SOIL–PLANT–WATER RELATIONSHIP OF BORON AND FACTORS AFFECTING ITS AVAILABILITY A REVIEW (PART–II)

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Functions of boron in plants

The exact and specific function of boron in plant vegetative life is not understood as yet. However, investigations have shown that it causes death of the terminal growing point, breakdown of the conducting tissues and results in the brittleness of stem and petiole which finally causes brown coloration and cessation of roots and height-growth (Bangash & Gardiner, 1985). Boron deficiency causes increase in total sugar and starch in leaves and stems of boron deficient plant (Oram, 1961); while a greater amount of benzene insoluble matter is also found in the leaves of normal plants and in the stem of boron deficient plants. Certain parts of plants die because of lack of sugar of inadequate presence of boron. Thus boron deficiency symptoms may be an expression of sugar deficiency. Boron is essential to cell division (Haas and Klotz, 1931) in the meristematic tissue and in the cambium and is a necessary component of cell wall (Berger, 1949). It prevents excessive swellings & Plays some part in the formation of pectin. Its deficiency results in cellular swellings of the middle lemella followed by the discoloration & breakdown of cell wall as a result of boron starvation strongly indicates that boron plays definite role in the formation of pectin substances and in cell rigidity (Oram, 1961).

Boron also plays an important role in the nitrogen metabolism and consequently in the synthesis of protein in the plant tissues because nitrogen compounds and sugar accumulate while meristematic tissues dies in absence of boron (Berger, 1949). There may also be an accumulation of soluble nitrogen and carbohydrates in plants and a reduction of amount of protein formed. Its deficiency results in higher NO_3-N, whereas its sufficiency decreases NO_3-N in plants (Oram, 1961). Boron has an effect on pollen germination and prevents bursting of Pollen Tube, hastens flowering and fruiting process and increases seed & fruit formation, activities salt absorption, Increases seed & Fruit formation, hormone movement, metabolism of pecitc sustances, water metabolism and the water relations in plants and respiratory activities. Boron is said to be a constituent of membranes and serve in precipitating excess cations. This acts as a buffer necessary in the

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maintenance of conducting tissues and thus exerts a regulatory effect on other elements.

Boron is necessary for carbohydrate metabolism and transportation of sugars in plants (Hass and Klotz, 1931, Berger, 1949 and Oram, 1961). In order for highly Polar compounds such as sugars to move through cell walls and other membrances, energy must be expended. Boron may lower Polarity of the sugar, thus reduces the energy required for translocation by either or both of two modes of action. Boron may combine directly with sugar and thus move with it. B-deficient leaves have, therefore, comparatively high concentration of sugar & starch, & thus keeps the sugar-starch balance in plant (Oram, 1961). Boron controls the activity of oxidative enzymes, reduces adsorption of water in plants (Moldovan *et al.*, 1969). Further, B deficiency enhances the development of "Root diseases such as Fusarium Wilt and Root Rot". Whereas the excess amount of B destroys Chlorophyl content. Boron sufficient Plant can "better stands against drought and Frost".

Boron deficiency symptoms in plants

Visual symptoms of boron deficiency have been the subject of much investigations. They vary with type and age of the plant, prevailing soil and climatic conditions under which it is growing and the severity of the deficiency (Bangash and Gardiner, 1985, and Bangash, 2000). However, all crops have more or less characteristic growth abnormalities associated with deficiency of boron but these symptoms are manifestations of general boron deficiency symptoms found in crops.

The first and the most general specific visual symptom is the death of the terminal growing tip of the meristematic tissue. This indicates that boron is not translocated in the plant but is fixed in insoluble compounds and that it is needed for cell division. The lateral buds produces side shoots but the terminal buds in the shoot dies also. Due to the repeated death of apical bud, flowers may not form; if they do, fruits and seeds frequently fail to form. Further rebranching may occur, the internodes and stem become shortened bringing the upper branches closer together. This multibranched plant, in many cases, gives a "Rosetted appearance". The plant root are generally stunted thus the plant growth and yield start to decline before further boron deficiency symptoms becoms apparent (Bangash and Gardiner 1985).

Further symptoms are slight thickening of leaves leading to Curling and Chlorosis. The petiole and even the leaves become brittle. This is always