Torpedo Grass (*Panicum repens*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, November 2016
Revised, February 2017
Web Version, 1/6/2020

Photo: Forest & Kim Starr. Licensed under Creative Commons BY 3.0.

1 Native Range and Status in the United States

Native Range

From Australian Center for International Agricultural Research (2011):

"*Panicum repens* is native to Tropical Africa, North Africa and the Mediterranean (sometimes said to be native to Asia)."

From Masterson (2007):

"Believed native to Europe or Australia *Panicum repens* is now widely distributed"

GISD (2020) reports *Panicum repens* as native to Albania, Algeria, Angola, Botswana, Cameroon, China, Cote d'Ivoire, Cyprus, Egypt, Ethiopia, Yugoslavia, France, Ghana, Greece, Guinea, India, Indonesia, Iraq, Israel, Italy, Japan, Jordan, Kenya, Lebanon, Liberia, Libya, Madagascar, Malawi, Mali, Morocco, Mozambique, Namibia, Nepal, Nigeria, Philippines, Portugal, Saudi Arabia, Senegal, Sierra Leone, South Africa, Spain, Sri Lanka, Sudan, Swaziland, Syria, Taiwan, Tanzania, Thailand, Tunisia, Turkey, Uganda, Yemen, Zambia, and Zimbabwe. CABI (2016) reports the following additional countries as part of the native distribution: Central African Republic, and Niger.

From Smith et al. (2004):

"Torpedograss [*sic*] is a terrestrial plant of unresolved origin (Webster 1987); however, according to Holm et al. (1977), it is an Old World species […]"

Status in the United States

From Texas Invasive Species Institute (2014):

"Torpedo grass was first collected in 1876 in Alabama, but is believed to have been introduced to the United States first in Louisiana."

According to Texas Invasive Species Institute (2014), *Panicum repens* is currently established in Alabama, California, Florida, Hawaii, Louisiana, Mississippi, North Carolina, South Carolina, and Texas. CABI (2016) lists *P. repens* as introduced and present in Puerto Rico and the Northern Mariana Islands.

From Hanlon and Brady (2005):

"In Florida, torpedograss is found throughout much of the state and was present in 72% of surveyed public lakes and rivers (Schardt 1994)."

From MacDonald et al. (2008):

"*Panicum repens* is one of the most serious weeds in Florida."

From GISD (2011):

"Brecke et al. (2001) state: "[…] It has spread throughout the gulf coast region from Florida to Texas (McCarty et al. 1993; Murphy et al. 1992). It is a serious problem in the lower coastal plain of Alabama and Mississippi, and in much of Florida where it is primarily a weed of moist, sandy soils, but it can also grow in finer textured soils (Wilcut et al. 1988[a])."""

From Masterson (2007):

"In the U.S. southeast, the plant can be found from Florida to the Gulf coast of Texas, and northward along the Atlantic Coast to North Carolina. The species has also been introduced to California and Hawaii, where it has become a pest plant to the sugarcane industry (Holm et al.

1977, Godfrey and Wooten 1979, Small 1933, Langeland and Burks 1998). By 1995 *P. repens* was reported as naturalized in 75% of Florida counties (Wunderlin and Hansen 2004). As of April, 2007, the Florida Exotic Pest Plant Council (FLEPPC) reports the species as present in 57 of 67 Florida counties."

GISD (2020) reports *Panicum repens* as introduced and established on Saipan Island (Northern Mariana Islands).

Panicum repens is a Class C noxious weed in Alabama, a Prohibited noxious weed in Arizona, and a noxious weed in Hawaii and Texas (USDA, NRCS 2016). *P. repens* is regulated in Texas, Arizona, Alabama, Georgia, South Carolina, and Florida (EDDMapS 2020).

Means of Introductions in the United States

From MacDonald et al. 2008:

"Native to Africa and/or Asia, it was introduced to the United States before 1876, primarily through seed used for forage crops. In the early 1900's the United States Department of Agriculture imported and distributed *Panicum repens* seed for planting in pasturelands, providing forage for cattle."

From NatureServe (2015):

"In California, *Panicum repens* was introduced from Melaleuca stock received from Florida (Baldwin et al. 2008)."

Remarks

From Masterson (2007):

"Several *Panicum* congeners similar in appearance occur in Florida. Beachgrass (*Panicum amarum*), redtop panicum (*P. rigidulum*), and maidencane (*P. hemitomon*) [(]all can be found within the IRL [Indian River Lagoon] watershed counties). Details of the rhizomes, leaves, and inflorescence must be studied to distinguish among species."

"The original native range of *Panicum repens* is in dispute. The type specimen from which the species was first described by Linnaeus in 1762 was collected from Spain, although several authorities suggest the native range of the species to be Australia. The first description of this species (as *P. airoides*) from Australia dates to 1810, therefore it is clear that the species has been historically present in both locations."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2014):

"Kingdom Plantae
Subkingdom Viridaeplantae
Infrakingdom Streptophyta
Division Tracheophyta
Subdivision Spermatophytina
Infradivision Angiospermae
Class Magnoliopsida
Superorder Lilianae
Order Poales
Family Poaceae
Genus *Panicum* L.
Species *Panicum repens* L."

"Taxonomic Status:
Current Standing: accepted"

Size, Weight, and Age Range

From GISD (2011):

"Flowering stems are erect and up to 0.8m tall."

From Masterson (2007):

"Shoots, up to 1 m tall, […]"

Environment

From CABI (2016):

"[…] it [*P. repens*] does persist in Masvingo Province of Zimbabwe where temperatures fall below 0°C in some years. In the tropics it may occur up to 2000 m altitude."

CABI (2016) lists the upper and lower limits for the mean annual temperature as 19ºC and 27ºC, the mean maximum temperature of hottest month as 25ºC and 31ºC, and the mean minimum temperature of coldest month 16ºC and 22ºC.

From Masterson (2007):

"Torpedo grass distribution is restricted to the tropcs [*sic*] and subtropics. The above-ground portions of the plant are easily killed by frost (FAO undated)."

"*Panicum repens* exhibits moderate salinity tolerance. It is reported to grow on saline sands in western Zambia (Verboom & Brunt 1970)."

From Hanlon and Brady (2005):

"Richardson et al. (1995) reported that in Lake Okeechobee, torpedograss was restricted to the higher elevation regions of the marsh that had an average hydroperiod of 81%."

Climate/Range

From CABI (2016):

"[…] occurring throughout the tropics and sub-tropics between about 35°S and 43°N."

From Shilling and Haller (1989):

"Although research by Wilcut *et al.* (1988[a]) indicated that sensitivity to low temperatures would probably limit the spread of torpedograss into more temperate regions, […]"

Distribution Outside the United States

Native

From Australian Center for International Agricultural Research (2011):

"*Panicum repens* is native to Tropical Africa, North Africa and the Mediterranean (sometimes said to be native to Asia)."

