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Temperature Influence on Seeded Bermudagrass Germination

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ABSTRACT

Slow germination of bermudagrass (*Cynodon dactylon* [L.] Pers.) seed causes difficulty in stand establishment because of weed competition and drought. Temperature has a major influence on germination rate and total germination. Hulled and unhulled common bermudagrass seed were placed in a germinator for 28 days at night (12 hr)/day (12 hr) temperatures of 5/15, 10/20, 15/25, 20/30, 25/35, and 30/40°C. Germinated seed were recorded every two days. The best germination of hulled seed was at 20/30°C followed by 25/35°C and 15/25°C temperature treatments. Optimum germination of unhulled seed was more specific with the most rapid and total germination at 25/35°C. Temperature treatments lower than 15/25°C severely reduced germination rate and total germination of both hulled and unhulled seed. In the southeastern US, hulled bermudagrass seed should be planted from mid-April through June and unhulled seed from mid-May through June.

KEY WORDS: seeded bermudagrass, bermudagrass germination, bermudagrass establishment

INTRODUCTION

Bermudagrass is the most widely used subtropical perennial grass in the southeastern US (Burton and Hanna, 1995). It has good drought tolerance because of a deep root system, is well adapted to sandy soils, and can tolerate close continuous grazing. Most available cultivars are hybrids that must be established vegetatively (sprigged) because of very poor seed production (Taliaferro et al., 2004). There is a great deal of interest in using bermudagrasses that can be established from seed as opposed to sprigging. In addition to being less expensive and not as burdensome as sprigging, seeded bermudagrass can be used on small acreages that are not economical to sprig, on steep slopes subject to erosion if plowed, and on cut-over timberland where good seedbed preparation necessary for sprigging is not feasible. Approximately 70% of bermudagrass seed production in the United States is common bermudagrass (Tom Bodderij, personal communication). Field trials in recent years have shown that seeded bermudagrass cultivars and blends are as productive as Coastal bermudagrass, the predominant sprigged cultivar in the southeastern United States (Evers et al., 2004; Marsalis et al., 2007; Teutsch et al., 2004).

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As a forage class, warm-season perennial grasses, such as bermudagrass, are difficult to establish from seed (Masters et al., 2004). Slow germination and emergence in addition to poor seedling vigor make warm-season perennial grass seedlings vulnerable to competition from annual weeds and drought. Temperature is a major factor to consider when identifying the optimum planting date for maximum germination and rapid emergence of warm-season perennial grasses (Masters et al., 2004).

Keeley and Thullen (1989) examined planting date on common bermudagrass establishment for two years at Shafter, CA (35°47´N 119°18´W). Plugs grown in the greenhouse were transplanted monthly from March through October. Emergence began from the March plantings when the soil temperature reached 17°C at the 5 cm depth. Growth was most rapid from plugs planted from May through August when air temperature exceeded 20°C. Seed harvested from the different planting dates were germinated the following spring at night/day temperatures ranging from 10/15 to 32/38°C. Seed germination was very limited at the coldest temperature treatment but increased as the temperature treatments increased.

Bermudagrass seed can be purchased as hulled (lemma and palea removed) or unhulled (lemma and palea attached). Wheeler and Hill (1957) reported that hulled bermudagrass seed germinates more quickly than unhulled seed. There is no available information on the effect of temperature on germination rate of hulled or unhulled bermudagrass seed to determine the optimum planting date for seeded bermudagrass establishment. The International Seed Testing Association (2004) lists alternating temperatures of 20/35 or 20/30°C for seeded bermudagrass with the first count at 7 days and the final count at 21 days. Germination rate and total germination of hulled and unhulled common bermudagrass seed at various temperatures was determined to identify optimum planting time in the southeastern United States.

MATERIALS AND METHODS

Seed of hulled (Lot 14857) and unhulled (Lot 14771) common bermudagrass seed were obtained form Seeds West, Inc. (Yuma, AZ). Seed were stored at -3°C before and during the study from October 2005 to April 2007. Four replications of 100 seed, both hulled and unhulled, were treated with a light dusting of Gustafson Vitavax Captan 20-20 (5,6-dihydro-2-methyl-N-phenyl-1,4-oxathiin-3-carboxamide + N-Trichloromethylthio-4-cyclohexene-1,2-dicarboximide) seed protectant fungicide, and then were placed onto moistened blotter pads in petri dishes. The dishes were covered with lids and then enclosed in plastic food storage bags to retain moisture, and placed in a Model 818 Precision Scientific incubator (Chicago, IL).

Night/day temperature treatments were 5/15, 10/20, 15/25, 20/30, 25/35, and 30/40°C with 12-hr of light to simulate average monthly temperatures from February to July in the southeastern United States. Filtered deionized water was added as needed to keep the germination pads moist. Seed were monitored every 2 days to record germination for 28 days. A seed was counted as having germinated when both a green leaf and a radicle were visible to the naked eye. Germinated seeds were removed as they were counted. The first run of all temperature treatments occurred from October 2005 through March 2006 and a second run occurred from October 2006 through April 2007.

