr>
<tr>
<td><em>S. diphyllum</em> L.</td>
<td>twoleaf nightshade</td>
<td>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.</td>
<td><img src="image" alt="Map" /></td>
<td>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.</td>
</tr>
<tr>
<td><em>S. jamaicense</em> Mill.</td>
<td>Jamaican nightshade</td>
<td>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.</td>
<td><img src="image" alt="Map" /></td>
<td>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 midrib 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.</td>
</tr>
<tr>
<td><em>S. tampicense</em> Dunal</td>
<td>wetland nightshade</td>
<td>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).</td>
<td><img src="image" alt="Map" /></td>
<td>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.</td>
</tr>
</tbody>
</table>

*Photo: John J. Mullahey
Photo: Kenneth A. Langeland
Photo: William A. Overholt
Photo: Allison M. Fox*
Natural Area Weeds: Invasive Solanum spp. in Florida

Native Distribution

The four Solanum spp. on the FLEPPC 2013 list, along with Jamaican nightshade, 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 six species are indicated in Table 2.

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)

<table>
<thead>
<tr>
<th>Species</th>
<th>Native Distribution</th>
<th>Exotic Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. tampicense Dunal</td>
<td>West Indies, Caribbean, Mexico, Belize, Central America</td>
<td>North America: US (FL, OK, SC)</td>
</tr>
<tr>
<td>S. viarum Dunal</td>
<td>Argentina, central Brazil</td>
<td>North America: US (AR, AZ, FL, GA, PR, SC, TN, TX), Mexico; Africa, naturalized in certain tropical regions; and Asia, naturalized in various temperate and tropical regions</td>
</tr>
<tr>
<td>S. diphyllum L.</td>
<td>Mexico, Central America</td>
<td>North America: US (FL, TX)</td>
</tr>
<tr>
<td>S. torvum Sw.</td>
<td>West Indies, Antilles, Bermuda, Mexico, Peru, Venezuela</td>
<td>North America: US (AL, FL, HI)</td>
</tr>
<tr>
<td>S. jamaicense Mill.</td>
<td>West Indies, Central American and northern South America</td>
<td>North America: US (FL)</td>
</tr>
<tr>
<td>S. capsicoides All.</td>
<td>Lack of consensus among experts with eastern Brazil, the Caribbean, and the neotropics (including Florida) suggested as areas of nativity</td>
<td>North America: US (AL, FL, HI, LA, MS, NC, SC, TX); widely distributed in Asia, Australia, and Pacific Islands</td>
</tr>
</tbody>
</table>
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 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.

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 spray is before budding/early flowering if possible. For more, see EDIS Publication SSAGR77, 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 ½ gallons of Remedy Ultra in 100 gallons of total spray mixture) of remaining plants or newly germinated plants.

Solanum jamaicense/Solanum diphyllum. 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 250,000 beetles have been released in 42 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 cause considerable damage to tropical soda apple populations. In many cases, the beetles provide sufficient control and no additional control tactics are not required (Diaz et al. 2013).

References


