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Nitrogen, Phosphorus, and Potassium Fertilization for Newly Established Tall Fescue

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Abstract

Tall fescue production was studied during a third year at two locations. In 2015, Site 1 was affected by an interaction between nitrogen (N) and phosphorus (P) fertilization rates; while in 2016, Site 2 mainly received production differences by N fertilization rates. Potassium (K) fertilization caused little effect at both sites.

Third-year production of tall fescue was affected by an interaction between nitrogen (N) and phosphorus (P) fertilization rates at Site 1 in 2015, but mainly by N fertilization rates at Site 2 in 2016, with little effect from potassium (K) fertilization at either site.

Keywords

nitrogen, phosphorus, potassium, tall fescue

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Summary

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Introduction

Tall fescue is the major cool-season grass in southeastern Kansas. Perennial grass crops, as with annual row crops, rely on proper fertilization for optimum production; however, meadows and pastures are often under-fertilized and produce low quantities of low-quality forage. This is often true even when new stands are established. The objective of this study was to determine whether nitrogen (N), phosphorus (P), and potassium (K) fertilization improves yields during the early years of a stand.

Experimental Procedures

The experiment was established on two adjacent sites in fall 2012 (Site 1) and fall 2013 (Site 2) at the Parsons Unit of the Kansas State University Southeast Agricultural Research Center. The soil at both sites was a Parsons silt loam soil with initial soil test values of 5.9 pH, 2.8% organic matter, 4.2 ppm P, 70 ppm K, 3.9 ppm NH_4-N, and 37.9 ppm NO_3-N in the top 6 inches at Site 1; and 6.5 pH, 2.2% organic matter, 6.7 ppm P, 58 ppm K, 6.8 ppm NH_4-N, and 12.3 ppm NO_3-N in the top 6 inches at Site 2. The experimental design was a split-plot arrangement of a randomized complete block. The six whole plots were combinations of P_2O_5 and K_2O fertilizer levels allowing for two separate analyses: 1) applying four levels of P_2O_5 consisting of 0, 25, and 50 lb/a each year and a fourth treatment of 100 lb/a only applied at the beginning of the study; and 2) conducted a 2 × 2 factorial combination of two levels of P_2O_5 (0, 50 lb/a) and two levels of K_2O (0, 40 lb/a). Subplots were four levels of N fertilization consisting

of 0, 50, 100, and 150 lb/a. Phosphorus and K fertilizers were broadcast applied in the fall as 0-46-0 (triple superphosphate) and 0-0-60 (potassium chloride). Nitrogen was broadcast applied in late winter as 46-0-0 (urea) solid. Second-year samplings and harvests from each site were as follows. Early growth yield as an estimate of grazing potential in early spring was taken at E2 (jointing) growth stage on April 23, 2015, at Site 1 and on April 22, 2016, at Site 2 from a subarea of each plot not used for later spring and fall harvests. Spring yield was measured at R4 (half bloom) on May 19, 2015, at Site 1 and on May 13, 2016, at Site 2. Fall harvest was taken on September 29, 2015, at Site 1 and on September 21, 2016, at Site 2.

Results and Discussion

Third-year production of tall fescue (Site 1 in 2015 and Site 2 in 2016) was affected by an interaction between N and P fertilization at Site 1, but predominantly by N fertilization at Site 2, with little response to K at either site. At site 1 in 2015, early yield at the E2 (jointing) growth stage, to estimate forage available if grazed early, was increased with 50 lb N/acre without P fertilization, but higher N rates did not increase E2 yield (Table 1). However, with P fertilization, early yield at E2 increased with N rates up to 150 lb/a. At R4 hay harvest in 2015, yield was increased by N additions up to 100 lb/a with no P, but with 25 lb P_2O_5/acre yield was increased to more than 3 ton/acre with 150 lb N. Fall harvest yield was increased by N rates up to 150 lb/a with no P. However, fall yields that were obtained with higher N rates and P fertilization were lower than with no P and high N rates and the response to N was less. This potentially may be because of residual unused N due to lower R4 yields without P fertilization. Total yield ranged up to nearly 4 ton/a with P fertilization and higher N rates.

For the second year of production at Site 2 (2016), yield was mainly affected by N rate. Sampling at E2 and R4 and fall harvest yields were not affected by P fertilization and response to K fertilization was marginal. Increasing N rates tended to increase yield at the E2 sampling and R4 hay harvest, but response was less defined at the fall harvest (Table 2). Total yield averaged less than 3 ton/a, even at the 150 lb/a N rate.

Table 1. Third-year yield of newly established tall fescue in the spring and fall 2015 as affected by the interaction of P_2O_5 and N fertilization rates at Site 1

		Yield			
		Spring			Total
P_2O_5	N	E2 (jointing)	R4 (half-bloom)	Fall harvest	(R4 + Fall)
---------- lb/a ----------		---------- ton/a, 12% moisture ----------			
0	0	0.08	0.50	0.26	0.76
	50	0.49	1.49	0.38	1.87
	100	0.48	1.98	0.70	2.68
	150	0.50	1.76	1.12	2.88
25	0	0.09	0.59	0.36	0.96
	50	0.52	1.83	0.44	2.27
	100	0.81	2.80	0.55	3.35
	150	0.96	3.12	0.69	3.82
50	0	0.12	0.67	0.39	1.06
	50	0.42	1.75	0.39	2.14
	100	0.92	3.02	0.56	3.58
	150	1.25	3.13	0.68	3.81
100†	0	0.13	0.65	0.38	1.03
	50	0.55	2.17	0.55	2.71
	100	0.84	3.03	0.58	3.61
	150	1.11	3.24	0.68	3.92
$LSD_{(0.05)}$		0.04	0.31	0.17	0.35

†The 100 lb P_2O_5/a rate was only applied at the beginning of the study (Fall 2012).

Table 2. Third-year yield of newly established tall fescue in the spring and fall 2016 as affected by P_2O_5 and N fertilization rates at Site 2

	Yield			
	Spring			Total
P_2O_5	E2 (jointing)	R4 (half-bloom)	Fall harvest	(R4 + Fall)
lb/a	---------- ton/a, 12% moisture ----------			
0	0.26	1.09	0.84	1.94
25	0.23	1.02	0.79	1.81
50	0.23	1.08	0.82	1.89
100†	0.27	0.99	0.89	1.88
$LSD_{(0.05)}$	NS	NS	NS	NS
N				
0	0.06	0.16	0.84	1.00
50	0.13	0.74	0.63	1.37
100	0.34	1.41	0.81	2.22
150	0.46	1.87	1.06	2.93
$LSD_{(0.05)}$	0.20	0.09	0.13	0.15

†The 100 lb P_2O_5/a rate was only applied at the beginning of the study (Fall 2013).