2002

Nitrogen Phosphorus, and Potassium Effects on Seeded Buffalograss Establishment

Kevin Frank
University of Nebraska-Lincoln

Roch E. Gaussoin
University of Nebraska-Lincoln, rgaussoin1@unl.edu

Jack Fry
Kansas State University

Michael Frost
Oklahoma State University

James Baird
Oklahoma State University

HortScience 37(2):371–373. 2002.

Nitrogen, Phosphorus, and Potassium Effects on Seeded Buffalograss Establishment

Kevin W. Frank[1] and Roch E. Gaussoin[2]
Department of Horticulture, University of Nebraska, Lincoln, NE 68583

Jack D. Fry[3]
Department of Horticulture, Forestry and Recreation Resources, Kansas State University, Manhattan, KS 66506

Michael D. Frost[4] and James H. Baird[5]
Department of Horticulture and Landscape Architecture, Oklahoma State University, Stillwater, OK 74078

Additional index words. turfgrass, *Buchloe dactyloides*

Abstract. **Field studies were conducted in Kansas, Nebraska, and Oklahoma in 1996 to evaluate the influence of nitrogen (N), phosphorus (P), and potassium (K) applied alone or in combination on the establishment rate of buffalograss [*Buchloe dactyloides* (Nutt.) Engelm.] from seed. 'Cody' buffalograss burrs were planted at 98 kg·ha^{-1}. Nitrogen was applied at 0 or 49 kg·ha^{-1} at planting and at 49 kg·ha^{-1} weekly or every other week for 5 weeks after seeding (WAS). The total N amounts applied were 0, 49, 147, or 294 kg·ha^{-1}. Phosphorus and K were applied at rates of 0 or 49 kg·ha^{-1} at planting only. Percent buffalograss coverage ratings were taken weekly for up to 11 WAS. Buffalograss coverage was enhanced by N rates up to 147 kg·ha^{-1}. Application of P improved buffalograss establishment at the Nebraska and Oklahoma sites but had no effect at the Kansas site. Potassium application had no influence on establishment at any site. Chemical names used: methyl 2-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)-amino]carbonyl]amino] sulfonyl]benzoate (metsulfuron methyl); 6-chloro-*N,N*´-diethyl-1,3,5-triazine-2,4-diamine (simazine)**

Buffalograss [*Buchloe dactyloides* (Nutt.) Engelm.] is a warm-season, stoloniferous species that is native to the Great Plains of North America. It is desirable as a turfgrass species because of its tolerance to drought and temperature extremes. Furthermore, established buffalograss turf requires reduced inputs of mowing, fertilizer and pesticides in order to achieve optimum growth and quality compared to other turfgrass species.

Buffalograss is dioecious and can be established vegetatively or by seeding. Female plants produce burrs near the soil surface. Each burr contains one to five caryopsis (Quinn and Engel, 1986). Vegetative propagation, especially sodding, is favored when speed of establishment is the top priority. In the past, establishing buffalograss from seed has been difficult due to seed dormancy and weed interference. Currently most buffalograss seed is available as intact burrs primed with potassium nitrate (KNO_3) to improve germination.

Given that buffalograss provides a low input turf, it would be desirable to combine a low cost method of establishment with the low cost of maintenance. Recent research has investigated date of planting effects (Frank et al., 1998; Fry et al., 1993), and herbicides (Dotray and McKenney, 1996; Fry et al., 1997; Fry and Upham, 1994) on buffalograss establishment. In Kansas, buffalograss burrs planted in April or May at 49 kg·ha^{-1} required 12 to 13 weeks to reach 95% coverage (Fry et al., 1993). Without using herbicides, buffalograss cover from seed at Nebraska and Utah sites was <35% after one season (Frank et al., 1998). For both studies, a single nitrogen application of 49 kg·ha^{-1} was applied at planting (Frank et al., 1998; Fry et al., 1993). Despite the fact that herbicides are available, cost and use restrictions often limit the use of herbicides during establishment. Research to determine optimum fertility inputs for establishment of buffalograss from seed is lacking. Fertility applications have the potential to reduce the time to establishment without incurring significant cost.

