Prospects for Classical Biological Control of Torpedo grass, *Panicum repens* L. (Poaceae), in the United States of America

J. P. Cuda[1], G. E. MacDonald[2], and C. G. Hanlon[3]

[1] University of Florida, Gainesville, Florida, USA 32611-0620

[2] South Florida Water Management District, West Palm Beach, Florida, USA 33416-4680

INTRODUCTION

Selecting a weed as a target for classical biological control is probably the most critical step of a research program. If the wrong target is selected and the project fails, millions of dollars may be invested in research and development with little or no return on the investment. To minimize the risk of failure, specific criteria for ranking weeds as suitable targets for classical biological control should be identified and carefully considered (Pemberton 1996). Several quantitative methods that have been developed recently for selecting and prioritizing new targets for biological control (McClay 1989, Peschken and McClay 1995, Palmer and Miller 1996), allow the researcher to objectively rank potentially invasive non-native weeds for their suitability as targets for classical biological control. This approach is especially relevant to high-risk grass weed targets such as torpedo grass, *Panicum repens* L. (Poaceae or Gramineae).

Description

Torpedo grass is an invasive perennial with robust, creeping, sharply pointed rhizomes (Fig. 1a). Other distinguishing characteristics include stiff, erect stems; folded or flat alternate leaves that are sparsely hairy on the upper surface; open terminal panicles with many, ascending branches; and pale green or yellow spikelets often tinged with purple (Figs. 1b). Although torpedo grass produces flowers and seeds year-round, reproduction is mainly by rhizome extension and fragmentation (Holm et. al. 1977).

Importance

Torpedo grass causes problems because it spreads rapidly by producing coarse, persistent rhizomes and is allelopathic (Perera et al. 1989). It thrives in a variety of agricultural and natural settings in aquatic, wetland and terrestrial habitats, and is considered an invasive weed in the Gulf Coast Region of the southeastern US and some areas of Hawaii (Fig. 2b & c). The ability of torpedo grass to tolerate a broad range of environmental conditions led to the introduction of this species into Florida during the early 1900s as a potential marshland forage grass that is used to a limited extent today by cattle ranchers. However, the aggressive spreading habit of torpedo grass coupled with low palatability made this species more noxious than beneficial. The largest infestation of torpedo grass in Florida occurs in Lake Okeechobee. Between 1988 and 1992, nearly 6,100 ha (15,000 acres) of native sedge and rush communities along the northern shoreline of Lake Okeechobee were invaded and replaced by monospecific stands of torpedo grass (Fig. 3) (Ferriter et al. 1997).

Torpedo grass has become one of the most costly weeds to control in Florida's agricultural and natural areas. In flood control systems, the cost for torpedo grass management was estimated to be $2 million per year (Schardt and Schmitz 1990). An effective strategy for long-term torpedo grass management has been difficult to achieve in Florida because of the plant's general resistance to conventional herbicides. Therefore, the purpose of this study was to examine whether torpedo grass is an appropriate target for classical biological control.

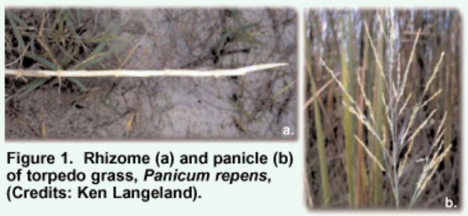

Figure 1. Rhizome (a) and panicle (b) of torpedo grass, *Panicum repens*, (Credits: Ken Langeland).

Figure 2. Distribution of torpedo grass, *Panicum repens*: (a) worldwide, (b) USA, and (c) Florida (Sources: Holm et al. 1977; USDA, NRCS Plant Profile; and Schardt 1992).

OBJECTIVES

1. Quantitatively evaluate the suitability of torpedo grass as a target for classical biological control using an objective scoring system.

2. Identify the native range and potential natural enemies of torpedo grass.

MATERIALS AND METHODS

Objective 1

The literature on torpedo grass was reviewed to determine what is known about the weed, including its biosystematics, distribution, economic importance (undesirable and beneficial attributes), and ecological value. The scoring system of Peschken and McClay (1995) was then used to determine the suitability of torpedo grass as a possible target for classical biological control. The Peschken-McClay scoring system consists of 2 sections. The first section examines various economic aspects of the target weed in the following 6 categories: economic losses, infested area, expected spread, toxicity, available means of control, and beneficial aspects. The second section focuses on biological aspects of the target weed in 12 categories: infraspecific variation, geographical area where weed is native, relative abundance, success of biological control elsewhere, number of known agents, habitat stability, and number of economic, ornamental and native species in the same genus/tribe. A numerical score was selected and then assigned to each category based on the information available in the published literature. A total score was obtained by adding together the individual scores in both sections.

