Nitrogen and Sprigging Rate Effects on 'Latitude 36' Hybrid Bermudagrass Establishment

Gregg C. Munshaw^{1,5}, Jeffery S. Beasley², Christian M. Baldwin³, Justin Q. Moss⁴, Kenneth L. Cropper¹, H. Wayne Philley³, Chrissie A. Segars⁴, and Barry R. Stewart³

ADDITIONAL INDEX WORDS. *Cynodon dactylon* × *Cynodon transvaalensis*, propagation, turf cover

SUMMARY. Hybrid bermudagrass [*Cynodon dactylon* × *Cynodon transvaalensis*] is frequently used throughout the southern and transitional climatic zones of the United States. These grasses can only be vegetatively propagated, such as by sprigging. Turf managers will often apply high rates of sprigs and nitrogen (N) in an attempt to minimize the time to establishment. However, little is known about how planting and N rates affect establishment. The objective of this study was to determine optimum sprigging and N rates during the establishment of 'Latitude 36' hybrid bermudagrass to minimize time to full surface cover. The study was conducted in four locations across the southern United States during Summer 2015. Sprigging rates consisted of 200, 400, 600, and 800 U.S. bushels/acre (9.3 gal/bushel), and N rates were 0, 11, 22, and 44 lb/acre N per week. Results showed that as the N rate increased, percent cover generally increased but only slightly [7% difference between high and low rates 5 weeks after planting (WAP)]. The effect of sprig rate on percent cover indicated that as rate increased, cover also increased. Differences in establishment due to sprig rate were present until 6 WAP at which time all plots achieved 100% cover. The greatest difference between N and sprig rate was that sprig rate showed differences in percent cover immediately, whereas N rate differences were not apparent until 2 WAP. Increasing sprig rather than N rate should be considered to speed up establishment.

Bermudagrass (*Cynodon* sp.) is widely grown throughout the southern United States for recreational and aesthetic purposes. Bermudagrass provides a heat- and drought-tolerant turfgrass that exhibits vigorous growth and good wear tolerance. Bermudagrass is also a popular selection for athletic fields and golf courses because of the speed in which it establishes and recuperates (McCarty and Miller, 2002). Turf managers are often faced with

the need to establish turfgrass rapidly to keep athletic surfaces in play and maximize their use.

Establishment of bermudagrass from sprigs on large acreage sites provides an economical propagation method compared with sod. Although much research has focused on bermudagrass seeding rates for establishment (Munshaw et al., 2001; Patton et al., 2004), very little information is available concerning optimum sprigging rates for bermudagrass. Noer (1965) recommended a minimum rate of 100 U.S. bushels (bu)/acre and reported excellent cover in 3 weeks. Johnson (1973) sprigged 'Tifway' hybrid bermudagrass at a low, medium, and high rate (870, 1740, and 3480 ft³/acre) and found quicker cover with higher

sprigging rates. Duple (1989) recommended rates of 218 to 653 bu/acre to reach full cover within 10 to 12 weeks after sprigging. For quicker establishment, he recommended sprigging rates up to 1089 bu/acre. The lower rates recommended by Duple (1989) are common recommendations for several extension publications (Han and Huckabay, 2008; Relf, 2009; Samples and Sorochan, 2007). The common logic across many of these publications is that higher sprigging rates result in faster establishment than lower rates (Brede, 2000; Duple, 1989).

The effect of N on bermudagrass establishment has been well documented; however, there appear to be large discrepancies in recommended N rates for establishing vegetative cultivars. Recommended N rates from previous establishment studies on 'Tifway' hybrid bermudagrass range from 44 lb/acre per month (Dudeck et al., 1985; Johnson, 1973) to 271 lb/acre per month (Guertal and Hicks, 2009). However, a study looking at establishment of 'Tifway' and 'Latitude 36' hybrid bermudagrass showed that high N rates (175 lb/acre N per month) were only beneficial shortly after planting, and lower N rates were equally effective for establishment as the study progressed (Munshaw and Woosley, 2014). Although discrepancies in N recommendations during bermudagrass establishment exist, most agree that at least some N is required to improve establishment.