The objective of this research was to determine the effects of N, P, and K on seeded buffalograss establishment at three sites.

Materials and Methods

In 1996, identical experiments were conducted in Kansas, Nebraska, and Oklahoma. The Kansas experiment was conducted at the Rocky Ford Turfgrass Research Center in Manhattan. Soil was a Chase silt loam (Fine, montmorrillonitic, mesic, Aquic Argiudoll) (20% sand, 54% silt, 26% clay). The Nebraska experiment was conducted at the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead. Soil was a Tomek silty clay loam (Fine, montmorillonitic, mesic Typic Argiudoll) (7% sand, 63% silt, 30% clay). The Oklahoma experiment was conducted at the Turfgrass Research Center in Stillwater. Soil was a Kirkland silt loam (Fine, mixed, thermic Udertic Paleustolls) modified with sand topdressing from previous studies (53% sand, 30% silt, 17% clay). Soil was tested for acidity, organic matter, N, P, and K prior to initiation of the experiments (Table 1).

'Cody' buffalograss burrs were obtained from the same seed lot (Johnston Seed Co., Enid, Okla.), seeded at 98 kg burrs/ha, and lightly raked 2.5-cm deep into the soil surface. The herbicide simazine was applied to the seedbed at 1.12 kg·ha^{-1} for preemergence weed control. About 6 to 12 mm of water was applied following N applications and the seedbed was kept moist throughout the first several weeks of establishment. Planting dates for the Kansas, Nebraska, and Oklahoma experiments were 14 June, 1 July, and 14 June, respectively. In Kansas, metsulfuron methyl was applied on 8 July at 0.4 kg·ha^{-1} to control broadleaf weeds.

Nitrogen was applied at 49 kg·ha^{-1} from urea (46% N) using the following regimes: 0 N; 49 kg·ha^{-1} at planting only; 49 kg·ha^{-1} at planting and 49 kg·ha^{-1} once weekly thereafter for 5 weeks; and 49 kg·ha^{-1} at planting and 49 kg·ha^{-1} every two weeks thereafter for 5 weeks. Total N applied was 0, 49, 147, or 294 kg·ha^{-1}. Phosphorus treatments included P at 0 and 49 kg·ha^{-1} at planting from triple superphosphate (20% P). Potassium treatments included K at 0 and 49 kg·ha^{-1} at

Table 1. Soil test results prior to initiation of buffalograss fertility experiments in Kansas, Nebraska, and Oklahoma.

Location	pH	Organic matter	NH_4^+-N	NO_3^--N	P[z]	K
		(%)	(μg·g^{-1})			
Kansas	6.8	2.7	3.2	18.0	50.0	471
Nebraska	6.3	2.2	12.8	18.7	20.2	443
Oklahoma	6.8	1.1	4.1	16.0	56.2	283

[z]Bray P_1 extractable P.

Received for publication 18 Dec. 2000. Accepted for publication 4 June 2001. Kansas Agr. Exp. Stn. Pub. 01-233-J. Oklahoma Agr. Exp. Stn. Project 2264. We thank Johnston Seed Co., Enid, Okla, for providing seed.
[1]Former Graduate Assistant. Current address: Dept. of Crop and Soil Sciences, Michigan State Univ., East Lansing, MI 48824.
[2]Associate Professor.
[3]Professor.
[4]Former Graduate Assistant. Current address: 2000 Montego Ave. #32, Escondido, CA 92026.
[5]Former Assistant Professor. Current address: U.S. Golf Association, P.O. Box 4717, Easton, PA 18043.

planting from muriate of potash (50% K) in Oklahoma or sulfate of potash (42% K) in Kansas and Nebraska.

