Missouri Fertilizer and Lime Grant
Second Year Report

Increasing the magnesium concentration of stockpiled tall fescue leaves with phosphorus and boron fertilization

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Missouri is number one in tall fescue production among states in the USA, and is number two in cattle numbers and feeder calf production (Missouri Farm Facts, 2002). The beef cattle industry is based on over 10 million acres of tall fescue pasture in the state. Missouri is also the leading state in tall fescue hay production, however many people are suggesting that it would be better economically for cattle producers to stockpile some tall fescue for winter grazing rather than investing in the harvesting and storage of hay. We have found that phosphorus fertilization of tall fescue pastures in southern Missouri is an effective way to increase the magnesium concentration of leaves during the early spring. Based on our work on grass tetany, we have become concerned about the nutrient quality of tall fescue pastures and hay, specifically of the magnesium, calcium and phosphorus concentrations. A search of the literature revealed very little information on the nutrient concentration of stockpiled tall fescue leaves. We have found that increasing levels of both phosphorus and boron nutrition increased magnesium uptake by plant roots in our laboratory studies. Therefore the objective of this study was to determine if fertilization with phosphorus and boron would increase leaf magnesium, calcium and phosphorus concentrations in stockpiled tall fescue.

Materials and Methods

A tall fescue plot area was selected on August 9, 2001 at the University of Missouri Southwest Center near Mt. Vernon (Creldon silt loam soil; Fine, mixed, mesic Mollic Fragiudalfs) and this site had the following soil test results: pH 5.4; N.A. 3.0 meq/100g; O.M. 2.9%; Bray I P 7 lbs/acre; Ca 2687 lbs/acre; Mg 247 lbs/acre; K 667 lbs/acre and B 0.26 lbs/acre. Please note two important problems with this soil, P level is very low and should be around 40 lbs/acre, and B level is low and should be 1.0 lb/acre for pastures. These problems are typical of tall fescue pastures in this part of SW Missouri. During the third week of August in 2001, 2002 and 2003, tall

fescue on the selected site was cut with a forage chopper and the forage was removed. Then in 2001, 10' x 25' plots with 5' alleys were prepared and treated with the various quantities of P and B. Each treatment was replicated six times. In both 2001 and 2002, phosphorus was applied at rates of 12.5 or 25 lbs P/acre, as triple super phosphate, and boron was added at 0.5 and 1.0 lb B/acre as boric acid each year. In both years, within a week or two after the August harvest, nitrogen was applied as topdress 100-0-0. After forage removal in late August, the tall fescue grew and on October 23, 20 of the most recently collared leaf blades were harvested from each plot. Other leaf harvests were made in late November, December, January, February, March and April of each year (except in December of 2001 weather conditions did not permit a harvest). Hay was harvested the third week of May and the third week of August in 2002 and 2003. Hay samples were dried and forage yields were calculated. Leaf and hay samples were dried, ground, and wet ashed nitric acid. During the last year, all digestions were made with a new microwave digestion system. These samples were used for flame ionization (K) and atomic absorption analyses (Mg and Ca). Phosphorus concentrations in the samples were determined colorimetrically. All samples have been collected for this two-year study. All samples have been dried, ground, digested and analyzed. Most of the data have been analyzed and figures have been prepared. Data not yet analyzed will be presented and provided at the February, 2004 meeting.

Results

Magnesium concentrations of the tall fescue leaves declined from October to March of winter 2001/2002 (Fig. 1). This indicates the mobility of magnesium in the tall fescue plants. The problem with this mobility is that magnesium concentrations in the tall fescue drop below those recommended for grazing beef cows by January in forage not treated with phosphorus. Even though magnesium concentrations drop in leaves from all treatments, those from plants treated with 25 lbs P/acre remain the highest. The same pattern is seen for phosphorus concentrations of the tall fescue leaves, in that they dropped from October/November until February and by December they fell significantly lower than levels required by grazing/lactating beef cows with all phosphorus treatments. In fact, the biggest nutrient problem observed in the stockpiled tall fescue was the low phosphorus concentrations observed in winter samples regardless of treatment (Fig. 1).

Fig. 1. Leaf magnesium and phosphorus concentrations in stockpiled tall fescue treated with phosphorus fertilizer in late August, 2001and sampled during fall, winter and spring of 2001 and 2002. Twenty of the most recently collared leaves were harvested from each plot, and each point represents the mean of 18 plots. Boron treatments were pooled in these figures.

