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Cover Page Footnote

We appreciate the Farmers Co-op of Columbus and Baxter Springs, KS, which provided the fertilizer for the Columbus field trial; Midwest Minerals donated the lime for the Girard plots; Pro-Ag, LLC, donated fertilizer for the Parsons, Girard, and Altamont plots. This work was supported by Labette County Conservation District; Spring 2022 Kansas State University Small Research Grant; the U.S. Department of Agriculture National Institute of Food and Agriculture, Hatch project 1003478; and the K-State Research and Extension Wildcat Extension District.

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K-STATE Research and Extension

2023 SEREC AGRICULTURAL RESEARCH

Nutrient Management Strategies to Control Broomsedge Infestation and Improve Yield and Quality of Tall Fescue Hayfields

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Summary

A study in tall fescue hayfields infested with broomsedge and bluestem was conducted at four locations in southeast Kansas. The purpose of this study was to evaluate how phosphorus, nitrogen, and potassium fertilization affect yield, forage quality, and broomsedge/bluestem control in tall fescue hayfields. This trial will be repeated in 2023.

Introduction

Tall fescue (*Lolium arundinaceum*) is a cool-season grass widely used to feed animals across the U.S. (Young et al., 2014) due to its high yield and quality. However, in the last few decades, tall fescue hayfields have been infested by weeds such as broomsedge (*Andropogon virginicus*).

Broomsedge is a perennial grass that provides low forage yield and quality, and for these reasons is not desirable for grazing or hay production. Even though broomsedge does not compete well with tall fescue, under limited soil fertility conditions (low P, K, and pH), it can slowly take over the hayfields. Blevins et al. (2018) in a 3-year study found that low P soil favored broomsedge on tall fescue pasture. Thus, establishing a soil fertility program based on sampling can be an alternative to increase tall fescue yield and forage quality, and simultaneously suppress the broomsedge population by competition.

Our objective was to evaluate the impact of nutrient management strategies on the forage yield and quality of 'Kentucky 31' tall fescue hayfields, and the broomsedge population in southeast Kansas.

Experimental Procedures

The project was carried out at four locations in Kansas: the Southeast Research and Extension Center in Parsons, the research field in Columbus, and two production farms located in Girard, and Altamont. 'Kentucky 31' tall fescue pastures infested by broomsedge were used in all locations. The soil in all areas was a Parsons silt loam. Before starting the study, soil samples were taken in all locations to identify nutrient

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deficiencies and develop nutrient management plans based on soil pH, P, and K (Table 1). At the research fields in Parsons and Columbus, a complete trial was established with 3 replicates, but in the production fields in Altamont and Girard, only one replicate was established (demonstration plots).

The experimental design for each trial was a randomized complete block under a split-plot arrangement. Treatments were: three phosphorus (P) rates (0, 100, and 125% of the soil test recommendation and from the K-State Research and Extension publication Soil Test Interpretations and Fertilizer Recommendations (*bookstore.ksre.ksu.edu/pubs/mf2586.pdf*) and nitrogen (N), potassium (K), N+K, and control (without fertilization) in the sub-plots. Plots were 30 × 40 ft and sub-plots were 10 × 30 ft. Phosphorus rates (plots) used were 0, 20, and 25 lb/a in Parsons; 0, 70, and 88 lb/a in Columbus; 0, 65, and 81 lb/a in Girard; and 0, 50, and 63 lb/a in Altamont. Nitrogen and K rates were 100 and 30 lb/a, 100 and 35 lb/a, 130 and 35 lb/a, and 140 and 15 lb/a for Parsons, Columbus, Girard, and Altamont, respectively. Nitrogen and K rates were determined based on soil test reports and K-State fertilization recommendations for each site.

In Girard, 2750 lb/a of lime ECC was applied in the total area on July 2, 2021; N, P, and K were applied on August 12, 2021, and forage yield and quality were measured on October 8, 2021. In Altamont, fertilizers were applied on June 28, 2021, and the yield was estimated on October 8, 2021. In Parsons, 1100 lb lime ECC/a was surface-applied on October 18, 2021; P and K were hand-applied on December 3, 2021; N was surface-applied on March 3, 2022, and forage yield was measured on May 19, 2022. In Columbus, 200 lb lime ECC/a was surface-applied on November 18, 2021; P and K were hand-applied on December 13, 2021; N was hand-applied on March 3, 2022, and forage yield was measured on May 31, 2022.

