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Influence of cultural practices and herbicides on torpedograss [Panicum repens (L.) Beauv.] infestation in centipedegrass [Eremochloa ophiuroides (Munro, Hack)]

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INFLUENCE OF CULTURAL PRACTICES AND HERBICIDES ON TORPEDOGRASS [*PANICUM REPENS* (L.) BEAUV.] INFESTATION IN CENTIPEDEGRASS [*EREMOCHLOA OPHIUROIDES* (MUNRO, HACK)]

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ABSTRACT

Torpedograss (*Panicum repens* L. Beauv.) is a common weed problem along the Gulf Coast in highly managed turf. Non-selective herbicides are currently used to control torpedograss within centipedegrass [*Eremochloa ophiuroides* (Munro) Hack.] and St. Augustinegrass [*Stenotaphrum secundatam* (Walt.) Kuntze], but turfgrass injury can be extensive. Research was conducted to evaluate torpedograss and centipedegrass response to the application of the selective, post-emergence herbicides quinclorac, sethoxydim, and clethodim. Quinclorac applied at 0.42 kg ai ha^{-1} three times 4 wks apart reduced torpedograss to 25% coverage (55% of control) 10 weeks after initial treatment (WAIT), but re-establishment was rapid and by 16 WAIT coverage was greater than that of the control. Centipedegrass injury to quinclorac was 46% 6 WAIT. Sethoxydim or clethodim applied at rates of 0.32 kg ha^{-1} or 0.30 kg ha^{-1}, three times at 4 wk intervals reduced torpedograss coverage 79% and 84% from control 10 WAIT. Centipedegrass injury at 10 WAIT was 4% for sethoxydim and 13% for clethodim. Torpedograss treated with sethoxydim and clethodim was able to re-establish, and by 16 WAIT, groundcover was 25% and 26% compared to 59% for the control. Effects of N fertility and mowing height to reduce torpedograss infestation in centipedegrass and St. Augustinegrass were also examined. Nitrogen and mowing treatments were categorized as low, recommended and high according to each turfgrass species. For St. Augustinegrass, N fertility regimen were 0 kg N ha^{-1} $month^{-1}$, 50 kg N ha^{-1} $month^{-1}$, and 100 kg N ha^{-1} $month^{-1}$and mowing heights were 2.54 cm, 6.35 cm, and 10.16 cm. Centipedegrass N fertility regimen were and 0 kg N ha^{-1} $month^{-1}$, 12.5 kg N ha^{-1} $month^{-1}$, or 25 kg N ha^{-1} $month^{-1}$ with mowing heights of 2.54 cm, 5.08 cm, or 7.62 cm. Torpedograss spread increased in both turfgrasses under all N and mowing regimen. The highest mowing height accelerated torpedograss spread. Control of torpedograss in St. Augustinegrass and centipedegrass using cultural management practices proved unsuccessful.

Some success in controlling torpedograss was attained with use of sethoxydim and clethodim in centipedegrass. Prevention by use of un-infested soils and application of non-selective herbicides during turfgrass establishment should be employed.

CHAPTER 1: LITERATURE REVIEW

Torpedograss (*Panicum repens* L. Beauv.) Morphology and Growth Characteristics

Torpedograss is a perennial, rhizomatous, C_4 grass that is a severe weed problem in many tropical and subtropical areas of the world (Holm et al., 1977), including portions of Southern Europe, tropical regions of Africa, temperate and tropical areas of Asia including India and Australia, southern portions of North America and areas of South America (Holm et al., 1977). In these regions, torpedograss is considered a significant weed in rice and sugarcane production (Peng, 1984), orchards, and an increasingly troublesome weed in managed turf (Holm et al., 1977).

Torpedograss has an extensive rhizome system and derives its name from the sharp or “torpedo shaped” rhizome ends. Other defining characteristics include rigid stems that lean slightly at the base and grow to heights of 0.75 m (Langeland and Burks, 1998). Leave blades are stiff and narrow (0.75 cm) and can extend to 25 cm in length; fine hairs are present along the upper leaf surface. In the reproductive phase, inflorescences range from 7.5 to 22.5 cm long with white spikelets and yellow flower parts (Langeland and Burks, 1998). Seeds are typically smooth and white in color (Langeland and Burks, 1998) and seed viability differing from region to region. Studies in the United States have shown extremely poor germination rates (Moreira, 1978) indicating invasion of torpedograss primarily through vegetative propagation.

Torpedograss grows best under mild climatic conditions with optimal growth occurring under day and night temperatures of 30 and 25° C, respectively (Wilcut et al., 1988). Torpedograss is typically found in moist, sandy soils along coastal areas, but can grow on heavy upland soils due to excellent drought tolerance (Holm et al., 1977). Other environmental conditions such as acid soils and occasional flooding do not appear to adversely affect torpedograss growth (Wilcut et al., 1988). Although torpedograss has been reported to grow on saline soils, no published data is available on salt tolerance.

Over time, torpedograss develops robust rhizomes that allow it to survive under less than ideal growing conditions. As a result, torpedograss has excellent regenerative capabilities. Torpedograss rhizomes can survive at temperatures as low as -14° C with axillary buds along rhizomes tolerating burial depths of 8-16 cm (Wilcut et al., 1988).

Torpedograss Invasion in the United States

Torpedograss was first reported in the United States near Mobile, Alabama, in 1876 (Tarver, 1979). Since that time, torpedograss has become a common weed in many areas along the Gulf Coast (Murphy et al., 1992). Because torpedograss has a vigorous growth habit, the United States Department of Agriculture sought to incorporate torpedograss into forage systems. The use of torpedograss as a forage grass contributed considerably to its cultivation and dissemination (Tarver, 1979). Unfortunately, compared to other forage grasses, torpedograss was not as suitable due to low protein content and poor field sward compositions (Holm et al., 1977). Use of torpedograss as a forage grass was further hindered due to equine toxicity (Tarver, 1979).

Today torpedograss dissemination along the Gulf Coast is believed to be the direct result of human activity associated with construction and soil movement (Strahan, 2002). The spread of torpedograss through infested soils is further supported through reports of low seed viability in the Southeastern United States and high re-generative capacity from rhizome material (Wilcut et al., 1988). Stored energy within rhizomes fuels rapid shoot regeneration that in turn allows torpedograss to effectively compete with other grass species (Manipura and Somaratine, 1974). In Louisiana, movement of soils infested with torpedograss from the Bonne Carré Spillway is thought to be a major vector for torpedograss dissemination throughout South Louisiana;

especially within the New Orleans metro area (Strahan, 2002). Therefore, increased soil movement from torpedograss infested borrow pits has led to more pervasive torpedograss spread to surrounding areas.

Centipedegrass [*Eremochloa ophiuroides* (Munro) Hack.] Morphology and Culture

Centipedegrass is a medium textured warm-season turfgrass that originated in Southeast Asia (Hanson et al., 1969). With the introduction of centipedegrass in the United States in 1916 by Frank Meyer, it has become a popular turfgrass utilized in residential and commercial landscapes in the Southern United States (McCarty et al., 1995) below 35ºN latitude (Hanson et al., 1969). Centipedegrass can be established from sod, sprigs, plugs, or seed. Centipedegrass is a stoloniferous grass that grows best in full sun, under low nitrogen fertility, and in acidic soils (Turgeon, 2002). Optimal soil pH range for centipedegrass is from 4.5 to 6.1 (Waddington, 1992). Centipedegrass has a natural light green color (Hanna, 1995) and grows best when maintained at a mowing height of 5 to 6.3 cm. Centipedegrass will tolerate temperatures in excess of 35° C, but it is extremely cold sensitive. At temperatures below 13° C, centipedegrass will enter a state of dormancy until more favorable growing conditions occur. Although cooler temperatures are often the mechanism by which centipedegrass enters dormancy, extreme drought conditions can also elicit dormancy (Turgeon, 2002).

Centipedegrass is noted for its slow growth rate and low nitrogen requirement making it a popular choice for low maintenance areas. Centipedegrass is intolerant of heavy wear and will recover slowly from this injury. Centipedegrass decline, disease, weeds, and reduced stress tolerances can often be associated to N over fertilization (Turgeon, 2002).

One advantage centipedegrass has over other warm-season turfgrasses is tolerance to cyclohexanedione herbicides such as sethoxydim (McCarty et al., 1986) and clethodim (Cox et al., 1999). These herbicides are routinely used in herbicide management programs to effectively control annual and perennial grassy weeds (Ross and Lembi 1985).

St. Augustinegrass [*Stenotaphrum secundatam* (Walt.) Kuntze] Morphology and Culture

St. Augustinegrass is primarily grown along the Gulf Coast, Southern Atlantic Ocean seaboard, and in Southern California. Native to the Gulf of Mexico and Mediterranean areas, St. Augustinegrass is well adapted to warm, tropical and subtropical regions of the world (Sauer, 1972). St. Augustinegrass is a popular warm-season turfgrass for homeowners due to low maintenance, medium shade tolerance, salt tolerance, and adaptability to a wide range of soils (Busey and Davis, 1991). The proper soil pH range for St. Augustinegrass is 5.5 to 8.5.

