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Growth of Torpedograss from Rhizomes Planted under Flooded Conditions[1]

DAVID L. SUTTON[2]

ABSTRACT

Sections of torpedograss (*Panicum repens* L.) rhizomes with three to four well-developed buds planted in flooded, sand-filled containers with controlled release fertilizer resulted in 100% survival. For these rhizomes cultured outdoors for 16-weeks in south Florida, only 2% of the total biomass was produced during the first 4 weeks after they were planted. The most rapid growth occurred between 8 and 12 weeks when 39 to 52% of the total biomass was produced. Roots, which included the rhizomes, comprised from 39 to 55% of the total plant biomass. However, higher root to shoot ratios were associated with lower rates of fertilizer. Total dry weight was 26 to 52 g per container after 16 weeks for plants in containers with fertilizer at a low rate of 2.5 g per 330 cm^2. The highest dry weight occurred during the summer when 656 g were produced by plants at 40 g of fertilizer per 330 cm^2. Based on initial dry weights representative of rhizomes planted, this high rate represents a 728-fold increase in weight during the 16-weeks. Biomass was not increased by amounts of fertilizer higher than the 40-g rate. There was an initial lag phase of growth that lasted 4 weeks after planting the rhizomes under flooded conditions. However, once the rhizomes became established, growth continued at a rapid rate under both summer or winter conditions depending on fertility of the sand culture medium. These data show that herbicide treatments for control of torpedograss problems must kill all the rhizomes since a few nodes have the potential to produce a large amount of plant material in a short period of time.

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[2]Professor, University of Florida, IFAS, Fort Lauderdale Research and Education Center, 3205 College Ave, Fort Lauderdale, Fl 33314.

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INTRODUCTION

Torpedograss (*Panicum repens* L.), a perennial grass with coarse, long-lived rhizomes, grows under conditions ranging from sandy soils low in moisture to muck soils flooded with several meters of water in tropical and subtropical areas around the world (Holm et al. 1977). It was probably introduced in North America around the turn of the century (Hitchcock 1950).

Torpedograss plants produce seed, but conflicting information occurs concerning their viability. Peng (1984) reported it did not produce viable seed in Taiwan, but viable seed have been found in Portugal (Moreira 1978). Wilcut et al. (1988) reported torpedograss spreads only by rhizomes in the lower coastal plains of the United States. In Florida, Smith (1995)[3] found an extremely low germination, one out of a thousand, of torpedograss seed.

Torpedograss is a serious weed problem in many countries (Holm et al. 1977) and in Florida, it is a major weed problem in both terrestrial and aquatic sites. During the 1992 annual survey of public waters by the Florida Department of Environmental Protection (Schardt 1992), torpedograss ranked as the fourth most abundant plant in Florida's public lakes and rivers. In 1982, this plant was present in 6,883 ha (Schardt and Nall, 1983), but was found in 17,544 ha during the 1992 survey. This represents a 2.5-fold increase during this 10-year period despite efforts to control its growth with herbicides.

Glyphosate provides limited control of torpedograss (Baird et al. 1983a and Baird et al. 1983b). Once the top portion of the plant is killed, regrowth may occur quickly from

[3]Smith, B. E. 1995. Personal communication.

rhizomes (Shilling and Haller, 1989). The root system provides the plant with food reserves and buds for growth. Repeat applications of this herbicide are required to reduce torpedograss populations to low levels.

Information is lacking on growth of torpedograss from rhizomes. The goal of this study was to evaluate growth of torpedograss from rhizomes after being planted under flooded conditions. Information on growth rates of torpedograss will be useful in evaluating its potential to regrow from rhizomes after use of herbicides to control weed problems caused by this plant.

MATERIALS AND METHODS

Culture Conditions. Torpedograss was cultured outdoors at the University of Florida's Fort Lauderdale Research and Education Center in round plastic containers with tapering sides with no drainage holes. Dimensions of these containers were 20.5 cm in diameter at the top by 20.5 cm in height with a bottom diameter of 17 cm. Coarse builders sand was used to fill the containers to a depth of 9 cm. Sierra fertilizer (17-6-10 plus minors)[4], formulated for an 8-9 month release rate was placed on top of the sand followed by an additional layer of sand 8 cm in depth. The container was filled with water and flooded with 3.5 cm of water.

Containers for each culture period were placed on an asphalt surface in four rows under an overhead sprinkler system supplied with water from a nearby pond. Fertilizer rates were randomized within each row. Surface temperatures of the asphalt were recorded on weekdays between 3:30 and 4:00 P.M. during May 5 to August 31, 1994 and November 23, 1994 to March 15, 1995 by placing a maximum/minimum thermometer on the surface.