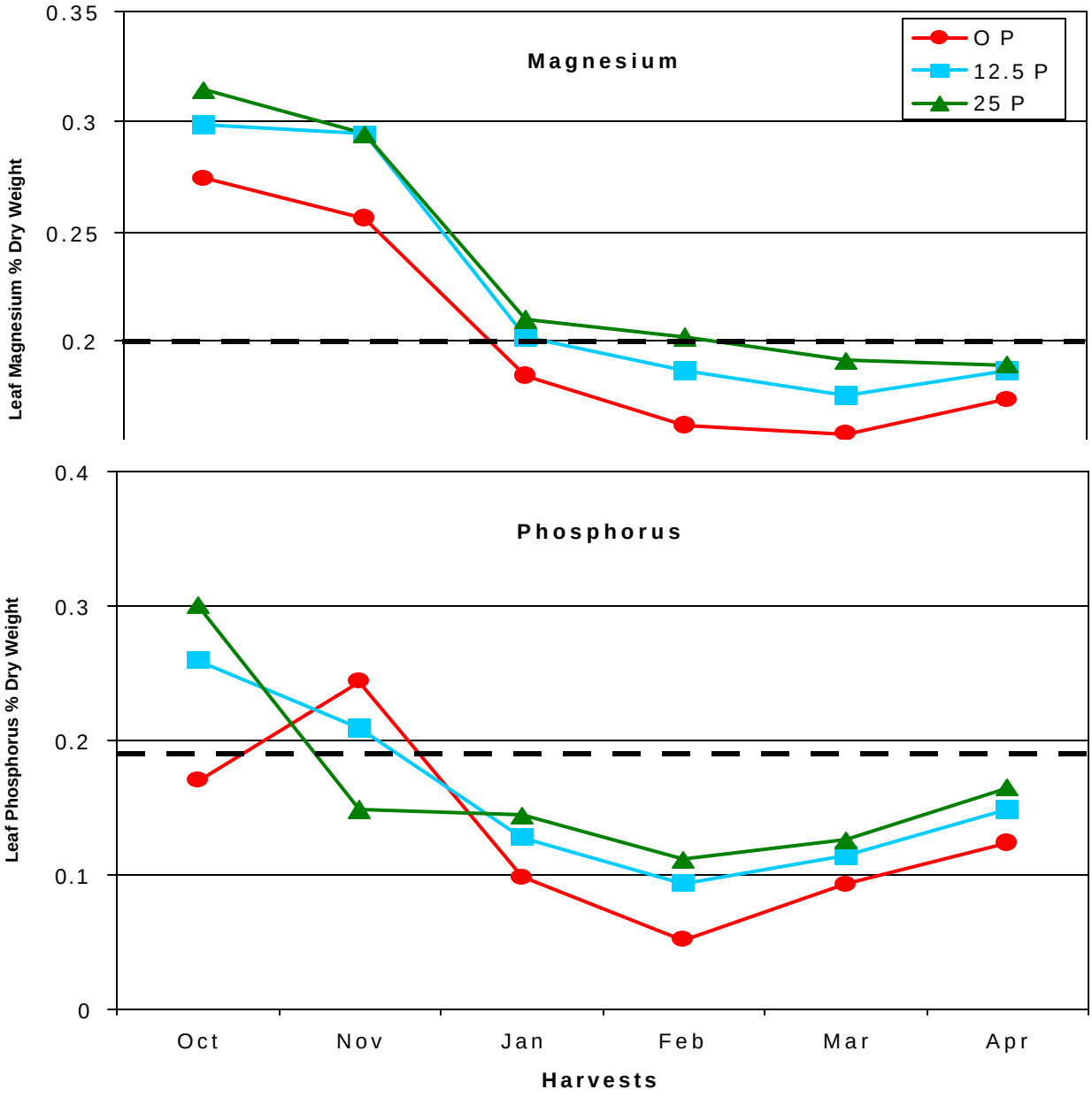
