Using Magnesium and Phosphorus Fertilization to Improve the Macronutrient Quality of Stockpiled Tall Fescue

Missouri Fertilizer and Lime Council

2007 Second Year Report

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Objective: To determine if phosphorus (P) and magnesium (Mg) concentrations in leaves of stockpiled tall fescue during winter can be increased by fertilization with both P and Mg. The acreage involved makes this research important to the Missouri fertilizer industry. Missouri leads the nation in tall fescue production and is second in beef calf production (Missouri Farm Facts, 2005). Of the 13 million acres of tall fescue pasture in Missouri, much of it grows on soils low in plant available P (Bray I). When forage is produced on these soils, there may be a problem with macronutrient quality of leaf tissue. Our previous work on low Bray I P soils has shown that P fertilization of tall fescue pastures improved leaf P and Mg concentrations (Reinbott and Blevins 1997). Currently, it is recommended that cattle producers stockpile tall fescue to reduce winter feeding costs. However, there is very little information available on the macronutrient quality of stockpiled tall fescue and management practices that can be used to improve it.

Procedure: During summer 2006, an established stand of tall fescue (K31, endophyte infected) was selected at the University of Missouri, Southwest Research Center near Mt. Vernon. Soil samples were taken and sent to the University of Missouri Soil Testing Lab for analysis. The soil test results were used for making the final site selection. On September 20, forage was removed from the plot area and plots of 10’ x 25’ with 5’ foot alleys were treated with combinations of 0, 50, 100, or 200 lbs P/acre (as 0-46-0) and 0 or 50 lbs Mg/acre (K-Mag). The use of K-Mag required that potassium (K) and sulfur (S) be added separately to all treated plots to balance K and S added in the K-Mag treatments. Each treatment combination was replicated six times. From mid-October through mid-April (2007), 20 of the most recently collared leaves were harvested monthly from each plot. Samples were dried, ground and digested in nitric acid in a microwave accelerated digestion system (CEM Corp.). Digested samples were filtered, diluted and macro- and micronutrient concentrations were determined by ICP analysis.

Results: During the first stockpiling season, P fertilization increased leaf P concentrations, as expected (Fig. 1). The increasing P treatment levels clearly increased the leaf P concentrations with each increment added. Interestingly, at the 0, 50 and 100 P treatments levels, Mg fertilization tended to increase leaf P concentrations, as well. When Mg fertilizer was applied without also applying P fertilizer, the Mg was ineffective at increasing leaf Mg concentrations above control levels in February, March and April (Fig. 2). When Mg fertilizer was applied with P fertilizer, leaf Mg concentrations were increased. However, with all treatments, except the 200P 100Mg treatment, leaf Mg levels in February fell below the 0.2% level required by lactating beef cows. Leaf Ca
concentrations also increased with P fertilization treatments (Fig. 3). With 0 P and 50 P treatments, Mg fertilization decreased leaf Ca concentrations below the target 3.0% level during winter months (Fig. 3). In Nov and Dec 2006, P treatments increased leaf K concentrations above control levels, but there were no clear treatment affect in winter and spring months of 2007 (Fig. 4). Leaf concentrations of most essential micronutrient elements showed only limited response to the P and Mg treatments, Mn was an exception however. Leaf Mn concentrations increased significantly with increasing P treatments, and the addition of Mg tended to lessen this response (Fig. 5).

**Discussion:** Clearly the combination of P and Mg fertilization was effective in increasing leaf Mg concentrations in the stockpiled tall fescue. However, in February, only the high treatment levels produced leaf Mg concentrations that were about 0.2%. Our hypothesis is that tall fescue naturally mobilizes “mobile” nutrients, like Mg, and moves them out of leaves down to roots and rhizomes during winter. These nutrients are then available to support new growth in the early spring, even when soil temperatures are low. Experiments are underway to test this hypothesis. In addition to the interest in wintertime leaf Mg and Ca concentrations, increased leaf Mn concentrations with P fertilization should be mentioned. In Missouri soils, we have found that leaf Mn concentrations can be greatly increased with P fertilization and greatly decreased with liming! These are important points since different crop species seem to have very different Mn requirements. For example, soybean and switchgrass seem to have high Mn requirements, while corn and sorghum do not. Therefore we can use P fertilization or liming to increase or decrease leaf Mn concentrations in specific crops.

**Last six month schedule:** Leaf samples were collected from Oct to Dec 2007, and will be collected monthly through April 2008. Hay will be harvested for yield determinations in late May 2008. All second year samples will be analyzed for macro- and micronutrients using ICP, and the effects of P and Mg fertilization will be determined. Of special interest will be fertilization treatment responses of leaf P and Mg concentrations during the late winter months.

![Figure 1. Response of leaf P concentrations in stockpiled tall fescue to P and Mg fertilization.](image-url)
Figure 2. Response of leaf Mg concentrations in stockpiled tall fescue to P and Mg fertilization.

Figure 3. Response of leaf Ca concentrations in stockpiled tall fescue to P and Mg fertilization.
Figure 4. Response of leaf K concentrations in stockpiled tall fescue to P and Mg fertilization.

Figure 5. Response of leaf Mn concentrations in stockpiled tall fescue to P and Mg fertilization.