Tolerant of high summer temperatures, St. Augustinegrass will maintain green color up to 12° C lower than for bermudagrass (*Cynodon dactylon* L. Pers.). Stoloniferous growth without viable seed production requires vegetative propagation by sod, sprigs, and plugs (Beard, 1973). St. Augustinegrass is highly shade tolerant (Barrios et al., 1986) making it ideal for lawns with moderate shade. Weekly to bi-weekly mowing with rotary mowers at 6.5 cm is necessary for maintenance. Drought tolerance is low and supplemental irrigation may be necessary. Nitrogen fertilization requirements are greater for St. Augustinegrass (97.6 - 195.3 kg ha^{-1} $year^{-1}$) than centipedegrass (48.8 - 97.6 kg ha^{-1} $year^{-1}$). The best swards occur when mowed at 7.6 to 10.1 centimeters for most varieties. St. Augustinegrass can produce thatch under high fertility and irrigation regimes. Poor tolerance to chinch bugs, brown patch, and gray leaf spot can limit St. Augustinegrass use. Currently, there are no herbicides available to homeowners to control established annual and perennial grassy weeds (Trenholm, et al 2006).

Torpedograss Invasion and Cultural Management in Fine Turfgrasses

In recent years, torpedograss has become a troublesome weed in fine turfgrasses throughout the Southern United States (McCarty et al., 1993). Golf courses from Florida to

Texas have reported some degree of torpedograss infestation, while reports of torpedograss invasion in commercial and residential turfgrass sites remain limited (Strahan, 2002). Torpedograss infestation in commercial and residential sites, however, may not be an accurate reflection of the problem, but rather a function of mis-identification or poor reporting.

Torpedograss has increased as a weed problem because of its ability to withstand frequent mowing at low cutting height; a common practice in the management of fine turfgrasses (Ross and Lembi, 1985). With a tremendous regenerative capacity, close mowing does not appear to significantly slow torpedograss growth or shift the competitive edge to the desired turfgrass species (Manipura and Somaratine, 1974). Other cultural practices for managed turfgrasses such as increased fertilization may contribute to torpedograss invasion in certain turfgrass swards. Higher nitrogen applications are directly correlated to enhanced photosynthetic response and competitiveness for many turf species (Bowman, 1991). Torpedograss is very competitive in turfgrass stands and has reduced common bermudagrass yields as much as 37% (Wilcut et al., 1988). Cultural control practices have generally proven unsuccessful in controlling torpedograss and have contributed to even greater infestations (Kigel and Kollier, 1985).

Chemical Control and Suppression of Torpedograss

The limited success in controlling torpedograss through cultural practices and its spread throughout the Gulf Coast area, have shifted the focus to potential herbicide control. Initial studies reported torpedograss to be tolerant to many commonly used herbicides for turfgrass application (McCarty et al., 1993). Therefore, torpedograss control was relegated to nonselective herbicides such as glyphosate (Baird et al., 1983), paraquat (Manipura and Somaratine, 1974), and dalapon (Fleming et al., 1978). Burt and Dudeck (1975) reported glyphosate applied at 0.92 kg ai per ha^{-1} provided good torpedograss control with reduced application rates giving less consistent control. Chandrasena (1990) reported that up to 1.84 kg ai per ha^{-1} of glyphosate may be necessary to control mature torpedograss.

Though somewhat effective in controlling torpedograss invasion, non-selective herbicides can injure desired turfgrass. The collateral injury from non-selective herbicides has led to more extensive research to evaluate selective post-emergence herbicides such as asulam, a graminicide applied to St. Augustinegrass. In sugarcane, three sequential asulam applications applied at 3 kg ai ha^{-1} at 40 day intervals reduced torpedograss re-growth for nearly one year after initial application (Hossain et al., 2002). MSMA, used on bermudagrass and zoysiagrass (*Zoysia japonica* Steud.) has little to no activity on mature torpedograss (Fleming et al., 1978; McCarty et al., 1993).

Quinclorac, used for broadleaf and grassy weed control in rice (Street et al., 1988) and turfgrass, has also been evaluated for torpedograss control. Quinclorac can be effective in removing torpedograss from mature bermudagrass swards with little to no injury to bermudagrass (McCarty, 1992; McCarty et al., 1993). Sequential quinclorac applications at 21 day intervals applied at 0.6 kg ha^{-1} provided the best control (Brecke et al., 2001). When nitrogen was evaluated with quinclorac, torpedograss control was not improved and bermudagrass re-growth was not sufficiently stimulated to offset torpedograss invasion (Brecke et al., 2001). Though quinclorac is the most promising compound for torpedograss control, there is some reservation regarding usefulness of quinclorac since quinclorac is a root absorbed compound and highly water soluble (Williams et al., 2004). Unfortunately, quinclorac is not labeled for use on centipedegrass due to unacceptable injury.

More recent torpedograss studies have focused on sulfonylurea herbicides. Trifloxysulfuron applied sequentially at 0.025 kg ai per ha^{-1} provided torpedograss control similar to that of quinclorac. Excessive rainfall, however, can greatly reduce trifloxysulfuron efficacy (Stephenson et al., 2006).

Non-chemical Control

Methods to control torpedograss other than chemical control have been examined using a mixture of fungi for bio-control. The mixture is composed of the fungi *Drechslera gigantean*, *Exserohilum longirostratum*, and *Exserohilum rostratum*. Studies in Florida have evaluated this mixture in an integrated torpedograss control program for native areas and orchards (Chandramohan et al., 2002). Torpedograss was reduced 60 to 70% with this mixture, however, hopes of achieving similar results in turfgrasses may be limited by the detrimental effects of fungi to the desired grass (Chandramohan et al., 2002).

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CHAPTER 2: CHEMICAL SUPRESSION OF TORPEDOGRASS (*PANICUM REPENS* L. BEAUV.) IN MATURE CENTIPEDEGRASS [*EREMOCHLOA OPHIUROIDES* (MUNRO) HACK.] SWARDS

Introduction

Centipedegrass [*Eremochloa ophiuroides* (Munro) Hack.] is a common turfgrass grown throughout the southern United States (Duble, 2001). Centipedegrass is suitable for use in home lawns, landscapes, and utility areas because it tolerates low nitrogen fertility, acidic soils, and warm temperatures. The grass also possesses good disease and insect resistance and has low maintenance requirements (Turgeon, 2002). However, infestations of torpedograss (*Panicum repe*ns L. Beauv.) have severely limited centipedegrass growth and quality along the Gulf Coast.

Torpedograss is a rhizomatous, perennial warm-season grass that is a major weed in tropical and subtropical areas of the world (Holm et al., 1977). Torpedograss grows best under mild climatic conditions with optimal growth occurring at day and night temperatures >25° C (Wilcut et al., 1988). Although torpedograss is typically found in moist, sandy soils, it can also grow on heavy upland soils (Holm et al., 1977; Wilcut et al., 1988; Strahan, 2002). Environmental conditions such as acidic soils (pH 4 to 6) and occasional flooding do not appear to substantially affect torpedograss growth (Wilcut et al., 1988).

Most of the research that has examined herbicidal control of torpedograss in turf has focused on common or hybrid-bermudagrass (*Cynodon dactylon* vars. L. Pers.). Quinclorac, a herbicide routinely applied for annual grassy weed control in bermudagrass, reduced torpedograss infestation 84% when applied sequentially at 0.45 kg ai ha^{-1} every 21 days (Brecke et al., 2001). More recently, sulfonylurea herbicides have been evaluated for selective torpedograss control. Trifloxysulfuron exhibited the greatest activity by achieving torpedograss control equal to quinclorac (Stephenson et al., 2006). Sequential applications of trifloxysulfuron at 0.025 kg ai ha^{-1} were needed to attain 87% torpedograss control (Stephenson et al., 2006).

Neither quinclorac nor trifloxysulfuron, are labeled for application to centipedegrass. As a result, current recommendations for torpedograss control in centipedegrass include non-selective herbicides such as glyphosate (Baird et al., 1983; Chandrasena, 1990; Manipura and Somaratine 1974), glufosinate (Manipura and Somaratine 1974), or sulfosate (Manipura and Somaratine 1974). Glyphosate provides excellent torpedograss control at 0.92 kg ai ha^{-1}, however, rates as high as 1.84 kg ai ha^{-1} may be required where torpedograss has more developed rhizome systems (Burt and Dudeck 1975, Chandrasena 1990).

Torpedograss control from non-selective herbicides results in unacceptable injury or death of the desired turfgrass. In the case of centipedegrass, spot sprays of non-selective herbicides coupled with the less vigorous growth habit of centipedegrass would slow recovery and allow weed invasions. Therefore, the objective of this study was to evaluate selective post-emergence herbicides applied at several rates and frequencies for torpedograss control in centipedegrass.

Materials and Methods

Field studies to evaluate three post-emergence herbicides for torpedograss control in centipedegrass were conducted. Experiments were initiated on mature centipedegrass swards on 14 July 2007 in Baton Rouge, LA, on an Oliver silt loam (fine-silty, mixed, thermic, Typic Fragiudalf) and 21 July 2007 in Hahnville, LA, on a Cancienne silt loam (Fine-silty, mixed, superactive, nonacid, hyperthermic Fluvaquentic Epiaquepts). Centipedegrass swards at each location were heavily infested (>40% sward cover) with a natural torpedograss population.