Objective 2

The geographical origin of torpedo grass, and the existence of potential arthropod natural enemies were determined from the published literature. A list of countries was compiled where the plant is presumed to be native. The literature on potential natural enemies of the plant was reviewed, and information on their taxonomy, abundance, geographical location, and host plant relationships (feeding niche) was examined.

Table 1. Application of the Peschken and McClay (1995) scoring system to assess the suitability of torpedo grass, *Panicum repens*, as a target for classical biological control.

CATEGORY	RANK	SCORE
A. ECONOMIC CRITERIA		
Economic Losses	Very Severe	30
Infested Area	Very Large	10
Expected Spread	Small	0
Toxicity	None or Small	0
Available Means of Control		
Environmental Damage	High	20
Economic Justification	Low or Not Justified	20
Beneficial Aspects	None or Small	0
B. BIOLOGICAL CRITERIA		
Infraspecific Variation	Small	10
Native Range	Outside USA	30
Relative Abundance	Possibly More or Not So	0
Success Elsewhere	Biocontrol Not Attempted	0
Number of Known Agents	1	1
Habitat Stability	High	30
Economic Species in Genus	>1	0
Economic Species in Tribe	4 - 8	1
Ornamental Species in Genus	1 - 5	1
Ornamental Species in Tribe	1 - 15	1
Native Species in Genus	> 20	0
Native Species in Tribe	> 120	0
TOTAL		**154**

Figure 3. Monoculture of torpedo grass, *Panicum repens*, on north end of Lake Okeechobee, Florida, January 2001. (Credits: SFWMD).

Figure 4. Scanning electron micrograph of tarsonemid mite similar to *Steneotarsonemus* (=*Parasteneotarsonemus*) *panici*, a potential natural enemy of torpedo grass, *Panicum repens* (Credits: E. Erbe and C. Pooley, USDA, ARS).

RESULTS

Objective 1

The suitability of torpedo grass as a target for classical biological control based on the scoring system of Peschken and McClay (1995) is shown in Table 1. The maximum number with no known biological control agents is 179. Torpedo grass received a composite score of 154.

Objective 2

Torpedo grass is found throughout the tropics and subtropics from approximately 43° North latitude to 35° South latitude (Fig. 2a) (Holm et al. 1977). The native range of this species allegedly encompasses Europe (Tarver 1979); tropical and north Africa, the Mediterranean (Waterhouse 1994); the Arabian Peninsula, Argentina, Israel (Holm et al. 1991); and Australia (Hoyer et al.1996). The phytophagous mite *Steneotarsonemus* (=*Parasteneotarsonemus*) *panici* (Acari: Tarsonemidae) may be a promising candidate for biological control of torpedograss (Fig. 4) (Waterhouse 1994). This mite has been recorded only from India where it causes rusting symptoms beneath the leaf sheaths of torpedo grass (Mohanasundaram 1984), and is the only natural enemy known thus far that has not been reported as a crop pest (Waterhouse 1994). Mites of the genus *Steneotarsonemus* are specialists on monocots, and there is evidence from a related species that attacks only rice that torpedo grass may be the only host plant for *S. panici* (Lindquist 1986).

CONCLUSIONS

Torpedo grass is a serious grass weed of 17 crops in 27 countries (Holm et al. 1977), and also is considered one of the most invasive non-native, perennial grass species of terrestrial, wetland and aquatic natural areas in tropical and subtropical regions worldwide (Sutton 1996). In Florida, torpedo grass is one of the most abundant nonindigenous aquatic plants, where it has been reported from over 70% of the state's public waters (Schardt 1992). Its key impact in Florida is the displacement of native vegetation along freshwater shorelines (Fig.3). With the exception of some golf courses and citrus groves in Florida that have become infested (Fleming et al. 1978, Baird et al. 1983), torpedo grass typically is a perennial weed of uncultivated stable habitats that would favor establishment and survival of approved host-specific arthropod biocontrol agents. Furthermore, because the plant was presumably introduced without its normal complement of natural enemies, the absence of host specific herbivores and diseases in the introduced range of torpedo grass may be one of the factors contributing to the plant's invasiveness in the United States and other countries where it has become a problem weed. Because torpedo grass is difficult to control using conventional methods, a biological control program may be appropriate. The initiation of classical biological control programs against other invasive grass weeds in the United States (Schwarzländer and Häfliger 2000, Wu et al. 1999) suggests this approach is feasible and should be given serious consideration. Like other grass weeds, the botanical position of torpedo grass makes this species a high-risk target for classical biological control. The large number of North American congeners of torpedo grass (Table 1) as well as other closely related native grasses, including threatened and endangered species and economically important graminaceous crops plants, will complicate the screening process. The Indian tarsonemid mite *S. panici* and other candidate arthropods (if they indeed exist) would require extensive host range testing to ensure that only torpedo grass will be attacked. As torpedo grass is not reported as a weed of crops in tropical Africa or the Mediterranean (Holm et al. 1977, Waterhouse 1994), these regions should be surveyed for other promising natural enemies. Although biological control is not risk free, the introduction of host specific arthropod natural enemies that are capable of damaging or killing torpedo grass may provide an environmentally sound and long-term solution to the torpedo grass problem in Florida and other states where the plant is invasive.