From Masterson (2007):

"Believed native to Europe or Australia *Panicum repens* is now widely distributed"

GISD (2020) reports *Panicum repens* as native to Albania, Algeria, Angola, Botswana, Cameroon, China, Cote d'Ivoire, Cyprus, Egypt, Ethiopia, Yugoslavia, France, Ghana, Greece, Guinea, India, Indonesia, Iraq, Israel, Italy, Japan, Jordan, Kenya, Lebanon, Liberia, Libya, Madagascar, Malawi, Mali, Morocco, Mozambique, Namibia, Nepal, Nigeria, Philippines, Portugal, Saudi Arabia, Senegal, Sierra Leone, South Africa, Spain, Sri Lanka, Sudan, Swaziland, Syria, Taiwan, Tanzania, Thailand, Tunisia, Turkey, Uganda, Yemen, Zambia, and Zimbabwe. CABI (2016) reports the following additional countries as part of the native distribution: Central African Republic, and Niger.

From Smith et al. (2004):

"Torpedograss [*sic*] is a terrestrial plant of unresolved origin (Webster 1987); however, according to Holm et al. (1977), it is an Old World species […]"

Introduced
From Australian Center for International Agricultural Research (2011):

"It was introduced to Java about 1850, but is said not to occur in the Moluccas. No seeds are produced in Indonesia (Soerjani et al. 1987)."

From Pallewatta et al. (2003):

"*Panicum repens*, another aggressive grass, is found invariably in the coastal region of Bangladesh, and was introduced over a hundred years ago."

CABI (2016) lists *Panicum repens* as introduced and present in Bangladesh, Brunei Darussalam, Cambodia, China, Hong Kong, India (with restricted distribution), Indonesia, Iraq, Israel, Japan, North and South Korea, Laos, Malaysia, Myanmar, Nepal, Philippines, Saudi Arabia (with restricted distribution), Singapore, Sri Lanka, Taiwan, Thailand, Vietnam, Sudan, Costa Rica, Cuba, Dominican Republic, Argentina, Bolivia, Brazil, Paraguay, Uruguay, Albania, Cyprus, France, Corsica, Portugal, Spain (including the Balearic Islands), former Yugoslavia, Australia, and Palau.

From Masterson (2007):

"Believed native to Europe or Australia *Panicum repens* is now widely distributed"

Means of Introduction Outside the United States

From CABI (2016):

"*P. repens* has become established as an invasive species beyond its natural range through introduction as a fodder species. It is cultivated on wet alluvial sandy soils in Africa, South America, North America and India but is very difficult to eradicate once established. After it was introduced into Pakistan for this purpose it did not persist (Cope, 1982)."

Short Description

From GISD (2011):

"*P. repens* is a perennial grass that frequently forms dense colonies and has long, creeping rhizomes. Flowering stems are erect and up to 0.8m tall. The lower stems sometimes lack leaf blades and consist of only sheaths. Leaves of the upper stem have sheaths and blades. The blades are relatively short, flat or sometimes folded and from 2 to 5mm wide. The inflorescence is a loose, open panicle that is 3 to 10cm long that has weakly divergent to ascending branches. Spikelets are about 2.5mm long (ERDC, UNDATED)."

From Masterson (2007):

"Torpedo grass, *Panicum repens*, is a hardy perennial grass occurring widely throughout Florida but not native to North America. Shoots, up to 1 m tall, arise from sturdy, creeping or floating

rhizomes. The rhizomes are pointed with torpedo-like growing tips. Aerial stems are rigid, erect to leaning, with lower portions often wrapped in bladeless sheaths. The upper leaf sheaths are mostly glabrous with hairs usually restricted to the upper margins. The ligule (thin outgrowth at the junction of the leaf and leafstalk) is a short-ciliate membrane. Leaf blades are narrow, linear, stiffly ascending to 25 cm long and 0.6 cm wide. The inflorescence is a loose open terminal panicle 7-22 cm long with with few to many branches and stakled spikelets that are 2-3 mm long and approximately 1 mm wide, with flower parts white with yellow. The small seeds are smooth and whitish (Langeland and Burks 1998, CAIP, ISSG)."

Biology

From Smith et al. (2004):

"There is little evidence that topedograss produces viable seed in the southeastern United States (Wilcut et al. 1988[b]). It is thought that torpedograss disperses primarily by vegetative fragments, as both shoot and rhizome fragments readily establish and develop new colonies (Chandrasena and Peiris 1989)."

From GISD (2011):

"Brecke et al. (2001) state that, "*P. repens* rhizomes have the potential to regenerate and produce dense stands from small fragments. Due to the lack of apical dominance, each node has the unique ability to produce axillary buds along the entire rhizome (Wilcut et al. 1988[a]). Emergence of new shoots from buried rhizome fragments occurs from as deep as 50cm (Hossain et al. 1999)." FLEPPC (2003) report that *P. repens*'s growth rate is stimulated by tilling and fertilization, and reproduces principally by rhizome extension and fragmentation."

"Hossain et al. (2001a) state that, "*P. repens* propagates mainly by rhizomes, which are difficult to control when well established. *P. repens* develops rhizomes when around 50 days old in the summer season (24-30°C), and primary and secondary branches of the rhizome usually develop 70 and 130 days after planting (DAP), respectively. Rhizomes can penetrate into soil up to 50cm deep, and they require up to 120 days after planting to complete emergence depending on their burial depth. A single culm emerging from a single rhizome bud produced about 23,000 rhizome buds in 1 year. The biomass of *P. repens* increases rapidly from 50 DAP with the increasing number of rhizome buds and shoots.""

"ERDC (UNDATED) reports that, "*P. repens* grows in moist, often sandy soil along beaches and dunes, margins of lagoons, marshy shorelines of lakes and ponds, drainage ditches and canals. Its rhizomes or runners often extend several feet out into the water, and the plant frequently forms dense floating mats.""

"Brecke et al. (2001) state: "*P. repens* is a perennial weed that can be found along ditch banks, around ponds, along roadsides, and in managed turfgrass areas, including golf courses (McCarty et al. 1993). This exotic grass persists in terrestrial, wetland, and aquatic environments of tropical and subtropical regions around the world (Sutton 1996)."

From Masterson (2007):

"*Panicum repens* can reproduce sexually through flowering and seed production, though the principal means of propagation is reported to be rhizome extension and fragmentation (Holm et al. 1977)."

"Small *P. repens* fragments can give rise to dense clonal stands through vegetative growth and rhizome fragments buried as deep as 50 cm can send up new shoots (Hossain et al. 1999, Brecke et al. 2001). The lack of apical dominance also allows each node the ability to produce axillary buds along entire rhizome lengths (Wilcut et al. 1988[a]). Hossain et al. (2001a) reports that a single culm emerging from a single rhizome bud produced approximately 23,000 rhizome buds in a single year."

