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RESPONSE OF RYEGRASS TO LIMESTONE, NITROGEN, AND POTASSIUM

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Background. Production of annual ryegrass for cool-season pasture has become popular among cattlemen in East Texas. New varieties such as TAM 90, Marshall, and Surrey have made ryegrass more dependable and higher yielding than old selections such as Gulf, or common that probably descended from Gulf, or a mixture of Gulf with some other variety. Usually, response of ryegrass to fertilization has been similar to that of wheat, rye, or oats grown for forage production. The seasonal growth curve of ryegrass is different from rye and wheat, but close to oats. The objectives of this study were to determine more precisely the optimum fertility requirements of annual ryegrass for lime (pH), potassium (K), and nitrogen (N).

This experiment was established on a Bowie loamy fine sand that had been treated with elemental sulfur in the winter of 1989 to acidify the soil. In mid-spring, we established the experimental area in a central-composite, rotatable design to evaluate limestone, N, and K variables at 5 rates each. Limestone (ECCE 62%) rates applied to selected plots were 0, 811, 2000, 3189, and 4000 lb/ac. These treatments were reapplied in September, 1992 and incorporated by disking. Previous N treatments of 0, 30, 60, 90, and 120 lb/ac were increased 50% for ryegrass in 1993, split into three applications, and surface-applied as urea. Potassium (KCl) was applied at rates of 0, 50, 100, 150, and 200 lb K_2O/ac. Plots measuring 13.33 ft by 20 ft were fertilized with adequate rates of phosphorus for ryegrass production. Ryegrass was planted on 8 Oct. 1992. In 1993, ryegrass was harvested from these plots on 22 Feb., 19 Apr., and 26 May. Soil samples collected from the 0-6-inch depth were analyzed for pH.

Research Findings. Effects of limestone treatment on soil pH are shown below:

Lime, t/ac	0	1000	2000	3000	4000
Soil pH	5.26	5.97	6.38	6.50	6.38

Levels of statistical significance for TAM 90 ryegrass response to treatments are shown in Table 1. Nitrogen was the only treatment factor that consistently increased yield of ryegrass at all harvests. Fertilization with N had a highly significant effect on yield at harvests. Ryegrass response to limestone treatment occurred only in the second harvest. Response of ryegrass to K treatment had a positive effect on ryegrass forage production at harvest 1. Potassium treatment depressed yield slightly. Ryegrass response to N and K is shown in Table 2. The first increment of N increased dry matter production by 1.3 t/ac. The second increment of N increased dry matter an additional 0.74 t/ac while the third increment increased yield only an additional 0.15 t/ac with no added K. Nitrogen rates above 135 lb/ac depressed yield at all K rates.

Application. Data from the first year of this study indicate that, of the three variables studied, N fertilization had the greatest effect on increasing yields of TAM 90 ryegrass. Lack of response to K fertilization indicates that this soil maintains a reserve of K available to plants. The sulfur treatment, applied in 1989 acidified the surface soil 6-inches deep. Once the ryegrass roots grew beyond this depth, plant growth was no longer inhibited by low pH.

Table 1. Levels of significance for TAM 90 ryegrass response to treatments.

Variable	Harvest 1 Level[1]	Harvest 1 Parameter Estimate	Harvest 2 Level	Harvest 2 Parameter Estimate	Harvest 3 Level	Harvest 3 Parameter Estimate	Total Level	Total Parameter Estimate
Intercept		-120.4218		-43.5859		-25.4925		620.1290
Lime			**	0.1008		0.3155		
Nitrogen	***	7.4736	***	48.3846	***	18.3116	***	71.7180
Potassium		3.0860			*	1.7384		-0.7469
L x L					**	-0.000065		
N x L					*	-0.00090		
N x N			***	-0.2103		-0.0709	***	-0.2890
K x L								
K x N						-0.0239		
K x K	**	-0.0154					*	0.0011

[1]*, **, *** represent statistical significance levels of 0.1, 0.05, and 0.01, respectively.

Table 2. Response of TAM 90 ryegrass to increasing rates of nitrogen and potassium on a limed, acid soil.

Nitrogen rates	Ryegrass dry matter yield, K_2O rates, lb/ac: 0	50	100	150	200
	------	------	lb/ac	------	------
0	620	586	556	533	515
45	3262	3228	3199	3175	3157
90	4734	4699	4670	4647	4629
135	5036	5001	4972	4948	4930
180	4167	4132	4103	4079	4061