To measure forage yield, quadrats (1.6 × 3.3 ft) were placed within each sub-plot and all forage inside the quadrat was harvested to a 3-in. stubble height at each location. In Girard and Altamont, the collected samples were sorted into tall fescue and weeds (broomsedge). All samples were weighed, dried at 130°F in a forced-air dryer until constant weight, and reweighed. These dried samples (except Girard) were sent to a laboratory for quality analysis, which included crude protein (CP), and TDN. Crude protein yield (CPY) was calculated by multiplying forage yield by CP.

Results and Discussion

The addition of P representing 100 or 125% of the soil test recommendation without N and K did not affect the forage yield, except in Columbus (Figure 1). In Columbus, the yield in the control plots (only P applied) was 77 and 64% higher in the P70 (2270 lb/a) and P88 (2106 lb/a) compared to P0 (1285 lb/a), respectively (Figure 1b). This result highlights the P fertilization potential when soil P is very low (1.0 ppm; Table 1) and, for this reason, the P application was more effective compared to other locations that had higher initial soil P. Therefore, it demonstrates the importance of taking soil analysis before applying any P fertilizers.

In general, K by itself had little effect on forage yield, CP, TDN, and CPY (Figure 1 and Table 2). Conversely, application of N significantly impacted yield regardless of

the P rate at all locations. The N input also increased TDN at all locations and CP at Altamont, achieving 14% CP when 50 lb P_2O_5/a was combined with 140 lb N/a. This is a high CP value for a tall fescue hayfield.

Even with the strong impact of N fertilization on forage yield, greater values were observed when N and K were applied together. In Altamont, for example, the N+K application produced 2315 lb/a more than when only N was applied, even with no P application (Figure 1d). This nutrient combination also resulted in higher CPY. These results support the importance of combining N and K fertilization when soil K is limited.

The broomsedge population was also reduced in the N+K treatments, especially when given with P fertilization (Figures 2a and 2b). As broomsedge infestation causes huge problems for producers, a fertilization package combining P, N, and K can be a powerful tool to suppress this weed while increasing tall fescue yield and quality.

Conclusions

The P application in tall fescue hayfields increases yield only when soil P is very low. Nitrogen application by itself increases yield, CP, TDN, and CPY. However, the N effect is enhanced if combined with K and P, resulting in higher forage yield, CP, CPY, and TDN, and better broomsedge suppression. The soil test is the most important tool to establish a fertilizer program for fescue hayfields. This study will be repeated in 2023.

Acknowledgments

We appreciate the Farmers Co-op of Columbus and Baxter Springs, KS, which provided the fertilizer for the Columbus field trial; Midwest Minerals donated the lime for the Girard plots; Pro-Ag, LLC, donated fertilizer for the Parsons, Girard, and Altamont plots. This work was supported by Labette County Conservation District; Spring 2022 Kansas State University Small Research Grant; the U.S. Department of Agriculture National Institute of Food and Agriculture, Hatch project 1003478; and the K-State Research and Extension Wildcat Extension District.

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Table 1. Initial soil chemical characteristics in the experimental areas in four locations in southeast Kansas

Local	pH	P	K
	---------- ppm ----------		
Parsons	5.3	14.2	76
Columbus	6.0	1.0	64
Girard	5.8	5.2	57
Altamont	6.7	1.7	103

Table 2. Crude protein level (CP), total digestible nutrients (TDN), and CP yield on tall fescue pastures infested by broomsedge in Parsons, Columbus, and Altamont

P rate, lb/a	N and K rates, lb/a	CP, %	TDN, %	CP yield, lb/a
		Parsons		
0	Control	11.0	46.3	73
	30K	11.2	46.5	116
	100N	11.2	49.7	239
	100N/30K	11.3	48.4	379
20	Control	10.9	49.6	83
	30K	11.1	47.8	90
	100N	11.2	50.7	365
	100N/30K	11.0	49.7	522
25	Control	11.2	46.5	88
	30K	11.3	48.4	91
	100N	11.3	51.2	323
	100N/30K	11.3	50.2	427
		Columbus		
0	Control	9.3	42.4	119
	35K	9.5	44.4	128
	100N	11.5	46.0	198
	100N/35K	9.5	44.4	128
70	Control	9.1	42.7	207
	35K	9.1	43.5	248
	100N	9.6	41.2	344
	100N/35K	9.9	41.5	410
88	Control	9.1	43.9	191
	35K	8.3	42.4	187
	100N	9.6	42.3	353
	100N/35K	9.9	43.9	388

continued

Table 2. Crude protein level (CP), total digestible nutrients (TDN), and CP yield on tall fescue pastures infested by broomsedge in Parsons, Columbus, and Altamont