Germination rate index (GRI) was calculated according to Maguire (1962). Germination rate index is a method to calculate the rate of seed germination. The more rapid the germination, the higher the GRI value. The number of germinated seed counted each day is divided by the number of days since the test was started. The values obtained at each count are then summed to obtain the GRI. One hundred percent germination is not necessary for GRI.

$$\text{GRI} = \frac{\text{no. of seed germinated}}{\text{day 1}} + \ldots + \frac{\text{no. of seed germinated}}{\text{day 28}}$$

Analysis of variance (SAS, 1996) was conducted on total germination at 28 days and on GRI. Data were analyzed in a split plot design with run as the main plot and temperature treatment as the subplot for both hulled and unhulled seed with four replications. There was no significant difference between runs at the 0.05 level of significance so data were pooled across runs.

RESULTS

Total Germination. Maximum germination was 93.0% at 20/30°C for hulled seed and 77.5% at 25/35°C for unhulled seed (Table 1). Although hulled and unhulled seed were from different seed lots, this is in agreement with Wheeler and Hill (1957) who reported greater germination for hulled then unhulled bermudagrass seed. However within

Table 1. Total germination percentage at 28 days for hulled and unhulled seed of common bermudagrass at different temperatures

Temperature night/day (°C)	Hulled seed	Unhulled seed
	--------------------------germination %	------------------------
5/15	0.5 f A†	0.0 e A
10/20	27.8 e A	16.3 d B
15/25	81.5 b A	65.3 b B
20/30	93.0 a A	63.0 b B
25/35	72.0 c A	77.5 a A
30/40	48.0 d A	45.5 c A
LSD (0.05)	4.2	11.3

†Values in a column followed by the same lowercase letter are not significantly different and values in a row followed by the same uppercase letter are not significantly different at the 0.05 level, using Fisher's Protected LSD.

temperature treatments, hulled seed germination was greater than unhulled seed only at temperatures from 10/20 to 20/30°C. Total germination was high for both hulled and unhulled seed at temperature treatments ranging from 15/25° to 25/35°C. The highest temperature treatment reduced germination to 48 and 45.5% for hulled and unhulled seed, respectively. There was essentially no germination at the lowest temperature treatment of 5/15°C with limited germination at 10/20°C. Keeley and Thullen (1989) reported germination of less than 16% at their lowest temperature treatment of 10/15°C with increasing germination as temperature increased. Although they did not report if they used hulled or unhulled seed in their study, their reported seed cleaning procedure indicates the seed were unhulled.

Germination Rate Index. Except for the lowest temperature treatment, hulled seed had greater GRI values than unhulled seed at all temperature treatments (Table 2). Hulled and unhulled seed were from different seed lots but total germination was not different at the 25/35 and 30/40°C treatments (Table 1). This suggests that the lemma and palea on the unhulled seed restricted moisture absorption for germination. This is in agreement with Wheeler and Hill (1957). West and Marowsky (1989) reported that removing the lemma and palea from bahiagrass (*Paspalum notatum* Flugge) seed significantly improved germination. The most rapid germination occurred at 25/35°C for both hulled and unhulled seed. Germination rate decreased as temperature decreased. For hulled seed, the second greatest GRI was at 20/30°C followed by 30/40°C. The opposite occurred for unhulled seed with a greater GRI at 30/40°C temperature treatment than 20/30°C treatment.

Table 2. Germination rate index (GRI) of hulled and unhulled common bermudagrass seed at different temperatures

Temperature night/day (°C)	Hulled seed	Unhulled seed
	--------------------------------GRI-------------------------------	
5/15	0.02 f A†	0.00 d A
10/20	2.19 e A	1.03 d B
15/25	11.02 d A	6.69 c B
20/30	19.26 b A	7.65 c B
25/35	23.93 a A	16.26 a B
30/40	17.17 c A	9.86 b B
LSD (0.05)	1.41	1.98

†Values in a column followed by the same lower-case letter are not significantly different and values in a row followed by the same upper-case letter are not significantly different using Fisher's Protected LSD at the 0.05 level.

Germination Over 28 Days. Germination of the hulled seed was most rapid at the three warmest temperatures (Fig. 1). However, total germination decreased as the temperature increased. Seed germination was slower at 15/25°C but total germination reached 82%. Temperatures of 10/20°C delayed germination and reduced total germination.

In contrast to the hulled seed, unhulled seed was more temperature specific with the best combination of germination rate and total germination at 25/35°C (Fig. 2). The 30/40° C temperature treatment had rapid germination but with a drastic reduction in total germination. Unhulled seed at 15/25 and 20/30°C temperature treatments germinated more slowly but reached a higher maximum germination than the highest temperature treatment. The two lowest temperature treatments resulted in very low or no germination.

