

Tropical Soda Apple (*Solanum viarum* Dunal) in Florida¹

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Tropical soda apple (*Solanum viarum* Dunal), is a serious weed problem in many perennial grass pastures and native areas of Florida. A plant with foliage unpalatable to livestock, this invasive weed can infest a pasture or rangeland in 1-2 years, resulting in lower stocking rates. Geographically, the incidence of this plant in Florida has been highest in south Florida, though it has been observed throughout the state. Tropical soda apple (TSA) has been observed as a weed in pastures, ditch banks, citrus groves, sugarcane fields, and rangeland. It appears to be restricted to semi-disturbed sites. Highest incidence of TSA has occurred in improved pastures, such as bahiagrass, with an estimated 1 million acres infested in Florida.

This invasive weed produces a yellow fruit (1-1.5 inches in diameter) which contains 200-400 seeds per fruit with a seed germination of 75% or more. The plant is readily identified by its immature fruit which are green with white mottling, similar to watermelon. Fruit production occurs throughout the year, but mostly from September through May, thus providing 40,000-50,000 viable seeds per plant for dispersal. Wildlife such as feral hogs, raccoons, and deer feed on the fruit and are vectors for spreading

seed through the feces. Beef cattle will also consume the fruit and spread the seed in a similar manner.

Weed Taxonomy

At maturity, TSA is 3-6 feet tall; stems, leaves, flower-stalks and calyxes have broad based white to yellowish thorns up to 0.4 inch long; pubescent leaves are 4-7 inches long and 2-6 inches wide, deeply divided into broad pointed lobes, flowers are white with yellow stamens, a few together on stems below the leaves; fruits are glabrous, globular, about 1 inch in diameter, yellow when mature; seeds are light red-brown, 0.10 inches in diameter. Seeds are only moderately flattened, contained in a mucilaginous layer that contains a glyco-alkaloid called solasodine.

Weed Ecology

Tropical soda apple is a common weed in South America, India, West Indies, Honduras, and Mexico. It is native to Argentina and central Brazil and has been introduced in Africa, much of India and Nepal, and can be expected to occur in other subtropical areas. It was probably introduced into North America by humans or human activities. In Florida, it is an

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obligate weed occurring mainly in association with man's activities.

In Florida, TSA has been observed as a common weed in pastures, ditch banks, citrus groves, sugarcane fields, and wet areas of rangeland. In south Florida, TSA is typically found in soils belonging to the order of Spodosols (nearly level, somewhat poorly drained sandy soil with a spodic horizon 3-6 feet below the soil surface). During extended periods (over 3 weeks) of standing water, plant death loss can occur. It is occasionally found growing as a monoculture covering up to 50 acres or more. Based on contact with IFAS County Extension Agents during 1998, infestations of pastures by TSA in Florida were estimated to be approximately 1 million acres.

Solanum sp. were first reported by ranchers in south Florida in the early 1960s. However, these initial reports indicated the fruit was a cherry red color, not yellow. Apparently ranchers were observing *Solanum capsicoides*, not TSA. For the past 10-15 years in south Florida, TSA has been the most prevalent of the two species. Reasons for the increase in TSA are not well understood. No incidence of severe plant defoliation or death loss from insects feeding on TSA has been observed. Occasionally plants appeared stressed and displayed symptoms of leaf mottling, inclusions, etc., associated with fungi or bacteria.

TSA populations have been observed to increase rapidly following extended periods of dry weather (1987-1989; 1999-2001) that are followed by subsequent years of normal rainfall. Research has shown that TSA seed can survive in dry soil moisture conditions for two or more years. When favorable rainfall occurs, the seed will germinate and new TSA plants will appear in areas that ranchers thought were clean of TSA.

Weed Biology

Tropical soda apple flowers throughout the year, though it is concentrated from Sept. - May. Fruit production is also yearly and commonly a mature plant will have both immature (green fruit) and mature fruit (yellow). Seed germination from green fruit can be similar to that of yellow fruit. Seed that

is white in color is not viable, regardless of fruit color.

Seedling emergence primarily occurs during the dry season (Oct. - May). New plants will emerge either from seed or from roots. Roots have buds which will regenerate new shoots. The root system can be extensive, with feeder roots (.25 - 1.0 inch diameter) located a few inches below ground extending 3-6 feet from the crown of the plant.

Seed germination has occurred from seed planted 3.25 inches into the ground. How deep the seed must be placed in the soil before germination is inhibited is not known. Seed germination is dependent upon temperature, light, and age of seed. Seed germination was highest (95%) for 5 month-old seed followed by a gradual decline to zero germination at 25 months.