P rate, lb/a	N and K rates, lb/a	CP, %	TDN, %	CP yield, lb/a
		Altamont		
0	Control	8.2	47.4	189
	15K	9.2	51.6	154
	140N	12.9	51.8	357
	140N/15K	11.9	50.4	601
50	Control	10.2	52.7	299
	15K	8.4	49.1	149
	140N	14.0	55.5	457
	140N/15K	11.4	47.4	488
63	Control	8.6	51.1	197
	15K	7.9	44.8	216
	140N	11.5	50.7	357
	140N/15K	10.1	47.3	515

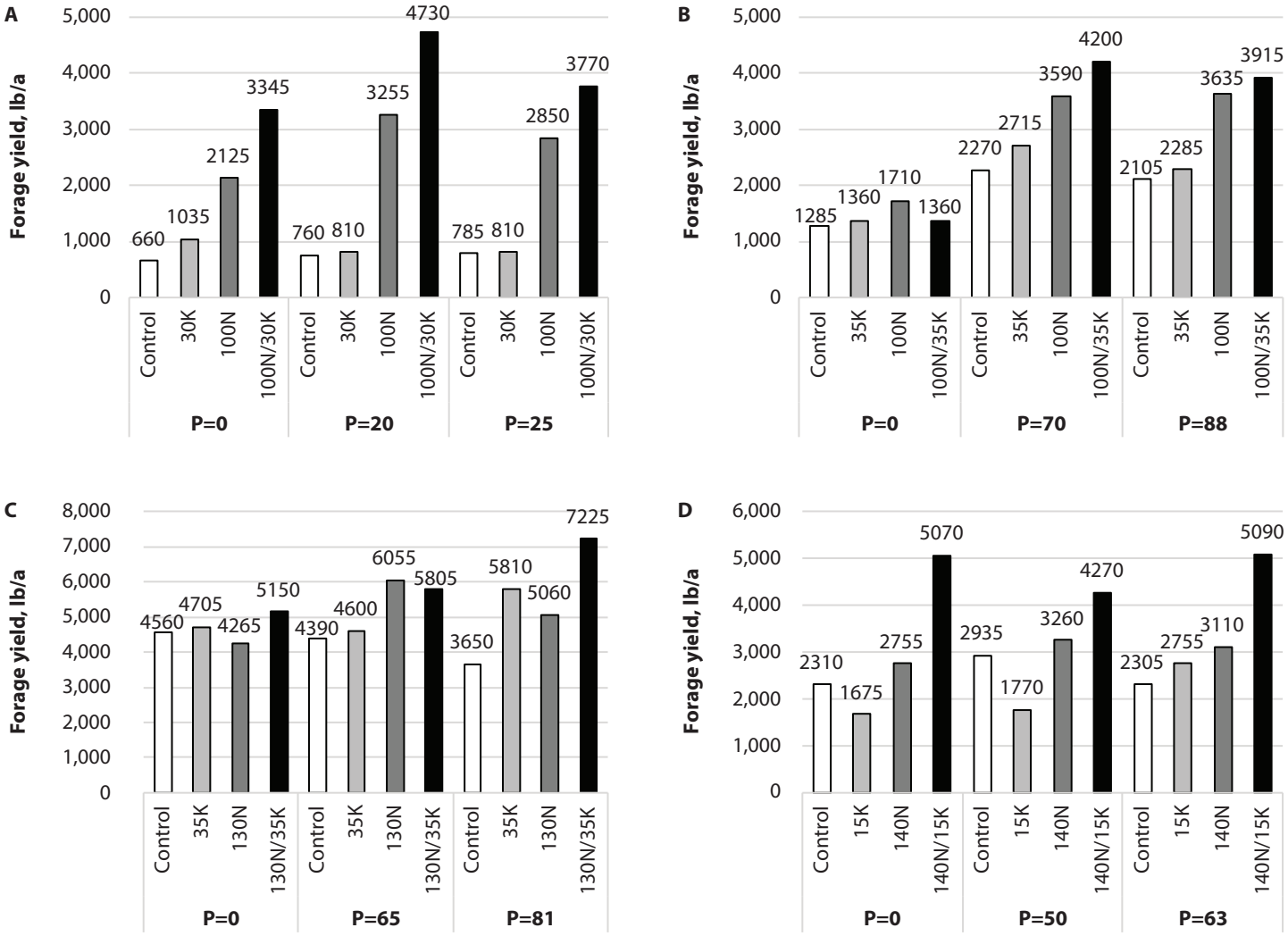

Figure 1. Forage yield on tall fescue pastures infested by broomsedge in (a) Parsons, (b) Columbus, (c) Girard, and (d) Altamont. Nutrient rates are given in lb/acre. Phosphorus rates were determined from initial soil test results based on 0%, 100%, and 125% of requirement.

