PHOSPHORUS FERTILIZATION IMPROVES THE QUALITY OF STOCKPILED TALL FESCUE

Dale G. Blevins, Matt Massie and Will McClain
University of Missouri, Columbia, Missouri

Abstract

Stockpiling tall fescue is a recommended practice for increasing profitability of beef cattle production. However, little information is available on the mineral element composition of tall fescue pastures stored for winter grazing. In fact, analysis of the few studies reported indicates that both phosphorus and magnesium levels may be low in stockpiled tall fescue by late winter. The objective of this study was to determine the impact of phosphorus fertilization on improving the nutrient quality of stockpiled tall fescue. Although phosphorus fertilization treatments increased the phosphorus and magnesium concentrations of tall fescue leaves during late fall and winter, levels of the nutrients dropped near or below those required by grazing, lactating beef cows. Our working hypothesis is that these mobile nutrients are translocated from leaves to roots, rhizomes or underground tillers for storage during winter. Phosphorus treatments were very effective for improving forage and hay production and these treatments proved to be cost effective, as well.

Introduction

Missouri is second in the U.S., after Texas, in feeder calf production (Missouri Farm Facts, 2003). Half of the feeder calves in Missouri are produced within a 100-mile radius of the University of Missouri Southwest Research Center near Mt. Vernon. Beef cattle production in Missouri and in a large portion of the U.S. is based on tall fescue pastures. Tall fescue in SW Missouri is typically grown on soils low in plant available phosphorus (P).

The major expense of beef cattle production is feeding costs, primarily in the harvesting, storage, and feeding of hay. Therefore it is often recommended that cattle producers save some tall fescue pasture for winter grazing, a practice called "stockpiling", to reduce winter feeding costs. However, early studies in Kentucky (Taylor and Templeton, 1976), Tennessee (Fribourg and Bell, 1984) and West Virginia (Balasko, 1977; Collins and Balasko, 1981) indicated that stockpiled tall fescue contained low P and magnesium (Mg) concentrations. In fact, by late winter and early spring, concentrations of these two nutrients were often below levels recommended for diets of lactating beef cows. This poses a problem for beef herds that calve in late winter and early spring.

Our studies in SW Missouri have shown that P fertilization of low P soils increased both P and Mg concentrations of tall fescue leaf tissue in early spring, and greatly increased total forage production (Reinbott and Blevins, 1994 and 1997). This work was conducted to try to increase the Mg concentrations of tall fescue leaves, in order to combat grass tetany in beef cattle. The study described here was designed to determine if the nutrient quality of stockpiled tall fescue during winter would be improved by P fertilization.

Materials and Methods

An established Kentucky 31 tall fescue pasture was selected at the SW Center near Mt. Vernon. Missouri on a Creldon soil that contained 7 lbs P/acre (Bray I) and 247 lbs Mg/acre. Phosphorus was applied to 10' x 25' plots at 0. 12.5 and 25 lbs P/acre and each treatment was replicated 18 times in the two-year experiment. The study was started the third week in August by cutting and removing all forage, and applying P fertilization treatments. Beginning in mid-October and through April, 20 of the most recently collared leaves were harvested each month. Hay was harvested during the third weeks of May and August. Leaf and hay samples were analyzed for macronutrient element concentrations and these concentrations were compared to those required for diets of lactating beef cows.

Results and Discussion

Tall fescue leaf P concentrations dropped during the fall and winter months, reaching their lowest levels by mid-February (Figure 1A). By January of the first year, P levels in leaves from all P treatments were below those required by lactating beef cows, and these P levels remained below 0.20% through mid-April. During the second year, leaves from untreated plots remained between 0.15% P during fall, winter and early spring, and this is much lower than levels required for lactating beef cows. However, with the 25 lbs P/acre applied during a second season. leaf P concentrations were around 0.20% throughout the winter. At the 12.5 lbs P/acre treatment level, leaves harvested during December, January and February of the second year dropped below the 0.20% P target level. It should be noted that leaf P concentrations declined during the second year, although not as dramatically as they did in the first year. Our working hypothesis is that leaves, of this perennial grass, translocate or move P out of leaves and down to roots, rhizomes or underground tillers during late fall and winter. This is called nutrient remobilization, and involves nutrient transport in phloem tissue.