Respective mean maximum and minimum air temperatures, and total precipitation for each site over the study periods were: Kansas, 31 °C, 20 °C, 129 mm; Nebraska, 27 °C, 16 °C, 133 mm; and Oklahoma, 35 °C, 22 °C, 76 mm. Visual estimates of buffalograss cover were made weekly on a 0% to 100% scale for a period of 8–11 weeks after seeding (WAS). The experimental design at each site was a randomized complete-block design with three replications. The N, P, and K treatments were arranged in a 4 × 2 × 2 factorial. Arcsin transformation was performed on percent coverage data prior to analysis of variance procedures. Analysis of variance (ANOVA) was performed on transformed data using statistical analysis aystems (SAS Institute, Cary, N.C.) and the general linear model (GLM) procedure. When effects were significant at $P \leq 0.05$, treatment means were separated using Fisher's least significant difference (LSD) test (SAS Institute, 1982).

Results and Discussion

The ANOVA indicated significant site differences for percent buffalograss coverage. Therefore, data were analyzed separately by site.

At the Kansas site, there were significant N rate effects from 6 to 8 weeks after seeding (WAS) (Table 2). By 7 WAS, the 147 and 294 kg·ha⁻¹ N rates had the highest percent buffalograss coverage (Table 3). There was no difference in percent buffalograss coverage between the 147 and 294 kg·ha⁻¹ N rates throughout the study. There was no difference in percent buffalograss coverage between the untreated control and the 49 kg·ha⁻¹ N rate. There were no significant effects of the P and K treatments at the Kansas site. The lack of P or K response observed was likely due to the adequate pre-planting soil levels. Zoysiagrass planted as vegetative plugs exhibited a similar lack of response to P and K when soil levels of each tested moderate to high in Maryland (Fry and Dernoeden, 1987).

Similar to the Kansas site, at the Oklahoma site there were significant N rate effects on percent buffalograss coverage throughout the study (Table 4). At 8 WAS, the 49 and 147 kg·ha⁻¹ N rates had the highest percent coverage, 36% and 44%, respectively (Table 5). The 294 kg·ha⁻¹ N rate consistently had the lowest percent coverage throughout the study. Weekly N applications of 49 kg·ha⁻¹ were also less effective in encouraging spread of vegetatively plugged 'Meyer' zoysiagrass compared to biweekly treatments (Fry and Dernoeden, 1987). From 7 to 11 WAS, there were no differences in percent coverage between the untreated control and the 294 kg·ha⁻¹ N rate. The highest percent buffalograss coverage at the Oklahoma site at 11 WAS was 61% (Table 5). This was substantially lower than the percent coverage achieved at the other sites and was likely due to weed interference from African bermudagrass (*Cynodon transvaalensis* Burtt-Davy) despite frequent attempts to manually remove this species from the plots.

Significant differences in percent coverage were present between P rates at 9, 10, and 11 WAS (Tables 4 and 6). Although pre-plant soil P levels at the Oklahoma and Kansas sites were similar, it is possible that competition for P from African bermudagrass at the Oklahoma site resulted in a positive P effect on buffalograss establishment.

At the Nebraska site, there was a significant P rate effect from 4 to 8 and at 10 WAS (Table 7). Application of P at planting increased buffalograss coverage during establishment compared to the untreated control (Table 8). At 8 WAS, the untreated control and the 49 kg·ha⁻¹ P rate had 35% and 43% coverage, respectively. By 10 WAS, percent coverage was 58% and 68% for the untreated con-

Table 2. Analysis of variance table for transformed percent buffalograss coverage data at the Kansas site.

		Weeks after seeding					
Source	df	3	4	5	6	7	8
		Pr > F					
Rep.	2						
N[z]	3	NS	NS	NS	**	**	**
P[y]	1	NS	NS	NS	NS	NS	NS
N × P	3	NS	NS	NS	NS	NS	NS
K[x]	1	NS	NS	NS	NS	NS	NS
N × K	3	NS	NS	NS	NS	NS	NS
P × K	1	NS	NS	NS	NS	NS	NS
N × P × K	3	NS	NS	NS	NS	NS	NS
Error	32						

[z]Nitrogen.
[y]Phosphorus.
[x]Potassium.
NS, *, **Nonsignificant or significant at $P = 0.05$, and $P = 0.01$, respectively.