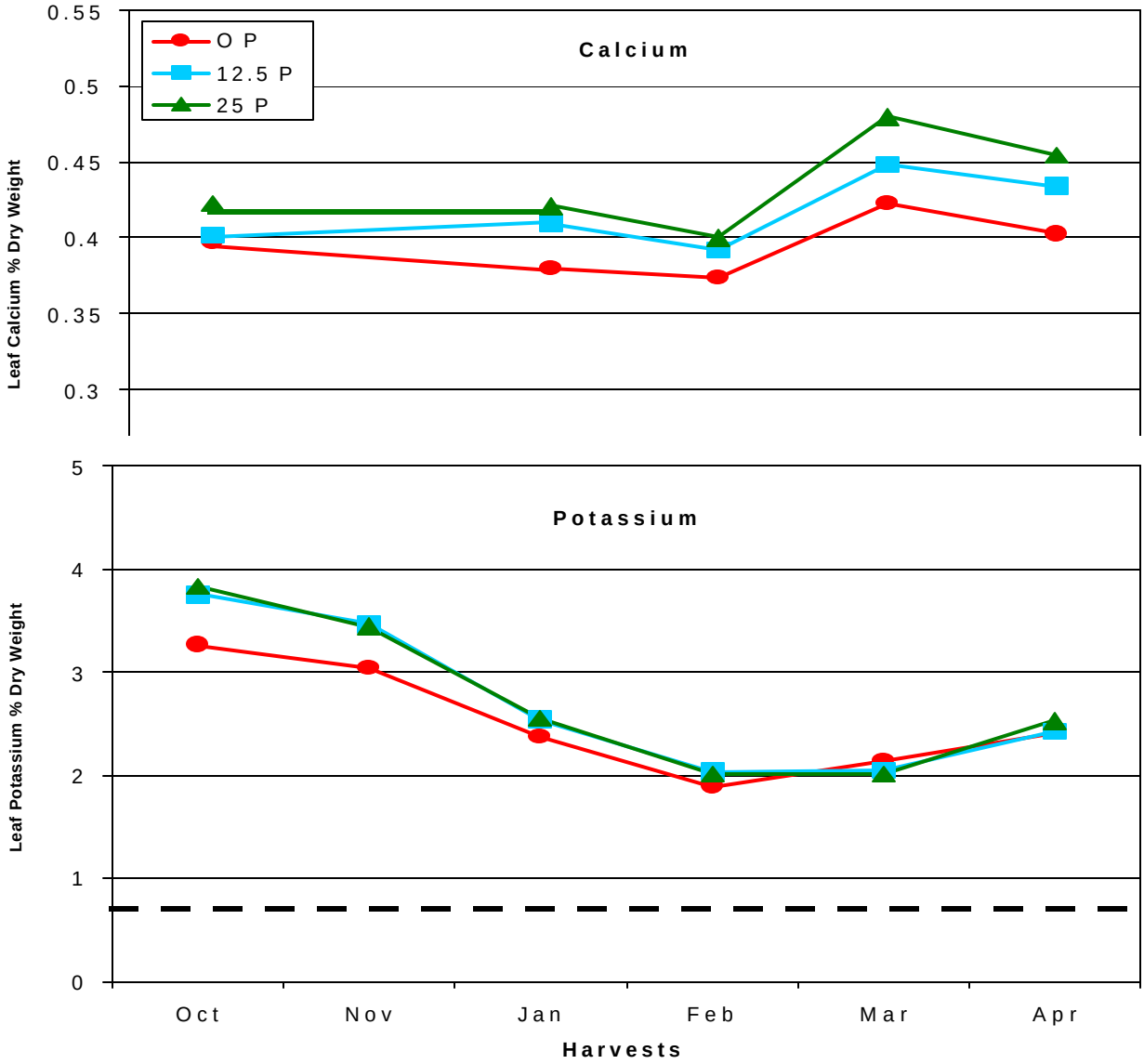


