Boron the Mighty Micronutrient!

by Dr. Tarlok Singh Sahota, *CCA*

Boron is one of the 17 essential nutrients (considering cobalt as an essential nutrient as well). Continuous cropping with high yielding varieties, without additions of micronutrients is leading to increased micronutrient deficiencies. Boron deficiency is fairly widespread in North America. Response to boron application has been reported from at least 43 states in the USA and throughout Canada. Even though it is (i) required in small amounts in the plant's tissue (30 ppm in canola at flowering, top 15 cm of alfalfa at 10 % bloom, and only 5 ppm in cereals whole plant before filling) and (ii) removed in small amounts by crop plants from soils (100 gram/ha by alfalfa and barley grains, 700 gram/ha by corn grains, 60 grams/ha wheat grains, 70 grams/ha peas-vines, pods and potatoes), its deficiency in soils and crops can cause serious physiological damage. Deficiency retards plant growth and causes substantial reduction in crop yields even when other nutrients are applied in sufficient quantities and the deficiency symptoms of boron are not clearly seen. For example, in legumes, boron deficiency, without any visible symptoms, can reduce the legumes seed yield by 40-50%.

Deficiency Symptoms of Boron:

The symptoms of boron deficiency vary with crops. In soybean, boron deficiency often induces an internal empty space known as "hollow heart". Legumes sown in boron deficient soil have a poor rate of germination. More seed must be sown, and seedlings are stunted. Alfalfa grown in boron deficient soils, exhibits reduced root and shoot growth and yellow, red or purple discoloration on the upper leaves. In apples, boron deficiency causes internal corking, while shoot tips form a rosette shape. Crooked stem in celery and 'Black Heart' (heart rot) in sugarbeets are signs of boron deficiency. In canola, symptoms of boron deficiency can be confused with that of sulphur. In boron deficient tissues, cambial cells cease to divide. Boron deficiency is known to inhibit protein synthesis. *In general, a common consequence of boron deficiency in all crops is an interruption in flowering and fruiting, so that yields are poor and the fruit or grain is deformed or discoloured.*

Functions of Boron in Plants:

Boron plays an important role in sugar transport, cell wall synthesis, lignification, cell wall structure, respiration, metabolism, membranes, root growth, pollination, plant maturity and disease resistance. Boron also influences the colonization of Mycorrhiza at the root surface and thereby influences P (and also K) uptake. It also regulates K/Ca ratio in plants. Research in the USA has shown that boron is important in nitrogen fixation and nodulation in legumes. Boron plays an important role in plant diseases control. It synthesizes lignin as a pathogen barrier and restricts fungal hyphae from movement through the cell walls. Boron application is reported to decrease rust in wheat and control postharvest gray mold in grapes (caused by *Botrytis cinerea*) by strongly inhibiting spore germination, germ tube elongation, and spread of mycelia. Deficiency of boron could result in pollen sterility and thus increase ergot risk in cereals. Barren corn stalks and unfilled tops in corn cobs could be a strong pointer to boron deficiency!

Boron in Soils:

In soils, boron is present in four forms: (i) as soluble boric acid or H3BO3 in the soil solution that is directly plant-available, (ii) mineral boron, released in the soil on weathering of minerals, (iii) adsorbed by the clay minerals and iron hydroxides; released to the soil solution upon desorption, and (iv) in organic matter; released to the soil solution upon microbial decomposition of the organic matter. The largest amount of boron in the soils is found in the organic matter; decomposition of which will be slow in cold weather/regions such as ours. Solubility of boron is restricted under dry weather conditions which can lead to temporary deficiency of boron in crops even when boron is present in sufficient amounts in the soils. A good rain will fix such a situation. For example, an alfalfa crop with shorter internodes, as a result of boron deficiency due to dry weather, will outgrow that stage after a good rain. The new internodes will be a normal length though the older internodes will remain short. In acidic soils, boron is more water-soluble and is therefore liable to leaching below the root-zone. Liming of acidic soils to improve soil pH could restrict boron availability. Maximum availability of boron is at a soil pH of 6.0-6.5. For adequate supply of boron to crops, soils should have at least 1.2 ppm boron. Boron deficiency is most common in coarse textured (sandy) soils that are low in (i) organic matter and (ii) boron containing minerals.

Correcting Boron Deficiency:

Boron deficiency can be corrected by soil or foliar application. Generally, micronutrient uptake is rapid during early growth and there is a gradual dilution as the plant matures. Therefore, it is advisable to apply boron at seeding @ 2.5 kg boron/ha in soils highly deficient in boron (<0.4 ppm) and @ 1 kg boron/ha in soils deficient/or marginal in boron (0.4-1.2 ppm). Higher amounts could also be applied to crops that show high response to boron application (alfalfa, apple, sugarbeet, sweet potato, tomato, cauliflower and celery) and lower amounts could be applied to crops that have a low response (cereals, soybean, potato, pasture grasses and blueberries). Because of relatively low amounts of recommended boron, and a narrow range between deficiency and toxicity of boron, it is advisable to blend boron with other fertilizers that are applied at seeding to ensure its uniform application/ and optimum nutrition. Borax (15% boron) and Solubor (20% boron) are good fertilizer sources of boron. Boron deficiencies at later stages of crop growth (e.g. flowering) could be corrected by spray application of boron @ 1 kg/ha. There should be no concern about boron toxicity as long as the amount of boron in soils does not exceed 5 ppm and the amount of applied boron is no greater than 2.5 kg/ha.

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