Herbicides treatments included sethoxydim, clethodim and quinclorac. Each herbicide was evaluated in separate experimental treatments that were arranged in a randomized complete block design with four replications. Sethoxydim and clethodim were applied at manufacturer's recommended label rates for grassy weed control at 0.32 and 0.30 kg ai ha^{-1}, respectively, or at twice manufacturer's label rates at 0.63 and 0.60 kg ai ha^{-1}. Quinclorac was applied at 0.42 kg ai ha^{-1} based on preliminary trials where rates in excess of 0.42 kg ai ha^{-1} resulted in unacceptable centipedegrass injury (data not shown).

For each herbicide, treatments were applied to plots measuring 1.5 m x 1.5 m as single or sequential applications (1, 2, or 3 applications) four weeks apart. Four weeks was chosen as the interval for sequential applications to allow torpedograss shoots to re-grow to assure maximum foliar uptake (Senseman, 2007) of clethodim and sethoxydim. A non-ionic surfactant (Lesco® Spreader Sticker) at 0.25% v/v was applied with all herbicide treatments with the exception of sethoxydim treatments which received no surfactant.

Treatments were applied using a backpack sprayer with CO_2 as the propellant and water as the carrier. The spray boom was fitted with three nozzles (8002 VS Teejet®) spaced 45 cm apart. Application pressure was 172 kPa and water volume was 95 L ha^{-1}. Herbicide applications were made when rain was not forecasted within 24 hours.

General turfgrass maintenance included weekly mowing to a height of 5 cm using a rotary mower and irrigation applied as needed to prevent sward wilting. Each site was fertilized with 24 kg nitrogen ha^{-1} 8 weeks prior to the initial herbicide application and no additional fertilization thereafter. Prior to initial herbicide application, ratings for percent torpedograss composition were visually recorded using a scale of 0 to 100% (0% = no torpedograss present, 100% = complete torpedograss coverage). Ratings were made every two weeks after initial treatment (WAIT) for a period of 16 weeks for changes in torpedograss coverage and centipedegrass injury. Centipedegrass injury was assessed using a rating scale of 0 to 100% (0% = no injury, 100% = death) with an injury rating over 25% considered unacceptable.

Data were analyzed as repeated measures using the mixed procedure in SAS (SAS, 1989). Location was treated as a random variable. Treatment means were separated using Fisher's LSD at a p-value <0.05.

Results and Discussion

Compared to previous herbicide studies examining torpedograss control in bermudagrass, quinclorac did not provide long-term torpedograss suppression in centipedegrass (figure 2.1).

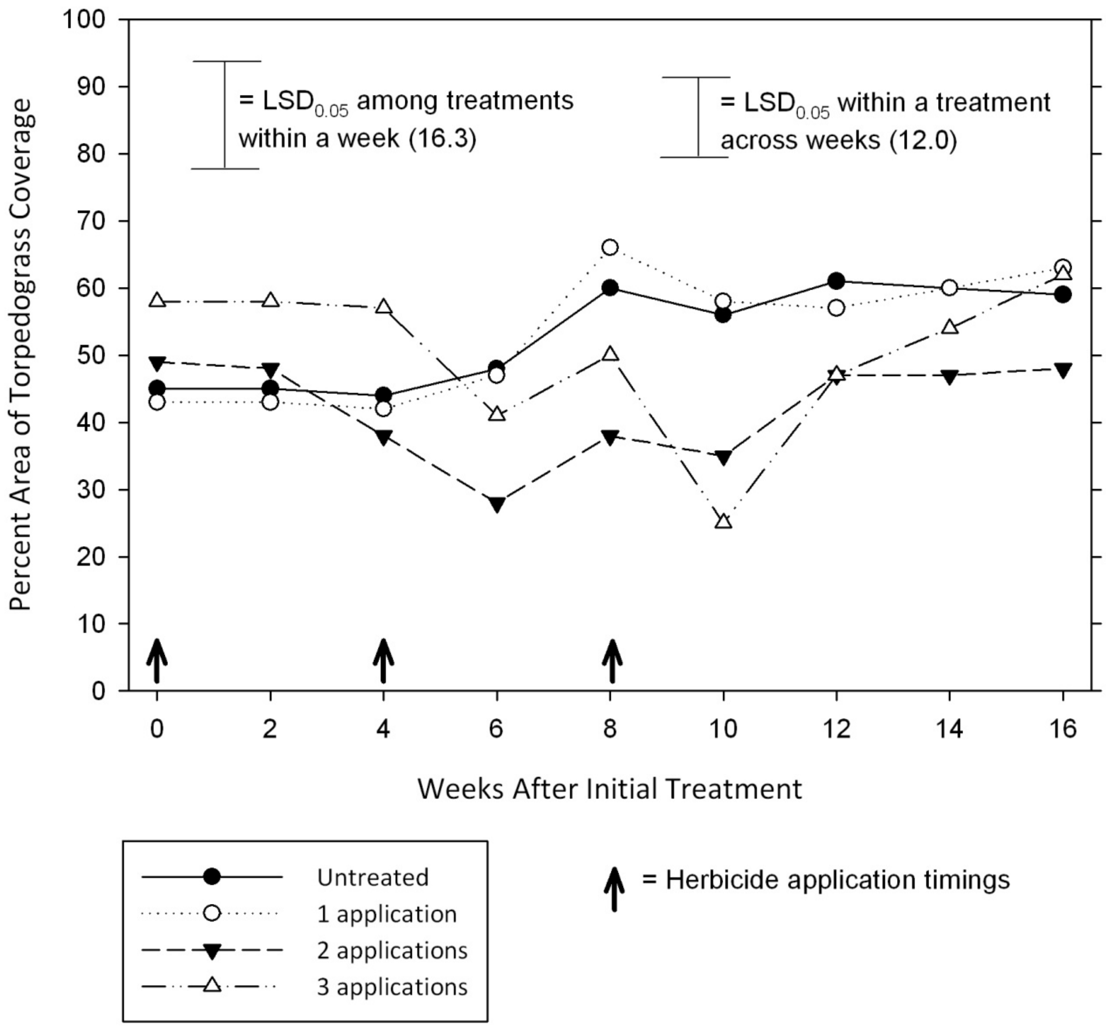

Figure 2.1. Control of torpedograss (*Panicum repe*ns L. Beauv.) in mature centipedegrass [*Eremochloa ophiuroides* (Munro) Hack] with quinclorac applied as single or sequential applications at 0.42 kg ai ha^{-1} during 2007. Data are combined from Baton Rouge and Hahnville, LA. Arrows indicate herbicide applications.

Quinclorac applied as a single application did not reduce torpedograss growth compared to the untreated control at any time during the study. In contrast, two sequential quinclorac applications reduced torpedograss cover 42% and 38% at 6 and 10 WAIT, respectively, followed by a steady increase in torpedograss re-growth. When quinclorac was applied three times, torpedograss cover was reduced 55% from control at 10 WAIT. Greater torpedograss control has been observed from quinclorac applications of 0.6 kg ai ha^{-1} (Brecke et al., 2001), Lower levels of torpedograss control could be attributed to the lower application rate (0.42 kg ai ha^{-1}). Injury to centipedegrass was 41% 6 WAIT following two applications of quinclorac. Injury was 21 and 22% at 8 and 10 WAIT, respectively, when applied three times (table 2.1). Centipedegrass phytotoxicity not only resulted in poor sward aesthetics but also limited lateral growth, allowing torpedograss to quickly re-infest.

Sethoxydim and clethodim, two herbicides labeled for grassy weed control in centipedegrass, exhibited the greatest activity on torpedograss (figures 2.2 and 2.3). However, neither herbicide provided additional torpedograss control when applied above manufacturer's labeled rates of 0.32 kg ai ha^{-1} (sethoxydim) and 0.30 kg ai ha^{-1} (clethodim). Therefore, presented data for each of these compounds represents an average of the manufacturer's labeled rate and twice the label rate. Failure to see increased control as rates of sethoxydim or clethodim increased, suggest that frequency of application is more important to long-term control. Averaged across herbicide rates, single applications reduced torpedograss coverage 35% for sethoxydim (figure 2.2) and 50% for clethodim (figure 2.3) from the untreated control 6 WAIT and torpedograss re-growth occurred steadily in subsequent weeks. By 16 WAIT, torpedograss re-growth attained coverage values of 58% and 43% coverage for sethoxydim and clethodim-treated swards; in excess of initial torpedograss coverage's of 42% (sethoxydim) and 43% (clethodim).

Table 2.1.
Centipedegrass [*Eremochloa ophiuroides* (Munro) Hack] injury following herbicide applications in Baton Rouge and Hahnville, Louisiana in 2007.