Human Uses

From CABI (2016):

"*P. repens* has been widely used as a forage species. Its salt tolerance makes it a useful species for reclaiming saline soils (Ghaly, 2002). It is a source of ethno-medicines in India (Kaushal-Kumar, 2002)."

Diseases

From CABI (2016):

"Natural enemy: *Ustilago hypodytes* [grass smut]"

"*P. repens* may act as an alternative host to rice leafhopper, *Ustilago* and *Pyricularia* spp. (Holm et al., 1977)."

Threat to Humans

No threats to humans from *Panicum repens* were found.

3 Impacts of Introductions

From Hanlon and Brady (2005):

"In Lake Okeechobee, Florida, torpedograss has severely impacted the lake's 40,000 ha marsh landscape by displacing more than 6,700 ha of native plants and shallow areas of open water. Two of the most impacted native species include spikerush and beakrush (*Rhynchospora* spp.) (Richardson et al. 1995)."

From Shilling and Haller (1989):

"Torpedograss often displaces other grass species in both terrestrial and aquatic environments (Schardt, 1986; Wilcut *et al.* 1988[a]). Problems with flood control, navigation, recreation and irrigation are encountered when torpedograss becomes established due to its ability to invade

diverse ecosystems (Manipura & Simaratne, 1974; Flemming, Palmertree & Houston, 1978; Baird *et al.*, 1983a; Baird *et al.*, 1983b; Wilcut *et al.*, 1988[a]).

From Peng and Sze (1974):

"In the warm and wet southern Taiwan, almost no sugar cane fields are without worsening infestation of a perennial weed species, the *Panicum repens* Linn. (torpedo grass, as is called in Hawaii). […] Where this grass has once established not only other species is crowded out but the sugarcane is greatly affected in yield particularly during ratooning cultivations […]. In 1965, for example, over 200 hectares of ratoon fields in Pingtung were so severely infested that one could not readily distinguish cane plants from the grass. Most of such fields then had to be cross-plowed to remove the half-grown poor stands of cane for replanting as continual ratooning would be worthless."

"The destructive effect on cane caused by competition of this weed can be demonstrated by planting various amounts of its springs ogether [*sic*] with a single-bud cane cutting in clay pots."

"A simple correlation coefficient (r) between the weights of weed and cane per pot calculated as –0.892, significant at the 0.01 level of probability, depicted vividly that the growth of cane was proportionately reduced as that of weed increased. However, it should be noted that the weight of cane plants began to decrease sharply and leveled off to about 50% of the check pot when the weight of weeds in pot increased to the point of 60 g/pot. Beyond this and to the range of 60.0-104.0 g/pot the proportionate reduction of cane growth thus resulted was somehow very slight. It could be imagined therefore that a mild occurrence of this weed in a field may result in equally heavy loss in cane yield as caused by fully-established weeds."

"From Table 3 [in source material] it is noted that the six-times clean hand-hoeing […] to remove aerial parts of the torpedo grass during early growth of cane effectively exhausted its rhizomes to a remnant of the 1.10 t/ha [tons/hectare] which was only 15.7% of the non-weeding plots observed 10 months later at harvest. This manual operation meanwhile brought about a 45 t/ha high yield of cane with 32.2% advantage over the non-weeding plots. The reduction of grass rhizomes and increase in cane yield by the clean hand-hoeing were both statistically significant."

"The field experiment was initiated in Liu-kwi-chu, another plantations in Pingtung district [Taiwan] also heavily infested by these species [*P. repens*]. The field was first cross-plowed in March 1968 after harvesting the last ratoon crop which was estimated to yield less than 30 tons per hectare of cane stalks, about 65% lower than normal average."

"The treated autumn-planting crop was found to give cane yield 62-98% higher than the control plots as competition effect from the grass rhizomes was reduced to minimum. Still 20-53% and at least 14-32% increment of cane yields were maintained through the first and second ratoons respectively, though being not statistically significant from the control plots."

From GISD (2011):

“ERDC (Undated) reports that, "The dense floating mats of *P. repens* may impede water flow in ditches and canals and restrict recreational use of shoreline areas of lakes and ponds." The Florida Exotic Pest Plant Council (FLEPPC, 2003) states that, "*P. repens* has been reported as a weed of 17 crops in 27 countries, and is considered one of the most serious grass weeds." The authors go on to state that, "*P. repens* quickly forms monocultures that displace native vegetation, particularly in or near shallow waters."”

From MacDonald et al. 2008:

“Torpedograss management costs approximately $2 million a year in flood control systems. In Florida, torpedograss is also a major problem for the citrus and golf course industries. The denseness of the mats may impede water flow in ditches and canals and restrict recreational use of shoreline areas of lakes and ponds.”

“It grows in or near shallow waters forming monocultures where it can quickly displace native vegetation. It can also be found in more upland situations and is a frequent problem in sod production.”

From CABI (2016):

“*P. repens* is a troublesome weed in a wide range of perennial crops, being noted by Holm et al. (1977) as a serious or principal weed of sugarcane in Taiwan and Hawaii; pineapple in West Africa; tea in India, Indonesia and Sri Lanka; various orchard crops in Thailand; rubber, coconut and oil palm in Malaysia; also of rice in Indonesia and Sri Lanka. In a number of these situations it is listed as one of the three most serious weeds. There are few estimates of crop losses but Peng and Sze (1974) report that in Taiwan rhizome density can reach 15 t/ha, while a density of 5 t/ha can cause 50% reduction in sugarcane yield. It is also reported to have allelopathic effects (Perera et al., 1989; Chon, 1989).”

“*P. repens* may act as an alternative host to rice leafhopper, *Ustilago* and *Pyricularia* spp. (Holm et al., 1977).”

From Masterson (2007):

“In addition to overtaking natural areas, *P. repens* invades cultivated lands and displaces more desirable forage species. Although it was originally introduced for cattle forage, torpedograss becomes tough later in the growing season and is generally neglected by livestock.”

“Limited management of *P. repens* in Florida (e.g., management in flood control systems) from 1980-1988 cost an average of $2-2.5 million per year (Schmitz et al. 1988, Schardt and Schmitz 1991).”

From NatureServe (2015):

"Forms dense pure stands that replace native species (Weber 2003). In Lake Okeechobee, Florida, *Panicum repens* displaced 14,000 acres of native marsh (Langeland & Burks 1998)."

Panicum repens is a Class C noxious weed in Alabama, a Prohibited noxious weed in Arizona, and a noxious weed in Hawaii and Texas (USDA, NRCS 2016). *P. repens* is regulated in Texas, Arizona, Alabama, Georgia, South Carolina, and Florida (EDDMapS 2020).