Because very little scientific based information exists on newer cultivars regarding optimum sprigging and N rates during bermudagrass establishment, a study was conducted to examine these factors across four locations in the United States for the new cultivar Latitude 36. Therefore, the objective of this study was to characterize the effect of the combination of sprigging and N rates on bermudagrass establishment in the

The authors thank David Blouin, Department of Experimental Statistics, Louisiana State University, for his assistance with experimental design and statistical analysis.

¹Department of Plant and Soil Sciences, University of Kentucky, 313 Plant Science Building, Lexington, KY 40546

²LSU Ag Center, Louisiana State University, 137 J.C. Miller Hall, Baton Rouge, LA 70803

³Department of Plant and Soil Sciences, Mississippi State University, P.O. Box 9555, Mississippi State, MS 39762

⁴Horticulture and Landscape Architecture Department, Oklahoma State University, 336 Agricultural Hall, Stillwater, OK 74078

⁵Corresponding author. E-mail: gcmunshaw@uky.edu.

doi: 10.21273/HORTTECH03628-16

Units

To convert U.S. to SI, multiply by	U.S. unit	SI unit	To convert SI to U.S., multiply by
0.4047	acre(s)	ha	2.4711
0.3048	ft	m	3.2808
3.7854	gal	L	0.2642
2.54	inch(es)	cm	0.3937
1.1209	lb/acre	kg·ha ⁻¹	0.8922

areas throughout the southern and transitional climatic zones of the United States.

Materials and methods

SITE DESCRIPTIONS AND DATA COLLECTED. The experiment was conducted in Summer 2015 at university research facilities in Baton Rouge, LA; Starkville, MS; Stillwater, OK; and Lexington, KY [U.S. Department of Agriculture (USDA) hardiness zones 9A, 8A, 7A, and 6B, respectively]. The soil at the Burden Center (Louisiana State University) was an Olivier silt loam [fine-silty, mixed, thermic, Typic Fragiudalf; pH: 7.3; 88 lb/acre phosphorus (P); 473 lb/acre potassium (K)]. The soil at the R.R. Foil Research Center (Mississippi State University) was a Marietta fine sandy loam (fine-loamy, siliceous, Fluvaquentic Eutrochrept; pH: 5.7; 329 lb/acre P; 341 lb/acre K). The soil at the OSU Turfgrass Research Center (Oklahoma State University) was a Norge loam (fine-silty, mixed, active, thermic Udic Paleustolls; pH: 7.2; 144 lb/acre P; 263 lb/acre K). The site was modified in 2009, and U.S. Golf Association (USGA) specification sand (U.S. Golf Association, 2004) was added and mixed to the top 20 cm of the soil profile. A soil sample was collected on 15 July 2015, and the soil texture was classified as a sandy loam according to the USDA soil textural triangle (U.S. Department of Agriculture, 2016) and consisted of 72.5% sand, 13.8% silt, and 13.8% clay. The soil at the A.J. Powell, Jr. Turfgrass Research Center (University of Kentucky) was a Maury silt loam (fine, mixed, mesic, typic Paleudalf; pH: 5.2; 448 lb/acre P; 318 lb/acre K). ‘Latitude 36’ hybrid bermudagrass sprigs for all locations were donated by Winstead Turf Farms, Arlington, TN.