In earlier work, we found that late winter P treatments increased tall fescue leaf Mg concentrations during March and April (Reinbott and Blevins, 1994 and 1997). Based on these studies, we think that tall fescue growing on low P soils has a problem with Mg uptake by roots and Mg transport from roots to leaves. Therefore we were interested in the response of Mg to P treatments in stockpiled tall fescue. A decline in leaf Mg concentration occurred during late fall and winter, reaching the lowest levels in mid-March (Figure 1B). This decline was very similar to the decline in leaf P concentrations, except P levels were lowest in mid-February. A sharp decline in Mg concentration also occurred during the second year, but with the 25 lbs P/acre treatment, leaf Mg concentrations remained about 0.20%. Again, our hypothesis is that this mobile divalent cation, Mg, is translocated during late fall and winter months from leaves to roots, rhizomes or underground stems. Magnesium concentrations in leaves of untreated tall fescue dropped below the 0.20% target in January, February and March of both years, indicating a nutritional problem for late winter or early spring calving beef cows

Leaf K concentrations declined each fall and winter, however leaf K concentrations did respond to the P treatments (Figure 1C). The K levels of leaves from all treatments exceeded the nutrient requirements for lactating beef cows. Potassium is very mobile element in the phloem tissue of plants, therefore remobilization of K during winter is not surprising.

Calcium is not mobile in phloem tissue of plants, and is not remobilized and translocated from leaves to roots during winter. Therefore it was not surprising to find that Ca concentrations in leaves remained level during late fall and winter (Figure 1D). During the second year, there was an obvious Ca response to the P treatments with leaves from the 25 lbs P/acre treatment being higher than those from the 12.5 lbs P/acre treatment. Leaves from both P treatments were higher in Ca that those from the untreated control plots. The Ca concentrations of leaves of the stockpiled tall fescue remained about those required for diets of lactating beef cows all winter and spring.

As we have reported in the past, P fertilization at this location increased tall fescue hay production by over 1500 lbs/acre/year (Figure 2). This yield increase is equivalent to about two big round bales of hay, and at $25 per bale, this would equal $50 of increased hay production/acre as a result of P fertilization. Fertilizer for 25 lbs P/acre would cost around $7.50, therefore the net (minus application cost) return on the investment would be around $42.50/acre. For a forage production system, it is not uncommon to harvest four tons/acre/year of tall fescue, either by grazing or by hay harvests, and based on our results, this would remove about 16 lbs P/acre/year.

Analysis of soil P levels after two years of fertilization revealed that this soil "fixed" P making it unavailable to plants. Initial tests showed that Bray I (available P) levels were 7 lbs/acre, and after two years this had fallen to 5 lbs/acre. However, in the 12.5 and 25 lbs/acre P treatments, the Bray I P concentrations were 8 and 13 lbs/acre, respectively. The Bray I plus the Bray II (unavailable P) levels at the end of two years accounted for 44% of the applied P in the 12.5 lbs/acre treatment and 76% of the P in the 25 lbs/acre treatment (Figure 3).

Summary

The quality of stockpiled tall fescue during winter months may be a product of the physiological nature of this perennial grass. Leaf P and Mg concentrations declined during late fall and winter, and research is underway to determine if these mobile elements are translocated from leaves to roots, rhizomes or underground tillers as winter approaches. By late winter, both P and Mg levels of leaves dropped below those required for lactating beef cows, unless plots were treated with 25 lbs P/acre. This P application rate boosted hay production by the equivalent of two big round bales or by about $50 worth at a cost of $7.50 for the P, and would also reduce the amount of supplemental Mg required by the grazing beef cows.