4 Global Distribution

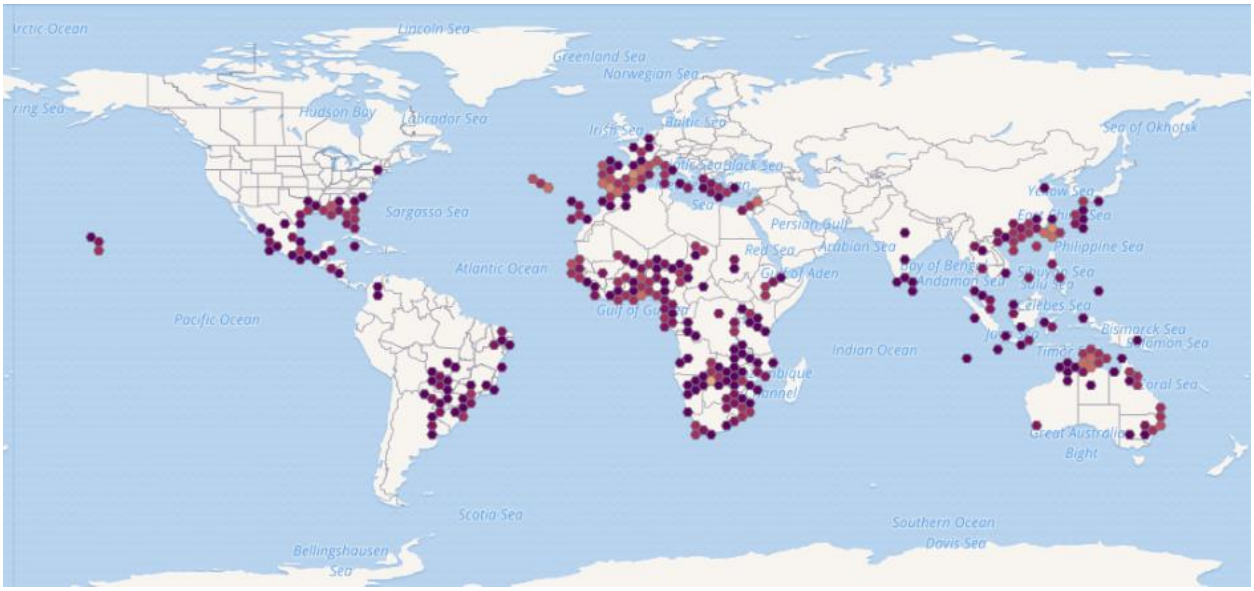

Figure 1. Known global distribution of *Panicum repens* as reported by GBIF Secretariat (2020).

5 Distribution Within the United States

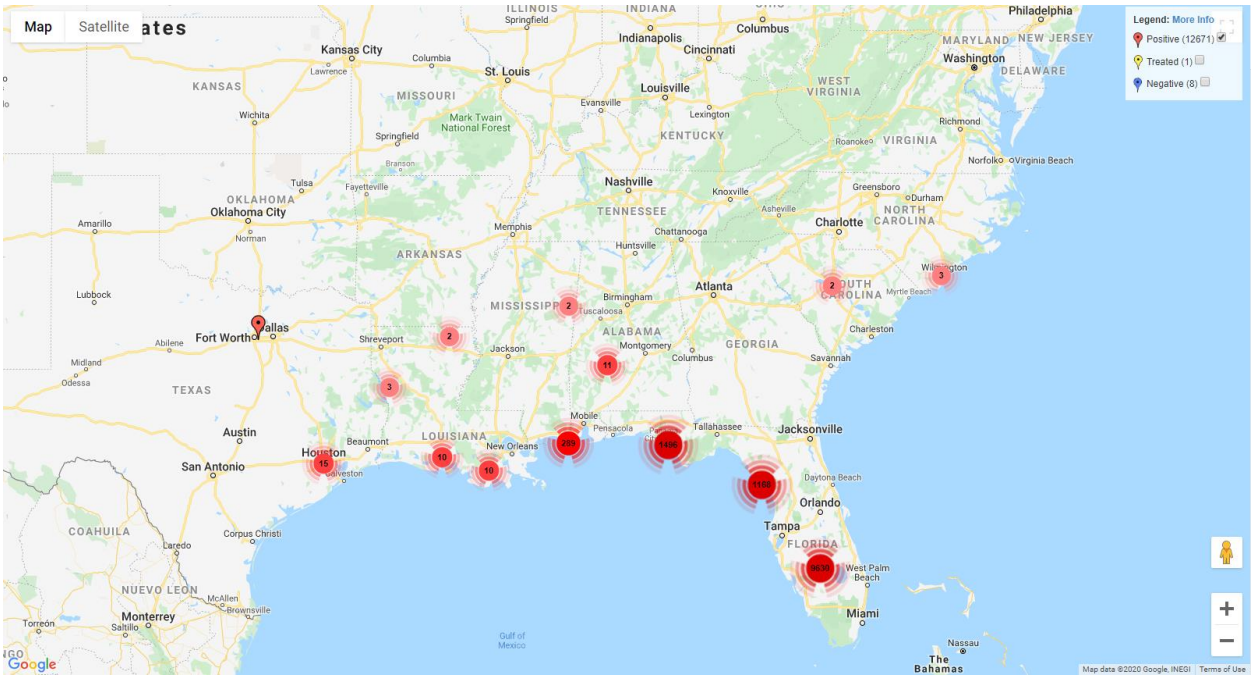

Figure 2. Known distribution of *Pancium* repens in the United States. Observations are reported from Texas, Louisiana, Mississippi, Alabama, Florida, and South Carolina. Map from EDDMapS (2020).