Treatment	Rate	Applications	Weeks After Initial Treatment (WAIT)								
			0	2	4	6	8	10	12	14	16
	kg ai ha^{-1}										
Control		0	0 aA	0 aA	0 aA	0 aA	0 aA	3 aA	0 aA	0 aA	0 aA
Sethoxydim	0.32	1	0 aA	0 aA	0 aA	0 aA	0 aA	0 aA	0 aA	0 aA	0 aA
Sethoxydim	0.32	2	0 aA	0 aA	0 aA	7 bB	0 aA	0 aA	0 aA	0 aA	0 aA
Sethoxydim	0.32	3	0 aA	0 aA	0 aA	0 aA	0 aA	4 aA	0 aA	0 aA	0 aA
Clethodim	0.30	1	0 aA	0 aA	0 aA	8 bB	2 abAB	0 aA	0 aA	0 aA	0 aA
Clethodim	0.30	2	0 aA	0 aA	0 aA	23 dC	9 bB	0 aA	0 aA	0 aA	0 aA
Clethodim	0.30	3	0 aA	0 aA	0 aA	16 cB	3 abA	13 bB	4 aA	1 aA	0 aA
Sethoxydim	0.63	1	0 aA	0 aA	0 aA	1 abA	0 aA	0 aA	0 aA	0 aA	0 aA
Sethoxydim	0.63	2	0 aA	0 aA	0 aA	4 abA	2 abA	0 aA	0 aA	0 aA	0 aA
Sethoxydim	0.63	3	0 aA	0 aA	0 aA	7 bB	0 aA	10 bB	1 aA	1 aA	0 aA
Clethodim	0.60	1	0 aA	0 aA	1 aA	0 aA	0 aA	0 aA	0 aA	0 aA	0 aA
Clethodim	0.60	2	0 aA	0 aA	3 aA	41 eC	16 cB	0 aA	0 aA	0 aA	0 aA
Clethodim	0.60	3	0 aA	0 aA	1 aA	43 eD	8 bB	26cC	11bB	4 aA	0 aA
Quinclorac	0.42	1	0 aA	0 aA	5 aA	0 aA	0 aA	0 aA	0 aA	0 aA	0 aA
Quinclorac	0.42	2	0 aA	0 aA	5 aA	41 eC	18 cB	2 aA	0 aA	0 aA	0 aA
Quinclorac	0.42	3	0 aA	0 aA	1 aA	46 eD	21 cC	22 cC	11 bB	4 aA	0 aA

$LSD_{0.05}$ = 6.9 for all treatments in a single WAIT (a)
$LSD_{0.05}$ = 7.0 for a single treatment across all WAIT (A)
Unacceptable injury level is 25%.
Data pooled over two locations.
Sequential applications made on four week intervals.

Robust torpedograss rhizome systems contain high carbohydrate stores that are capable of providing energy for shoot re-growth (Wilcut et al., 1988). Other research has shown that single applications of non-selective were generally not as effective as multiple applications for controlling mature torpedograss stands (Baird et al., 1983; Burt and Dudeck, 1975; Chandrasena, 1990; Fleming et al., 1978; Manipura and Somaratine, 1974).

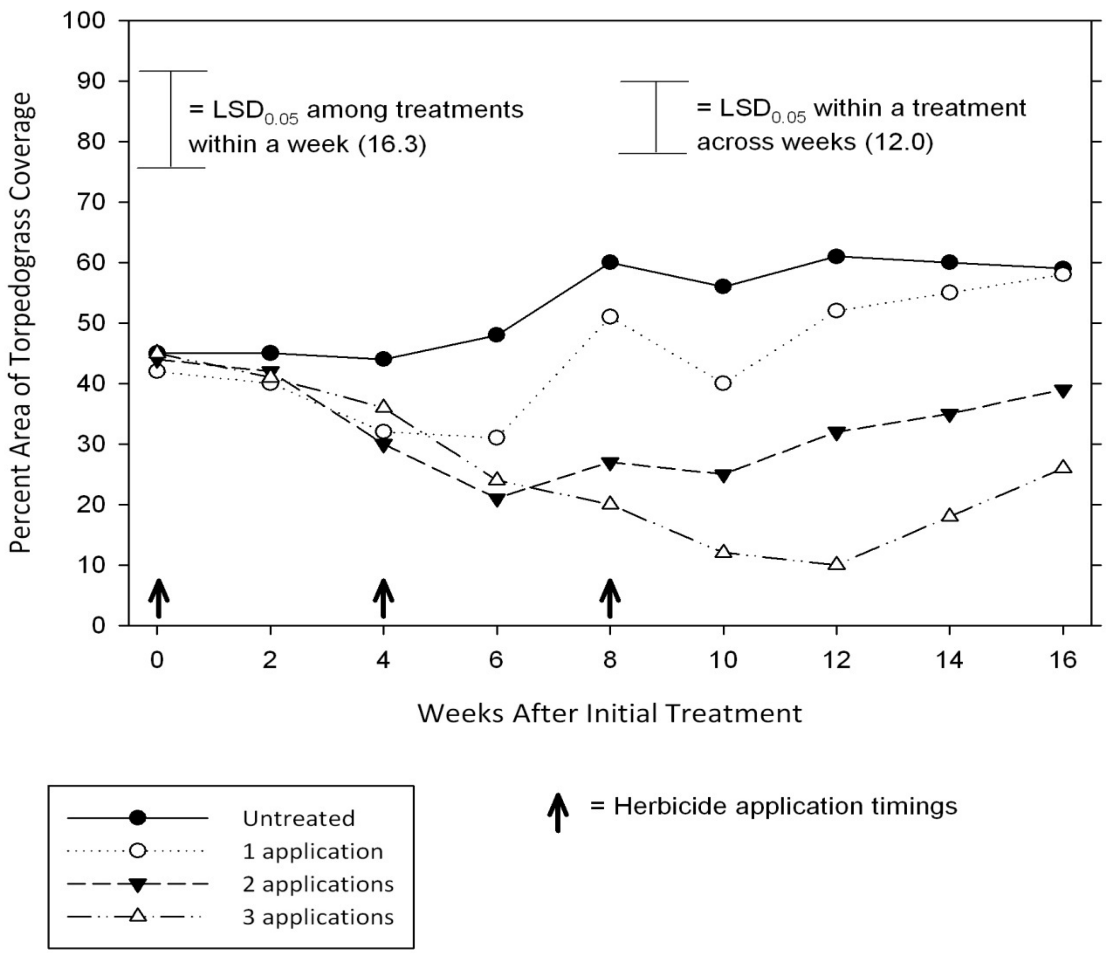

Figure 2.2. Control of torpedograss (*Panicum repe*ns L. Beauv.) in mature centipedegrass [*Eremochloa ophiuroides* (Munro) Hack] with sethoxydim applied as single or sequential applications in 2007. Presented data are a combination of manufacturers' labeled rate (0.32 kg ai ha^{-1}) and twice the labeled rate (0.63 kg ai ha^{-1}) and from two locations (Baton Rouge and Hahnville, LA). Arrows indicate herbicide applications.

At 8 WAIT, two applications of sethoxydim or clethodim reduced torpedograss coverage 55% and 73% from control 8 WAIT, respectively, while a third herbicide application showed a pattern of greater torpedograss control at 84% and 87% from control 12 WAIT (figure 2.2 and 2.3). After the third applications of sethoxydim and clethodim, torpedograss re-growth began to occur 12 WAIT. For example, swards receiving three sethoxydim and clethodim sequential herbicide applications had torpedograss re-growth of 16% to 18% 16 WAIT above the lowest suppression levels of 10% and 8% 12 WAIT.

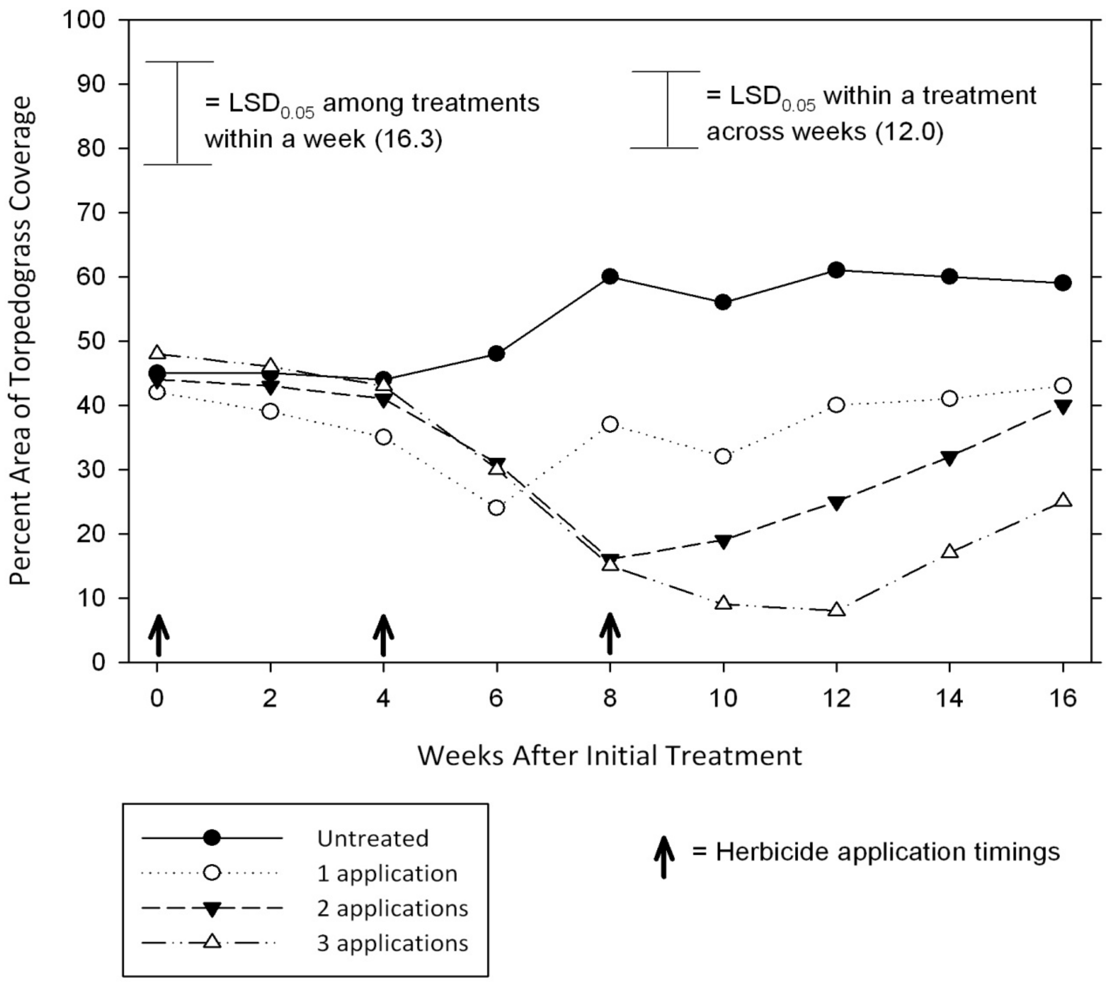

Figure 2.3. Control of torpedograss (*Panicum repe*ns L. Beauv.) in mature centipedegrass [*Eremochloa ophiuroides* (Munro) Hack] with clethodim applied as single or sequential applications in 2007. Presented data are a combination of manufacturers' labeled rate (0.30 kg ai ha^{-1}) and twice the labeled rate (0.60 kg ai ha^{-1}) and from two locations (Baton Rouge and Hahnville, LA). Arrows indicate herbicide applications.