Plots were established during the second week of July at all locations with the exception of Louisiana, where the study was established during the third week of July. Whole plots measured 12 × 10 ft. Granular fertilizer was applied at planting at rates of 0, 11, 22, and 44 lb/acre N with 13N–5.7P–10.8K, and then weekly at the same rates using urea (46N–0P–0K) until plots were established (≈90% groundcover measured by digital

image analysis). Bermudagrass was hand-sprigged at rates of 200, 400, 600, and 800 bu/acre to cover the spectrum between low, high, and commonly recommended sprigging rates (Han and Huckabay, 2008; Relf, 2009; Samples and Sorochan, 2007). Plots were rolled after sprigging to increase sprig to soil contact, and oxadiazon (Ronstar G; Bayer Crop Science, Research Triangle Park, NC) was applied over the sprigs at a rate of 150 lb/acre. ‘Latitude 36’ was chosen for this study because of it being a new, yet highly used cultivar that exhibits excellent turf-quality characteristics, as well as its suitability to be grown at all locations of this study (Morris, 2013). Photos were taken weekly with a light box and digitally analyzed with SigmaScan Pro (Systat Software, San Jose, CA) using methods described by Richardson et al. (2001) to objectively measure plot cover. Plots were mowed twice per week with a rotary mower set at 2 inches with clippings returned. Irrigation was supplied as needed to prevent wilt. No pesticide applications were performed during the experimental period.

STATISTICAL ANALYSIS. The experimental design was a split-plot with four replications nested at each location. The fixed effects of sprig and N rates were the main plots and subplots, respectively. The dependent variable bermudagrass coverage was recorded weekly (Blouin et al., 2011). Rather than looking for differences across locations, the statistical design was selected to find general trends in bermudagrass establishment requirements across the southern region of the United States during suitable environmental conditions for establishing bermudagrass. Statistical analysis of bermudagrass coverage data

was performed using the mixed procedure in SAS (version 9.4; SAS Institute, Cary, NC) with weekly bermudagrass coverage analyzed over time using repeated measures analysis. Means for the dependent variable bermudagrass coverage were separated according to Fisher’s least significant difference (LSD) at $P \leq 0.05$ when the fixed effects of sprig rate, N rate, or week were significant at $P \leq 0.05$.

Results and discussion

THE INFLUENCE OF NITROGEN ON ESTABLISHMENT RATE. The single effects of sprig rate, nitrogen rate, and week as well as the interactions of N rate by week and sprig rate by week were all significant ($\alpha = 0.05$) with regard to turfgrass coverage (Table 1). In general, as N rate increased from 0 to 44 lb/acre, bermudagrass coverage increased concurrently over the establishment period (Table 2). Interestingly, all N rates resulted in ≈90% coverage within 4 WAP indicating the aggressiveness of ‘Latitude 36’ compared with ‘TifSport’ and ‘Tifway’ hybrid bermudagrass that typically take 5 to 7 weeks to achieve full coverage (Guertal and Hicks, 2009). Although N rate was statistically significant at almost every observation date, differences were slight (i.e., <4% difference in plot cover between high and low N rates at 4 WAP) and likely not relevant for the practitioner. In a similar work examining the effect of N and sprigging rates, Guertal and Evans (2006) also reported that increasing N rates up to 33 lb/acre N improved the establishment of ‘TifEagle’ hybrid bermudagrass. It has also been reported that shoot density of ‘TifSport’ and ‘Tifway’ hybrid bermudagrass increased as N rates increased up to 68 lb/acre N (Guertal and Hicks, 2009). However,

Table 1. Type 3 fixed effects for ‘Latitude 36’ hybrid bermudagrass cover affected by sprig and nitrogen (N) rates and time (weeks) at four locations in 2015.

Effect	Numerator df	Denominator df	F value	P > F
Sprig rate	3	43.9	54.32	<0.0001
N rate	3	177	23.21	<0.0001
Sprig × N	9	177	0.51	0.8660
Week	5	1,076	1,684.56	<0.0001
Sprig × week	15	1,088	12.16	<0.0001
N × week	15	1,102	1.99	0.0134
Sprig × N × week	45	1,102	0.35	1.0000

Table 2. Effect of nitrogen (N) rate on 'Latitude 36' hybrid bermudagrass cover across four sprigging rates over a 6-week observation period at four locations during Summer 2015.