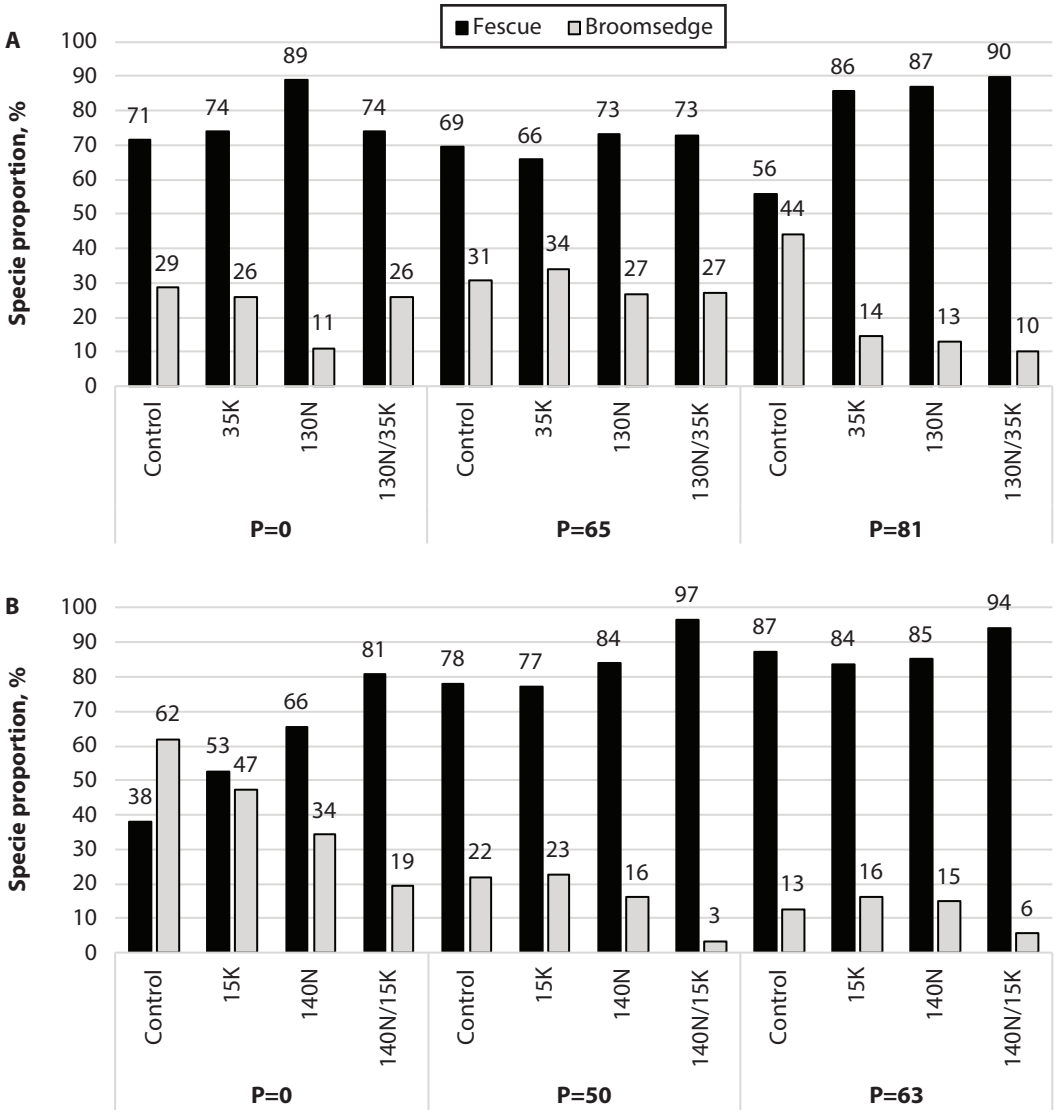

Figure 2. Effect of phosphorus (P), potassium (K), and nitrogen (N) in the tall fescue and broomsedge proportions at (a) Girard and (b) Altamont. Phosphorus rates were determined from initial soil test results based on 0%, 100%, and 125% of requirement.