Table 3. Effect of nitrogen (N) rate on percent buffalograss coverage at the Kansas site.

	Weeks after seeding					
N rate[z]	3	4	5	6	7	8
0	11	11	16	37 b[y]	51 b	73 b
49	14	13	19	43 ab	57 b	79 b
147	11	12	20	50 a	67 a	88 a
294	11	12	19	50 a	67 a	87 a

[z]N rate units are kg·ha⁻¹
[y]Means in columns for N rates followed by the same letter are not significantly different according to Fisher's LSD at the 5% level.

Table 4. Analysis of variance table for transformed percent buffalograss coverage data at the Oklahoma site.

		Weeks after seeding								
Source	df	3	4	5	6	7	8	9	10	11
		P > F								
Rep.	2									
N[z]	3	**	*	NS	NS	*	**	**	**	**
P[y]	1	NS	NS	NS	NS	NS	NS	*	*	*
N × P	3	NS	NS	NS	NS	NS	NS	NS	NS	NS
K[x]	1	NS	NS	NS	NS	NS	NS	NS	NS	NS
N × K	3	NS	NS	NS	NS	NS	NS	NS	NS	NS
P × K	1	NS	NS	NS	NS	NS	NS	NS	NS	NS
N × P × K	3	NS	NS	NS	NS	NS	NS	NS	NS	NS
Error	32									

[z]Nitrogen.
[y]Phosphorus.
[x]Potassium.
NS, *, **Nonsignificant at $P = 0.05$ or significant at $P = 0.05$, and 0.01, respectively.

Table 5. Effect of nitrogen (N) rate on percent buffalograss coverage at the Oklahoma site.

	Weeks after seeding								
N rate[z]	3	4	5	6	7	8	9	10	11
0	2 a[y]	13 ab	13	20	23 ab	31 bc	41 b	45b	48 b
49	2 a	14 a	15	19	23 ab	36 ab	49 ab	53a	55 ab
147	2 a	16 a	17	23	28 a	44 a	56 a	59 a	61 a
294	1 b	10 b	12	18	20 b	27 c	41 b	45b	48 b

[z]N rate units are kg·ha⁻¹.
[y]Means in columns for N rates followed by the same letter are not significantly different according to Fisher's LSD at the 5% level.

Table 6. Effect of phosphorus (P) rate on percent buffalograss coverage at the Oklahoma site

	Weeks after seeding		
P rate[z]	9	10	11
0	44 b[y]	47 b	50 b
49	51 a	54 a	57 a

[z]P rate units are kg·ha^{-1}.
[y]Means in columns for P rates followed by the same letter are not significantly different according to Fisher's LSD at the 5% level.

Table 7. Analysis of variance table for transformed percent buffalograss coverage data at the Nebraska site.

		Weeks after seeding							
Source	df	3	4	5	6	7	8	9	10
		$P > F$							
Rep.	2								
N[z]	3	NS	NS	NS	NS	NS	NS	NS	NS
P[y]	1	NS	**	**	**	**	*	NS	*
N × P	3	NS	**	NS	NS	NS	NS	NS	NS
K[x]	1	NS	NS	NS	NS	NS	NS	*	NS
N × K	3	NS	NS	NS	NS	NS	NS	NS	NS
P × K	1	*	NS	NS	NS	NS	NS	NS	NS
N × P × K	3	NS	NS	NS	NS	NS	NS	NS	NS
Error	32								

[z]Nitrogen
[x]Phosphorus
[w]Potassium
NS, *, **Nonsignificant at $P = 0.05$ or significant at $P = 0.05$ and 0.01, respectively.