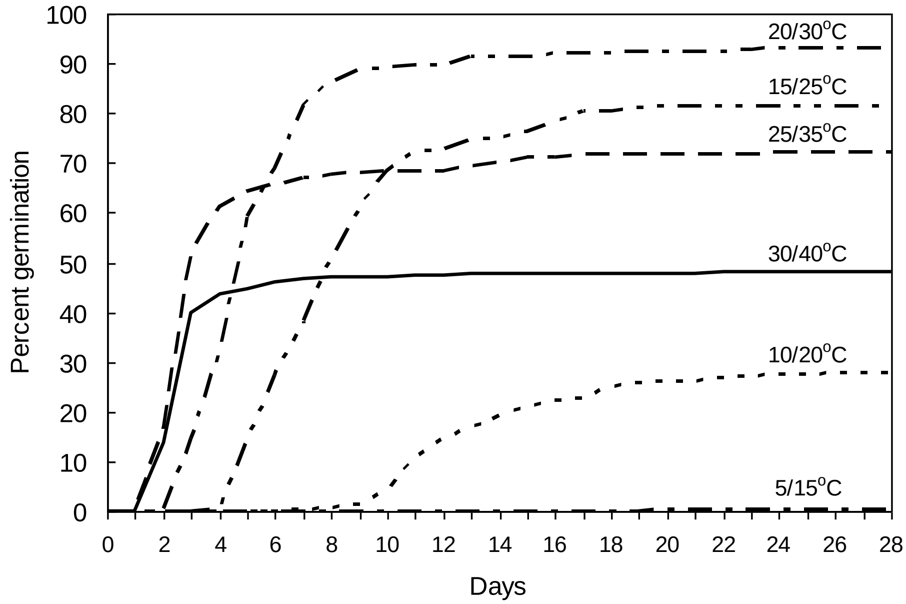

Figure 1. Germination of hulled common bermudagrass seed over 28 days at six night/day temperatures

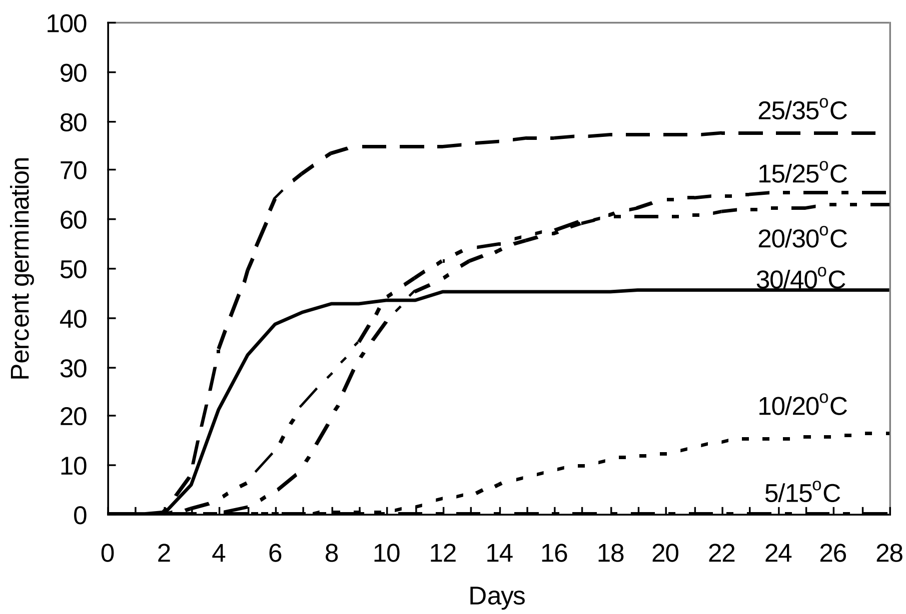

Figure 2. Germination of unhulled common bermudagrass seed over 28 days at six night/day temperatures

The best combination of rapid and total germination for hulled and unhulled bermudagrass seed occurred from 15/25 to 25/35°C. In the southeastern United States these optimum temperatures normally occur from mid-April through July. The mid-April through May time frame would be preferred because of higher probability of rainfall and cooler temperatures which reduces the risk of drought. These temperatures would also maximize bermudagrass growth according to Keeley and Thullen (1989). Germination of unhulled bermudagrass seed was more temperature specific with the best germination at 25/35°C. Therefore, unhulled bermudagrass seed should be planted at warmer temperatures from mid-May through June. Higher temperatures reduced total germination to less than 50%. Lower temperatures resulted in very slow germination, if any, and total germination of less than 30%.

The International Rules for Seed Testing (2004) does not differentiate between hulled and unhulled bermudagrass seed. Temperatures of 20/35 or 20/30°C are recommended for bermudagrass with germination counts taken at 7 and 21 days. Results from this study support the 20/30°C temperature for hulled seed but not unhulled seed. Although 20/35°C was not used in this study, the 25/35°C temperature treatment was optimum for unhulled seed.

Because bermudagrass seed is so small, it is best to broadcast the seed on the soil surface of a prepared seedbed and rolled with a packer to press the seed into the soil surface. This avoids placing the seed too deep and reducing seedling emergence. Summer planting should be avoided because the soil surface temperature will exceed the air temperature in the afternoons and result in lower germination rates according to this study. A disadvantage of a shallow planting depth is the rapid drying of the surface of sandy soils after rainfall which could lead to loss of germinated seed due to lack of soil moisture. Planting a mixture of hulled and unhulled seed may enhance the establishment of a seeded bermudagrass stand.

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