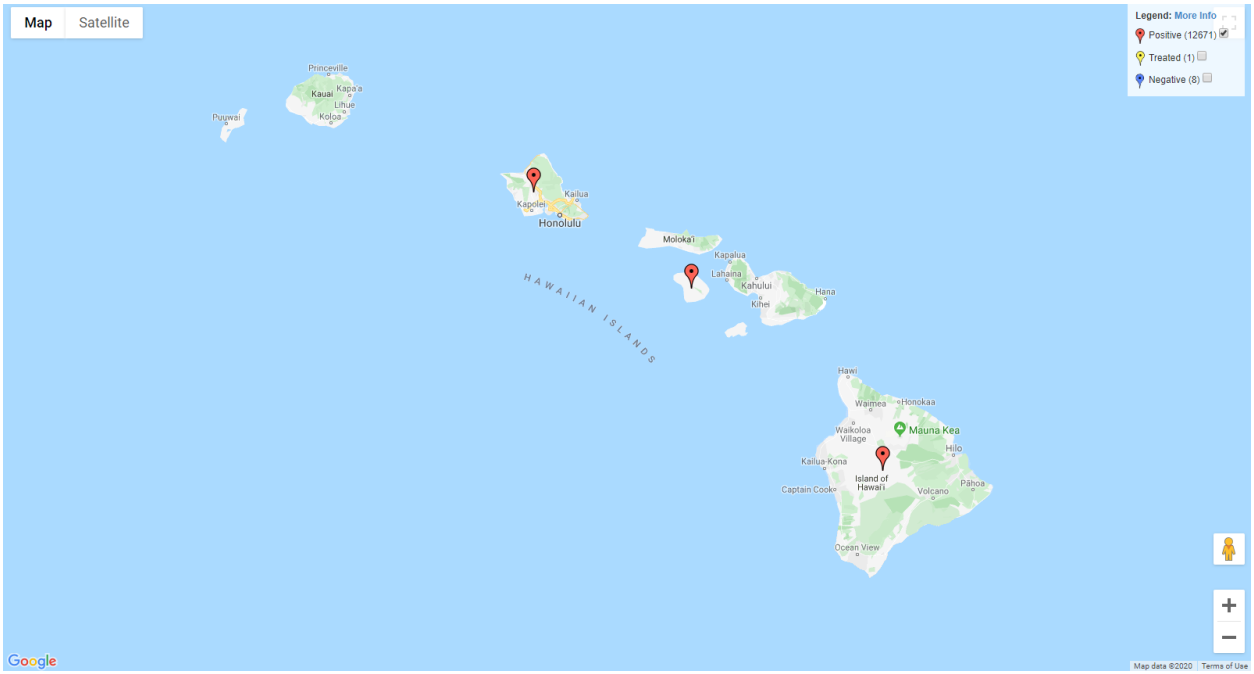

Figure 3. Known distribution of *Panicum repens* in Hawaii. Map from EDDMapS (2020).

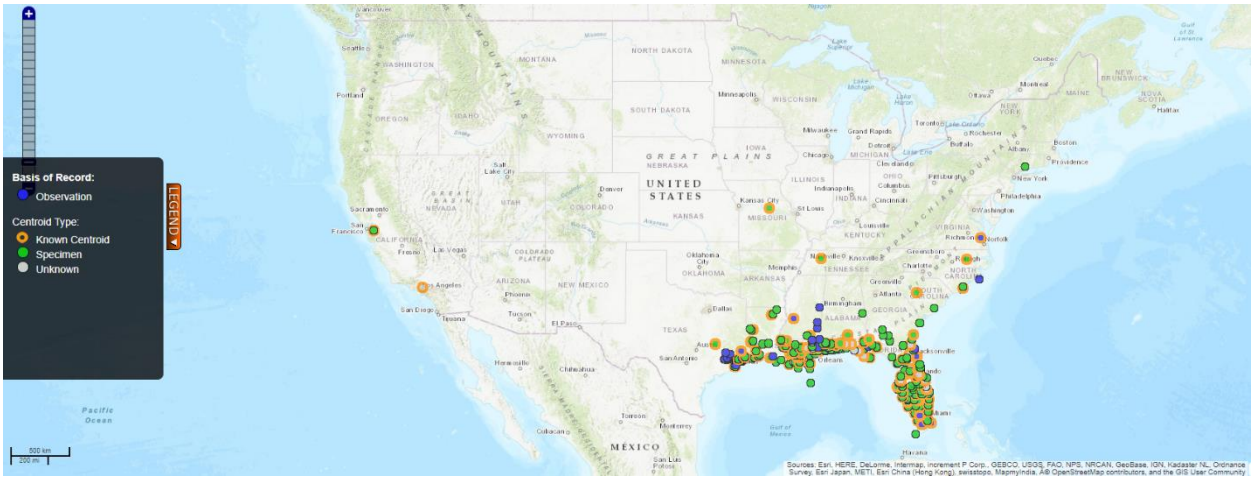

Figure 4. Additional known distribution of *Panicum repens* in the contiguous United States. Observations are reported from California, Texas, Missouri, Louisiana, Mississippi, Alabama, Georgia, Florida, Tennessee, South Carolina, North Carolina, Virginia, and New York. Map from BISON (2020). The observations in Missouri, New York, Tennessee, and Virginia were not used to select source points for the climate match, there was no supporting evidence for an established population in those States.

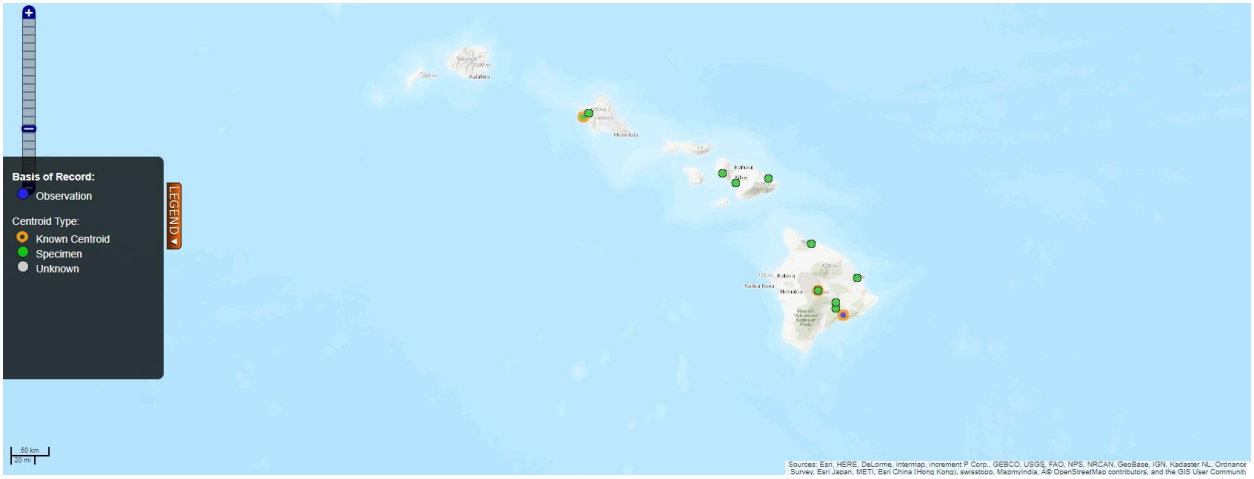

Figure 5. Additional known distribution of *Panicum repens* in Hawaii. Map from BISON (2020).

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Panicum repens* was high to medium across much of the contiguous United States except the Rocky Mountain area, far Northern Great Plains, and the Upper Midwest east to Lake Michigan, which had a low climate matches. Areas of high match were found from the Mid-Atlantic south to Florida, across the southeast into Texas, in the southwest, and in small pockets in the Pacific Northwest. The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.435, high. (Scores of 0.103 or greater are classified as high.) Most States had high individual Climate 6 scores, except for Idaho, Kansas, Montana, New York, Rhode Island, and Utah, which had medium individual scores, and Colorado, Connecticut, Maine, Michigan, Minnesota, North Dakota, Nebraska, New Hampshire, South Dakota, Vermont, Wisconsin, and Wyoming, which had low individual scores.