Based on this research, sethoxydim and clethodim efficacy on torpedograss is dependent on herbicide application frequency. The need to apply multiple herbicide applications to achieve acceptable levels of control for perennial, warm-season grassy weeds has been demonstrated previously (Brecke et al., 2001; Henry, 2007; Pessarakli, 2007). Waltz et al. (2001) reported clethodim applied four weeks apart at 0.6 kg ai ha^{-1} and 1.2 kg ai ha^{-1} provided acceptable bermudagrass control in centipedegrass compared to single applications. Brecke et al. (2001) and Stephenson et al. (2006) both noted that acceptable torpedograss control in bermudagrass was only achieved with multiple applications of quinclorac or trifloxysulfuron for infested bermudagrass. Brecke et al. (2001) reported that quinclorac applications may be required for more than one year to sufficiently control severe torpedograss infestations in bermudagrass. The need for multiple applications may be due to rapid metabolism of the active ingredients by torpedograss, before basipital translocation can occur. Differences in rates of sethoxydim metabolism have been reported as a mechanism for tolerance between species (Hosaka et al., 1987)

In centipedegrass, Waltz et al. (2001) reported clethodim to be slightly more effective (95%) than sethoxydim (80 – 90%) for bermudagrass control. However, in the present study there was no significant difference in torpedograss control between sethoxydim and clethodim when applied as three sequential applications (figure 2.4). Instead, differences in sethoxydim and clethodim were represented by centipedegrass injury in the form of leaf chlorosis (table 2.1).

Centipedegrass injury was no more than 10% for sethoxydim applied at 0.32 or 0.64 kg ai ha^{-1} for single or sequential applications at any date during the study, in contrast, centipedegrass treated with clethodim displayed 16% and 23% injury 6 WAIT for sequential applications at 0.3 kg ai ha^{-1} compared to no more than 8% injury for single clethodim applications. When the rate of clethodim was increased to 0.6 kg ai ha^{-1}, and two applications were made, centipedegrass was injured 41% 6 WAIT. Clethodim applied at 0.6 kg ai ha^{-1} in three sequential applications resulted in centipedegrass injury of 43% 6 WAIT and 26% 10 WAIT. Injury from clethodim was transient with recovery occurring, in most cases, 2 to 4 weeks after the second application.

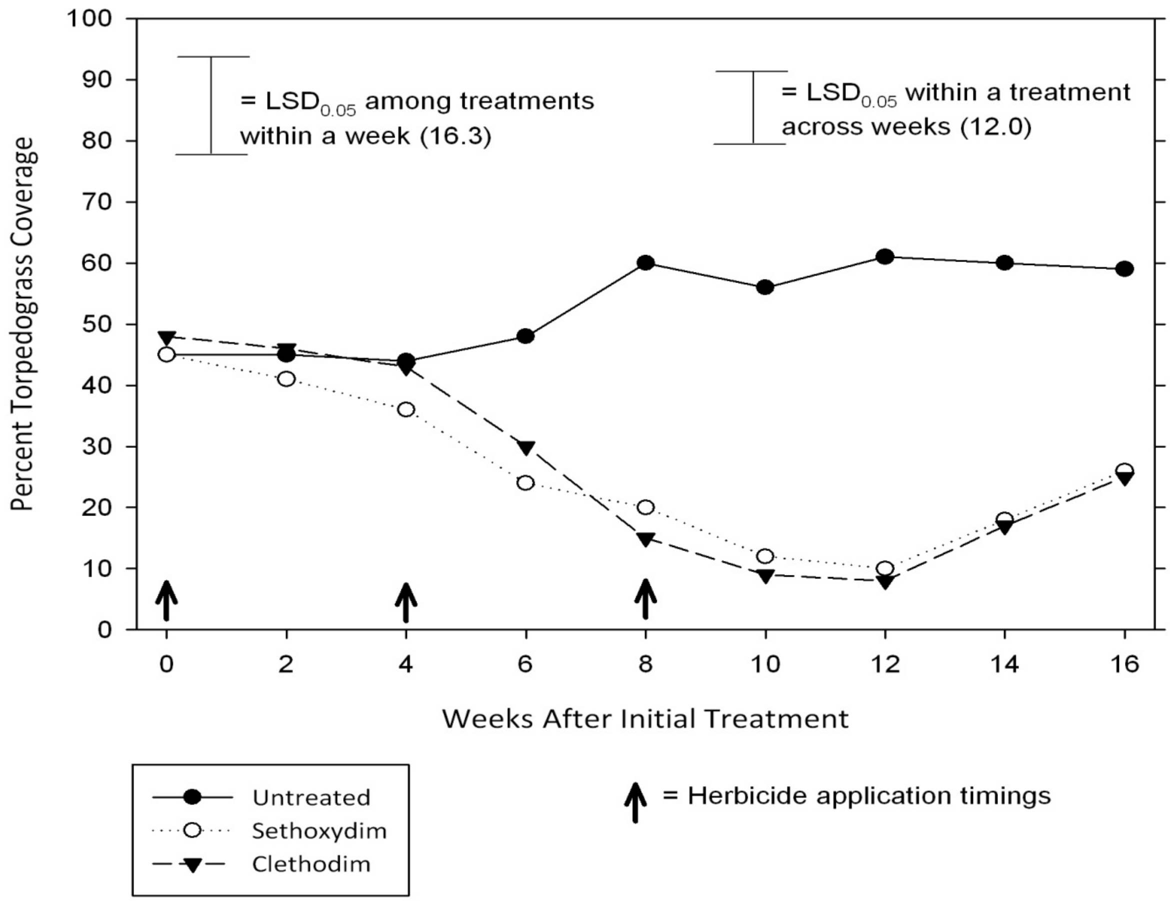

Figure 2.4. Control of torpedograss (*Panicum repens* L. Beauv.) in mature centipedegrass [*Eremochloa ophiuroides* (Munro) Hack] with sethoxydim or clethodim applied as three sequential applications in 2007. Presented data are a combination of manufacturers' labeled rate and twice the labeled rate for sethoxydim (0.32 kg ai ha^{-1}, 0.63 kg ai ha^{-1}) and clethodim (0.30 kg ai ha^{-1}, 0.60 kg ai ha^{-1}) and from two locations (Baton Rouge and Hahnville, LA). Arrows indicate herbicide applications.

Excessive injury to centipedegrass from applied herbicides would slow centipedegrass growth and reduce competitiveness with weeds. Attempts to accelerate centipedegrass recovery through N additions would potentially diminish sward health (Duble, 2001) and possibly enhance torpedograss re-growth (Sutton, 1996). In bermudagrass, Brecke et al. (2001) reported that N fertilization did not improve the recovery rate of bermudagrass treated with quinclorac. An effort to enhance centipedegrass competitiveness with torpedograss infestation using cultural practices has not been fully examined and warrants further study.

Conclusion

Competitiveness of torpedograss in centipedegrass can be reduced with sethoxydim or clethodim applied at manufacturer's label rates of 0.32 kg ai ha^{-1} or 0.30 kg ai ha^{-1}, respectively, 4 weeks apart. Even with three applications, torpedograss was able to recover and re-infest the centipedegrass sward.

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CHAPTER 3: INFLUENCE OF CULTURAL PRACTICES ON TORPEDOGRASS (*PANICUM REPENS* L. BEAUV.) COMPETITION IN TWO WARM-SEASON LAWN GRASSES

Introduction

Torpedograss (*Panicum repens* L. Beauv.) infestation of highly managed warm-season turfgrasses has become a severe problem throughout the Gulf Coast of the United States (Wilcut et al., 1988). This perennial, C_4 grass has long been a major weed in tropical and subtropical areas of the world (Holm et al., 1977) and an increasing problem in turf (Brecke et al., 2001).