Torpedograss Plants. Rhizomes were selected from torpedograss maintained in stock culture under the overhead irrigation system cultured in sand with 40 g of Sierra fertilizer per 330 cm^2. Sections of rhizome material with three to four well-developed buds were selected for the initial plantings for each experimental culture period. A single section was placed in each culture container. For each culture period, four sections of rhizomes representative of those planted were selected for a determination of initial weight.

Fertilizer Treatments

Experiment A. Sierra fertilizer was added in amounts of 2.5, 5, 10, 20, 40, and 80 g to each of four containers (four replications). A total of 48 containers were used for each of four culture periods of June 15 to October 5, 1993, November 16, 1993 to March 8, 1994, May 5 to August 31, 1994, and November 23, 1994 to March 15, 1995.

Experiment B. Sierra fertilizer was added in an amount of 20 g to each of 16 containers. Four containers were used to determine plant dry weight after 4, 8, 12, and 16 weeks of growth. Culture periods for this experiment were May 23 to September 12, 1994 and November 30, 1994 to March 22, 1995.

Torpedograss Growth. Growth of torpedograss was determined by plant dry weight. Dry weight was determined by washing the plants with pond water to remove sand, fertilizer, and any other debris. Washed plants were separated into (1) a shoot portion that included the leaves and stems, and (2) a root portion that included the rhizomes and roots. The plants were then dried to a constant weight in a forced-air oven held at 60°C.

Statistical Analysis. Values for dry weight of torpedograss were statistically analyzed using General Linear Models (GLM) procedures of the Statistical Analyses System (SAS Institute Inc., Cary, NC 27511) developed for personal computers. Results are shown as bar graphs with vertical lines to show standard deviations. Values shown for dry weight are the average for plants in four culture containers. Values for dry weight within each culture period followed by the same letter are not significantly different at $P < 0.001$ according to the Waller-Duncan Bayesian procedure (Peterson, 1985).

RESULTS AND DISCUSSION

Surface temperatures of the asphalt averaged 33 ± 10 C during May 5 to August 31, 1994. A maximum of 49 C and a minimum of 17 C were recorded during this period. During November 23, 1994 to March 15, 1995, the surface temperature was 21 ± 8 C with a maximum of 38 C and a minimum of 4 C. Average temperatures for these two periods were within the formulated release rate of 21 C for the Sierra fertilizer used in this study.

Dry weight of rhizomes representative of those planted in the treatment containers averaged 0.9 ± 0.3 g. None of the rhizomes died following their removal from the stock plants and planting in the fertilizer treatments, showing the extremely high potential for survival and growth that torpedograss rhizomes exhibit.

Dry weight of torpedograss in relation to fertilizer added to the sand rooting medium resulted in similar patterns of response to fertilizer for all four culture periods (Figure 1); however, differences among some fertilizer treatments did occur. For example, the highest total dry weight was observed for plants cultured with 20 g and 40 g per container for June 15 to October 1993 and November 16, 1993 to March 8, 1994. For May 5 to August 31, 1994 and November 23, 1994 to March 15, 1995, the highest dry weight was observed for plants in the 40-g treatment.

Dry weight of torpedograss plants at the 80-g amount was lower than the 40-g treatments for all four culture periods (Figure 1) perhaps due to a high salt effect of the fertilizer at this rate. Dry weight of plants at the 80-g rate was similar to weight of plants grown with 20 g of fertilizer for all culture periods except November 16, 1993 to March 8, 1994 when the 80-g and 5-g rate produced plants with similar weight.

As expected, plant weight for the two summer periods of June 15 to October 5, 1993 and May 5 to August 31, 1994 were higher than for the winter periods of November 16, 1993 to March 8, 1994 and November 23, 1994 to March 15, 1995. The highest dry weight for all culture periods occurred at the 40-g rate during May 5 to August 31, 1994 where an

[4]Manufactured by Grace Sierra, Agricultural Products Company, 1001 Yosemite Drive, Milpitas, CA. Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product by the University of Florida and does not imply its approval to the exclusion of other products that also may be suitable.

average of 656 g of total dry weight per container was produced. Based on the initial dry weight, this represents a 728-fold increase in plant dry weight in a 16-week period. For the 40-g rate during November 16, 1993 to March 8, 1994, total plant dry weight per container averaged 200 g for a 222-fold increase in weight for this winter period.

Dry weight for the 2.5-g fertilizer treatment resulted in the least amount of dry weight for all four culture periods except May 5 to August 31, 1994 when dry weights of the 2.5- and 5-g fertilizer treatment were similar. For the 2.5-g treatment for May 5 to August 31, 1994 and November 23, 1994 to March 15, 1995, total torpedograss dry weight averaged 52 and 26 g per container, respectively.

