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Impact of Lime, Phosphorus, and Potassium on Yield and Forage Quality on Native Hay Meadows in Southeast Kansas

Junior I. Yasuoka
Kansas State University, junioriy@ksu.edu

Wendie Powell
Kansas State University, Wildcat Extension District, wendiepowell@ksu.edu

Walter H. Fick
Kansas State University, whfick@ksu.edu

See next page for additional authors

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Cover Page Footnote

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Authors

Junior I. Yasuoka, Wendie Powell, Walter H. Fick, and Bruno C. Pedreira

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K-STATE Research and Extension

2023 SEREC AGRICULTURAL RESEARCH

Impact of Lime, Phosphorus, and Potassium on Yield and Forage Quality on Native Hay Meadows in Southeast Kansas

J.I. Yasuoka, W. Powell,[1] W. Fick,[2] and B.C. Pedreira

Summary

Native meadows are frequently harvested for hay in southeast Kansas to produce forage for winter use. However, the low soil fertility associated with nutrient removal has resulted in limited yield potential and broomsedge infestation. This study evaluated the effect of phosphorus, potassium, and lime on the forage yield and quality in a native meadow. Our results indicated that P and K fertilization contributes to improving yield and quality on native meadows in southeast Kansas. This study will be repeated in 2023, including broomsedge measurements.

Introduction

In Kansas, native meadows are widely utilized for hay or grazing, especially in areas with shallow soils and/or hills. Native plants have low yield potential and low forage quality. The native meadows are commonly harvested once a year, but fertilizers or lime have not been traditionally applied to replace the soil nutrients. After decades of utilization, some farmers have taken note of the lowering yield and the presence of broomsedge (*Andropogon virginicus*) and bluestem (*Bothriochloa* spp.).

Thus, recognizing the need to replenish nutrients that would improve yield and quality, even knowing the limited response of native species, this study aims to evaluate the combinations of phosphorus (P), potassium (K), and lime (L) on yield and forage quality in native meadows in southeast Kansas.

Experimental Procedures

The trial was conducted at the Southeast Research and Extension Center in Parsons, KS, in a native meadow, which has been harvested and baled annually for more than 30 years. The soil is a Parsons silt loam. Soil samples were taken on September 28, 2021, resulting in pH = 5.6, P = 0.3 ppm, and K = 69 ppm.

The experimental design was a randomized complete block in a split-plot arrangement, with three replications. The plots (30 × 40 ft) were P rates, and the sub-plots (10 × 30 ft) were the application of K, L, K+L, and a control. Phosphorus rates were 0,

[1] Wildcat Extension District Livestock Production agent, K-State Research and Extension.
[2] Department of Agronomy, College of Agriculture, Kansas State University.

50, and 100% (0, 25, and 50 lb P_2O_5/a; P0, P25, and P50, respectively). The K rate was 100% (20 lb K_2O/a) of the soil test recommendation based on the K-State Research and Extension publication Soil Test Interpretations and Fertilizer Recommendations (*bookstore.ksre.ksu.edu/pubs/mf2586.pdf*). As the spreadsheet has no native species listed, it was set for tall fescue with a 1 ton/a yield goal. The lime rate was 2200 lb/a, half applied on October 18, 2021, and another half on April 25, 2022. On May 6, 2022, P and K were applied in the respective treatments.

On July 6, 2022, the plots were harvested using a flail harvester (Carter) where a 3 × 25 ft area was sampled at 3-in. stubble height to determine forage yield. The collected forage was weighed, dried in a forced-air dryer at 130°F for three days, and weighed. To evaluate forage quality, dry samples were sent to the laboratory for crude protein (CP) and total digestible nutrients (TDN) analyses. Crude protein yield (CPY) was calculated by multiplying yield and CP. In 2022, the broomsedge population was not evaluated, but it will be in the fall of 2023.

Results and Discussion

When no P was applied, L, K, or L+K had little effect on yield. However, at the 25 and 50 lb P_2O_5/a rates, K and L+K increased the yield, mainly at the P25 level which was, on average, 43% greater than when no P, K, and lime were applied (Figure 1). Lime application increased the forage yield only when combined with 50 lb P_2O_5/a.

Another interesting result, regardless of the P rate, the forage yield was similar among K and K+L. These results indicate that K can be applied without lime and is associated with at least 25 lb P_2O_5/a. The strategy based on the soil test report contributes to reducing costs and increasing hay production on native meadows.

All combinations among P rates and lime, K, and L+K application resulted in CP values below 7%, considered the minimum to keep ruminal animals healthy. Treatments had little effect on TDN, with values ranging from 37.0 to 40.6%. Both CP and TDN values are much lower than commonly reported for tamed forage species. Our results, therefore, highlight that native meadows produce forage with low quality (protein and energy) even with P and K fertilization or lime application. For this reason, energy and protein supplementations are essential to sustain animal nutrient requirements when cattle are fed with native hay.