Torpedograss grows best under mild climatic conditions with optimal growth occurring at day and night temperatures >25° C (Wilcut et al., 1988). Although torpedograss is typically found in moist, sandy soils, it has been reported to grow on heavy upland soils (Holm et al., 1977; Strahan, 2002; Wilcut et al., 1988). Environmental conditions such as acidic soils (pH 4 to 6) and occasional flooding do not appear to substantially affect torpedograss growth (Wilcut et al., 1988). Poor torpedograss seed viability indicates dissemination occurs through vegetative propagation of rhizome-contaminated soils (Moreira, 1978; Wilcut et al., 1988). The robust rhizome system of torpedograss, with high carbohydrate concentrations, provides energy for rapid shoot re-generation even from small rhizome fragments (Manipura and Somaratine, 1974; Wilcut et al., 1988). Under favorable conditions, weed growth is rapid with dense rhizome systems produced within a few months (Chandrasena, 1990).

Control of torpedograss using selective, post-emergence herbicides such as quinclorac and trifloxysulfuron has been attained in common or hybrid bermudagrass (*Cynodon dactylon* vars. L.) (Brecke et al., 2001; McCarty, 1992; McCarty et al., 1993; Stephenson et al., 2006) and zoysiagrass (*Zoysia japonica* Steud.) (Anonymous, 2007). In centipedegrass [*Eremochloa ophiuroides* (Munro) Hack.] and St. Augustinegrass [*Stenotaphrum secundatam* (Walt.) Kuntze], no reports of selective post-emergence herbicide control for torpedograss has been published.

Non-selective herbicides and/or renovation are currently used to control severe torpedograss infestations in these grasses.

The use of herbicides can be an effective means to reduce weed infestations, however, it is widely accepted that increasing turfgrass vigor reduces weeds populations in mature turfgrass stands (Calhoun et al., 2005; Watschke, 1994). Mowing and N fertility have been regarded as two of the most utilized cultural practices in weed control. In a review of cultural management of weeds in turfgrass, Busey (2003) concluded that mowing a turfgrass too high or low or infrequently generally increases weed colonization, while mowing at recommended or intermediate mowing heights and frequencies help to maintain a grass monoculture. Reducing a mowing height below recommended levels often results in decreased sward density creating conditions conducive to greater weed encroachment and competitiveness (Busey, 2003). While lower mowing heights may allow greater weed invasion, mowing heights above recommended levels imposed infrequently may also increase the potential for specific weeds to compete in turf (Henry et al., 2007). Therefore, maintaining mowing heights in accordance with current recommendations is an important component of any turfgrass weed control program.

While adjustment of mowing height is considered a primary cultural practice for weed control, N fertility can be another factor used to increase turfgrass competitiveness. Several studies have shown increased rates of N reduced crabgrass (*Digitaria* spp.) populations within Kentucky bluegrass (*Poa pratensis* L.) (Dunn et al., 1981; Johnson, 1981; Johnson and Bowyer, 1982; and Murray et al., 1983); tall fescue [*Schedonorus phoenix* (Scop.) Holub] (Dernoeden et al., 1993; Voigt et al., 2001), and Chewings fescue (*Festuca rubra* L. var. commutata Gaud.) (Jagschitz and Ebdon, 1985). However, Johnson and Burns (1985) reported increasing N rates up to 400 kg N ha^{-1} yr^{-1} did not reduce large crabgrass (*Digitaria sanguinalis* L.) within bermudagrass, a warm-season turfgrass. Busey and Johnston (2006) found herbicide applications in conjunction with cultural practices necessary to maintain high turfgrass quality.

No weed control program should rely solely on herbicides for weed management. There are situations where there is no known selective herbicide option for killing or suppressing a particular weed (Busey, 2003). Therefore, cultural management practices that increase turfgrass vigor are necessary components of a complete weed control program. In the case of torpedograss infestation of St. Augustinegrass and centipedegrass, cultural management practices may be the key in preventing or limiting torpedograss invasion. This study examined the influence of mowing height and N fertility on torpedograss infestation in St. Augustinegrass and centipedegrass.

Materials and Methods

Two field experiments were initiated in May 2007 located at the LSU AgCenter Burden Research Station in Baton Rouge, LA on an Oliver silt loam (fine-silty, mixed, thermic, Typic Fragiudalf) and LSU AgCenter Hammond Research Station in Hammond, LA on a Cahaba fine sandy loam (fine-loamy, silicious, thermic, Typic Hapludult). Site preparation at both locations included two applications of glyphosate at 1.84 kg ai ha^{-1} applied four weeks apart to kill existing vegetation. When the vegetation was sufficiently destroyed, soil was tilled, graded, and rolled to provide a smooth surface for sod establishment. Plots measuring 30 m^2 arranged in a Latin rectangle design with four replications were sodded with St. Augustinegrass cv. Palmetto or common centipedegrass.

Two weeks after St. Augustinegrass and centipedegrass were sodded; each replication of each species was divided into nine sub-plots (3x3 arrangements). In the middle of each sub-plot an area of 0.84 m^2 was cleared and established with 0.09 m^2 of torpedograss. Torpedograss sod (30 cm x 30 cm) was harvested from a pure, mature stand in Hammond, LA to a depth of 2.5 cm using a sod cutter. After torpedograss was established, the remaining bare area (0.75 m^2) around each torpedograss sod slab was allowed to grown-in with torpedograss and the surrounding turfgrass species. This was done to simulate as well as accelerate torpedograss invasion of St. Augustinegrass and centipedegrass lawns. During establishment, irrigation was applied daily. After establishment, irrigation was applied as needed to prevent sward stress.

Cultural practices, N fertility and mowing treatments, were imposed. Nitrogen and mowing treatments were applied as columns and rows, respectively across each turfgrass species. Treatments were categorized as low, recommended, and high based on current recommendations for each species grown within Louisiana (Louisiana Cooperative Extension Service, 2006). St. Augustinegrass N fertility regimens were 0 kg N ha^{-1} $month^{-1}$, 50 kg N ha^{-1} $month^{-1}$, and 100 kg N ha^{-1} $month^{-1}$. For centipedegrass, regimens were 0 kg N ha^{-1} $month^{-1}$, 12.5 kg N ha^{-1} $month^{-1}$, or 25 kg N ha^{-1} $month^{-1}$. All N fertilizer was applied as NH_4-NO_3 (34-0-0) using a drop spreader (Lesco®, John Deere® Landscapes, Troy, MI). Mowing regimen for St. Augustinegrass were 2.54 cm, 6.35 cm, and 10.16 cm and centipedegrass was maintained at 2.54 cm, 5.08 cm, or 7.62 cm. Grasses were mowed bi-weekly using a rotary mower.

Changes in torpedograss, St. Augustinegrass, and centipedegrass coverage were measured monthly during actively growing periods from March to July. Measurements were recorded from each sub-plot using a grid system with a total area of 2.32 m^2 and 49 total sub-sections. Grass species coverage was visually estimated within each 473.5 cm^2 sub-section with estimates totaled across all sub-sections. Grass coverage is presented in cm^2. Average temperature and monthly precipitation were recorded at each location. Data were analyzed using the statistical program SAS (1989) as repeated measures over time. Locations were considered a random variable with treatment means separated using Fisher's LSD at a p-value ≤ 0.05.

Results and Discussion

Fertility Regimen

Consistent differences in torpedograss growth within centipedegrass or St. Augustinegrass as affected by fertility regimen were not evident from March to July (tables 3.1 and 3.2). Torpedograss coverage slowly increased over time for all fertility treatments regardless of grass species. Grasses fertilized at recommended levels never had torpedograss coverage exceed coverages observed at the low and high fertility treatments during the study. For example, in centipedegrass during May, torpedograss coverage was 3000 cm^2 for the recommended N treatment compared to 3000 cm^2 and 3200 cm^2 for low and high fertilities, respectively. By July, the recommended N-treatment had 3500 cm^2 torpedograss coverage compared to 3900 cm^2 and 3500 cm^2 torpedograss coverage for the low and high N-treatments (table 3.1). In April, St. Augustinegrass fertilized at the recommended N-treatment resulted in 2600 cm^2 versus 2600 cm^2 and 2800 cm^2 torpedograss for low and high N-treatments, whereas, in July the recommended and low N-treatments had 3200 cm^2 torpedograss compared to 3700 cm^2 torpedograss for the high fertility treatment (table 3.2).

Poor response by torpedograss to increasing N levels does not support the findings of Calhoun et al. (2005) who reported a fertilized cool-season mixture [Kentucky bluegrass (*Poa pratensis* L.), perennial ryegrass (*Lolium perenne* L.) and fine fescue (*Festuca rubra* L.)] slowed re-infestation of broadleaf weeds compared to non-fertilized areas, or, Lowe et al., (2000) who reported that in weak Tifway bermudagrass, increasing N to 49 kg ha^{-1} per month reduced green kyllinga (*Kyllinga brevifolia* Rottb.) spread 40% to 50%. Results for the present study indicate torpedograss is able to grow and persist under a wide range of N fertilities.   Therefore, altering recommended N levels would not result in reduced torpedograss coverage or accelerate centipedegrass or St. Augustinegrass growth.

