Control of torpedograss (*Panicum repens*) through submersed applications of systemic and contact herbicides – Interim report

Interim Report

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Introduction

Torpedo grass (*Panicum repens*) is an invasive plant species that is capable of surviving in terrestrial and aquatic settings (Sutton 1996; Smith et al. 2004; Toth 2007). In aquatic systems, the species causes problems by impeding boat access and drainage flow in waterbodies (Smith et al. 1993; Smith et al. 2004). If left uncontrolled, torpedo grass can shade out native submersed, floating, and emergent plant species that are beneficial habitat for native fauna (Hanlon and Brady 2005; Toth 2007) thereby causing ecological problems. Currently, the plant is distributed across the Southeastern US, California, and Hawaii. It is capable of aggressive range expansion in shallow water bodies where no management activities are occurring. Foliar applications of the herbicides imazapyr and glyphosate are typically used to control the species, however, these are non-selective systemic herbicides capable of drifting onto non-target species and damaging them (Hanlon and Langeland 2000; Shilling et al. 1990; Smith et al. 1993; Smith et al. 1999).

Some work has been done examining root uptake of herbicides via the roots of torpedo grass in terrestrial systems (Williams et al. 2003) but to date no studies have been done examining root or shoot uptake of submersed applications of herbicides in aquatic systems. Neither glyphosate nor imazapyr is active under water so submersed chemical treatments would need to focus on other herbicides that are active in the water column and readily absorbed through roots and submersed foliage. Systemic herbicides would be preferable as they would be expected to give long term control of torpedograss in a manner similar to foliar applications of glyphosate or imazapyr. Submersed applications of systemic herbicides have been shown to be very effective at controlling other submersed species (Madsen et al. 2016b). Similarly, multiple treatments of contact herbicides per growing season have been shown to give long term reduction of problematic perennial species in other systems (Madsen et al. 2016a).

Additionally, selective control of torpedo grass would be desired as native aquatic flora in mixed stands that survives herbicide treatments could spread into areas previously inhabited by torpedograss.

The purpose of this study was to examine submersed applications of submersed herbicide applications for selective control of torpedo grass.

Materials and Methods

This study was conducted at the Aquatic Plant Research Facility at Mississippi State University's R. R. Foil Plant Research Center (MSU North Farm). Torpedograss was grown in 378 L (100 gal) outdoor mesocosms. Mesocosms were filled to a volume of 278 L (16 inch depth). Enough plant material was established so that multiple plant harvests (short and long term) could be carried out during the course of the study.

Torpedograss was established in 3.78 L (1.1 gal) pots filled with sand and amended with a slow release fertilizer[2] to stimulate growth and were then placed in mesocosms. Six pots of torpedograss were established per mesocosm. Plants were given one month to establish prior to herbicide treatments.

There were eight herbicide applications plus an untreated reference for a total of nine treatments. Each treatment was replicated four times. Additionally, two extra mesocosms were established with plants that were harvested as pre-treatment specimens for a total of 38 mesocosms. Systemic herbicides were applied (submersed injection) and left in the mesocosms as a static treatment. Contact herbicides were applied (submersed injection) and left in mesocosms for one day, then treated water was drained and mesocosms refilled. Four weeks after initial treatment, tanks receiving contact herbicides were re-treated in the same manner.

Prior to herbicide applications a pre-treatment harvest was carried out to establish base line plant growth. The pre-treatment harvest consisted of harvesting all pots in two mesocosms and separating root/rhizome (belowground)) from shoot/leaf (aboveground) tissues and placing them in labeled paper bags. Bags were placed in a forced air oven for five days at 70C to dry plant material. After drying the specimens were weighed. After the pre-treatment harvest, plants in treatment mesocosms were exposed to submersed applications of herbicide treatments (Table 1).

The first post-treatment harvest was conducted eight weeks after treatment (WAT). The eight WAT post-treatment harvest consisted of laying three 0.1 m^2 PVC frames on the surface of a mesocosm and harvesting all plant material within each frame. Harvested material was separated and processed in the same manner as pre-treatment specimens. At 52 WAT, a second harvest post-treatment harvest will be conducted in the same manner as the eight WAT harvest to determine long term effects of submersed herbicides on torpedograss control.

An analysis of variance (ANOVA) was used to test for statistical differences in treatment means (Analytical Software 2009). Any differences in means that were detected were further separated using a Fishers Least Significant Difference test (Analytical Software 2009).

Results and Discussion

None of the herbicides significantly reduced torpedograss belowground tissues at 12 WAT (Figures 1). Penoxsulam, topramazone, endothall, and bispyiribac-sodium had no effect on aboveground tissues of torpedograss when compared to reference plants (Figure 1). Triclopyr, diquat, flumioxazin, and carfentrazone-ethyl all significantly reduced torpedograss aboveground tissues (57%, 47%, 98%, and 49% reduction, respectively) when compared to reference plants (Figure 1). Flumioxazin had a higher level of control than all herbicides except triclopyr (Figure 1). Triclopyr also had the same level of control as diquat, carfentrazone-ethyl, penoxsulam, topramezone, endothall, and bispyribac-sodium (Figure 1).