N rate (lb/acre per week) ^z	Weeks after planting					
	1	2	3	4	5	6
	Turfgrass cover (%)					
0	31.7 M ^y	54.1 L	71.3 I	86.9 F	93.1 DE	97.0 CD
11	31.6 M	57.0 KL	77.6 H	90.7 E	98.7 BC	100 AB
22	30.3 M	58.1 JK	79.5 GH	91.8 E	99.6 ABC	100 A
44	30.3 M	60.7 J	81.6 G	94.0 DE	100 AB	100 A

^z1 lb/acre = 1.1209 kg·ha⁻¹.^yValues followed by the same letter are not significantly different via Fisher's least significant difference at $P \leq 0.05$.**Table 3.** Effect of sprigging rate on 'Latitude 36' hybrid bermudagrass cover across four nitrogen rates over a 6-week period at four locations during Summer 2015.

Sprig rate (lb/acre) ^z	Weeks after planting					
	1	2	3	4	5	6
	Turfgrass cover (%)					
200	19.9 O ^y	40.1 L	63.6 DJ	82.6 G	94.1 CDE	100 A
400	27.8 N	56.5 K	77.1 H	91.3 E	98.7 ABC	100 A
600	34.4 M	63.4 J	82.2 G	94.1 DE	99.5 AB	100 A
800	41.8 L	69.9 I	86.9 F	95.4 BCD	100 A	100 A

^z1 lb/acre = 1.1209 kg·ha⁻¹.^yValues followed by the same letter are not significantly different via Fisher's least significant difference at $P \leq 0.05$.

they found that increased shoot density did not result in an overall increase in percent cover.

In the current study, the results align with N rates reported by Johnson [1973 (44 lb/acre N per month)] rather than those of Guertal and Hicks (2009) [(271 lb/acre N per month)] when evaluating bermudagrass propagation by sprigs. Because all but the lowest N rate reached $\geq 90\%$ coverage within 4 WAP, the use of additional N may not be warranted, especially if mitigation of potential offsite N pollution is a concern. Reduction in N rates from 44 to 11 or 22 lb/acre is supported from an economical and environmental standpoint, but also when considering that unfertilized plots exhibited improvements in coverage at each observation date with $\geq 90\%$ coverage 5 WAP, the benefits of high N rates are questionable.

SPRIG RATE AFFECTS ESTABLISHMENT RATE. The more important factor to accelerate bermudagrass establishment appears to be sprig rate (Table 3). The effect of sprig rate on turfgrass cover showed that increasing rates not only resulted in higher initial coverages but also maintained higher coverages until all sprig rates resulted in full coverage 6 WAP. For example, sprigs planted at the lowest rate of

200 bu/acre had initial coverage of 19.9% and achieved $>90\%$ cover 5 WAP compared with the highest sprig rate of 800 bu/acre which had 41.8% initial coverage and 95.4% cover within 4 WAP. This increase in bermudagrass coverage may be attributed to increased plant survival after planting, the possibility of a mulching effect retaining moisture in the soil, and a greater interception and use of applied N. However, as is the case with N, excessive sprigging rates do not necessarily provide proportional benefits. For example, sprigging rates of 400 and 600 bu/acre resulted in coverages of 91.3% and 94.1%, respectively, at 4 WAP compared with the highest sprig rate of 800 bu/acre at 95.4% cover. The influence of sprig rate on bermudagrass establishment may be more pronounced for slower-growing bermudagrass cultivars.

