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Nitrogen and Phosphorus Fertilizer Requirements of Tall Fescue Grown on Blackland Prairie Soils

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Summary

Dal-100 tall fescue (*Festuca arundinacea* Schreb.) was established by seeding into a prepared seedbed during the fall of 1987 at the Texas A&M University Research and Extension Center at Dallas, Texas, to determine the nitrogen (N) and phosphorus (P) fertilizer requirements for seed and forage production. Fertilizer treatments consisting of 0, 60, 120, and 180 lb N/acre at 0 or 50 lb P/acre were applied in September of 1988, 1989, and 1990. Dry matter increased with increasing N rate during each year of the study. No seed was produced in 1989, and N did not increase seed production in 1990. In 1991 the seed produced with 0 N was less than seed produced in plots having N, but seed production did not differ at 60, 120, and 180 lb N/acre. Protein content increased with increased N for each harvest, but the greatest difference in protein content was due to harvest date. No differences in dry matter production, seed production, or protein content were attributed to P treatments.

Introduction

Tall fescue is a widely used cool-season perennial grass that was introduced into the United States from Europe in the early 1800's. The region of greatest use is in the transition states between the climatic conditions of the northern states and the southern states of the eastern United States. It is also used extensively in the southern United States in a region that includes east Texas through Georgia (Burns and Chamblee 1979). Much acreage of tall fescue is used in the northern blackland prairies of Texas to supplement the warm-season perennial grasses during the late fall, winter, and spring.

Keywords: *Festuca arundinacea* / protein content / dry matter production.

Many tests have evaluated N and P fertilizer requirements of tall fescue, but none have been conducted on the Blackland Prairie soils of Texas. The general recommendation to not exceed 100 lb/acre of N is not based upon the lack of increased yield but is due to increased fescue toxicity to livestock at the higher N levels. The discovery that tall fescue toxicity was due to an endophyte (Bacon et al. 1977) and that the presence of the endophyte also affects the growth and survival of tall fescue (Read and Camp 1986) necessitated a fertility test on endophyte-free tall fescue. This study was initiated to investigate the effect of N and P on forage and seed yield and protein content of an endophyte-free tall fescue.

Materials and Methods

Dal-100 tall fescue, an endophyte-free line developed at the Texas A&M University Research and Extension Center at Dallas, was established on Houston Black clay in the fall of 1987 by broadcast-seeding at a rate of 15 lb/acre on a prepared seedbed. Experimental design was a randomized complete block with four replications and fertilizer treatments consisting of 0, 60, 120, and 180 lb N/acre with 0 or 50 lb P/acre imposed during the fall of 1988, 1989, and 1990. The plots for dry matter production and the ones for seed production were adjacent to each other. Plot size was 10 ft by 15 ft. Forage plots were harvested with a sickle-bar forage harvester at a 3-in. stubble height and were weighed. A subsample was dried at 150°F for calculating dry matter yield. All forage samples were ground to pass a 1-mm screen in a Wiley mill (Arthur A. Thomas Co., Philadelphia, PA). The samples were evaluated for N concentration by micro-Kjeldahl digestion, and N percentage was multiplied by 6.25 to convert the values to crude protein. Plots for seed production were harvested with a plot combine at seed maturity. Dry weight yields of forage and seed

and CP values were analyzed by analysis of variance and mean separation by Duncan's multiple range test using SAS.

Results and Discussion

There were no differences in dry matter production, seed production, or protein content accruing from the application of P fertilizer. From these results, a yield response to P fertilizer applied to tall fescue pastures in the northern blacklands of Texas should not be expected. The amount of P in the soil, however, should be monitored by soil testing.

Dry matter production did increase for each additional increment of N fertilizer for each year; a high of 4,657 lb/acre was produced at the 180-lb-N/acre rate during the 1990-91 growing season (Table 1). The response was linear each year and could be described with the equations Y = 2,010 + 447X, Y = 767 + 621X, and Y = 1,130 + 896X for years 1, 2, and 3. The initial assumption in establishing N rates was that yield response to N would be parabolic with a maximum at less than the 180-lb-N/acre rate because of soil moisture limitation. The linear response obtained follows the trend observed in Georgia, where dry matter continued to increase with applications of as much as 800 lb N/acre/year (Wilkinson and Mays 1979).

Protein content increased as N fertilizer rate increased at all harvest dates except 20 May 91 (Table 2). The largest differences in protein content were due to harvest date. This difference was most likely due to stage of growth of the plants at the time of harvest as well as to depletion of available N near the end of the harvest season.

Table 1. Influence of nitrogen fertilizer on dry matter production of tall fescue.

1988-89 growing season				
N rate	7 Apr 89	10 May 89	17 Jun 89	Season total
	lb/ac			
180	1855 a*	1178 a	1515 a	4548 a
120	1826 a	884 b	1257 a	3967 b
60	1677 a	907 b	838 b	3421 c
0	1148 b	726 b	699 b	2574 d
CV	16	26	23	9

1989-90 growing season			
N rate	23 Mar 90	7 May 90	Season total
	lb/ac		
180	1371 a*	2639 a	4009 a
120	1287 ab	2171 b	3458 b
60	1123 b	1770 c	2893 c
0	601 c	1102 d	1703 d
CV	20	10	10

1990-91 growing season				
N rate	1 Dec 90	5 Apr 91	10 May 91	Season total
	lb/ac			
180	791 a*	783 a	3085 a	4657 a
120	915 a	819 a	2467 b	4201 ab
60	986 a	663 a	2091 b	3740 b
0	484 a	436 b	1261 c	2182 c
CV	36	22	18	14

*Values within a column followed by the same letter are not significantly different at 0.05 level, Duncan's multiple range test.

Table 2. Influence of nitrogen fertilizer on protein content of tall fescue.

1989-89 growing season			
N rate	7 Apr 89	10 May 89	17 Jun 89
lb/ac	%		
180	24 a*	18 a	13 a
120	20 b	17 ab	12 b
60	17 b	15 bc	12 b
0	18 b	14 c	11 c
CV	18	8	6

1989-90 growing Season		
N rate	23 Mar 90	7 May 90
lb/ac	%	
180	18 a*	12 a
120	19 a	11 ab
60	16 b	11 ab
0	15 b	10 b
CV	11	15

1990-91 growing season			
N rate	1 Dec 90	5 Apr 91	20 May 91
lb/ac	%		
180	23 a*	19 a	11 ns
120	22 a	18 b	11
60	21 b	17 b	10
0	17 c	16 c	9
CV	7	7	27

*Values within a column followed by the same letter are not significantly different at 0.05 level, Duncan's multiple range test.

Seed produced in 1989 was insufficient to justify harvest. The 1990 seed production was low: production varied from 138 to 109 lb/acre. This difference was not significant at the 0.05 level (Table 3). In 1991 the amount of seed produced with no applied N was significantly lower than when N was applied, but differences in seed yields resulting from N rate were not significant. The 1991 seed yields were comparable to the 224-lb/acre average yields produced in Missouri but not to the 600-lb/acre average yields in Oregon (Youngberg and Wheaton 1979).

Table 3. Influence of nitrogen fertilizer on seed production of tall fescue.

	Year	
N rate	1990	1991
	..... lb/ac	
180	109 ns	262 a*
120	111	240 a
60	138	210 a
0	111	92 b
CV	30	42

*Values within a column followed by the same letter are not significantly different at 0.05 level, Duncan's multiple range test.

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