Department of **Agriculture and Fisheries**
Biosecurity Queensland

Invasive plant risk assessment

Tropical soda apple

Solanum viarum

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Contents

Summary

Tropical soda apple is a quick growing coloniser of open, disturbed sites and is native to parts of South America.

After being detected in Florida in 1987, tropical soda apple spread over an estimated 503 000 hectares and is currently estimated to cost landholders $6.5 million to $16 million annually. It was declared noxious in Florida in 1995. Primary impacts include invasion of pasture and reduction of cattle carrying capacity. In addition, tropical soda apple is a host of at least six viruses that affect vegetable crops including tomato, tobacco, eggplant, potato and pepper. Crop pathogens include the cucumber mosaic virus, gemini virus, potato leafroll virus, potato virus Y, tobacco etch virus, tomato mosaic virus, tomato mottle virus and the fungal pathogen, *Alternaria solani*.

While the leaves are unpalatable to cattle, the fruit are readily consumed and the seeds are dispersed in dung. Hence, cattle are the primary dispersal vector.

Tropical soda apple was first detected in Queensland in November 2010 at a cattle yard near Coominya.

Considering the history of the species as a significant weed in Florida and elsewhere, it is highly likely to have similar impacts in Queensland. Climate modelling suggests it is well suited to most of coastal Queensland. Habitats most at risk are predicted to include a range of disturbed sites, especially overgrazed cattle paddocks.

Introduction

Identity and taxonomy

Species: *Solanum viarum* Dunal, in DC

Synonyms: *Solanum chloranthum* DC, *Solanum khasianum* var. *chatterjeeanum* Sen Gupta, *Solanum viridiflorum* Schltdl.

Common names: Tropical soda apple, Sodom apple

Family: Solanaceae

S. viarum has been wrongly identified in the literature as *S. khasianum* (= *S. aculeatissimum*) and *S. reflexum* (Mullahey et al. 1993).

S. viarum is similar to *S. myriacanthum* and *S. aculeatissimum* and these three species form a closely related complex (Nee 1979,1991).

Description

Tropical soda apple is an upright, much-branched perennial 0.5–2 m tall (Figure 1). Its leaves and stems are armed with thorn-like prickles up to 12 mm long (Figure 2). Leaves are 10–20 cm long and 6–15 cm wide and covered with short hairs. Flowers are white with five recurved petals and white to cream-coloured stamens (Figure 3).

Figure 1. *S. viarum*

Figure 2. Distinctive thorns on leaves of *S. viarum*

Figure 3. Flowers of *S. viarum*

The immature fruits are mottled light and dark green like a watermelon. The mature fruits are smooth, round, yellow, and 1–3 cm in diameter with a leathery skin surrounding a pale green, scented pulp.

Tropical soda apple is similar in appearance to *S. capsicoides*. The latter has cherry red fruit, rather than yellow.[1]

Ecology

Tropical soda apple is a fast-growing plant that has evolved to take advantage of disturbance. As such, it is quick to colonise open areas where other vegetation is either sparse or absent. In southern Brazil (part of its native range) it exists as minor, scattered infestations near cattle facilities (Bianco et al. 1997) and elsewhere, in grassland, thickets and disturbed places.

Reproduction and dispersal

Reproduction is from seeds. Each fruit contains 180 to 420 seeds and a single plant can produce 50 000 seeds with 75 per cent viability (Mullahey et al. 1993).

Flowering occurs throughout the year in Florida (Mullahey et al. 1993). Time from germination to first flowering has been recorded to be 108 days (Mullahey & Cornell 1994).

Seeds are dispersed primarily by cattle but also by birds, feral pigs and deer which eat the sweet-smelling fruit. Seeds remain viable inside the gastrointestinal tracts of cattle for up to six days (Brown et al. 1996).

The average period of seed dormancy is about one month (Bryson & Byrd 2007), although Pingle and Dnyansagar (1979) reported dormancy of several years.

