Boron

AGRONOMY

Boron (B) was unknown as an essential plant nutrient until 1926. Since then, there have been three main crops that consume most of the boron fertilizer manufactured today: alfalfa, apples, and Brassicaceae crops (e.g., cabbage, cauliflower, broccoli, and brussel sprouts). Because alfalfa's need for boron is most widely known, alfalfa is recognized as the market's largest consumer of boron.

Nevertheless, there are a number of crops that frequently exhibit boron deficiencies but never receive adequate boron applications (e.g. sugarbeets, peanuts and cotton). In addition, management of boron is quite different than management of other micronutrients because boron is a leachable anion which can readily become toxic if misapplied. This article provides information on boron's role and deficiency symptoms, the factors affecting its availability, and application recommendations.

Role And Deficiency Symptoms

Boron plays an essential role in promoting cell elasticity, which is critical for newly developed cells that need to elongate rapidly. An example would be reproductive cells during pollination in corn silks or pollen tubes. Boron also helps prevent excessive conversion of sugar to starch.

While boron is mobile in cherries, almonds, apricots, plums, apples, and pears, it is immobile in most other plants. This means the plant is unable to supply boron for newly developing tissues. Therefore, boron must be readily available in the soil at all times.

Deficiency symptoms in plants with immobile boron are most apparent in the youngest leaves or in growing points, which results in poor seed or fruit set. The crops most sensitive to boron deficiency are alfalfa, sunflowers, peanuts, sugar beets, cotton, cauliflower, table beets and apples.

Factors Affecting Boron Availability

Boron availability is dependent upon soil organic matter and clay, soil moisture, and the amount of leaching or rainfall.

- **Organic matter and clay** – Most available boron is absorbed by organic matter and, to a much lesser degree, by clay particles. Sandy soil with low organic matter is most prone to boron deficiency.
- **Soil moisture** – Average soil has a total boron content of 10 ppm. Boron availability decreases during periods of dry weather, but tends to increase rapidly as soon as the soil becomes moist again. This is attributed to the fact that 3 to 5 percent of the total boron in the soil is dissolved in soil moisture. Thus, low soil moisture means less boron is dissolved in the soil.
- **Boron leaching** – Boron is also the most mobile (leachable) micronutrient in the soil. Should leaching occur, nitrate would be the most soluble followed by chloride, sulfate and boron. Boron toxicity can be reduced by leaching.

Diagnosing Deficiencies

Hot water is the most commonly used method for extracting and testing boron. The critical soil-test range for hot-water extractable boron is 0.3 ppm for non-sensitive crops and 1.0 ppm for sensitive crops. The interpretation of the boron soil test can be improved when other factors that affect boron availability, as previously mentioned, are factored into the equation. For example, a boron soil-test level of 0.3 ppm would probably be adequate for corn in a medium-textured soil with 2.0 percent organic matter. However, a 0.3 ppm soil-test level could possibly result in boron deficiency in corn grown on sandy soil with low organic matter.

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Compared to broadleaf crops, grass crops require about one-fourth as much boron for normal growth. Boron levels in boron-deficient plant tissue are < 5 ppm in less sensitive grass crops such as corn, sorghum, and wheat, and < 20 ppm in broadleaf crops such as soybeans. Sensitive crops such as sugar beets, sunflowers, alfalfa, and some tree crops, are usually deficient when the boron tissue level is < 30 ppm.

Recommendations

Soil-Boron Levels

- Since boron is mobile in the soil, annual or semi-annual applications are needed to maintain adequate levels.
- Attempting to build boron soil-test levels would be unadvised, since leaching boron beyond the reach of the roots would likely happen within 3 to 4 years (or possibly sooner).

Application Rates

- Application rates range from 0.25 to 3 lbs. of boron per acre.
- Higher application rates are generally required for broadcast application versus band application.
- High application rates should never be used on crops highly sensitive to excess boron (e.g., beans, peas, grapes, lemons, and strawberries).

Cautions

- Boron fertilizer should never be applied in a band with direct contact on the seed.
- Broadcast application should be used to establish and maintain no-row crops such as alfalfa.
- For greater efficiency of fertilizer use, band application should be used when low application rates are used.
- Band application rates should be less than 0.5 lbs./acre to reduce the chance of depressed root growth within the rich boron band zone.
- Foliar spray applications are quite effective, but repeated applications may be required due to the poor transfer of boron from older to younger leaves.
- Most boron sources are crystalline; therefore, their average particle size is much smaller than that of granular NPK fertilizers. Because the difference between deficiency and toxicity is rather slim, caution should be exercised to ensure the fertilizer blend is homogenous.
- Manure is another good source of boron, containing approximately 1 lb. of boron per 10 tons of beef feedlot manure.
- Irrigation water is another source of boron to be considered. In many regions of the country, irrigation water boron levels are more than adequate to meet plant needs.

Conclusion

Boron is an essential plant nutrient for many crops. Boron fulfills a crucial role in promoting cell elasticity, which is especially important for reproductive cells, and in preventing excess conversion of sugar to starch. The factors affecting boron availability include organic matter and clay, soil moisture, and leaching. Because boron is held primarily by soil organic matter, soil that is low in organic matter naturally suffers from excessive boron leaching.

Deficiency symptoms are most apparent in the youngest leaves or in growing points. Crops most sensitive to boron deficiency are alfalfa, sunflowers, peanuts, sugar beets, cotton, cauliflower, table beets, and apples. Boron fertilizer recommendations are usually less than 3 lbs. of boron per acre and vary by crop and soil composition. Since boron can easily become toxic, boron fertilizer should never be applied with the seed.

If you are using or planning to use boron, make sure you are on a soil-testing program. The multitude of factors affecting boron levels, and the thin line between boron deficiency and toxicity, make a good soil-testing program vitally important.