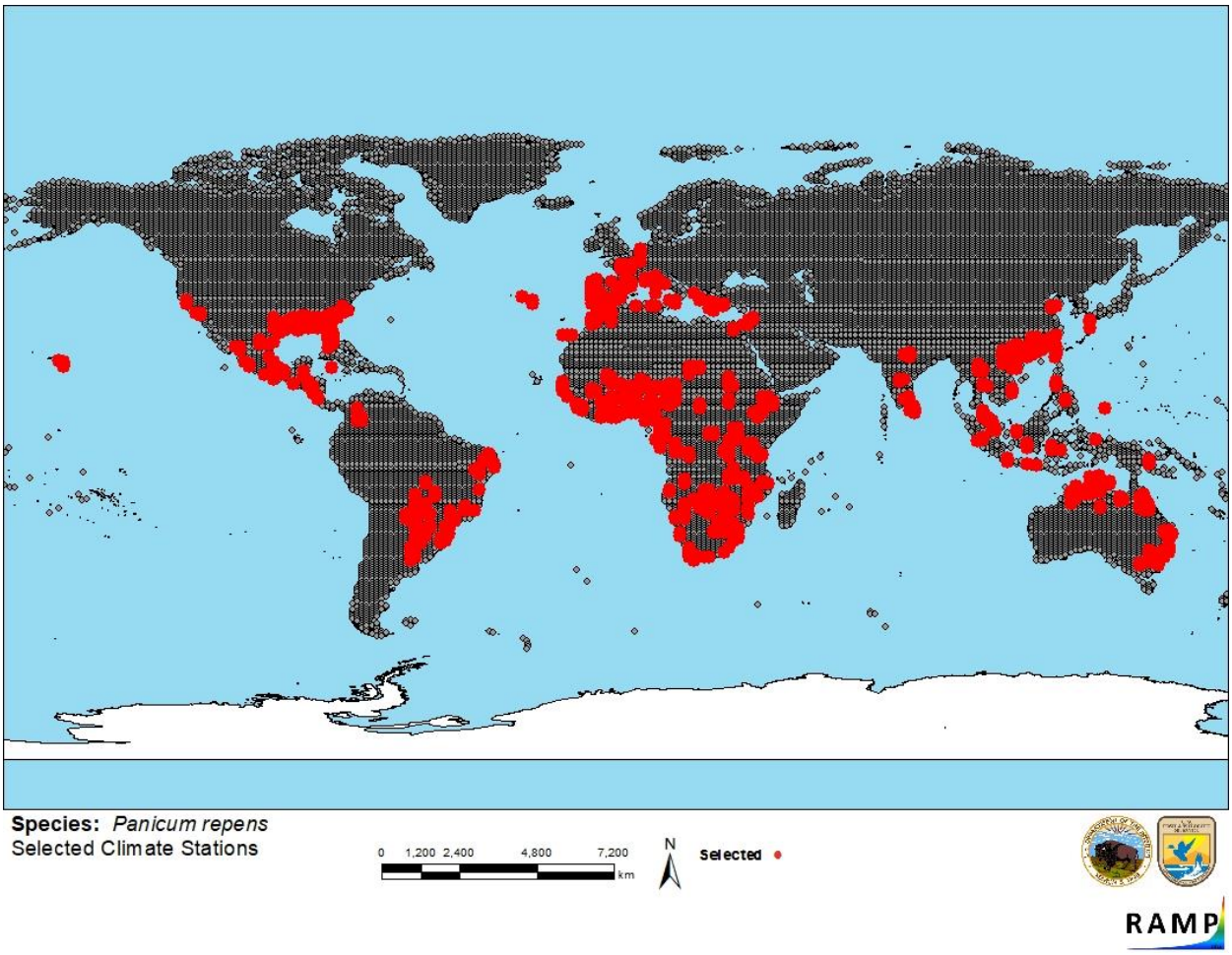

Figure 6. RAMP (Sanders et al. 2018) source map showing weather stations selected as source locations (red) and non-source locations (grey) for *Panicum repens* climate matching. Source locations from BISON (2020), EDDMapS (2020), and GBIF Secretariat (2020). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

