



# BORON AS A PLANT NUTRIENT

## FACT SHEET

Boron is, of all the micronutrients, the least understood. Boron is neither an enzyme constituent nor does it affect enzyme activities in the plant.

Boron, however, is involved in or plays a major role in a number of plant functions, some of which are not clearly understood, but in the absence of Boron, these processes are greatly affected.

The roles of Boron in the plant are: a) sugar transport, b) cell wall syntheses, c) lignification, d) cell wall structure, e) carbohydrate metabolism, f) RNA metabolism, g) respiration, h) indole acetic acid, (IAA) metabolism, i) phenol metabolism, j) membranes, k) root growth, and l) pollination.

### Root Elongation

Root Elongation is one of the quickest responses to Boron deficiency. In the absence of Boron, root growth is inhibited and the roots take on a stubby bushy appearance. In studies of a hydroponic test, when Boron is taken out of the solution, within 3 hours root growth is inhibited and within 6 hours it becomes more severe with complete cessation of growth within 24 hours. When Boron supply is restored to the deprived root within 12 hours root growth is fully restored.

### Cell Wall Synthesis

In Boron deficient plants the cell walls of the plants are dramatically altered. Disorders such as cracked stem, stem corkiness, hollow stem disorder, black heart, etc. may occur.

Boron deficiency is not bound to the cell wall the same way that Calcium is. However, cell disruption is similar to that of Calcium deficiency.

Cell wall formation and functioning is also evident in pollen tube growth and elongation. In cell wall synthesis, after germination, pollen tubes extend by tip growth from deposition of new cell material at the growing tip rather than by cell extension. In the absence of external Boron the plant may have abnormal swelling in the tip region of even cell destruction. Boron plays a role in IAA synthesis, which effects not just root tip growth but also all meristematic growth in vascular plants.

In lignification and cell wall formation Boron deficiency will also affect the formation and proliferation of cambia cells and impaired xylem differentiation.

With adequate Boron nutrition the structure and function of the xylem responsible for nutrient transport is enhanced and contributes to the mobility and uptake of nutrients.

### Membrane Integrity and Turgor Pressure

Boron plays a role in membrane integrity and Turgor pressure and turgor-related nyctinastic movements of leaves.

Boron levels in the plant influence uptake of phosphorus, by root tips. It is not clear how Boron influences ion uptake but membrane-bound ATPase activity is influenced by Boron levels in the root. For this reason Boron application to the soil is important for root growth and early Phosphorus uptake.

### Boron and Potassium Uptake

Plants that are large consumers of Potassium require Boron levels greater than 20 ppm in the

A & L CANADA  
LABORATORIES, INC.

2136 Jetstream Rd.  
London, ON N5V 3P5

Phone: 519-457-2575  
Fax: 519-457-2664  
Aginfo@alcanada.com  
www.alcanada.com

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tissue to accomplish this. Heavy users of Potassium in the bulking stage of production will require Boron levels in the tissue in the 60 to 80 ppm range in order to take up the Potassium they require.

### **Pollination and Fertilization**

Boron also affects fertilization by increasing the pollen producing capacity of anthers and pollen grain viability.

An indirect effect on pollination is the role Boron plays in increasing the concentration of sugars in nectar of plants that are pollinated by insects and birds.

### **Boron Influences on Carbohydrate Production**

In the plant, Boron plays a major role in the production and translocation of sugars. When Boron is present simple organic sugars (Glucose 1-P) will form complex sugar molecules and carbohydrates. In the absence of Boron these simple sugars will form phenols (quinone phenols), which will accumulate and attract insects and increase disease pressure.

Boron also influences the colonization of Mycorrhiza at the root surface by increasing the carbohydrate in the root exudates that increase the colonization of these organisms.

Towards maturity Boron plays a role in a number of processes in forming abscission layers such as the scar tissue at the stem end of a potato that seals the tuber prevents the disease and bacteria from entering the tuber in storage.

Similar to this is the abscission layer at the leaf stem of deciduous trees when they senesce. In a dry season when Boron uptake is limited, many deciduous trees do not lose their leaves due to poor formation of this abscission layer.

### **High Nitrate-Nitrogen in Petiole Tests**

A plant cannot have high carbohydrate levels and high nitrate levels, therefore when petiole tests detect excessive levels of nitrate-nitrogen, an application of .2 lbs per acre of boron per acre is recommended. Foliar application of boron accelerates translocation of nitrogen compounds, increases protein synthesis and stimulates fruiting. Likewise, when boron is applied in combination with urea nitrogen it hastens the translocation of nitrogen and sugars, improves fruiting, and may make plants less attractive to insects. NB. No more than three successive applications of boron at 0.2 lb/A should be made.

### **Boron and Late Season Translocation of Sugars.**

When Boron is deficient in tissue cambial cells cease to divide but cell elongation continues in growing zones, and as a result xylem and phloem cells are displaced from their original position which leads to inactivation of vascular tissue. Inactivation of phloem cells leads to a failure of translocation of carbohydrates and sugars to tubers and fruits.

### **Boron Fertilization**

It has generally been accepted that Boron mobility in the plant is restricted to Xylem movement only and is influenced by respiration. In a dry season, when respiration is restricted, Boron uptake by the plant is reduced. However, if Boron levels in the soil are maintained or amended allowing for some Boron in the plant subsequent application of foliar Boron does move from the phloem to the Xylem (bleeding through the sieve tube cells) due to a concentration gradient and further redistribution of Boron by Xylem does take place. This is however limited if Boron fertilization early in the season to the soil has not taken place.

Recent research has determined that Boron mobility and redistribution by Phloem is species dependant. This research has identified that species that use complex sugars as primary photosynthetic metabolite will redistribute Boron by Phloem.

General fertilization of Boron should include a pre-plant or pre-emerge application of Boron. This is best accomplished as a spray to ensure good distribution. I generally recommend a pound of actual Boron per acre sprayed on pre-plant. Further application of Boron, based on tissue tests, would be foliar applied as required. Boron however, is very toxic to plants and concentrations applied foliar at concentrations greater than 100 ppm can be toxic. This sensitivity is variety and species dependant; therefore in order to avoid phytotoxicity to plants, I suggest that foliar applications never exceed ¼ pound ai. per application.