Seeds can also be spread with contaminated manure, hay, seed and sod from infested areas. High-risk destinations are pastures, stockyards, slaughterhouses, truck washes and roadsides.

Figure 3. Fruit of *S. viarum*

Origin and distribution

Mullahey et al. (1993) state that tropical soda apple is native to Argentina and central Brazil. The United States Department of Agriculture (2010) states that it is native to Argentina, Brazil, Paraguay and Uruguay. Naturalised populations have been recorded in India, Nepal, Mexico, Greater and Lesser Antilles, areas of Africa, Myanmar (Indochina), Honduras, West Indies, parts of South America (outside its native range) and south-eastern United States (United States Department of Agriculture 2010).

Figure 5. Global distribution of *S. viarum* (GBIF n.d.)

Preferred habitat

Climatically, tropical soda apple is best suited to tropical and subtropical areas. Preferred habitats include a range of highly disturbed sites, often where there is a lack of competition from other plants. This often includes overgrazed and unhealthy pasture.

According to Mullahey et al. (1993), tropical soda apple is a common weed in 'pastures, ditch banks, citrus groves, sugarcane fields, and wet areas of rangeland' in Florida. In Florida, it is 'typically found in soils belonging to the order of spodosols (nearly level, somewhat poorly drained sandy soil with a spodic horizon 1–2 m below the soil surface)'. Within its native range it is noted to exist in 'pastures, roadsides, ditch-banks, cultivated ground and along edges of forests at low elevations'. It also persists in 'sugar cane fields, vegetable fields, citrus plantations, natural areas (including oak hammocks, cypress heads and swamps), sod fields, ditch banks, lawns, state parks, nature preserves, landfills and county municipal parks' (Mullahey 1996).

History as a weed elsewhere

Tropical soda apple is a weed in parts of South America, Africa, India, Nepal, the West Indies, Honduras, Mexico and the United States (Bryson et al., 2002). It was first detected in Florida in 1987 (Mullahey et al. 1993) and has since spread to adjacent states (Alabama, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, Pennsylvania, South Carolina, Tennessee and Texas), where it is a pest of pasture, citrus crops, vegetable crops, sugarcane and natural areas (Mullahey & Cornell 1994). Under favourable conditions, it can form extensive, pure stands. Spread rates in Florida have been rapid over the last 20 years. Currently, the area infested is estimated at 503 000 hectares, with an estimated annual spread rate of 35 per cent (Duncan et al. 2004). It can sometimes form pure stands that cover 20 hectares or more (Mullahey et al. 1993).

Tropical soda apple has invaded 20 natural areas in Florida, including local, state and federal reserves, where it 'outcompetes native plant species' (Langeland & Burks 1998).

Tropical soda apple has been listed among 16 'key invasive plants' in the United States (Duncan et al. 2004) and was placed on the Florida noxious weed list in 1994 and added to the federal (United States) noxious weed list in 1995.

Tropical soda apple can readily invade pasture and reduce cattle carrying capacity (Mullahey et al. 1993). In addition, it is a host of at least six viruses that affect vegetable crops including tomato, tobacco, eggplant, potato and pepper. Crop pathogens include the cucumber mosaic virus, gemini virus, potato leafroll virus, potato virus Y, tobacco etch virus, tomato mosaic virus, tomato mottle virus and the fungal pathogen, *Alternaria solani*.

Mullahey et al. (1994) estimated that tropical soda apple was costing $11 million per year in Florida. Similarly, Thomas (2007) (cited in Medal 2010) estimated losses at $6.5 million to $16 million annually.

A biological control project was started in January 1997 by the University of Florida in collaboration with other agencies.

Pest potential in Queensland

Distribution and status in Queensland and Australia

Tropical soda apple was first detected in Australia in northern New South Wales (Kempsey) in August 2010. Subsequent searching revealed an additional 38 sites, from near Taree to north of Coffs Harbour, including a 50 hectare infestation along some 100 km of riverbank near Kempsey.