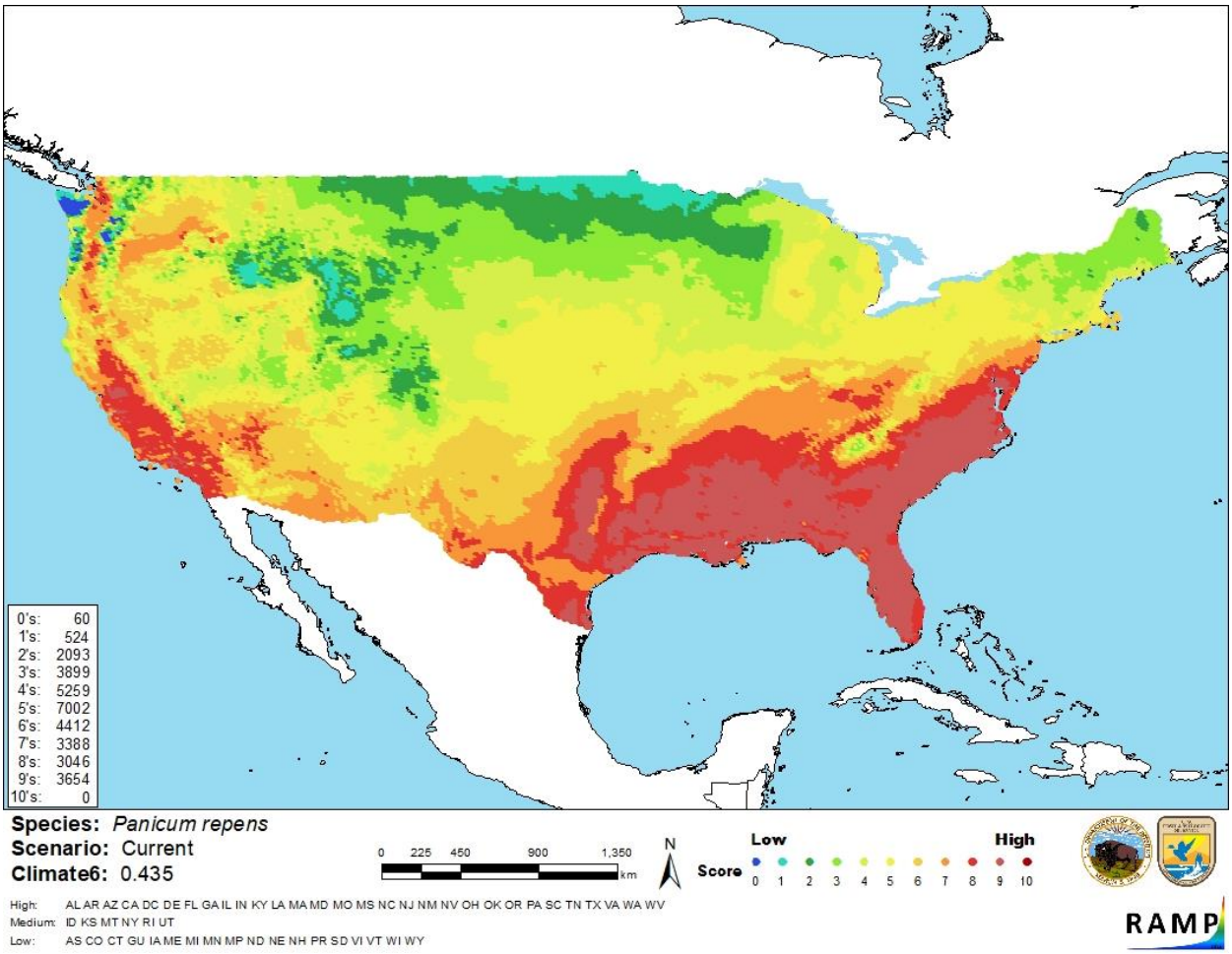

Figure 7. Map of RAMP (Sanders et al. 2018) climate matches for *Panicum repens* in the contiguous United States based on source locations reported by BISON (2020), EDDMapS (2020), and GBIF Secretariat (2020). 0 = Lowest match, 10 = Highest match.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

7 Certainty of Assessment

The certainty of this assessment is high. *Panicum repens* had adequate quality information about its biology, ecology, distribution, and history of invasiveness available for the assessment. Records of introduction and impacts were well documented. Scientifically defensible, peer-reviewed, documentation of the negative impact of *P. repens* on sugar cane crops was available.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Panicum repens, Torpedo Grass, is believed to be native to Europe and Africa, with some sources including Asia. It has been used as pasture grass, livestock fodder, and possibly for erosion control. The history of invasiveness is high. There have been many introductions resulting in established populations around the world and documented significant ecological and economic impacts. *P. repens* has had significant negative impact on sugar cane crops in Taiwan, has displaced 1,000s of hectares of native species in Florida marshes, and has cost the Florida economy millions in control costs. *Panicum repens* is listed as a prohibited or noxious weed in at least four states. The climate match with the contiguous United States is high. The largest area of high match is in the southeast, centered on existing populations. The certainty of assessment is high due to the amount and quality of information available. There is scientifically defensible information on impacts of introductions. The overall risk assessment category is high.

Assessment Elements

- **History of Invasiveness (Sec. 3): High**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): High**
- **Remarks/Important additional information** No additional remarks.
- **Overall Risk Assessment Category: High**

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

Australian Center for International Agricultural Research, Biological Control of Weeds, Southeast Asian Prospects. 2011. Available: http://aciar.gov.au/files/node/2160/MN26%20Part%209.pdf. (March 2011).

BISON. 2020. Biodiversity Information Serving Our Nation (BISON). United States Geological Survey. Available: https://bison.usgs.gov. (January 2020).

CABI. 2016. *Panicum repens* [original text by J. Doe]. *In* Invasive Species Compendium. CAB International, Wallingford, UK. Available: http://www.cabi.org/isc/datasheet/38670. (November 2016).

EDDMapS. 2020. Early Detection & Distribution Mapping System. University of Georgia, Center for Invasive Species and Ecosystem Health, Tifton, Georgia. Available: http://www.eddmaps.org/. (January 2020).

GBIF Secretariat. 2020. GBIF backbone taxonomy: *Panicum repens* L. Global Biodiversity Information Facility, Copenhagen. Available: http://www.gbif.org/species/2705093. (January 2020).

GISD (Global Invasive Species Database). 2011. Species profile: *Panicum repens*. Invasive Species Specialist Group, Gland, Switzerland. Available: http://www.issg.org/database/species/ecology.asp?si=777&fr=1&sts=sss&lang=EN. (March 2011).

GISD (Global Invasive Species Database). 2020. Species profile: *Panicum repens*. Invasive Species Specialist Group, Gland, Switzerland. Available: http://www.iucngisd.org/gisd/species.php?sc=777. (January 2020).

Hanlon, C. G., and M. Brady. 2005. Mapping the distribution of torpedograss and evaluating the effectiveness of torpedograss management activities in Lake Okeechobee, Florida. Journal of Aquatic Plant Management 43:24–29.

ITIS (Integrated Taxonomic Information System). 2014. *Panicum repens* L. Integrated Taxonomic Information System, Reston, Virginia. Available: http://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=504106. (March 2014).

MacDonald, G., J. Ferrell, B. Sellers, K. Langeland, T. Duperron-Bond, and E. Ketterer-Guest. 2008. Invasive species management plans for Florida. University of Florida, IFAS Extension, Circular 1529.

Masterson, J. 2007. Species name: *Panicum repens*; common name: torpedo grass. Smithsonian Marine Station at Fort Pierce, Fort Pierce, Florida.

NatureServe. 2015. NatureServe explorer: an online encyclopedia of life, version 7.1. NatureServe, Arlington, Virginia. Available: http://explorer.natureserve.org. (November 2016).

Pallewatta, N., J. K. Reaser, and A. T. Gutierrez, editors. 2003. Invasive alien species in south Southeast Asia: national reports & directory of resources. Global Invasive Species Programme, Cape Town, South Africa.

Peng, S. Y., and W. B. Sze. 1974. Competition effect of *Panicum repens* Linn. on sugarcane and its eradication by herbicides. Taiwan Sugar 21(5):155–166.

Sanders, S., C. Castiglione, and M. Hoff. 2018. Risk assessment mapping program: RAMP, version 3.1. U.S. Fish and Wildlife Service.

Shilling, D. G., and W. T. Haller. 1989. Interactive effects of diluent pH and calcium content on glyphosate activity on *Panicum repens* L. (torpedograss). Weed Research 29:441–448.

Smith, D. H., R. M. Smart, and C. G. Hanlon. 2004. Influence of water level on torpedograss establishment in Lake Okeechobee, Florida. Lake and Reservoir Management 20(1):1–13.

Texas Invasive Species Institute. 2014. Torpedo grass. Lamar University, Sul Ross State University, Texas State University, San Marcos. Available: http://www.tsusinvasives.org/home/database/panicum-repens. (January 2020).

USDA, NRCS. 2016. *Panicum repens*. The PLANTS database. National Plant Data Team, Greensboro, North Carolina. Available: http://plants.usda.gov/core/profile?symbol=PARE3. (November 2016).

10 References Quoted But Not Accessed

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

Baird, D. D., V. M. Urrutia, and D. P. H. Tucker. 1983(a). Management systems with glyphosate on torpedo grass in citrus. Proceedings of the Southern Weed Science Society 36:201–209.