Table 8. Effect of Phosphorus (P) rate on percent buffalograss coverage at the Nebraska site.

	Weeks after seeding							
P rate[z]	3	4	5	6	7	8	9	10
0	4	7 b[y]	8 b	14 b	26 b	35 b	43	58 b
49	4	9 a	12 a	22 a	36 a	43 a	51	68 a

[z]P rate units are kg·ha^{-1}.
[y]Means in columns for P rates followed by the same letter are not significantly different according to Fisher's LSD at the 5% level.

trol and the 49 kg·ha^{-1} P rate, respectively. The pre-planting P level at the Nebraska site was significantly lower than at the Kansas and Oklahoma sites (Table 1). The low pre-planting P level and subsequent P effects on establishment were a greater factor in establishment than N and K rate at the Nebraska site.

Normal establishment time for seeded buffalograss is between 7 and 13 WAS (Fry et al., 1993). At the Kansas and Oklahoma sites N rate effects were significant. At the Kansas site > 70% coverage was observed for all N rates at 8 WAS (Table 3). At the Oklahoma site the highest percent coverage for all N rates was 44% and 61% at 8 and 11 WAS, respectively (Table 5). The lower percent coverage at the Oklahoma site was likely due to weed interference from African bermudagrass. At the Nebraska site P rate was significant throughout the study. The highest percent coverage when P was applied was 43% and 68% at 8 and 10 WAS, respectively (Table 8). Lower mean maximum and minimum air temperatures at the Nebraska site could have resulted in the lower percent coverage achieved when compared to the Kansas site.

Research has shown that established buffalograss requires relatively low amounts of nitrogen, 98 kg·ha^{-1}/year, to achieve high quality (Frank, 2000). Our research indicates that depending upon location, seeded buffalograss establishment can be hastened by N fertilizer applications up to 147 kg·ha^{-1}/year. Higher rates of N during establishment most likely favor competition from undesirable plant species, as observed at the Oklahoma site. Application of P improved establishment at the Nebraska and Oklahoma sites. At the Nebraska site, the response to P application was due to low pre-plant soil levels while at the Oklahoma site the response to P application may have been due to competition for P from African bermudagrass. Application of K at planting did not effect buffalograss establishment. The lack of K effect on establishment was likely due to adequate pre-planting soil levels at the three sites. Optimum fertility regimes, together with use of treated burrs and herbicides, can contribute to more successful and expeditious establishment of buffalograss from seed.

Literature Cited

Dotray, P.A. and C.B. McKenney. 1996. Established and seeded buffalograss tolerance to herbicides applied preemergence. HortScience 31:393–395.

Frank, K.W., R.E. Gaussoin, T.P. Riordan, and E.D. Miltner. 1998. Date of planting effects on seeded turf-type buffalograss. Crop Sci. 38(5):1210–1213.

Frank, K.W. 2000. Nitrogen allocation of three turfgrass species and turf-type buffalograss management. PhD Diss., Dept. of Hort., Univ. of Nebraska–Lincoln.

Fry, J.D. and P.H. Dernoeden. 1987. Growth of zoysiagrass from vegetative plugs in response to fertilizers. J. Amer. Soc. Hort. Sci. 112:286–289.

Fry, J.D., R.E. Gaussoin, D.D. Beran, and R.A. Masters. 1997. Buffalograss establishment with preemergence herbicides. HortScience 32:683–686.

Fry, J.D. and W.S. Upham. 1994. Buffalograss seedling tolerance to postemergence herbicides. HortScience 29:1156–1157.

Fry, J.D., W.S. Upham, and L. Leuthold. 1993. Seeding month and seed soaking affect buffalograss establishment. HortScience 28:902–903.

Quinn, J.A., and J.L. Engel. 1986. Life-history strategies and sex ratios for a cultivar and a wild population of *Buchloe dactyloides* (Gramineae). Amer. J. Bot. 73(6):874–881.

SAS Institute. 1982. SAS user's guide. SAS Institute, Cary, N.C.