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## EFFECTS OF BORON ON SEEDLING ESTABLISHMENT OF ANNUAL LEGUMES

G. R. Smith, C. L. Gilbert, and I. J. Pemberton

**Background.** Winter-annual clovers are often overseeded on warm-season perennial grass sods for grazing in East Texas. Establishment, at initial planting or during natural reseeding, is a major management problem when using these annual forage legumes. Soils in the East Texas Timberlands are often sandy and acidic with low native fertility. Phosphorus and potassium fertilization and liming are generally necessary for annual clover forage production. Boron fertilization has been recommended but has not been used in recent forage fertilization programs. Field experiments at Overton have shown improved maintenance of reseeding annual clover stands when boron deficiencies were corrected. The objectives of this research were: 1) to evaluate the effects of boron on seedling establishment of annual clover; and 2) to evaluate the relationship between seedling drought tolerance and boron amendments.

**Research Findings.** Boron (B) was mixed into individual pots at the rate of 0, 1.5, or 3.0 lbs B/ac. Pre-germinated 'Mt. Barker' subterranean clover seed was planted and plants were harvested at 2, 3, or 4 weeks. Boron fertilizer significantly increased root, and to a lesser degree, shoot dry weights of sub clover seedlings when compared to unfertilized plants. These positive effects on growth were evident when plants were three weeks old; by four weeks, root dry weights of plants fertilized with 1.5 or 3.0 lbs B/ac were nearly twice that of unfertilized controls. Shoot dry weights at four weeks were 14 and 20 percent greater for plants fertilized with 1.5 or 3.0 lbs B/ac, respectively, than plants which received no boron.

The increased root mass was due to increases in taproot length, and number and size of lateral roots. Taproot lengths were already significantly longer at two weeks for boron fertilized plants and this difference was amplified by four weeks. Taproots of unfertilized plants grew an average of only 0.4 in. in two weeks, while those of plants receiving 1.5 or 3.0 lbs B/ac grew 2.6 and 2.7 in, respectively. The total number of lateral roots was higher in treatments with boron than in minus boron. A similar effect was observed for the number of lateral roots over 0.4 in and over 1.2 in. in length. In most cases, the 3.0 lbs B/ac rate caused a slight, but insignificant growth depression of the sub clover seedlings.

Plants which had not received boron exhibited typical boron deficiency symptoms: stunting of growth at the apical meristem, and wrinkled, thicker, bluish-green leaves. Most seedlings had not progressed beyond the cotyledonary stage. Stunted root growth was evident as well.

In a second experiment, boron was mixed into the soil on a soil weight basis at the rate of 0, 1.0, 2.0, and 3.0 lbs B/ac. Legume varieties used were 'Dixie' crimson, 'Yuchi' arrowleaf, 'Common' ball, 'Bigbee' berseem, 'H-18' rose, 'Hairy' vetch, and Mt. Barker sub. Measurements taken after 4 weeks were root length, shoot and root dry matter yield, number of lateral roots, number of lateral roots over 0.4 in, and number of lateral roots over 1.2 in.

Boron fertilizer, whether applied at 1.0, 2.0, or 3.0 lbs/ac, significantly increased some aspect of root growth compared to unfertilized controls for all clover species tested. Hairy vetch did not exhibit enhanced root growth. All clovers possessed longer roots and more lateral roots longer than 1.2 in when fertilized with boron. Except for sub and rose clovers, all clovers fertilized with boron had a greater number of total lateral roots.

In a third experiment, boron was applied at 1 and 2 lbs B/ac on three different field sites. Soil samples were taken 15 days before and after B application and at monthly intervals for five months. Sample depths included 0-6, 6-12, 12-24, and 24-36 inches. Preliminary analysis of this data set indicates that a 2 lb/ac rate of B applied in a field situation does not correct a boron deficiency on sandy soils. Two lbs B/ac increased soil B from 0.25 ppm to 0.41 ppm at the 0-6 inch sample depth and from 0.1 ppm to 0.36 ppm at the 6-12 inch sample depth.

**Application.** Our studies show that boron is crucial for annual clover seedling establishment, growth and survival. Boron applied to greenhouse pots at 1.5 lbs/ac pre-planting resulted in dramatically larger plants under conditions of adequate water supply. Plants fertilized with boron were also more drought tolerant than unfertilized plants. These dramatic effects were the result of the correction of soil boron deficiency. The native boron level of less than 0.3 ppm B was corrected to 0.8 - 1.0 ppm B by the addition of 1.5 lbs B/ac in the greenhouse experiment. Under field conditions, more than 2 lbs B/ac may be required to correct soil boron deficiency on sandy soils. More research is needed to determine the best method to deliver the required boron to the clover seedling. Annual clover forage production depends on successful seedling establishment. Correcting boron soil deficiency before planting will help ensure greater seedling survival under drought conditions and improve early seedling growth and establishment.