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PHOTOPERIOD RESPONSE IN PENSACOLA BAHIAGRASS

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Abstract

Photoperiod response has been found to influence the growth and development of >Pensacola' derived bahiagrass (*Paspalum notatum* Flugge var. *saure* Parodi). Four selection cycles [>Pensacola= (Cycle 0), Cycle 4, >Tifton 9' (Cycle 9) and Cycle 23] resulting from recurrent restricted phenotypic selection (RRPS) of spaced-plants, were field grown in 1999 and 2000, to study photoperiod sensitivity among genotypes. Two day-length treatments were imposed on the field grown plants. One treatment, used only natural light. The second treatment imposed an extended day-length treatment using Quartz-halogen lamps, installed in the field during the fall and winter, to extend day-length to15 hours. The top growth of individual plants was harvested three times during the fall and winter seasons and stolon spread was measured in mid February, 2000. Top growth was increased by the extended day-length treatment for Pensacola and RRPS Cycle 4 in all three harvest dates. Top growth of Tifton 9 was unaffected by the extended light for the September harvest, but increased in the late October and late January harvests. RRPS Cycle 23 plants grown under natural light, outyielded the plants grown under extended light treatment, for the first two harvests. There were no differences in yields of RRPS Cycle 23 plants from extended or natural light from the January harvest. The later cycles, Tifton 9 and RRPS Cycle 23, were less sensitive to day-length, than RRPS Cycles 0 and 4. Extended day-length, for all cycles, dramatically reduced stolon spread by nearly half that of the plants grown under natural light. Results from this experiment demonstrate a high sensitivity in growth and development of Pensacola-derived bahiagrass to day-length.

Keywords: bahiagrass, photoperiod, day-neutral, vegetative growth

Introduction

Pensacola bahiagrass occupies more than 2.5 million hectares in Florida and the southern Gulf Coast (Burton, et al., 1996), and is the predominant pasture grass species in Florida (Chambliss, 1996). Bahiagrass growth essentially ceases during the fall and winter months, which has a negative impact on livestock production in these areas. One hypothesis explains the cessation of growth as a response to shortening day-length during the fall, which has been shown to be associated with induced dormancy in floral initiation and vegetative growth behavior in plants (Aamlid, 1992; Damann and Lyons, 1993; Ellis, et al.,1997; Marousky, et al.,1991; Wallace, et al., 1993). Understanding the genetic and physiological mechanisms underlying the photoperiod response in forages would potentially allow the manipulation of genotypes to produce fall/winter forage growth. Therefore, the purpose of this research was to study the effect of day-length on the growth of bahiagrass and to identify day-length-neutral genotypes for variety development.

Materials and Methods

Seed from four selection cycles of Pensacola bahiagrass, a sexual diploid, [Cycle 0 (Pensacola), Cycle

4, Cycle 9 (Tifton 9) and Cycle 23] were obtained from G. W. Burton=s breeding program at the Coastal Plain Experiment Station, Tifton, Georgia. One hundred and seventy-five seedlings from each of the four selection cycles of bahiagrass, were seeded on February 19, 1999 in 5 cm X 5 cm containers of sterile potting soil and placed in a greenhouse, at the North Florida Research and Education Center, Quincy, Florida (31^0 N lat.). Plants were grown at a constant temperature of 28 ^{0}C, were fertilized with 0.1 g/plant Osmocote 14-14-14 (Scotts-Sierra, Marysville, OH 43041), and watered daily. At two months of age, each plant was assigned a unique number and divided into three clones.

On June 24, 1999 a 0.5- ha field was fumigated with methy-bromide at a rate of 39.2 g m^{-2} (90% methybromide:2% chloropicrin). An array of quartz halogen lamps was erected on July 12, 1999 for the extended light treatment. The lamps were mounted on wooden poles at 2.2 m above the soil in a 9.12 m X 3.65 m grid. Beginning on August 15, 1999, the lamps were turned on by a timer each afternoon at approximately 30 mins. before sunset and remained on until the day-length had been extended to 15 h. The settings were adjusted every two weeks to maintain the day-length extension throughout the experiment at 15 h.

