

# Identification, Biology, and Control of Small-Leaf Spiderwort (*Tradescantia fluminensis*): A Widely Introduced Invasive Plant <sup>1</sup>

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## Introduction

*Tradescantia fluminensis* (small-leaf spiderwort) is a perennial subsucculent herb native to tropical and subtropical regions of Brazil and Argentina (Maule et al. 1995). The species has been introduced to the southeastern United States as well as California, Hawaii, and Puerto Rico. It is also introduced to at least 13 other countries where it is often considered invasive. The species thrives in moist areas, where it forms dense monocultures and reduces recruitment of native plants. *Tradescantia fluminensis* alters the decomposition rate of leaf litter and is capable of altering the nutrient availability, moisture regime, and invertebrate community in invaded areas compared to non-invaded areas. A good management strategy should include preventative actions and any occurrences of this plant should be eradicated before it is allowed to spread.

## Taxonomy

*Tradescantia fluminensis* was described in 1825 by the botanist José Mariano da Conceição Vellozo. The genus *Tradescantia* alone contains an estimated 70–71 species (Faden 1998, Eminağaoğlu et al. 2012) and was named in honor of the 17<sup>th</sup> century English naturalist John Tradescant the Elder (Missouri Botanical Garden 2016). Nine species occur in Florida (Wunderlin and Hansen 2003), four of which are native to the state (<http://florida.plantatlas.usf.edu/Results.aspx>).

The placement of *T. fluminensis* within the *Tradescantia* genus was supported by DNA sequencing analysis by Burns et al. (2011). The specific epithet *fluminensis* is derived from the Latin *fluminis* meaning “a river” (Jaeger 1944) in reference to the Rio de Janeiro province of Brazil (da Conceição Vellozo 1825). Synonyms of *T. fluminensis* consist of *T. albiflora* Kunth, *T. decora* W. Bull, *T. laekenensis* Bailey & Bailey, *T. mundula* Kunth, and *T. tenella* Kunth (<http://theplantlist.org>).

It belongs to the family Commelinaceae, which comprises about 650 species worldwide (Panigo et al. 2011). The taxonomy suggests that multiple evolutionary origins of invasiveness exist within the family because both invasive and non-invasive species are present within multiple genera (Burns 2004). Alternate common names include green wandering Jew, inch plant, small-leaf wandering Jew, small-leaf spiderwort, wandering Willy, and white-flowered wandering Jew (Wunderlin and Hansen 2003, Langeland et al. 2008, Flora of Alabama 2016, Missouri Botanical Garden 2016).

## Description

*Tradescantia fluminensis* has white colored polysymmetric flowers with centrifugal development (Hardy and Ryndock 2012). There are five or six stamens per flower, each tipped

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with a bright yellow anther, and all stamens are fertile (Faden and Hunt 1991) (Figure 1). Blooms last less than one day (Godfrey and Wooten 1979). In northern Florida, flowering occurs most often in spring and fall (Langeland et al. 2008).



Figure 1. The distinctive white flowers of *Tradescantia fluminensis* have three petals and five or six stamens tipped with bright yellow anthers. Credits: Jason Seitz

Plants are typically comprised of a single vertically oriented leaf-bearing stem of about 50–60 cm long preceded by a 30–150 cm horizontal leafless stem with roots at the nodes (Maule et al. 1995). Leaves are waxy and bright green (Figure 2). Little or no branching occurs along the stem. Growth occurs at the stem apex and the posterior end of the horizontal stem typically decays (Kelly and Skipworth 1984a). The small root system does not usually reach below the leaf litter and humus layers (Maule et al. 1995).

When in bloom, *T. fluminensis* can be easily differentiated from most other members of the Commelinaceae family by its small white flowers (Figure 1) (versus pink, blue, or purple in most other species). The species can be differentiated from *Gibasis pellucida* (Tahitian bridalveil) by its flower stalk, which is short and of similar diameter to the stem of the plant (versus a long, thin flower stalk in *G. pellucida*). It can be differentiated from *Callisia cordifolia* (Florida roseling) by the presence of bright yellow anthers (versus snowy white anthers in *C. cordifolia*). These traits, combined with the lack of seed production, can help differentiate *T. fluminensis* from other spiderworts in Florida.