In late November 2010, tropical soda apple was detected for the first time in Queensland in cattle yards near Coominya (Figure 6). As yet, the full extent of the species in Queensland has not been delimited. Searching is likely to reveal additional populations in southern Queensland, most likely following transport routes for cattle.

Figure 6. Tropical soda apple near Coominya, Queensland (Photo: Sheldon Navie)

Potential distribution and impact in Queensland

Climate-matching software called Climatch (Bureau of Rural Sciences 2009) was applied to predict areas of Queensland where climate is similar to that experienced in Florida and across the native range of tropical soda apple. An extensive area of coastal and subcoastal Queensland appears suitable, from tropical areas south to the New South Wales border (Figure 6).

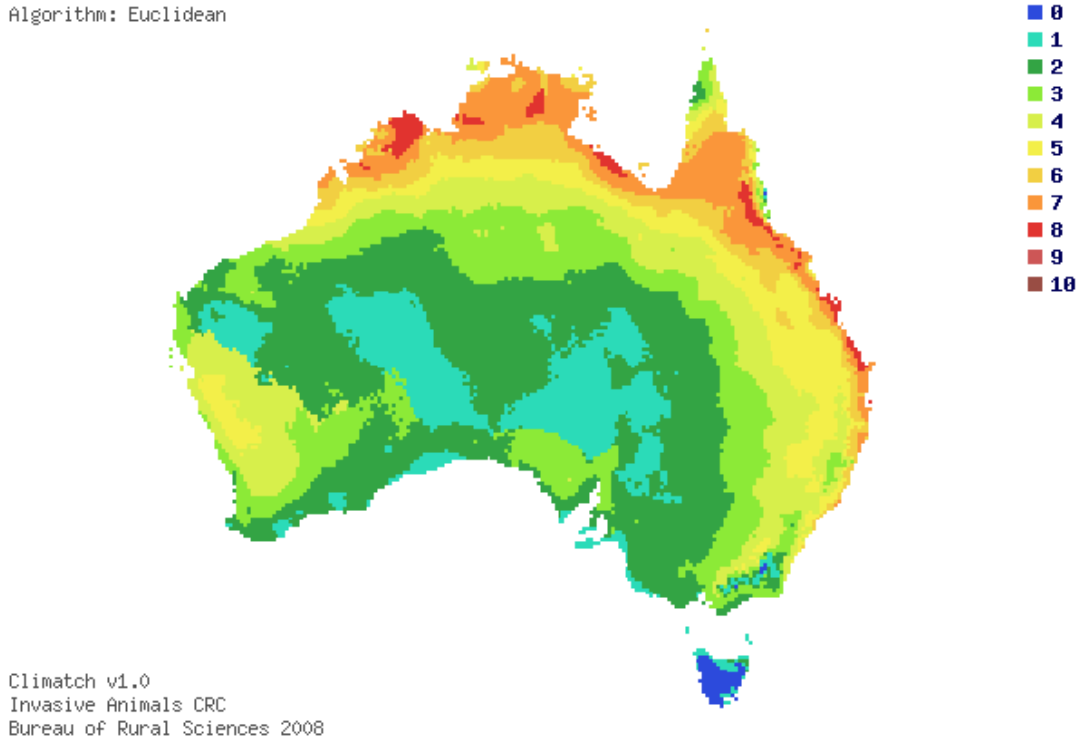

Figure 6. Area of Australia where climate appears suitable for survival of tropical soda apple. Red and orange are highly suitable, yellow is marginally suitable and green and blue are unsuitable. Map produced using Climatch computer software (Bureau of Rural Sciences 2009)

Within the area where climate appears suitable, habitats most at risk are predicted to include a range of disturbed (cleared or partially cleared) sites, such as grazing land (native and improved pasture), riparian areas (cleared or partially cleared creek banks) and perhaps the margins of cropping lands, roadsides and open forests and woodlands. Similar habitats have been invaded overseas.