Table 3.1.
Torpedograss (*Panicum repens* L.) and Centipedegrass [*Eremochloa ophiuroides* (Munro) Hack] Coverage under Various Fertility Regimen

		2008				
		March	April	May	June	July
Species	Fertility Level	cm^2				
	Low	2100 aA	2600 bB	3000 aC	2600 aB	3900 bD
Torpedograss	Rec.	1900 aA	2300 aB	3000 aD	2600 aC	3500 aE
	High	1900 aA	2600 bB	3200 aC	2600 aB	3500 aD
	Low	19400 aAB	20100 aAB	20700 aB	18500 aA	18400 aA
Centipedegrass	Rec.	20900 aA	20800 aA	20100 aA	19400 aA	19700 aA
	High	21300 aA	20700 aA	20000 aA	19500 aA	19800 aA

Low, Recommended (Rec.), and High fertility was 0, 12.5, 25 kg N ha^{-1} $month^{-1}$ respectively.
Total measured area is 2.32 square meters.
Data combined over two locations. (Baton Rouge and Hammond, LA)
To compare torpedograss across fertility regimen or within months, $LSD_{0.05}$= 283
To compare centipedegrass across fertility regimen or within months, $LSD_{0.05}$= 2100
LSD within months is lower case letters (a) and across fertility regimen is upper case (A)

Table 3.2.
Torpedograss (*Panicum repens* L.) and St. Augustinegrass [*Stenotaphrum secundatam* (Walt.) Kuntze] Coverage under Various Fertility Regimen

		2008				
		March	April	May	June	July
Species	Fertility Level	cm^2				
	Low	2100 abA	2600 aB	3200 aC	2800 aB	3200 aC
Torpedograss	Rec.	1900 aA	2600 aB	3200 aC	2800 aB	3200 aC
	High	2300 bA	2800 aB	3500 bC	2600 aB	3700 bC
	Low	19000 aAB	20600 aB	19900 aAB	19000 aAB	18000 aA
St. Augustinegrass	Rec.	20100 aAB	20600 aB	19900 aAB	20400 aAB	18400 aA
	High	20500 aB	20400 aAB	19800 aAB	18400 aA	19300 aAB

Low, Recommended (Rec.), and High fertility was 0, 50, 100 kg N ha^{-1} $month^{-1}$ respectively.
Total measured area is 2.32 square meters.
Data combined over two locations. (Baton Rouge and Hammond, LA)
To compare torpedograss across fertility regimen or within months, $LSD_{0.05}$ =283
To compare St. Augustinegrass across fertility regimen or within months, $LSD_{0.05}$= 2100
LSD within months is lower case letters (a) and across fertility regimen is upper case (A)

Busey and Johnston (2006) found fertility levels alone were unsuccessful in controlling weed infestations of St. Augustinegrass. Even though centipedegrass and St. Augustinegrass accounted for greater than 80% of the re-vegetated areas in March, the dominating presence of each turfgrass was not enough to retard torpedograss growth. In this study, torpedograss coverage increased, albeit slowly, within each turfgrass species while St. Augustinegrass and centipedegrass coverages failed to increase and in some instances decreased from March to July (tables 3.1 and 3.2). This may be explained by the rhizomatous growth habit of torpedograss. Because rhizome formation occurs underground the extent of torpedograss spread is not fully recognized until shoot emergence. Therefore, future studies should examine N effects on torpedograss rhizome development.

Mowing Regimen

Torpedograss coverage was influenced by mowing height within St. Augustinegrass and centipedegrass. Generally, the higher torpedograss was maintained the greater the area of torpedograss coverage. In centipedegrass, every month except June, torpedograss mowed at the highest height had the greatest coverage (tables 3.3). In May, torpedograss had 14% and 20% greater torpedograss coverage compared to the low and recommended mowing heights. This pattern continued into July, with 20% and 30% greater torpedograss coverage for the highest mowing height over the recommended and lowest mowing regimen, respectively. A similar pattern of greater torpedograss coverage for the highest mowing height was evident in St. Augustinegrass (table 3.4). Torpedograss coverage was 52% and 67% greater in the higher mowing regimen compared to the recommended or low mowing regimen. At the end of the study in July, torpedograss coverage was 16% and 23% greater than the low and recommended heights. Data from both species, St. Augustinegrass and centipedegrass, indicate mowing above recommended heights allows for greater torpedograss invasion. These results support findings of

Henry et al. (2007) who observed raising mowing heights increased the potential of *Paspalum* spp. to vegetatively spread in bermudagrass. Watschke (1994) reports mowing St. Augustinegrass at a recommended height of 7.5 cm to be an effective cultural method for the preventing bermudagrass encroachment, but the same cannot be said in the prevention of torpedograss. At the highest mowing height St. Augustinegrass coverage declined from 19000 cm^2 to 17500 cm^2 from March to July and declined from 20100 cm^2 to 18200 cm^2 for centipedegrass during the same period.

Table 3.3.
Torpedograss (*Panicum repens* L.) and Centipedegrass [*Eremochloa ophiuroides* (Munro) Hack] Coverage under Various Mowing Regimen

		----------2008----------				
Species	Mowing Height	March	April	May	June	July
		----------cm^2----------				
	Low	1900 bA	2300 aB	2800 aD	2600 bC	3200 aE
Torpedograss	Rec.	1600 aA	2300 aB	3000 bD	2800 cC	3500 bE
	High	2300 cB	2800 bC	3500 cD	1900 aA	4200 cE
	Low	20400 aA	20900 aA	20400 aA	19800 aA	19900 bA
Centipedegrass	Rec.	21100 aB	20900 aB	20200 aAB	18800 aA	19800 bAB
	High	20100 aB	20400 aB	19700 aB	18800 aAB	18200 aA

Low, Recommended (Rec.), and High mowing heights were 2.54, 5.08, 7.62 cm respectively.
Total measured area is 2.32 square meters.
Data combined over two locations. (Baton Rouge and Hammond, LA)
To compare torpedograss within months or across mowing regimen, $LSD_{0.05} = 40$
To compare centipedegrass within months, $LSD_{0.05} = 1200$
To compare centipedegrass across mowing regimen, $LSD_{0.05} = 1500$

Torpedograss naturally grows 40 to 100 cm tall in erect or decumbent forms (Hitchcock and Chase, 1910) and can reach 1 m in height (Langeland and Burks, 1998). The higher the cutting height, the more leaf area is available for photosynthesis and energy transfer, as carbohydrates, into rhizomes (Chandrasena, 1990; Manipura and Somaratine, 1974; Wilcut et al., 1988). Unlike most weeds disseminated from seed, energy stored within rhizomes is sufficient to support torpedograss shoot growth until leaves are present above the interfering grass species.

Increased torpedograss invasion from higher mowing heights does not directly support mowing below recommended heights. Although torpedograss growth was slowed at the low mowing height, growth did not cease. To the detriment of St. Augustinegrass and centipedegrass, the low mowing height showed decreased density and quality compared to the recommended mowing heights. Mowing below the recommended level for the desired turfgrass species can adversely affect turfgrass health (Busey, 2003) and result in greater susceptibility to other weed invasion, diseases, and insects.

Table 3.4.
Torpedograss (*Panicum repens* L.) and St. Augustinegrass [*Stenotaphrum secundatam* (Walt.) Kuntze] Coverage under Various Mowing Regimen

		2008				
Species	Mowing Height	March	April	May	June	July
		cm^2				
Torpedograss	Low	1600 aA	2100 aB	2800 aC	3000 cD	3200 bE
	Rec.	1600 aA	2300 bB	3200 bE	2800 bC	3000 aD
	High	3000 bB	3500 cC	4200 cE	2300 aA	3700 cD
St. Augustinegrass	Low	20100 abAB	21100 bB	20500 bAB	19200 abA	19700 bAB
	Rec.	20500 bB	20800 abB	20100 abB	20400 bB	18400 aA
	High	19000 aB	19700 aB	19000 aB	18300 aAB	17500 aA

Low, Recommended (Rec.), and High mowing heights were 2.54, 5.08, 7.62 cm respectively.
Total measured area is 2.32 square meters.
Data combined over two locations. (Baton Rouge and Hammond, LA)
To compare torpedograss within months or across mowing regimen, $LSD_{0.05} = 40$
To compare St. Augustinegrass within months, $LSD_{0.05} = 1200$
To compare St. Augustinegrass across mowing regimen, $LSD_{0.05} = 1500$
LSD within months is lower case letters (a) and across mowing regimen is upper case (A)

Conclusion

Calhoun et al. (2005) reported that without proper cultural management, weed control attained through herbicide use will be at best, temporary. Attempting to suppress or control torpedograss spread in St. Augustinegrass and centipedegrass using cultural management practices proved unsuccessful. Torpedograss spread increased over time under all fertility and mowing regimen with higher mowing heights being the only treatments to accelerate torpedograss spread. Prevention, through use of un-infested soils and/or application of non-selective herbicides during construction or repair, remains the best management practice.

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CHAPTER 4: SUMMARY

Torpedograss (*Panicum repens* L. Beauv.) has become a common weed in highly managed turf along the Gulf Coast of the United States. Selective, post-emergence herbicidal control options exist for torpedograss in bermudagrass (*Cynodon dactylon* vars. L.) and zoysiagrass (*Zoysia japonica* Steud.), but in centipedegrass[*Eremochloa ophiuroides* (Munro) Hack.] and St. Augustinegrass [*Stenotaphrum secundatam* (Walt.) Kuntze] non-selective herbicides are currently used for controlling torpedograss. Field studies evaluated several selective, post-emergence herbicides to control torpedograss in centipedegrass and evaluated cultural practices to control or suppress torpedograss in St. Augustinegrass and centipedegrass.