For the summer and winter culture periods at the 40-g fertilizer rate, the root portion comprised an average of 39 ± 1% and 43 ± 1% of the total torpedograss dry weight, respectively. For the 80-g rate, the root portion comprised an average of 33 ±2% and 46 ± 1% of the total plant weight for the summer and winter periods, respectively. However, for the 2.5-g fertilizer treatment, the root portion comprised 47 ± 3% and 55 ± 5% of the total plant dry weight for the summer and winter periods, respectively.

Of the total amount, 375 g per container, of torpedograss produced during 16 weeks of culture for plants planted May 23, 1994 in the 20-g fertilizer rate, 2%, 26%, 52%, and 20%, was produced during first, second, third, and final 4 weeks of growth, respectively (Figure 2). A similar pattern was observed for plants planted November 30, 1994, where 2%, 28%, 39%, and 31% of the total plant weight were produced respectively for these same 4-week periods.

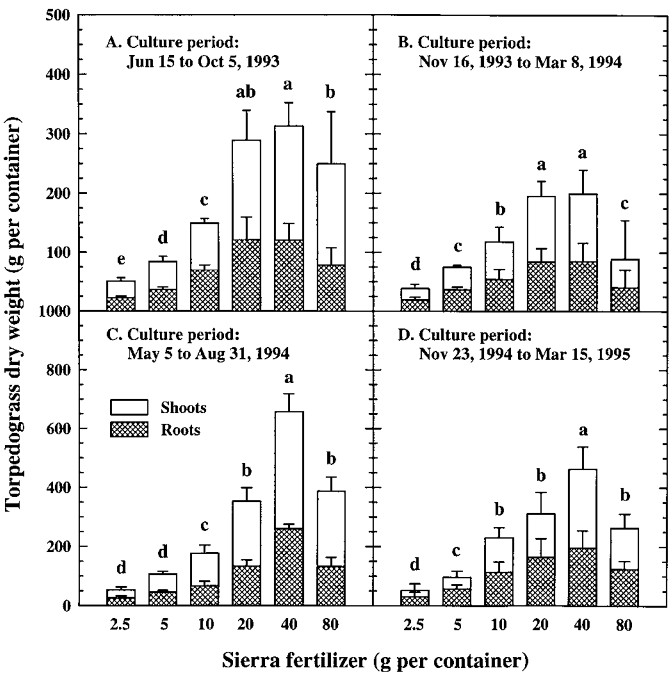

Figure 1. Dry weight of torpedograss cultured under flooded conditions with Sierra fertilizer. Each bar is the mean of four containers. Error bars are 1 standard deviation of the mean. Similar letters at the top of the bars for each date indicate no statistically significant difference for total weight at P < 0.001 according to the Waller-Duncan Bayesian procedure.

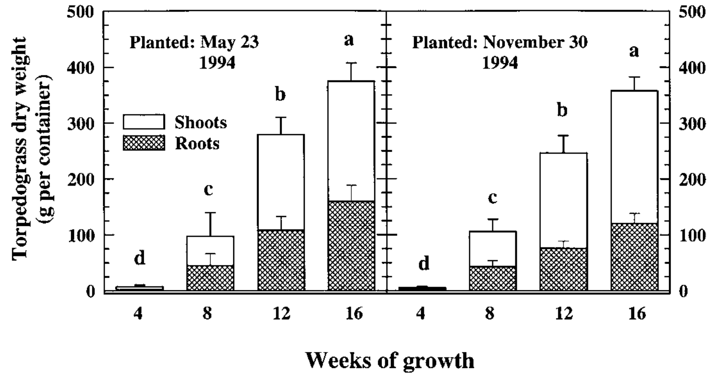

Figure 2. Dry weight of torpedograss cultured under flooded conditions with Sierra fertilizer. Each bar is the mean of four containers. Error bars are 1 standard deviation of the mean. Similar letters at the top of the bars for each date indicate no statistically significant difference for total weight at P < 0.001 according to the Waller-Duncan Bayesian procedure.

Holm et al. (1977) report that torpedograss cannot usually grow under permanently flooded conditions. However in this study in south Florida, rhizome sections became established and grew under flooded conditions with development of flowers toward the end of 16-week culture periods.

These data cannot be extrapolated to torpedograss growth on a per unit basis such as g per m^2 because the plants grew over the sides of the containers and spread outwardly. However, the fertilizer rates may be expressed on a unit basis. For example, the 40-g rate is equivalent to 1,212 g of fertilizer per m^2.

Biomass showed there was an initial lag phase of growth that lasted 4 weeks after establishment of the rhizomes. Once the rhizomes become established, growth continued at a rapid rate under both summer or winter conditions in south Florida. These data show that herbicide treatments must control all the rhizomes since a few nodes have the potential to produce a large amount of plant material in a short period of time.

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