Baird, D. D., G. E. Baker, H. F. Brown, and V. M. Urrutia. 1983b. Aquatic weed control with glyphosate in south Florida. Proceedings of the Southern Weed Science Society 36:430–435.

Baldwin, B. G., S. Boyd, D. J. Keil, R. W. Patterson, T. J. Rosatti, and D. H. Wilken, editors. 2008. Jepson flora project: Jepson online interchange for California floristics. Regents of the University of California, Berkeley. Available: http://ucjeps.berkeley.edu/interchange/.

Brecke, B. J., J. B. Unruh, and J. A. Dusky. 2001. Torpedograss (*Panicum repens*) control with quinclorac in bermudagrass (*Cynodon dactylon* × *C. transvaalensis*) turf. Weed Technology 15(4):732–736.

CAIP. [Source material did not give full citation for this reference]

Chandrasena, J. P. N. R., and H. C. P. Peiris. 1989. Studies on the biology of *Panicum repens* L. II. Intraspecific competition and source-allocation. Tropical Pest Management 35(3):316–320.

Chon, C. H. 1989. Allelopathic research of subtropical vegetation in Taiwan. IV. Comparative phytotoxic nature of leachate from four subtropical grasses. Journal of Chemical Ecology 15(7):2149–2159.

Cope, T. A. 1982. Poaceae. *In* E. Nasir, and S. I. Ali, editors. Flora of Pakistan. Royal Botanic Gardens, Kew, UK.

ERDC (Engineer Research and Development Center). No date. *Panicum repens* L. (Torpedo Grass). Noxious and Nuisance Plant Management Information System. U.S. Army Corps of Engineers.

FAO. No date. *Panicum repens* L., species fact sheet. Available online. [Source material did not provide url.]

Fleming, D. C., H. D. Palmertree, and D. W. Houston. 1978. Screening herbicides for torpedograss control in turf. Proceedings of the Southern Weed Science Society 31:136.

Florida Exotic Pest Plant Council (FLEPPC). 2003. *Panicum repens*. [No further information given by source material.]

Ghaly, F. M. 2002. Role of natural vegetation in improving salt affected soil in northern Egypt. Soil and Tillage Research 64(3-4):173–178.

Godfrey, R. K., and J. W. Wooten. 1979. Aquatic and wetland plants of southeastern United States, monocots. University of Georgia Press, Athens.

Holm, L. G., D. L. Plucknett, J. V. Pancho, and J. P. Herberger. 1977. The world's worst weeds: distribution and biology. University Press of Hawaii, Honolulu.

Hossain, et al. 1999. [Source material did not give full citation for this reference.]

Hossain, M. A., H. Kuramochi, Y. Ishimine, and H. Akamine. 2001a. Application timing of asulam for torpedograss (*Panicum repens* L.) control in sugarcane in Okinawa Island. Weed Biology and Management 1:108–114.

ISSG. [Source material did not give full citation for this reference.]

Kaushal, K., K. Kumar, V. K. Singh, J. N. Govil, and G. Singh. 2002. Ethnopharmacognostical studies on *Panicum repens* L. *In* Recent progress in medicinal plants, volume 1. Ethnomedicine and pharmacognosy. Sci Tech Publishing, Houston.

Langeland, K. A., and K. C. Burks, editors. 1998. Identification and biology of non-native plants in Florida's natural areas. University of Florida, Institute of Food and Agricultural Sciences, Gainesville.

Manipura, W. B., and A. Simaratne. 1974. Some effects of manual and chemical defoliation on the growth and carbohydrate reserves of *Panicum repens* (L.) Beauv. Weed Research 14:167–172.

McCarty, L. B. J. M. Higgins, and D. L. Colvin. 1993. Selective torpedograss (*Panicum repens*) control in bermudagrass (*Cynodon* spp.) turf. Weed Technology 7(4):911–915.

Murphy, et al. 1992. [Source material did not give full citation for this reference.]

Perera, K. A. D. N., J. P. N. R. Chandrasena, and L. M. V. Tillekeratne. 1989. Further studies on allelopathic effects of torpedograss (*Panicum repens* L.). Proceedings, 12th Asian-Pacific Weed Science Society Conference Taipei, Taiwan; Asian-Pacific Weed Science Society 2:433–439.

Richardson J. R., T. T. Harris, and K. A. Williges. 1995. Vegetation correlations with various environmental parameters in the Lake Okeechobee marsh ecosystem. Arch. Hydrobiol. Beih. Ergebn. Limnol. 45:41–61.

Schardt, J. D. 1986. Florida aquatic plant survey. Department of Natural Resources, Tallahassee, Florida.

Schardt, J. D. 1994. Florida aquatic plant survey 1992. Florida Dept. of Environmental Protection, Technical report 942- CGA, Tallahassee.

Schardt, J. D., and D. C. Schmitz. 1991. Florida aquatic plant survey 1990. Florida Department of Natural Resources, Technical Report 91-CGA.

Schmitz, D. C., B. V. Nelson, L. E. Nall, and J. D. Schardt. 1988. Exotic aquatic plants in Florida: a historical perspective and review of the present Aquatic Plant Regulation Program. Pages 303–326 *in* Proceedings of the Symposium on Exotic Pest Plants. University of Miami, Technical Report NPS/NREVER/NRTR-91/06, Miami, Florida.

Small, J. K. 1933. Manual of the southeastern flora, part one and two. University of North Carolina Press, Chapel Hill.

Sutton, D. L. 1996. Growth of torpedograss from rhizomes planted under flooded conditions. Journal of Aquatic Plant Management 34:5053.

Verboom, W. C., and M. A. Brunt. 1970. An ecological survey of Western Province, Zambia, with special reference to the fodder resources, volume 2. The grasslands and their development. Land Resources Division Land Resource Study 8. Directorate of Overseas Surveys, Tolworth (Surrey), UK.

Weber, E. 2003. Invasive plant species of the world: a reference guide to environmental weeds. CABI Publishing, Cambridge, UK.

Webster, R. D. 1987. The Australian Paniceae (Poaceae). J. Cramer, Berlin, Stuttgart, Germany.

Wilcut, J. W., R. R. Dute, B. Truelove, and D. E. Davis. 1988b. Factors limiting the distribution of cogon grass, *Imperata cylindrical*, and torpedo grass, *Panicum repens*. Weed Science 36:577–582.

Wilcut, J. W., B. Truelove, D. E. Davis, and J. C. Williams. 1988a. Temperature factors limiting the spread of cogongrass (*Imperata cylindrical*) and torpedograss (*Panicum repens*). Weed Science 36:49–55.

Wunderlin, R. P., and B. F. Hansen. 2004. Atlas of Florida vascular plants. Institute for Systematic Botany, University of South Florida, Tampa.