Low Phosphorus Soils Cause Major Problems with Forage and Livestock Production

By Tim Reinbott, Richard Mattas and Dale Blevins

The complex set of problems associated with grass tetany usually boils down to low magnesium (Mg) and calcium (Ca)...and perhaps phosphorus (P)...in the diet of cows, typically occurring in the late winter and early spring. The objective of the initial research was simply to learn how Mg and Ca contents of grass plants can be increased. Laboratory research using hydroponic plant culture, or water culture with pure chemicals, revealed that the P concentration around the roots was a major factor in controlling the uptake of Mg and Ca into grass plants. Work in the greenhouse showed that not only uptake of these two important macronutrients, but also their movement from roots to leaves was dependent on the P nutrition of the plant.

A project that was initially begun to address the sporadic problem with cattle, called grass tetany, has been expanded to increase the production of higher quality tall fescue.

The research was then moved to tall fescue pastures in Southwest Missouri where grass tetany is common. Soil tests indicated that soils in this area were naturally quite low in plant available P. The addition of 57 lb/A P_2O_5 resulted in significant increases in Mg and Ca contents of tall fescue leaf blades in late March and throughout April. These results are a testimony to the fact that a basic mechanism discovered in the laboratory with hydroponics can be reproduced in a field situation.

Although results from these experiments have been published, over 60 percent of all soil samples from Missouri analyzed by the University of Missouri Soil Testing Laboratory during the past couple of years remain low in plant available P. In an effort to get the attention of livestock producers and to get more producers to improve their soil P levels, we decided to determine the impact of adding P on forage production by tall fescue pastures on low P soils. We also studied the interaction of Mg and P fertilization on Mg content of tall fescue.

Missouri's soil P recommendation for cool season forage production in pastures is based upon grass legume mixtures. An optimal Bray-1 soil P level of at least 40 lb/A...20 parts per million (ppm)...is recommended. However, there is little information available on soil P levels required by tall fescue monocultures for optimal macronutrient quality and yield. On soils that ranged from 8 to 97 lb P/A, application of 57 lb/A P_2O_5 in early March increased early spring (late March/early April) tall fescue leaf content of Mg, Ca and P at each soil P level.

Magnesium fertilization (15 lb Mg/A) did not increase tall fescue leaf Mg content unless soil P levels were over 30 lb P/A (data not shown). However, treatments with both Mg and P fertilization increased leaf Mg concentration at all soil P levels (8 to 97 lb/A), as shown in **Figure 1**. These results

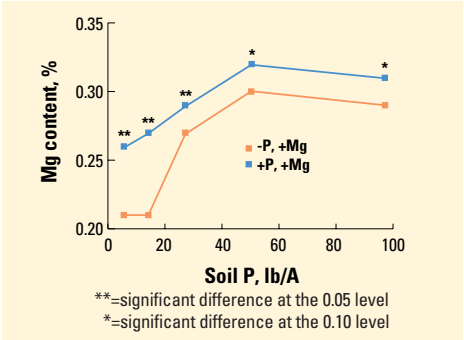

Figure 1. Leaf Mg content of tall fescue from plots treated with 15 lb Mg/A only and with 15 lb Mg plus 57 lb P_2O_5/A. Soil Bray-1 P levels ranged from 8 to 97 lb/A.

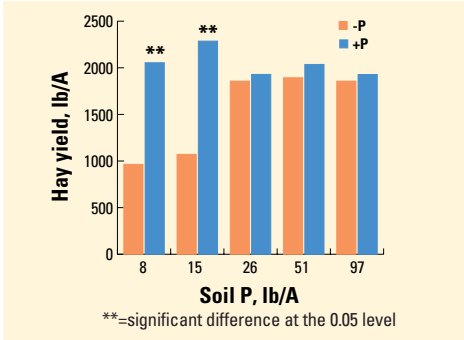

Figure 2. Hay yield of tall fescue harvested in May from plots either treated with or without 57 lb P_2O_5/A in early March. Soil Bray-1 P levels ranged from 8 to 97 lb/A.

are consistent with our previous results where Mg fertilization was effective only when P was also applied. These data may explain why in other studies Mg application of 100 lb/A on low P soils failed to increase leaf Mg content.

Phosphorus fertilization (57 lb P_2O_5/A) of soils with 8 or 15 lb Bray-1 P/A increased hay production by over 1,000 lb/A at both the May (**Figure 2**) and July harvests compared to untreated controls. Total hay production in spring and summer was increased by over one ton/A with P fertilization on these low P soils. Forage yields were not increased by P fertilization when soil P levels were at or above 26 lb/A. This confirms that the original 40 lb P/A soil test recommendation for mixed grass/legume pastures is on target for monoculture tall fescue forage production.

There was little increase in tall fescue forage production in October following P fertilization at any soil level. This indicates that most of the P applied in March had been taken up by the plants and/or fixed by the soil in a form not available to the tall fescue roots.

Annual P application (57 lb P_2O_5/A) was as effective as building soil levels to 26 lb P/A or greater for increasing both forage quality in the early spring and for increasing hay yield in May and July. Annual P fertilization may be a good alternative, economically, on certain soils that are very low in P since building up soil P levels to 40 lb/A would be more expensive.

Forage Mg, Ca and P contents of hay harvested in May were about one-half those found in grass samples in early April. In addition, P fertilization did not improve the Mg, Ca and P contents of the hay in May. However, forage from the July and October harvests was much higher in Mg, Ca and P contents than that harvested in May. Initially we were surprised by these findings but further investigation revealed that stems, which make up about one-half of the total hay yield in May, contain only about one-half the Mg, Ca and P found in leaves. The tall fescue harvested in July and October was nearly 100 percent leaves, and as a result, forage Mg, Ca and P contents were high. In order to produce high nutrient quality tall fescue hay, we are now working to minimize stem production. BC

Mr. Reinbott and Dr. Blevins are with University of Missouri, Columbia. Mr. Mattas is located at the University of Missouri Southwest Center, Mt. Vernon.