Figure 2. *Tradescantia fluminensis* (a) forms dense monocultures (b) and reduces recruitment of native species (c) in northern Florida and elsewhere. Its bright green shiny foliage and contrasting bright white flowers help to identify this natural areas weed. Credits: Jason Seitz

## Geographical Distribution

The native range of *T. fluminensis* includes subtropical and tropical portions of Brazil and Argentina (Maule et al. 1995). The species was originally described from specimens collected from the Rio de Janeiro province of Brazil (da Conceição Vellozo 1825).

*Tradescantia fluminensis* was introduced to New Zealand in 1910, where it is now invasive (Standish 2001a). It is also established in eastern Australia (Orchard 1994, Burns 2004), the Galapagos Islands (Guézou et al. 2010), islands off the coast of Chile (Cuevas et al. 2004), the Republic of Nauru in Micronesia (Thaman et al. 1994), Russia (Tolkach et al. 1990), Spain (Landcare Research 1998), the Kingdom of Thailand (Holm et al. 1979), Turkey (Tan 1984, Eminağaoğlu et al. 2012), Italy, Japan, Kenya, Portugal, California (Faden 2000), and the southeastern United States, as well as Puerto Rico (Standish 2001b) and Hawaii (Staples et al. 2006).

Although reported from North Carolina by Small (1933), recent records from this state are lacking (Langeland et al. 2008). It was reported in Louisiana by Faden (2000) and vouchered specimens have been collected in Conecuh, Houston, and Tuscaloosa counties of Alabama (Flora of Alabama 2016). It may also occur in Georgia (Langeland et al. 2008).

In Florida the species is most abundant in northern and central portions of the peninsula. Specimens have been vouchered from Calhoun and Leon counties in the panhandle; Alachua, Marion, Lake, Orange, and Seminole counties in north central Florida; Hernando, Hillsborough, and Manatee counties along the Gulf Coast; and Flagler and

St. Lucie counties along the Atlantic Coast (<http://florida.plantatlas.usf.edu>).

## Biology and Ecology

*Tradescantia fluminensis* is shade-tolerant (Samoilova et al. 2011) and can grow in light levels of 1% to 90% normal daylight during most of the year (Maule et al. 1995). The species grows most vigorously and attains highest biomass in reduced canopy coverage situations, such as in fragmented forest communities or at forest margins (Standish et al. 2001b). Rates of stem growth were determined to be 0.2–0.3 cm/day in summer and 0.04–0.06 cm/day in winter (60–70 cm/year) in a two-year study conducted in a New Zealand coastal forest (Maule et al. 1995). Apical growth was balanced by basal decay in the Maule et al. (1995) study.

The species thrives in moist conditions including riparian zones and forest margins. It may be able to sequester nutrients from the upper (organic) soil horizon (Standish et al. 2001b). Nitrate (NO<sub>3</sub><sup>-</sup>) is stored in shoots and subsequently utilized to sustain growth when external nitrogen supply would otherwise limit growth (Maule et al. 1995).

*Tradescantia fluminensis* is a larval host plant of the noctuid moth *Mouralia tinctorides* (Eichlin and Cunningham 1978). This moth has a native range from Florida and Texas south to Brazil (Landolt 1993) and is not considered to be a plant pest (Landolt 1993). The plant is also a host for at least five known plant viruses of the genus *Potyvirus* (family Potyviridae) (Standish 2001a, Ciuffo et al. 2005; see Biological Control section below).

## Reproduction and Colonization

In its native range of Brazil and Argentina, *T. fluminensis* reproduces by seed as well as vegetatively (M.O.O. Pellegrini pers. comm. 06/10/14). However, in Florida and New Zealand the species is completely reliant on vegetative propagation (Kelly and Skipworth 1984a, Butcher and Kelly 2011). Stems break apart easily and each fragment contains at least one node and thus has a high potential for regrowth (Hurrell and Lusk 2012).

