PUBLICATIONS
1992

FIELD DAY REPORT - 1992

Texas A&M University Agricultural Research and Extension Center at Overton

Texas Agricultural Experiment Station
Texas Agricultural Extension Service

Overton, Texas

April 30, 1992

Research Center Technical Report 92-1

PHOSPHORUS EFFECTS ON MAGNESIUM UPTAKE BY FORAGE GRASSES

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Background. Magnesium (Mg) is the fourth most abundant cation in the body. Approximately 65% of total body Mg is contained in bone. One-third of the Mg in bone is combined with phosphorus (P). Beef cow requirements for Mg are 21, 22, and 18 g/day during early, mid, and late lactation, respectively. Deficiencies of Mg in the beef cow can occur as a result of low Mg concentrations in forage or supplement. A severe deficiency is associated with the acute metabolic disorder hypomagnesemic tetany, commonly referred to as grass tetany. Grass tetany is most likely to occur in beef cows during initial stages of lactation while grazing pastures containing less than 0.2% Mg. This research evaluated the effect of P on Mg uptake by ryegrass.

Research Findings. Limestone [4.5% Magnesium (Mg)] was applied to major plots on a pH 4.5 Lilbert loamy fine sand at rates equivalent to 0, 600, and 3400 lb/ac. Phosphorus was applied to split plots at rates of 0, 31, 61, 92, 123, 245, and 491 lb P_2O_5/ac replicated 8 times. These treatments were roto-till incorporated into a bermudagrass hay meadow in mid-summer. A duplicate application of the phosphorus rates was surface applied in June the following year. No additional lime or P treatments were applied after this time. Nitrogen, potassium, Mg, and sulfur were applied to maintain grass production. Bermudagrass yields were taken in 1983, 1985, and 1986, and ryegrass harvests were made in 1984, 1986, and 1987.

Lime and P rates had significant effects on increasing soil test P levels (Fig. 1). This is an important consideration when evaluating the effect of P on Mg uptake. In 1985, soil test P in the 0 to 6 inch depth was increased linearly to 37.8, 40.0, and 55.4 ppm, respectively as applied P_2O_5 was increased from 0 to 982 lb/ac at

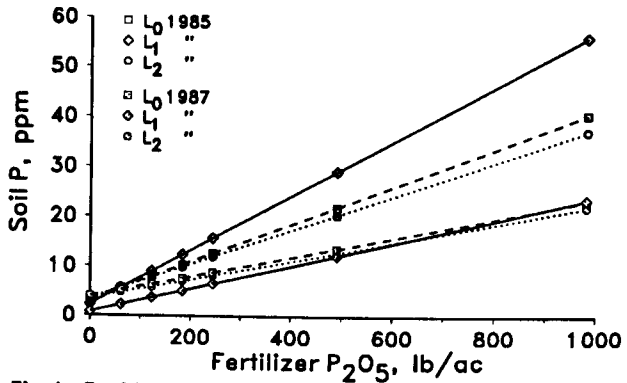

Fig. 1. Residual soil P two and four years after limestone treatment. L_0=none, L_1=600, and L_2=3400 lb lime/ac.

limestone rates of 0, 600, and 3400 lb/ac. Soil pH was 4.51, 4.65, and 6.19, respectively. In 1987 with no additional limestone or P applied, soil pH values were 4.50, 4.49, and 4.61 due to the respective lime rates. Residual soil P values were lower and similar due to lime rate.

Ryegrass yields in 1986 were increased by the higher lime and P rates (Fig. 2). The concentration of P and Mg in the ryegrass increased as the level of applied P increased (Fig. 3). The Mg concentration was well below the adequate forage dietary level for beef cattle in all ryegrass samples.

Phosphorus uptake significantly increased Mg uptake in 'Marshall' ryegrass (Fig. 4). The R^2 value of 0.86 indicates that 86% of the variability in Mg uptake is related to P uptake. As residual soil P declined due to increasing soil acidity, the amount of variability in Mg uptake that could be explained by P uptake increased. In the 1987 ryegrass harvest, P uptake alone explained 91% of the variability in Mg uptake.

Application. Proper limestone treatment of an acid soil and adequate fertilization with P will raise the soil test P level and result in increased P uptake by the plant. Although these data show that increased P uptake can increase the plant uptake of Mg in ryegrass, the level of Mg is quite low. Cattle grazing low Mg concentration ryegrass need supplemental Mg provided in a mineral mixture.

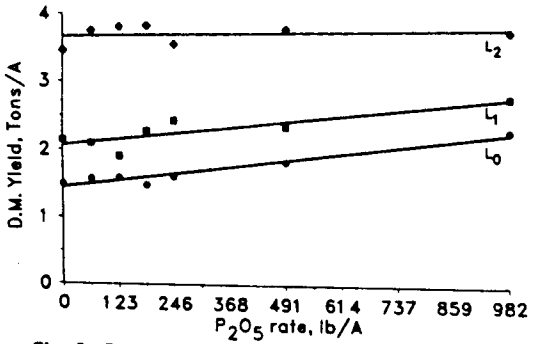

Fig. 2. Ryegrass yield response to the interaction of limestone and phosphorus.

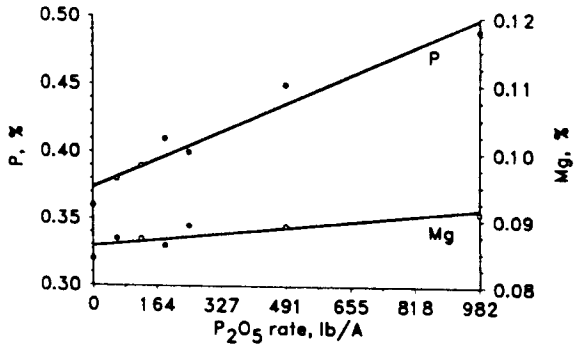

Fig. 3. Phosphorus and Mg concentration in ryegrass in 1986 after P fertilization 2 and 3 years earlier.

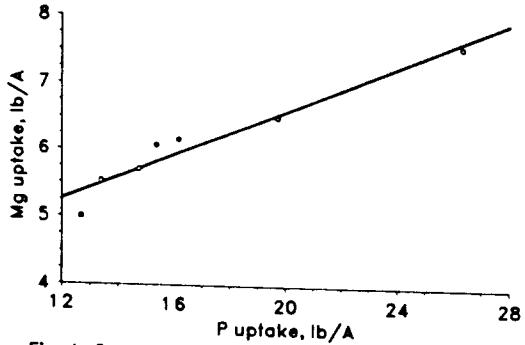

Fig. 4. Correlation of phosphorus and magnesium uptake in ryegrass tissue. (R^2 = .86)