Title: Using Dolomitic Limestone and Timing of Phosphorus Fertilization to Maintain High Leaf Phosphorus and Magnesium Concentrations in Stockpiled Fescue During the Winter

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Objective: to maintain high phosphorus (P) and magnesium (Mg) concentrations in tall fescue leaves in late winter by using dolomitic limestone (Mg source) and determining the correct timing of P applications. The dolomitic limestone should provide more soil Mg and the (timing) application of half of the P fertilizer during winter months may boost leaf Mg concentration during these months.

Procedures: An established tall fescue pasture was selected at the Southwest Center near Mt. Vernon, MO. Soil samples were collected in June, 2008 and analyzed by the University of Missouri Soil Testing Laboratory. The soil pH levels for this plot area were just below 6.0 and the Bray 1 P levels were 10 lbs/acre or lower. The Bray 2 levels were also extremely low, and the soil Mg levels were in the medium range. These soil test results are very typical of tall fescue pastures used in much of the state.

In mid-July 2008, forage was cut and removed from the plot area. Plots were established with the following dimensions: 10’ x 25’ with 5’ alleys. On July 19, 2008 dolomitic limestone (ENM = 467 & EMG = 137) was applied to specific plots at a rate of 0 or 2000 lbs/acre. During late August of each season, forage was harvested and removed from the plot area and in early September, 100 lbs N/acre (as urea) was applied to all plots. In mid-September of each season, a total of 25 lbs P/acre was applied to the September P treatment plots and all other P treated plots were treated with 12.5 lbs P/acre, as 0-46-0. Then in October of each year, the October plots were treated with their remaining 12.5 lbs P/acre, and in November, December January and February, specific P-treated plots received their remaining 12.5 lbs P/acre. Starting in October of each season, 20 of the most recently collared leaves from each plot were harvested monthly. Leaf samples were dried, ground, digested in nitric acid in our microwave digestion system, diluted, filtered and analyzed for macro- and micronutrient concentrations by ICP. Leaf P, Mg and Ca concentrations were plotted against the months of harvest for each of the two stockpiling seasons.

Results: Just a reminder that the key treatments in this study involve applying one-half of the P fertilizer (12.5 lbs/acre) in September and the other half (12.5 lbs/acre) in one of the months of the stockpiling season. The September treatment received all 25 lbs P/acre in September of each year. The split P applications in Nov and Dec were best for increasing leaf P concentrations from January through March (Fig. 1). The split application in other months also increased leaf P concentrations, but not as effectively as the Dec treatment. In the second season, all P applications greatly increased leaf P concentrations, although the split application in November and December seemed provide the greatest increases in leaf P concentrations (Fig. 1). Over the two years, the November and December split P
applications were best for increasing concentrations in both seasons. Interestingly, in the first season leaf P concentrations started to increase in January, while in the second season leaf P concentrations started to increase in February. The dolomitic limestone application did not increase leaf P concentrations in any month of the two year study.

The December split P application was best for increasing leaf Mg concentration in February and March of the first season (Fig. 2). These are the two months when grass tetany is most common in spring calving herds in Missouri. All P treatments increased leaf Mg concentrations in each month of the second season. In the second year, there were slight increases in leaf Mg concentrations with application of the dolomitic limestone in plots also treated with P. Interestingly, the “pattern” of changes in leaf Mg concentrations showed a continuous decline throughout each of the stockpiling seasons (Fig. 2), unlike P, which increased from February through April of each season (Fig. 1).

Dolomitic limestone application was not very effective in increasing Ca concentrations of stockpiled tall fescue leaves in this study (Fig. 3). However, split P applications made from Oct through Feb were effective in increasing leaf Ca concentrations in late winter of the first season. All P applications were effective at increasing leaf Ca concentrations in each month of the second season (Fig. 3). All of the leaf Ca concentrations were about the 0.3% required in the diet of a lactating beef cow during all months of both seasons. The pattern of leaf Ca concentration changes during the fall, winter and spring resembled those of P, not Mg. The leaf Ca concentrations were lowest in January of the first season and February of the second season and then leaf Ca concentrations increased, in general. Application of dolomitic limestone caused slight increases in leaf Ca concentrations in March and April of each year.

Summary: The design of this experiment was based on results that we observed on a poultry litter experiment, where we used an equivalent amount of fertilizer applied in three installments to mimic the slow release of nutrients from litter. A December fertilizer treatment in that experiment increased leaf P in January and February. Our hypothesis was that December P treatments might also increase leaf Mg concentrations, based on other research that we have done linking P fertilization with Mg uptake by plants. Indeed this was the case in the present experiment, where the December treatment with 12.5 lbs P/acre was best at increasing leaf Mg concentration in February and March of each season. During the second season, P fertilization was effective in increasing both leaf Mg and Ca concentrations during each month of the stockpiling season. In putting all of these results together, the macronutrient quality of the forage should be improved by the Dec application of P.

In summary, P fertilization in December is, in general, best for improving forage P, Mg and Ca quality of stockpiled tall fescue in late winter months. The addition of P fertilizer increased leaf P, Mg and Ca concentrations more effectively that lime applications alone.
Figure 1. Leaf P concentrations of stockpiled tall fescue following dolomitic limestone application, and split P fertilization treatments over two seasons. Note that November and December P fertilization split were best for increasing leaf P concentrations in late winter months.
Figure 2. Leaf Mg concentrations of stockpiled tall fescue following dolomitic limestone application, and split P fertilization treatments over two seasons. Note that the December P split application was best for increasing leaf Mg concentrations in late winter months during the first season, while all P treatments increased leaf Mg concentrations during each month of the second season, more so that just adding dolomitic limestone alone.
Figure 3. Leaf Ca concentrations of stockpiled tall fescue following dolomitic limestone application, and split P fertilization over two seasons. Note that the December P fertilization split was a little better for increasing leaf Ca concentrations in late winter months during the first season, while all P treatments produced increased leaf Ca concentrations in the second season.