Turf managers are commonly under pressure to establish turfgrass surfaces as quickly as possible. Decreasing the duration of establishment not only shortens the period turfed areas cannot be used but can also potentially reduce offsite sediment loading and P losses (Mostaghimi et al., 1994). Therefore, if the goal of a turf manager is to accelerate bermudagrass coverage, on finely

textured soils, it is recommended for them to increase sprig rate and apply 11 to 22 lb/acre N per week until established. However, increasing sprigging rate over 600 bu/acre results in only slight increases in cover during the establishment period and does not reduce time to full cover. As long as temperatures are suitable for bermudagrass growth and finer textured soils are used, results should be similar to those found in this study, regardless of location.

Literature cited

- Blouin, D.C., E.P. Webster, and J.A. Bond. 2011. On the analysis of combined experiments. *Weed Technol.* 25:165–169.
- Brede, D. 2000. *Turfgrass maintenance reduction handbook: Sports, lawns, and golf.* Ann Arbor Press, Chelsea, MI.
- Duble, R.L. 1989. *Southern turfgrasses: Their management and use.* TexScape, College Station, TX.
- Dudeck, A.E., C.H. Peacock, and T.E. Freeman. 1985. Response of selected bermudagrasses to nitrogen fertilization. *Intl. Turf. Res. J.* 5:495–504.
- Guertal, E.A. and D.L. Evans. 2006. Nitrogen and mowing height effects on Tifeagle bermudagrass establishment. *Crop Sci.* 46:1772–1778.
- Guertal, E.A. and C.A. Hicks. 2009. Nitrogen source and rate effects the establishment of 'TifSport' and 'Tifway' hybrid bermudagrass. *Crop Sci.* 49:690–695.
- Han, D.Y. and E. Huckabay. 2008. *Bermudagrass lawns.* Alabama Coop. Ext. System ANR-29.
- Johnson, B.J. 1973. Herbicides, sprigging rates, and nitrogen treatments for establishment of Tifway bermudagrass. *Agron. J.* 65:969–972.
- McCarty, L.B. and G.L. Miller. 2002. *Managing bermudagrass turf.* Ann Arbor Press, Chelsea, MI.

- Morris, K. 2013. 2007 National bermudagrass test. Final report No. 13-10. 2 Feb. 2017. <http://www.ntep.org/data/bg07/bg07_13-10f/bg07_13-10f.pdf>.
- Mostaghimi, S., T.M. Gidley, T.A. Dillaha, and R.A. Cooke. 1994. Effectiveness of different approaches for controlling sediment and nutrient losses from eroded land. *J. Soil Water Conserv.* 49:615–620.
- Munshaw, G.C., D.W. Williams, and P.L. Cornelius. 2001. Management strategies during the establishment year enhance production and fitness of seeded bermudagrass stolons. *Crop Sci.* 41:1558–1564.
- Munshaw, G.C. and P.B. Woosley. 2014. Evaluation of seeding/sprigging, nitrogen, and traffic rates on late established hybrid bermudagrass in the transition zone. *Agron. Abstr.* 87858.
- Noer, O.J. 1965. Restoring life to winter-killed bermuda turf: Quick cover is obtained by sprigging, although some supts. prefer to use hulled seed that is pre-germinated. *Golfdom Business J. Golf* 39 (7):30–32.
- Patton, A.J., G.A. Hardebeck, D.W. Williams, and Z.J. Reicher. 2004. Establishment of bermudagrass and zoysiagrass from seed. *Crop Sci.* 44:2160–2167.
- Relf, D. 2009. Establishing lawns. *Virginia Coop. Ext. Publ.* 426–718.
- Richardson, M.D., D.E. Karcher, and L.C. Purcell. 2001. Quantifying turfgrass cover using digital image analysis. *Crop Sci.* 41:1884–1888.
- Samples, T. and J. Soroachan. 2007. Turfgrass establishment: Sprigging. *Univ. Tennessee Ext. Serv. Publ.* W160-D.
- U.S. Department of Agriculture. 2016. Soil texture triangle. 2 Feb. 2017. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_054167>.
- U.S. Golf Association. 2004. USGA recommendations for a method of putting green construction. U.S. Golf Assn., Far Hills, NJ.