ACKNOWLEDGEMENTS AND REFERENCES

We thank **Mike Bodle**, South Florida Water Management District, for providing some of the images used in this poster, and **Mike Sanford**, University of Florida, for technical support. Funding for this research project is supported by a grant (No. #02082352) from the South Florida Water Management District, West Palm Beach, Florida, USA.

Baird, D.D., V. M. Urrutia, and D.P.H. Tucker. 1983. Proc. South. Weed Sci. Soc. 36: 201-209.

Ferriter, A., D. Thayer, B. Nelson, T. Richards, and D. Girardin. 1997. Pp. 317-325, In D. Simberloff, D.C. Schmitz and T.C. Brown (eds)Strangers in paradise: Impact and management of non indigenous species in Florida. Island Press, Washington, D.C.

Fleming, D.C., H.D. Palmertree, and D. W. Houston. 1978. Weed Sci. Soc. 31: 136.

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, Hawaii.

Holm, L.G., D.L. Plucknett, J.V. Pancho, and J.P. Herberger. 1991. A geographical atlas of world weeds. Krieger Publishing Co., Malabar, Florida.

Hoyer, M.V., D.E. Canfield, Jr., C.A. Horsburgh, and K. Brown. 1996. Cooperative Extension Service, University of Florida, IFAS, Gainesville, FL. SP 189.

Lindquist, E.E. 1986. Mem. Entomol. Soc. Can. 136: 1-517.

McClay, A.S. 1989. Selection of suitable target weeds for classical biological control in Alberta. AECV89-R1. Alberta Environmental Centre, Vegreville.

Mohanasundaram, M. 1984. Oriental Insects 18: 79-85.

Palmer, W.A., and E.N. Miller. 1996. Pp. 313-317, *In* V.C. Moran and J.H. Hoffmann (eds.), Proc. IX Intl. Symp. Biol. Cont. Weeds, 19-26 January 1996, Stellenbosch, South Africa, University of Cape Town.

Pemberton, R.W. 1996. Castanea 61: 313-319.

Perera, K.A., Chandrasena, J.P., and Tillekaratne, L.M. 1989. Proc. 12th Asian-Pacific Weed Sci. Soc. Conf. 2: 433-439.

Peschken, D.P., and A.S. McClay. 1995. Pp. 137-143, *In* E. S. Delfosse and R. R. Scott (eds.), Proc. VIII Intl. Symp. Biol. Cont. Weeds, 2-7 February 1992, Lincoln University, Canterbury, New Zealand. DSIR/CSIRO, Melbourne.

Schardt, J.D. 1992. 1992 Florida aquatic plant survey report. Unpublished report, Florida Department of Environmental Protection, Tallahassee.

Schardt, J.D., and D. C. Schmitz. 1990. 1990 Florida aquatic plant survey report. Unpublished report, Florida Department of Natural Resources, Tallahassee.

Schwarzländer, M. and P. Häfliger. 2000. Pp. 397-420. In Spencer, N.R. (ed.), Proc. X Intl. Symp. Biol. Cont. Weeds, Bozeman, Montana, USA, 4-14 July 1999. USDA, ARS, Sidney, MT, and Montana State University, Bozeman, MT.

Sutton, D.L. 1996. J. Aquat. Plant Manage. 34:50-53.

Tarver, D.P. 1979. Aquatics 1: 5-6.

Waterhouse, D.F. 1994. Biological control of weeds: Southeast Asian prospects. ACIAR Monograph No. 26. ACIAR, Canberra, Australia.

Wu, M., S. Hacker, D. Ayres, and D.R. Strong. 1999. Biol. Cont. 16: 267-273.

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