Considering the history of the species as a significant weed overseas (mainly in Florida), it seems reasonable to predict it will become a significant pest in Queensland. Potential impacts could include loss of pasture production and impacts on citrus, vegetables and perhaps sugarcane. The species would also provide an abundant alternative host for a range of pathogens that affect tomato, tobacco, eggplant, potato and pepper crops. Potential impacts on native vegetation are difficult to predict, but the species could temporarily colonise gaps created by disturbance within forests and woodlands.

Control

This assessment has not attempted to summarise the literature on control of tropical soda apple. However, for information on control using 28 different herbicides refer to Call et al. (2000).

References

Bianco, S, Pitelli, RA, Mullahey, JJ & Charudattan, R 1997, 'Response of tropical soda apple (*Solanum viarum* Dunal) to soil liming', *Weed Science Society of America Abstracts* 37: 29.

Brown, WF, Mullahey, JJ & Akanda, RU 1996, 'Survivability of tropical soda apple seed in the gastro-intestinal tract of cattle'. *Proceedings of the Tropical Soda Apple Symposium*, Bartow, Florida, pp. 35–39.

Bryson, C, Byrd, J & Westbrooks, R 2002, *Tropical soda apple*, Mississippi Department of Agriculture and Commerce, Jackson, Mississippi.

Bryson, CT & Byrd, JD 2007, 'Biology, reproductive potential and winter survival of tropical soda apple (*Solanum viarum*)', *Weed Technology* 21: 791–795.

Duncan, CA, Jachetta, JJ, Brown, ML, Carrithers, VF, Clark, JK, Ditomaso, JM, Lym, RG, McDaniel, KC, Renz, MJ & Rice, PM 2004, 'Assessing the economic, environmental and social losses from invasive plants on rangeland and wildlands', *Weed Technology* 18: 1411–1416.

Langeland, KA & Burks, KC 1998, *Identification and biology of non-native plants in Florida's natural areas*, Gainesville, Florida, University of Gainesville, Florida.

Medal, J 2010, *Implementation of biological control of Tropical soda apple*, University of Florida, ‹http://entomology.ifas.ufl.edu/medal/TropicalSodaApple/›.

Mullahey, JJ, Nee, M, Wunderlin, RP & Delaney, KR 1993, 'Tropical soda apple (*Solanum viarum*): a new weed threat in subtropical regions', *Weed Technology* 7: 783–786.

Mullahey, JJ, Hogue, P, Hill, KU, Sumner, S & Nifong, S 1994, 'Tropical soda apple census', *Florida Cattleman Magazine* 58(9): 69–75.

Mullahey, JJ & Cornell, J 1994, 'Biology of tropical soda apple (*Solanum viarum*) an introduced weed in Florida', *Weed Technology* 8(3): 465–469.

Nee, M 1979, 'A revision of *Solanum* section *Acanthophora',* PhD thesis, University of Wisconsin, Madison, Wisconsin, USA.

Nee, M 1991, 'Synopsis of *Solanum* section Acanthophora: a group of interest for glycol-alkaloids', in JG Hawkes, RN Lester, M Nee & N Estrada (eds), *Solanaceae III: Taxonomy, chemistry, evolution*, Royal Botanic Gardens, Kew, Richmond, Surrey, United Kingdom, pp. 258–266.

Nee, M 1999, 'Synopsis of *Solanum* in the New World', in M Nee, DE Symon, RN Lester & JP Jessop (eds), *Solanaceae IV: advances in biology and utilisation*, Royal Botanic Gardens, Kew, pp. 285–333.

Pingle, AR & Dnyansagar, VR 1979, 'Induction of germination in *Solanum viarum'*, *Current Science* 48: 449–450.

United States Department of Agriculture, ARS, National Genetic Resources Program 2010, *Germplasm Resources Information Network – (GRIN),* online database, National Germplasm Resources Laboratory, Beltsville, Maryland, ‹www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?317433›.