Boron-Lime Interactions on Clovers

By V.A. Haby, R.H. Loeppert, and R. Villavicencio

Liming to provide the proper pH for availability of major nutrients and activity of legume nodulating bacteria can increase plant needs for micronutrients, including boron (B).

BORON, an essential nutrient for plants, is needed in only small quantities. Clovers are among the more sensitive crops to B deficiency. The accumulation of carbohydrates, ammonium compounds, and other soluble nitrogenous compounds in B-deficient plants suggests a breakdown of protein synthesis.

Boron is involved in processes of cell division and transport of sugars. A buildup of sugars in plant leaves due to B deficiency can result in bright colors that may range from yellows to reds (**Figure 1**). Also, evidence links B to calcium (Ca) and potassium (K) metabolism of the plant.

Boron deficiency in clovers usually appears on the youngest leaves. These leaves will develop a red to reddish-yellow color, depending on the K level in the plant. If the deficiency is sufficiently severe, the growing point will die. Clover can grow out of a B deficiency but may suffer a significant yield loss.

Boron deficiencies are common in sensitive plants in higher rainfall areas. Boron is adsorbed by clay minerals and metal oxides more strongly than chloride (Cl) or nitrate (NO_3). Still, B is relatively mobile in the soil and can leach with heavy rainfall. Much of the available B in soil is associated with organic matter accumulated in the surface soil layer. Because of this, uptake by the plant may be reduced by surface soil moisture stress.

Figure 1. Rose clover sample at left shows B deficiency on early growth where 1 ton/A of 100 ECCE lime was applied with no B. Sample in center received 1 lb/A rate of B, and at right 2 lb/A. Although the plants appeared to overcome the early B deficiency, yield loss due to the deficiency was about 1,000 lb of forage per acre.

In **Figure 1**, the B deficiency symptoms appear on the lower leaves. The initial reddening of these leaves occurred when they were new growth during cool temperatures. As temperatures increased, B availability increased, probably because of organic matter mineralization and plant root extension. This allowed the clover plants to grow out of the deficiency.

Boron availability is affected by high soil pH. As soil pH increases, B availability decreases. Liming can lower B

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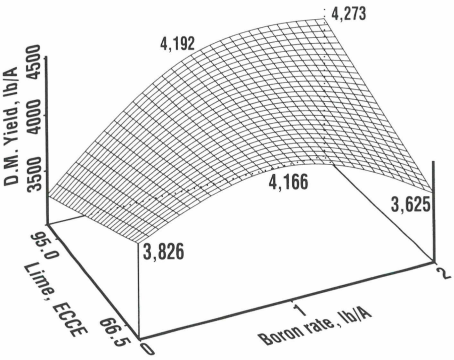

Figure 2. Rose clover response to lime ECCE and rate of B.

availability and increase the need for B fertilization. Research in Texas has shown that use of 100 percent effective calcium carbonate equivalent (ECCE) lime decreased B availability to clover and allowed the plants to tolerate 2 lb B/A (**Figure 2**). The less efficient 62 percent ECCE limestone was not as effective in increasing soil pH and lowering B availability. With the less effective liming material, the 2 lb/A rate appeared to be toxic to the clover, decreasing yield to levels below the zero B treatment.

In summary, liming soil to provide the proper pH for macronutrient availability and activity of legume nodulating bacteria can increase plant needs for micronutrients, including B. For optimum clover production, don't overlook this significant nutrient interaction on highly leached, limed soils. Soil tests for B availability and lime requirement are suggested. ■

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migration result from N source application, then N source should influence soil physical properties such as water content at the permanent wilting point. There were no significant differences in either soil layer in water content (at the permanent wilting point) among the four N sources or between the N treated and the no-N check.

Summary

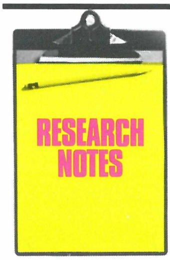
Grain yields at Ottawa and Powhattan during the period 1985 through 1988 indicated that plots receiving N yielded significantly more grain (overall average of 78 bu/A) than no-N check (average of 37 bu/A). There were no significant differences in grain yield among the four N sources.

The primary influence of 20 years of N fertilization has been on soil acidification and associated changes in nutrient availability. Lower nutrient availability probably reflected greater nutrient removal in the higher yields of N-fertilized areas.

Thus, N source selection should be based on:

- cost of N
- adaptability of the N source to the producer's crop-tillage system
- availability of N supply.

Pound for pound, all N sources in this study were shown to be agronomically equal when properly applied. ■



Kansas

Evaluation of Starter Fertilizers for Grain Sorghum Production

THREE YEARS OF FIELD WORK have provided good evidence of the responsiveness of grain sorghum to high phosphorus (P) starter fertilizers on low P soils. Yields were increased an average 21 to 27 bu/A (1,176 to 1,512 lb/A). The magnitude of response is comparable to that of wheat and corn under similar conditions. Results of the studies indicated no differences in effectiveness between a 9-18-9 (N-P_2O_5-K_2O) orthophosphate liquid starter and a polyphosphate containing 7-21-7. Researchers concluded that selection of a starter fertilizer source for grain sorghum should be made on the basis of economics and availability rather than formulation ingredients. ■

Source: R.E. Lamond and D.A. Whitney. Published in Journ. Fertilizer Issues, 8(1): 20-24 (1991).