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Fig. 1A

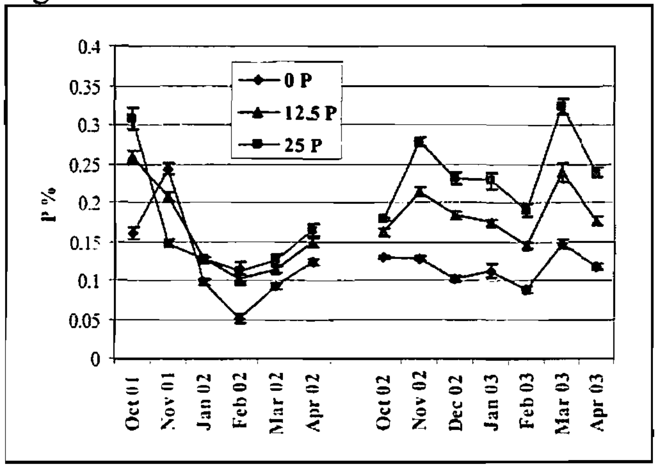

Fig. 1B

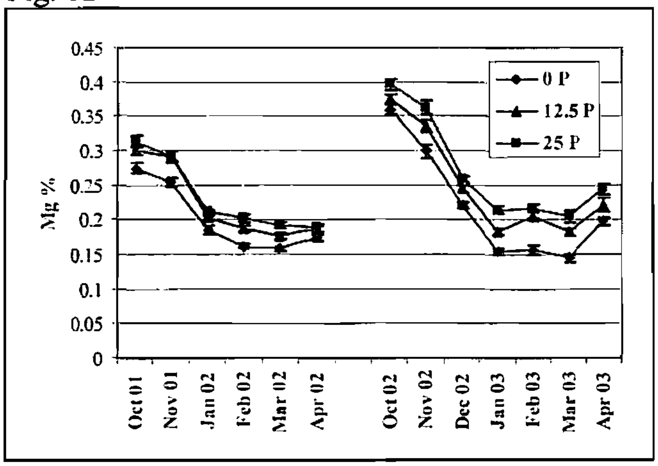

Fig. 1C

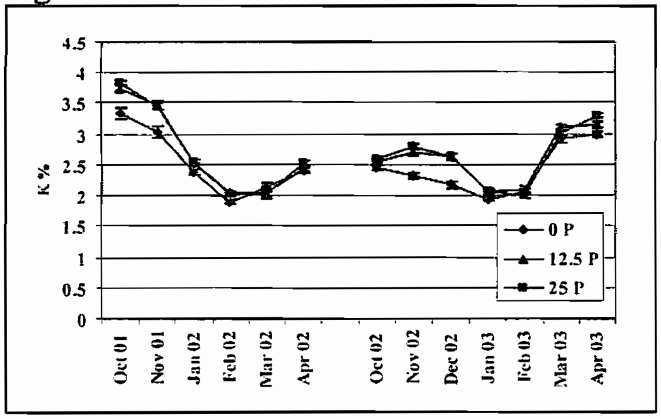

Fig. 1D

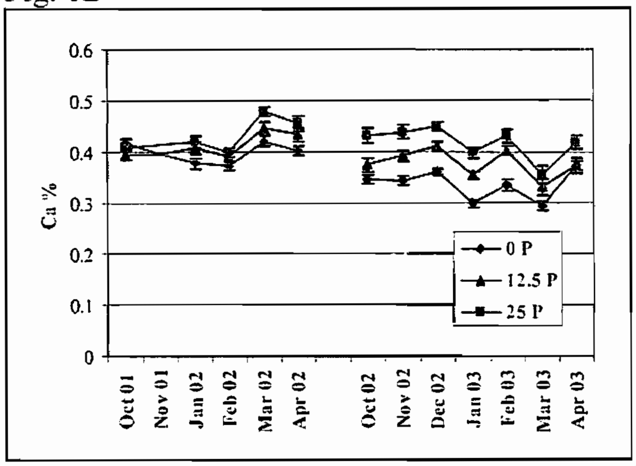

Figure 1. Leaf concentrations of macronutrient elements following phosphorus fertilization of stockpiled tall fescue. A) P %, B) Mg %, C) K%, D) Ca %

Fig. 2

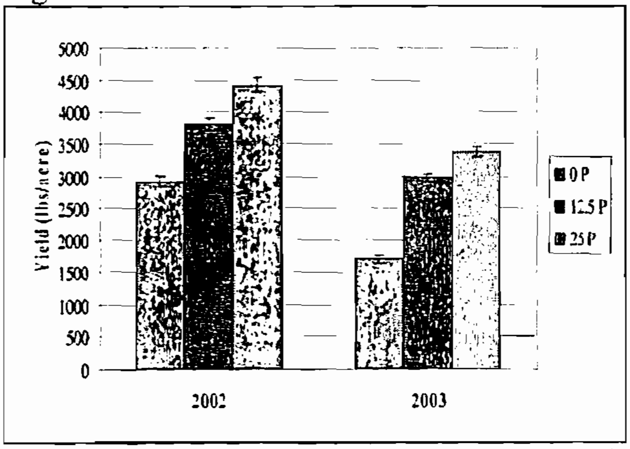

Figure 2. Hay yield of tall fescue treated with phosphorus fertilization. Hay was harvested in May and August of each year.

Fig. 3

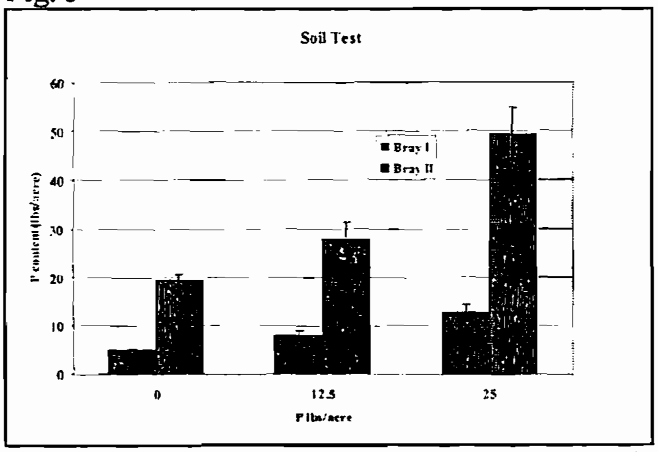

Figure 3. Soil test phosphorus levels at the end of the experiment.

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Program Chair:
Bob Hoeft
University of Illinois
Urbana, IL 61801
(217) 333-9480

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772 – 22nd Avenue South
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