On July 14, 1999, 967.5 mm^2 potted plants were all cut to 10 cm in height and transplanted to the field on a Norfolk sandy loam soil (fine-loamy, siliceous, thermic Typic Paleudalt). Two clones from the original plant was split between the area with the lamps for the extended day-length treatment and an area with no lamps, which served as the normal day-length control. The clones were transplanted into each of the day-length locations in a square grid on 0.6 m centers. The third clone from the original plant was retained in the greenhouse to maintain genetic purity. Individual plant top growth was harvested on 23 Sept. and 26 Oct., 1999 and 31 Jan., 2000. Top growth was dried at 49 ^{0}C for 3 days, weighed and recorded. Stolon spread was determined on 15 Feb., 2000 by using a 45-cm^2 plastic frame, arranged with cross section squares of 9 cm^2. The amount of total squares the stolons filled, provided a quick method to measure the area of stolon spread of an individual plant. The solon spread was reported as the total cm^2 area occupied within the frame. Group means were compared using SAS GLM (1987).

Results and Discussion

The extended day-length treatment significantly increased top growth yields for Pensacola and RRPS Cycle 4 plants at all three harvest dates (Table 1). Tifton 9 yields were not influenced by the extended light treatment at the 23 Sept. harvest, but plant top growth increased by 47% in the 23 Oct. and by 30% in the 31 Jan. harvests. The RRPS Cycle 23 plants grown under natural light, yielded 11% and 9% more than the plants grown under extended light treatment, for the 23 Sept. and 26 Oct. harvest dates, respectively. There were no differences in top yields of RRPS Cycle 23 plants between the treatments in the 31 Jan. harvest. Tifton 9 and RRPS Cycle 23 were less sensitive to extended day-length treatment, than Pensacola or RRPS Cycle 4.

Stolon spread was inversely affected by the extended day-length treatment (Table 2). Extended day-length, for all cycles, dramatically reduced stolon spread by nearly half that of the plants grown under natural light. Pensacola stolon spread was reduced by 49%, RRPS Cycle 4 by 52%, Tifton 9 by 49%, and RRPS Cycle 23 by 42%.

There was a clear trend in this study that the RRPS procedure utilized by G. W. Burton, over time, selected plant types with top growth that was less sensitive to the extended light treatment. The day-length insensitivity was apparent in the top growth of Tifton 9 plants grown under natural light in the 23 Sept. harvest date and the growth of RRPS Cycle 23 plants under natural light for all three harvest dates. The reduction in stolon spread under the extended light treatment indicated that upright, rather than prostrate or lateral growth, resulted from long-days. The results from this experiment clearly demonstrated a high sensitivity in growth and development of Pensacola bahiagrass to day-length.

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Table 1 - Mean top growth yield of Pensacola-derived bahiagrass plants grown under natural light (Mn) and extended light (Me) treatments at three harvest dates, in 1999 and 2000, Quincy, Florida.

Variety/Cycle	Harvest date	Mn g plant^{-1}	Me g plant^{-1}	Mn-Me g plant^{-1}
Pensacola	23 Sept.	27.23	30.90	-3.67*
	26 Oct.	40.31	67.97	-27.66*
	31 Jan.	19.61	32.69	-13.08*
RRPS Cycle 4	23 Sept.	30.41	41.59	-11.17*
	26 Oct.	53.47	94.04	-40.52*
	31 Jan.	11.40	20.72	-9.25*
Tifton 9	23 Sept.	62.51	59.09	2.92
	26 Oct.	61.88	90.30	-29.09*
	31 Jan.	25.23	32.52	-7.60*
RRPS Cycle 23	23 Sept.	96.71	85.75	10.96*
	26 Oct.	90.25	81.93	8.32*
	31 Jan.	23.67	25.37	-1.70

*Difference significant at the .01 probability level based on two-sample t-test.

Table 2 - Means stolen spread of Pensacola-derived bahiagrass plants grown under natural light (Mn) and extended light (Me) treatments recorded on 15 Feb., 2000 at Quincy, Florida.

Variety/Cycle	Mn cm^2 $plant^{-1}$	Me cm^2 $plant^{-1}$	Mn-Me cm^2 $plant^{-1}$
Pensacola	1747	886	861*
RRPS Cycle 4	1746	832	911*
Tifton 9	1217	616	597*
RRPS Cycle 23	619	361	258*

*Difference significant at the .01 probability level based on two-sample t-test.