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Importance of Boron in Crop Production

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Introduction

Boron (B) is one of the essential nutrients which is required for optimum growth, development, yield and maintenance of crop quality. It is a metalloid (intermediate properties between metals and non-metals) and the only element that is taken up by plants not only in ionic form ($B_4O_7^{2-}$, HBO_3^{2-} and HBO_3^{-}) but also as an uncharged molecule (H_3BO_3). B belongs to group 13 of the periodic group with atomic no. 5 and mass no. 11. It is neither constituent of any enzyme nor affects enzyme activity directly. Scientist associated with the establishment of essentiality of boron is Warington (1923) in England.

Role of boron in plants

- B is involved in the transport of sugar in plants. It is mediated by the formation of borate-sugar weak complexes and plays an important role in sugar translocation in crops like sugar beet. Therefore, in boron deficient soils, sucrose content of sugar beet decreases.
- B also plays a vital role in N_2 fixation. The enzyme responsible for N_2 fixation is nitrogenase and the stability of the envelopes that protect nitrogenese from inactivation by oxygen requires presence of B. It is also responsible for strengthening legume-rhizobium interaction. Under limited B conditions, nitrate reductase activity is reduced.
- B is responsible for cell wall formation, lignification and stabilization. It is cross-linked with pectin assembly and forms complexes with mannitol, mannans, polymanuronic acid in the hemicellulose structure and thus, provides rigidity to the cell wall. B also forms complexes with phenols and reduces accumulation of toxic chemicals. It also plays an important role in cell division of plants.

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- Boron also regulates root growth in plants. Since, root growth is the result of cell division and cell elongation and both of these processes are regulated by B. Deficiency of B also decreases the content of nucleic acid in crop plants.
- B also facilitates the transport of potassium in guard cells and thus, is involved in stomatal regulation.
- It also imparts drought tolerance to plants. Regular spray of boric acid helps in mitigating the effect of drought.
- It is also involved in movement of Ca into the plant and provides Ca nutrition to plants.
- Boron is also involved in the process of reproduction in plants and in germination of pollen spikelet's. It helps in pollen tube elongation, germination, seed and fruit development.

Boron deficiency

Boron deficiency is the second most important micronutrient constraint in crops after that of zinc on global scale. Boron deficiency symptoms appears on the terminal buds or the youngest leaves, as a result of which they becomes discoloured and may die under high deficiency conditions. Boron deficiency usually occurs under high rainfall and acidic soil conditions because of higher water solubility of boron under such conditions leading to leaching of boron. B is present as H_3BO_3 (boric acid) in acid soils which can easily leach out from light textured soils. Under alkaline conditions also deficiency can occur due to less solubility and less uptake.

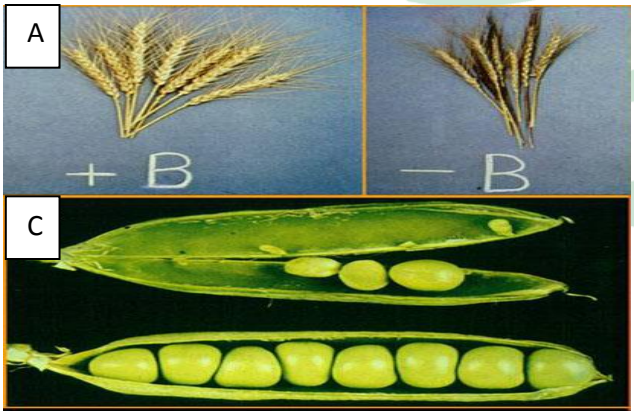

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Fig. Changes in plants due to boron deficiency

(A) B deficiency symptom in wheat plant. B requirement for monocots is very low and hardly produce any deficiency symptoms during the vegetative statge. But, symptoms appear during reproductive stage. (B) B deficiency symptoms in sugar beet. (C) B deficiency symptoms in pea. (D) B deficiency symptoms in cauliflower. (E) B deficiency symptoms in carrot.

Deficiency symptoms of boron

Commonly occurring B deficiency symptoms includes chlorosis, rosette formation, thickening and cracking of stems and multiple branching. Excessive branching of roots results in improper development and roots becomes twisted. Thus, affect the growth of root crops. Brown sunken areas may develop in the fruits and seed. Some of the boron deficiency symptoms in common crops are given below-

- Browning or hollow stem of cauliflower
- Internal cork of apple
- Top sickness of tobacco
- Heart rot of sugar beet
- Hen and chicken disease in grapes
- Crown choking of coconut
- Brown heart of radish
- Fruit cracking
- Cracked stem of celery
- Brown heart in root crops

Boron toxicity

Boron is unique among the micronutrients because very small quantities are necessary for normal crop production. Slightly higher concentration may become toxic for the plant. The range between deficient (<0.5 ppm) and toxic (>5 ppm) B concentration is very narrow. Boron toxicity is not common and generally occurs if the soil is inherently rich in boron or

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due to use of irrigation water high in B or as result of over fertilization with minerals that are high in B. Toxicity symptoms are spotting or drying of leaf tissue at the tips and edges.

Management of boron

Table: Sources of boron application

Material	Chemical fromula	% B
Borax	$Na_2B_4O_7.10\ H_2O$	10.5
Boric acid	H_3BO_3	17.5
Sodium tetraborate		
Fertilizer borate-48	$Na_2B_4O_7.5H_2O$	14
Fertilizer borate-68	$Na_2B_4O_7$	20
Solubor	$Na_2B_8O_{13}.4H_2O$	19

For ameloration of boron deficiency, soil application of borax can be done @ 0.5-2.5 kg/ha. Foliar sprayof boric acid is done (0.1-0.2 % boric acid solution). Both soil and foliar application of solubor is effective in improving crop yield, producing quality crops and for obtaining higher economic returns.