Fig. 2. Leaf calcium and potassium concentrations in stockpiled tall fescue treated with phosphorus fertilizer in late August, 2001, and sampled during fall, winter and spring of 2001 and 2002. Twenty of the most recently



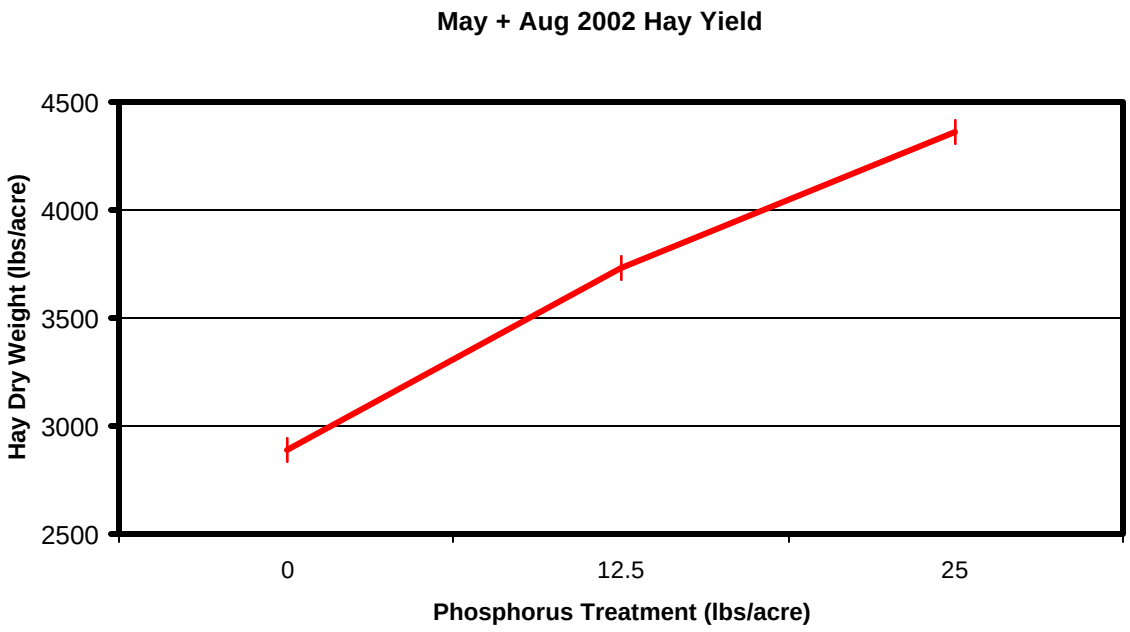
Calcium is an immobile nutrient in plants, and this is shown in the data presented in Figure 2, where calcium concentrations in the tall fescue leaves remains level through the fall and winter, and increased slightly in the spring. Leaf concentrations of calcium remain about those required for a grazing, lactating beef cow during the fall, winter and spring months regardless of treatment. Therefore there is apparently no problem with calcium concentrations of the tall fescue for grazing livestock. Interestingly

however, the calcium levels were higher in leaves of tall fescue treated with phosphorus.

Potassium is a mobile element in plant leaves, and this is shown in Figure 2 by the loss in leaf potassium concentrations during the winter months. Specifically, the leaf potassium concentrations drop from October through February and begin to climb in the spring. Like calcium, potassium concentrations exceed those required for grazing, lactating beef cattle during the fall, winter and spring, and there was no apparent response of leaf potassium concentrations to phosphorus treatments.

The May hay yield in 2002 was increased by 1000 lbs/acre by the 25 lbs/acre P treatment compared to the untreated control treatment (Fig. 3). The sum of the May and August hay yields in 2002 showed an increase of about 1500 lbs of hay per acre with the 25 lbs P/acre treatment compared to the untreated control plots (Fig. 3). When the May 2002 hay samples were analyzed, boron treatments produced some interesting results (Fig. 4). The 0.5 lbs B/acre treatment increased magnesium and calcium contents of the hay, especially at the zero and 12.5 lbs P/acre treatments, indicating possible phosphorus: boron interaction.

Figure 3. Hay production from the third week in May 2002 and the sum of the May plus August 2002 hay production as affect by phosphorus fertilization. The boron treatments were combined in these figures.