Comparing the P rates without any other addition (control), the application of 25 or 50 lb P_2O_5/a only increased CPY by 8% when compared to P0. It means that P fertilization by itself has little effect on CPY. On the other hand, the greater forage yield in the P25 combined with K and L+K and the highest CP values for P50 with L, K, and L+K resulted in better CPY results. These results support the use of P associated with L, K, and L+K if there is a need to improve CPY in a livestock system.

Conclusions

In the first year of this study, P (25 lb P_2O_5/a) and K (20 lb K_2O/a) fertilization increased native meadows' forage yield and CPY, based on the soil test requirement. In addition, lime had little effect in the year of application. Regardless of the P, K, and lime application, CP and TDN values were low, therefore, energy and protein supplemen-

tation are crucial to reach animals' nutrient requirements. Thus, P and K fertilization contributes to improving yield and quality on native meadows in southeast Kansas. The trial will be repeated in 2023 and broomsedge will be also evaluated.

Acknowledgments

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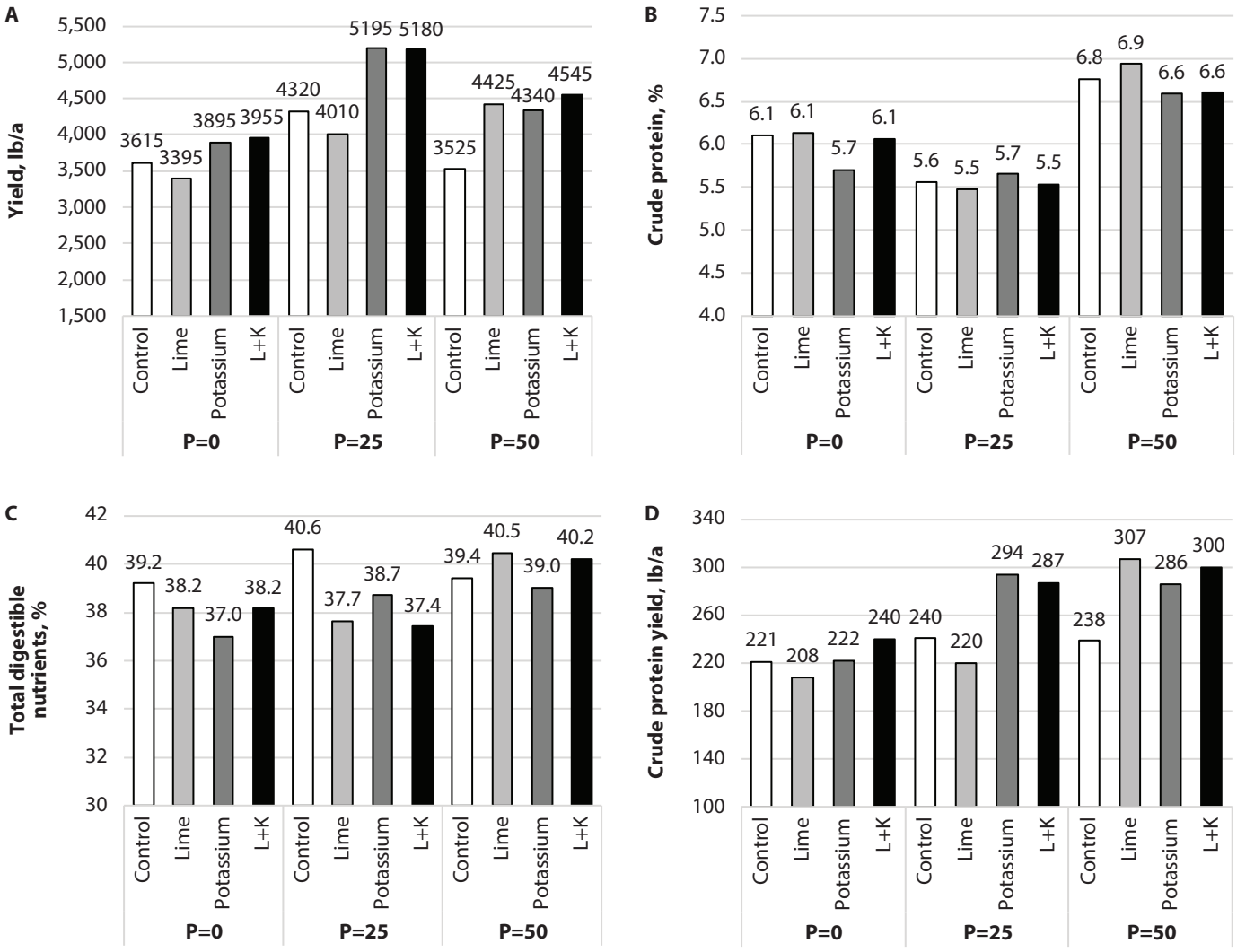

Figure 1. Forage yield (a), crude protein content (b), total digestible nutrients (c), and crude protein yield (d) on a native meadow in Parsons, KS.