*Tradescantia fluminensis* can colonize new areas by the spread of shoots via flowing water like that of river systems. In New Zealand, a colony was discovered about 2.6 km downstream from the original infestation, with the highest density of plants found along river channels (Hurrell et al. 2012). Fragments of the plant can survive for up to 48 hours in full-strength seawater (Hurrell and Lusk 2012). In addition to water-mediated dispersal, the shoots can

also become dispersed lodged in the hooves of cattle (*Bos taurus*) (Ogle and Lovelock 1989). Stems of this species may also become lodged in the feet of domestic chickens (*Gallus gallus*) and dispersed in a similar manner (Standish 2001a).

*Tradescantia fluminensis* can be spread by the improper disposal of landscape material along roadsides (Hurrell et al. 2012). Dumping of landscape waste is thought to be an important mechanism of long-distance dispersion. However, the relative importance of humans as dispersers of *T. fluminensis* has not been quantified (Butcher and Kelly 2011).

## Habitat

In its native range, *T. fluminensis* occurs in rainforests, shaded roadsides, and gardens (Eminağaoğlu et al. 2012); along the banks of waterways (da Conceição Vellozo 1825); and in cultivated areas of Brazil, where it is considered an agricultural weed (Dos Santos and De Araujo 1971 cited in Kelly and Skipworth 1984a). The original description of *T. fluminensis* referred to its occurrence in cleared areas under cultivation (da Conceição Vellozo 1825), suggesting the species was an agricultural weed even back in the mid-1800s. In Turkey it inhabits damp roadside areas and riparian habitats (Eminağaoğlu et al. 2012). In Hawaii, the species occurs in shaded, moist riparian habitats and along shaded forest edges (Staples et al. 2006).

In northern Florida, *T. fluminensis* occurs most often in shady mesic to hydric forests, especially those associated with riparian wetlands (Godfrey and Wooten 1979). It occurs less frequently in well-drained habitats including scrub, sandhill, and upland pine forests (Langeland et al. 2008). Urban settings include shady lawns, greenhouses, and areas used for disposal of landscape and yard waste (Small 1933, Langeland et al. 2008).

## Impacts

*Tradescantia fluminensis* has been recognized as a non-native invasive plant in the southeastern United States since 1947 (Langeland et al. 2008) and is now listed as a Category I invasive plant by the Florida Exotic Pest Plant Council (FLEPPC) based on documented ecological damage (FLEPPC 2015). The species is currently not included in the federal noxious weed list or the noxious weed list of the Florida Department of Agriculture and Consumer Services (<http://plants.usda.gov/java/noxious>). An assessment of *T. fluminensis* in September 2006 by the Institute of Food and Agricultural Sciences (IFAS) Invasive Plant Working Group concluded that this invasive plant is not recommended for

any use in northern or central Florida. *Tradescantia fluminensis* has also been documented in natural areas of southern Florida but may not be problematic there although this conclusion is pending further data (IFAS 2016).

The species forms dense monocultures and reduces recruitment of native species in northern Florida (Schmitz et al. 1997) (Figure 2). It was found to out-compete established native *Oplismenus hirtellus* (basketgrass) in a northern Florida study by McMillan (1999), who also found that it reduced the relative abundance and diversity of native plants in test plots in Alachua County floodplain forests and mesic hammocks. *Tradescantia fluminensis* forms a dense layer along the ground, preventing regeneration of native vegetation by shading them and is capable of affecting the long-term viability of forest fragments (Butcher and Kelly 2011). The presence of *T. fluminensis* was associated with a decrease in abundance and species richness of native seedlings in a study by Standish et al. (2001b). It is known to suppress native groundcover species in natural areas (Hurrell and Lusk 2012).

Impacts on forest floor invertebrates were detected in a study by Standish (2004) in New Zealand, where *T. fluminensis* caused a moderate reduction in taxonomic richness. Invaded forests of New Zealand were found to have a decreased diversity of fungus gnats and certain beetles compared to non-invaded forests (Toft et al. 2001).

*Tradescantia fluminensis* produces litter that decomposes more readily than that of the mixed-species forests where it invades, and the increased rate of litter decomposition can alter nutrient availability compared to non-invaded forests (Standish et al. 2001). The soil moisture regime under *T. fluminensis* stands is greater than under leaf litter of non-invaded forests (Standish 2004).