Weed Control

Dense Infestations

Milestone and Forefront are the most effective herbicides for controlling dense stands of TSA. These herbicides possess postemergence control of existing plants and preemergence control of germinating seeds. Our research has shown that Milestone and Forefront will control germinating seedlings for over 6 months after application.

The application rate for Milestone is 5 to 7 oz/A while Forefront is 2 to 2.6 pt/A. Although the lower application rates are highly effective on existing plants, the higher rates will provide more soil activity and are suggested if large amounts of TSA seed are present in the soil. Although mowing prior to herbicide application is not required, it is important to add a non-ionic surfactant (0.25% v/v) and apply in at least 20 gallons of water per acre.

Another option is to use Remedy herbicide. When using Remedy, mow plants to a 3-inch stubble height as soon as possible to keep plants from producing fruit and seed. Repeat mowing when plants reach the flowering stage (50-60 days) through April. Fifty to 60 days after the April mowing, when plant regrowth is at the first flower stage (late May - June), spray Remedy at 1 qt/A + 0.25% nonionic surfactant in 40 gal/A of water.

Remedy does not possess soil residual and follow up applications to control escaped or new seedlings will be necessary.

Regardless which herbicide is used, regular scouting after treatment is necessary. TSA can produce fruit at almost any time during the growing season and give rise to hundreds of additional plants. It is important to monitor the fields to ensure that no plants are allowed to reestablish and produce fruit.

Sparse Infestations

Sparse infestations include pastures, vegetable fields, sod fields, hammocks, ditch banks, and road sides with low infestations where each plant is individually sprayed. Mowing these areas is not necessary; instead, spray TSA in these areas for control and to stop additional development of new fruit and seeds. Recommended herbicides for 95-100% control using a spot application are as follows:

- Milestone at 0.3 oz per 2.5 gal (10 ml per 2.5 gal.) + 0.25% nonionic surfactant + color marker.
- Forefront or Remedy at 0.5% solution (50 ml per 2.5 gal) + 0.25% nonionic surfactant + color marker.
- Cover the entire TSA plant with spray to ensure herbicide uptake and maximum control. Allow herbicides to dry on plants 3-4 hours before rainfall. Use a colored marker with the herbicide solution to avoid spraying the same plant twice, or not spraying a plant at all. Monitor sprayed areas monthly and treat new TSA seedlings. Do not allow plants to produce fruit.
- TSA control can also be achieved using dicamba at 1% + 0.25% nonionic surfactant in 20 - 30 gallons of water. Dicamba (Banvel, Clarity or Vanquish) is effective at controlling TSA, but the 2 quart rate is more expensive than other options. Be sure and follow the guidelines for spraying volatile herbicides such as dicamba and Remedy. Refer to EDIS publication SS-AGR-12 Florida's Organo-Auxin Herbicide Rule (<http://edis.ifas.ufl.edu/WG051>) for more information.

It will take 1-3 years to completely control TSA from pastures. Prevent the movement of seed from one farm to another by encouraging your neighbor to control TSA in his pasture. Do not allow the plant to produce seed (i.e. fruit). Continually monitor pastures for this invasive weed and remove it where found.

To effectively control TSA, you must permanently stop seed production by controlling all existing plants in pastures, ditch banks, and hammock areas. Otherwise, this plant will continue to spread on your property and lower your profits.

Further Information

EDIS publications:

SS-AGR-78 Shipping Cattle, Not Tropical Soda Apple Seed (<http://edis.ifas.ufl.edu/UW187>)

SS-AGR-129 Tropical Soda Apple Control--Sorting Through the Options (<http://edis.ifas.ufl.edu/AG261>)

SS-AGR-130 Management Practices to Control Tropical Soda Apple (<http://edis.ifas.ufl.edu/UW188>)

SS-AGR-131 Tropical Soda Apple Making a Comeback (<http://edis.ifas.ufl.edu/UW189>)

ENY-826 Biology of *Gratiana boliviana*, the First Biocontrol Agent Released to Control Tropical Soda Apple in the USA (<http://edis.ifas.ufl.edu/IN487>)

ENY-824 Classical Biological Control of Tropical Soda Apple in the USA (<http://edis.ifas.ufl.edu/IN457>)

West Florida Research and Education Center:

Tropical Soda Apple (<http://tsa.ifas.ufl.edu/>)

Tropical Soda Apple Best Management Practices--

North Florida

(<http://tsa.ifas.ufl.edu/00Slides/NorthFlorida/index.html>)

South Florida

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[http://tsa.ifas.ufl.edu/00Slides/SouthFlorida/
index.html](http://tsa.ifas.ufl.edu/00Slides/SouthFlorida/index.html))