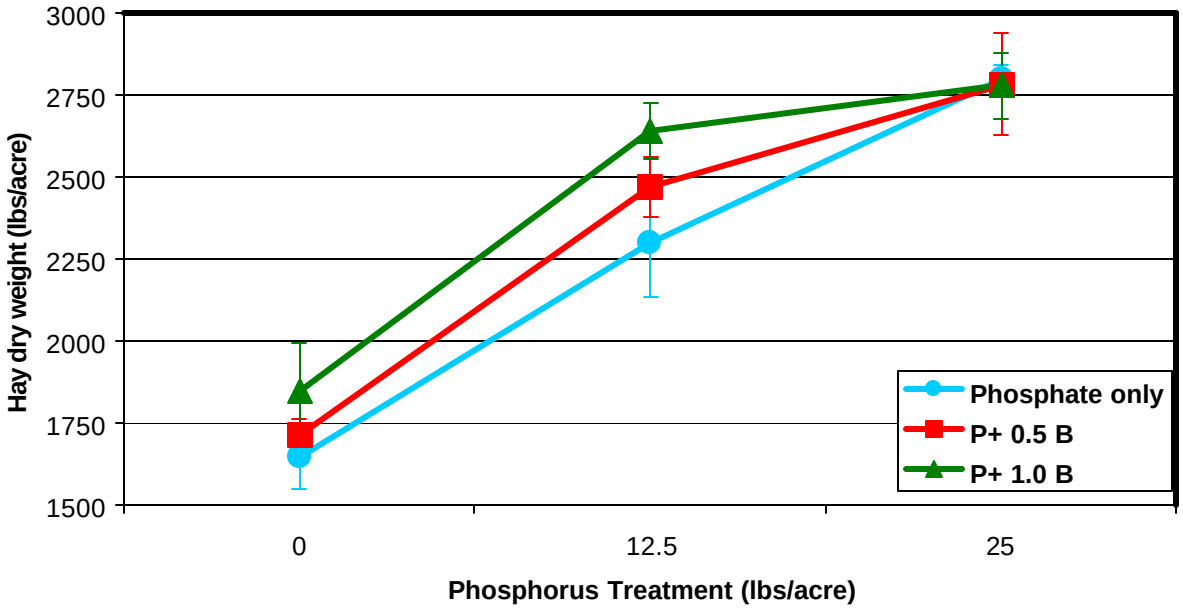
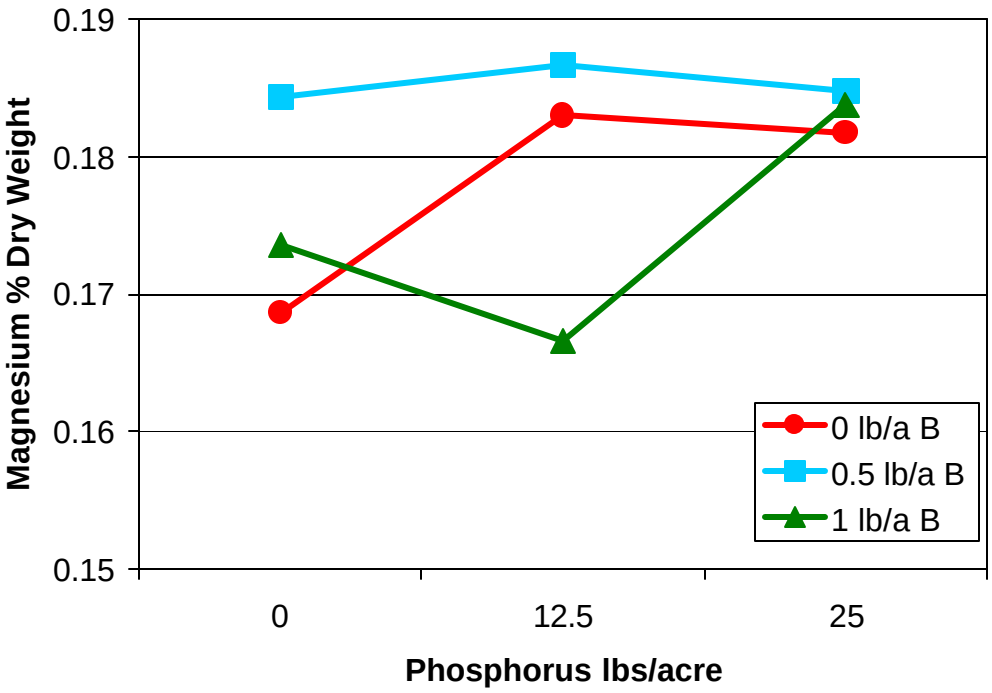


Figure 4. Magnesium and calcium concentrations of tall fescue hay harvested in May 2002 as affected by both phosphorus and boron treatments.