## Management

### Chemical

The use of herbicides is considered the only practical means of controlling large infestations of *T. fluminensis* (Standish 2001a, 2001b, 2002). Application methods include vehicle-mounted spraying, backpack spraying, and hand-spraying (Hurrell et al. 2012). *Tradescantia fluminensis* is difficult to control and will likely require more than one herbicide application to achieve satisfactory results. Foliar applications of 0.3% triclopyr amine in water with a non-ionic vegetable oil surfactant (such as Dyne-Amic) added appear to offer the best and most consistent control. This equates to using 6% Brush-B-Gon, 5% Brush Killer, or 1% Garlon 3A, in water and the surfactant. Follow all label directions.

Much of the control studies using herbicides have been conducted in New Zealand using chemicals that are either not registered in the United States, include active ingredients with use restrictions for natural areas in the United States, or have trade names that refer to different active ingredients outside the United States than the same trade name used in the United States. For these reasons, chemical control studies in New Zealand conducted by Kelly and Skipworth (1984b), Standish (2002), and Hurrell et al. (2012) are omitted from this summary.

### Physical

Physical removal of the plants requires special care to remove all stem segments in order to prevent regrowth. This labor-intensive method may be a viable option only when controlling small colonies (Standish 2001b). Hand-removal of *T. fluminensis* was found to be more successful than herbicide treatment in terms of reduction of percent coverage in a study comparing herbicide, hand-removal, and shading treatment methods (Standish 2002).

### Shading

Standish (2002) found that artificial shading was the most effective means of sustained control of *T. fluminensis* without invasion by other nonindigenous plant species. Artificial shading (three layers of shade cloth stretched over metal frames) reduced light levels to 2%–5% of full sunlight and reduced *T. fluminensis* cover to the equivalent of 40% coverage following 17 months of shading (Standish 2002). Percent cover remained at 100% for unshaded plots.

It is possible that the planting of native woody plants into areas dominated by *T. fluminensis* may decrease coverage of this plant by decreasing the amount of available light over time (Standish 2002). It should be noted that shade-intolerant native forest species may not become established under shade intended to reduce *T. fluminensis* coverage. However, shade-intolerant species may also not become established in areas having higher light levels (10% to 30% full light) if dominated by *T. fluminensis* (Standish 2002).

### Biological

There are currently no effective biological control agents being used on *T. fluminensis*. The presence of flavonoids in the leaves of the plant may deter generalist insect herbivores but may lead to adaptation of specialist insects (Standish 2001a). Certain members of the hemiptera family Miridae (plant bugs) hold promise as potential biological control agents. These insects are likely to cause damage to new

shoots of *T. fluminensis* (Eyles 1999), resulting in malformed shoots and reduced plant biomass (Standish 2001a).

Parasitic nematodes of the genus *Meloidogyne* (Tylenchida: Heteroderidae) have been reported associated with *T. fluminensis* (Yeates and Williams 2001), but a successful biological control program has not yet been conducted using nematodes.

Plant pathogens such as fungi hold promise as potential biological control candidates. At least nine fungal taxa have been recorded using *T. fluminensis* as a host (Farr and Rossman 2013), including the rust fungus *Physopella tecta* (synonym *Phakopsora tecta*) (Standish 2001a).

There are at least five plant viruses of the genus *Potyvirus* (family Potyviridae) known to infect *T. fluminensis*: bean yellow mosaic virus-BV, clover yellow vein virus, *T. albiflora* virus, *Tradescantia* mild mosaic *Potyvirus*, and *Tradescantia-Zebrina Potyvirus* (Standish 2001a, Ciuffo et al. 2005). Symptoms of these plant viruses include the presence of necrotic lesions; stunted, shrunken, or distorted leaves; mosaic; and mottling. Although the *T. albiflora* virus originates from a cool temperate climate (southeastern Russia), it may still be a suitable candidate for development as a biocontrol agent (Standish 2001a).

## Prevention

A good management strategy for *T. fluminensis* should include actions designed to prevent dispersal through landscape waste dumping, such as by educating the public and/or by modification of the physical environment (Butcher and Kelly 2011). Vulnerable locations, such as lands adjacent to two-lane roadways that have wide shoulders or close to residential areas, should have signage to discourage the dumping of yard waste and should be monitored for evidence of this species. Any occurrences of this plant should be eradicated before it is allowed to spread (Butcher and Kelly 2011).

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