This work suggests that submersed herbicide applications can control populations of torpedograss. The fact that no herbicides affected belowground tissues of torpedograss suggest that plants could recover from herbicide applications due to nutrient reserves stored in these tissues. However, some of the herbicides used require more time than 12 weeks before symptomology occurs. Therefore, these treatments may not have had sufficient time for herbicide symptomology to appear on belowground tissues. The 52 WAT harvest should determine if any of the herbicides used can deliver long term control of torpedograss.

It is important to note that torpedograss inflorescence development appeared to be stunted in some mesocosms. Future studies should quantify effects of herbicides on inflorescences as well as investigate the use of different herbicide rates and herbicide tank mixes on torpedograss biomass.

Acknowledgments

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Tables and Figures

Table 1. Herbicide treatments, translocation ability, use rate, exposure time, and exposure number for this study. Note that plants exposed to contact herbicides were exposed twice (four weeks apart).

HERBICIDE	TRANSLOCATION	RATE	EXPOSURE TIME	EXPOSURE NUMBER
Reference	-	-	-	-
Penoxsulam	Systemic	25 ppb	Static	1
Bispyribac-sodium	Systemic	50 ppb	Static	1
Triclopyr	Systemic	1.5 ppm	Static	1
Topramazone	Systemic	50 ppb	Static	1
Diquat	Contact	0.37 ppm	24 hr	2
Endothall	Contact	3.0 ppm	24 hr	2
Flumioxazin	Contact	0.4 ppm	24 hr	2
Carfentrazone-ethyl	Contact	0.2 ppm	24 hr	2

Torpedograss Biomass
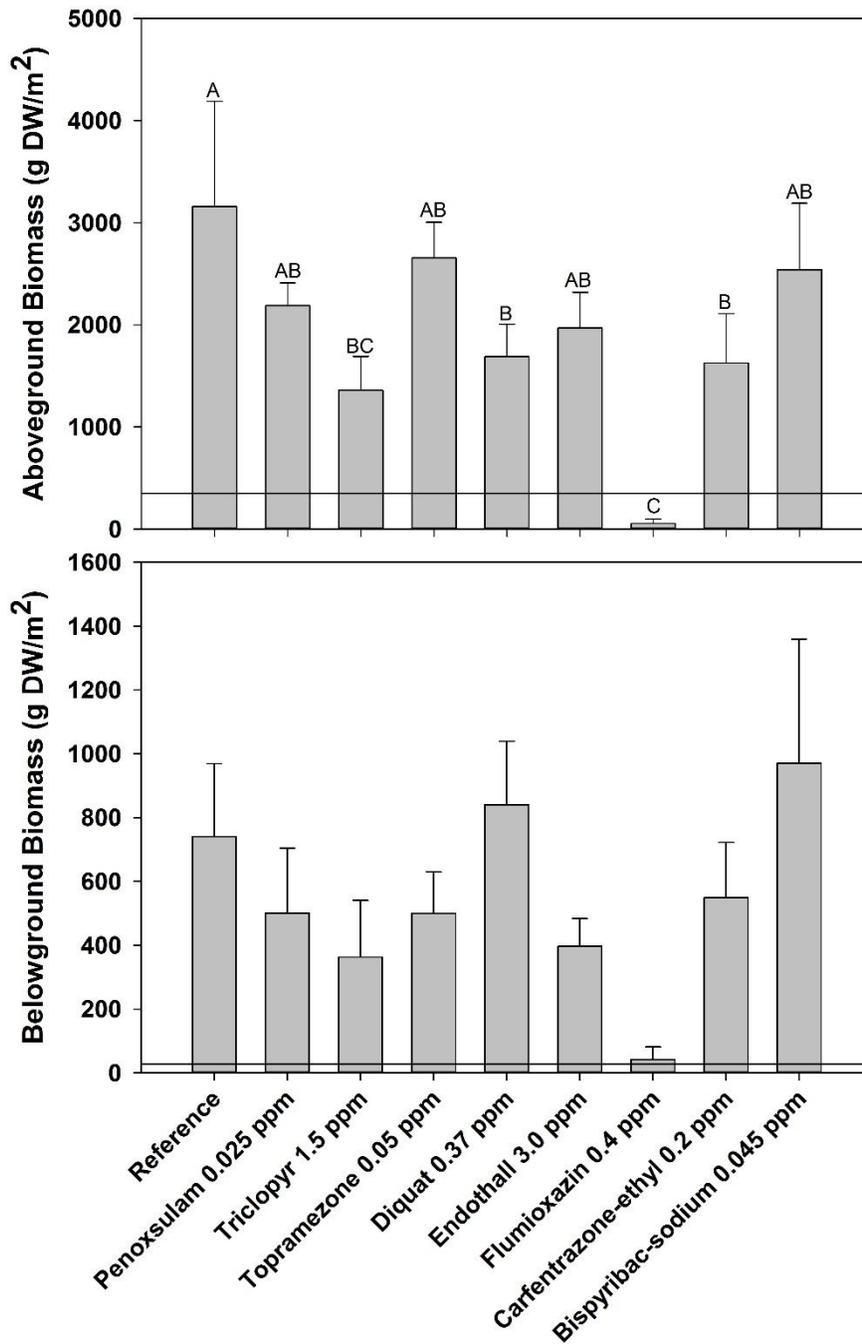
Figure 1. Torpedograss biomass at eight WAT. The solid lines are pre-treatment biomass levels. Error bars are one standard error of the mean. Tests were conducted at the $p = 0.05$ level of significance. Bars sharing the same letter are not significantly different from one another.