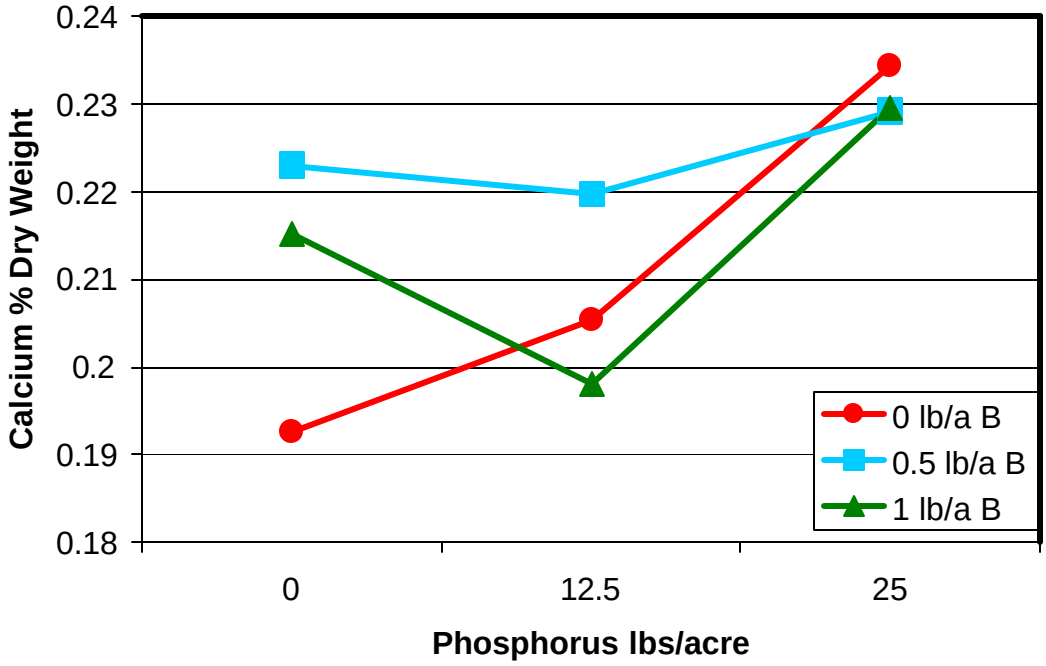
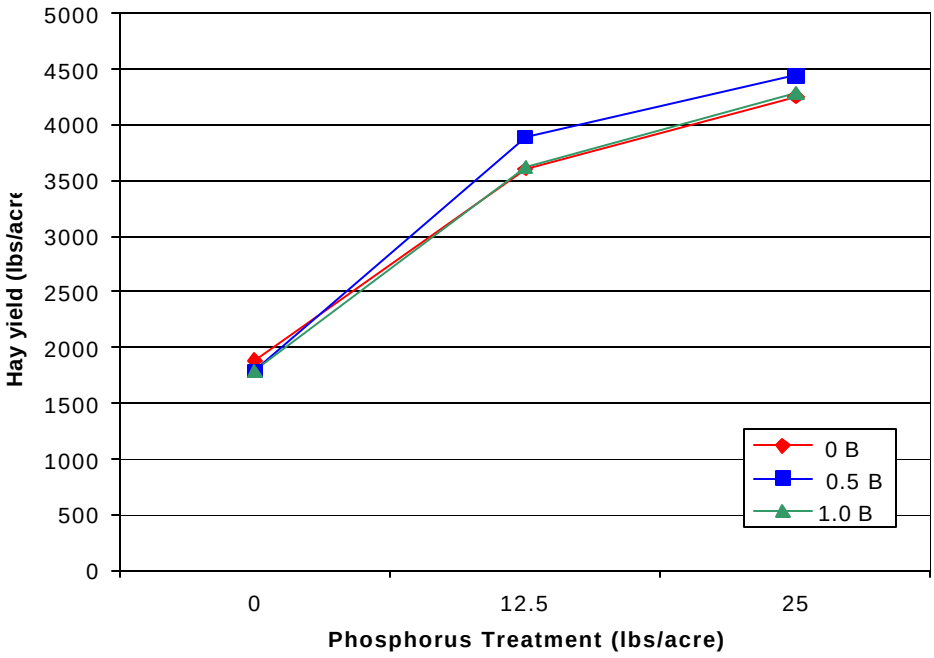


Figure 5. The May 2003 tall fescue hay yield following August 2001 and 2002 treatments with phosphorus and boron.



The May 2003 hay yield was increased by around 2500 lbs/acre with the high phosphorus treatment compared to the control treatment (Fig. 5). August hay yield showed little response to phosphorus treatments, but showed a small response to the 1.0 lb B/acre treatment (Fig. 6).

In summary, the phosphate treatments dramatically increase hay production of the tall fescue and help maintain higher levels of magnesium, phosphorus and potassium during the winter months for cattle grazing stockpiled tall fescue. However, even the 25lbs P/acre applications did not keep the phosphorus concentrations of tall fescue leaves about those levels recommended for grazing, lactating beef cows.

Figure 6. August 2003 tall fescue hay yield following August 2001 and 2002 treatments with phosphorus and boron.