Torpedograss can be reduced 84 to 87% in centipedegrass using sethoxydim or clethodim applied at manufacturer's label rates of 0.32 kg ai ha^{-1} or 0.30 kg ai ha^{-1}, respectively, when applied three times 4 weeks apart. Depending on environmental conditions, more than three applications may be needed to achieve season long suppression. Multiple herbicide applications were necessary and yet torpedograss re-growth still occurred.

Changes in recommended cultural practices, N fertility and mowing, did not reduce torpedograss spread in either St. Augustinegrass or centipedegrass. Torpedograss can grow and persist under a wide range of N fertilities, while, higher mowing heights increased torpedograss spread compared to recommended or lower mowing heights. Prevention of torpedograss spread using un-infested soils and non-selective herbicides remain the best practices.

APPENDIX

ENVIRONMENTAL DATA

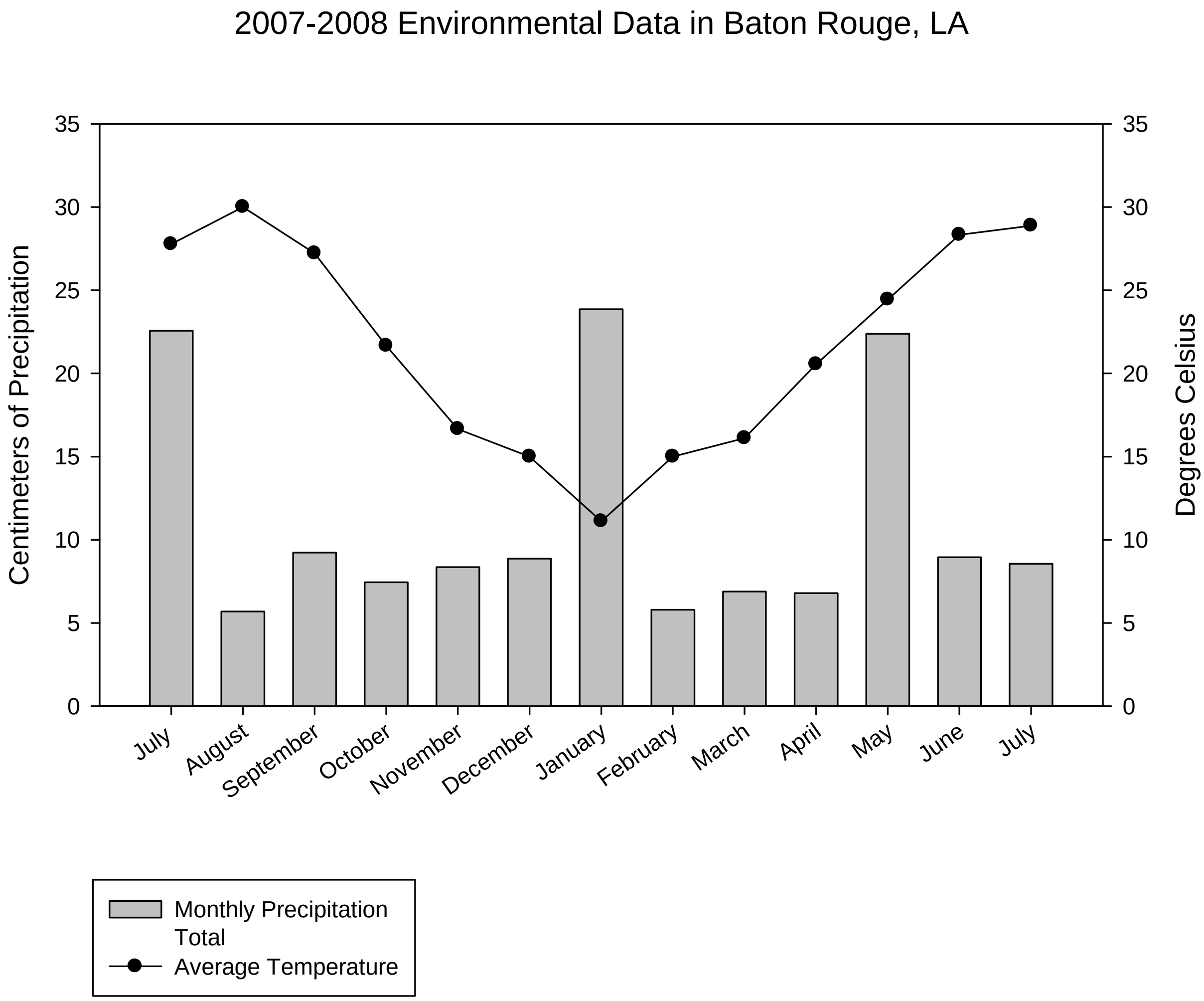

Figure A.1. Environmental data consisting of monthly precipitation and average monthly temperature for Baton Rouge, LA from July, 2007 through July, 2008.

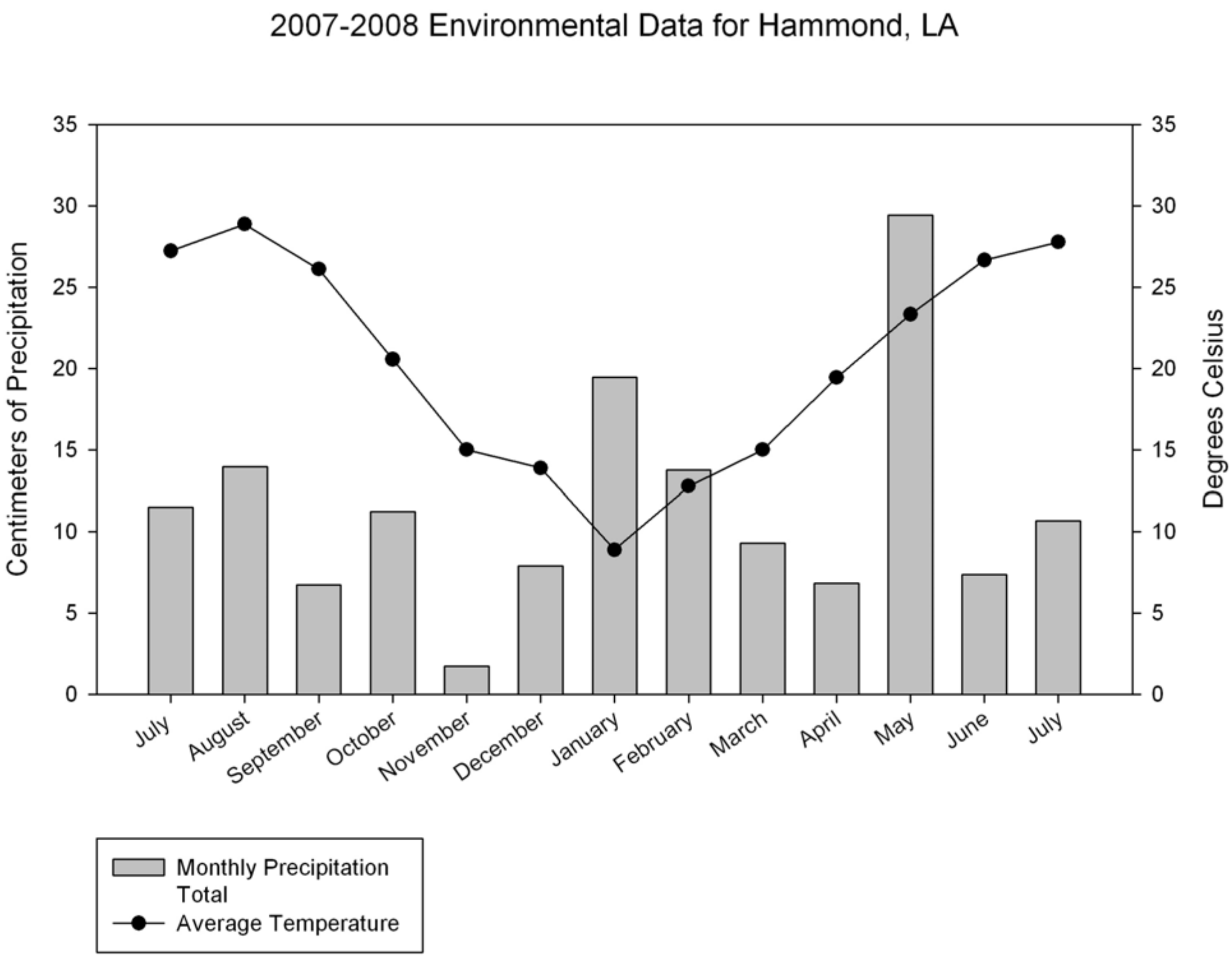

Figure A.2. Environmental data consisting of monthly precipitation and average monthly temperature for Hammond, LA from July, 2007 through July, 2008.

VITA

James Daniel Taverner, “Danny”, was born in July, 1975, as the oldest child of Everette and Kay Taverner. Raised in Minden, Louisiana, James graduated from Minden High School in 1993 and enrolled at Louisiana State University that fall. Graduating with a Bachelor of Science in horticulture in 1998, James became a Research Associate in the Department of Horticulture and began work on a Master of Science degree. Leaving LSU in 2000, James worked for a sod producer until his return as Research Associate in the School of Plant, Environmental, and Soil Science in 2004. Currently working under the direction of Dr. Jeffrey Beasley, James is a candidate for a Master of Science in horticulture with a research emphasis in turfgrass science.