Mosaic
AgriSight®
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ISSUE 15: 2018

Boron – A Critical Nutrient Required for Root Growth and Potassium Uptake

Boron plays an important role in plant cell walls, root growth and nutrient uptake.

A balanced supply of essential macro- and micronutrients is one of the most important factors to achieve higher crop yields. Boron (B) is one of eight micronutrients needed for proper plant growth. Lack of B in plant tissue can reduce cell wall function and stability, cell elongation, root growth, nutrient uptake and crop yields. This article describes the role of B in root growth and nutrient uptake, with a special emphasis on potassium (K).

Boron and Root Growth

Plants with low B supply undergo significant physiological and morphological changes. More than 90% of plant B exists in cell walls, indicating boron's very important role in plant growth (Brown, et al. 2002). In a B-deficient environment, structural stability and biological functions of cell walls are severely impaired, including a reduction of root growth and elongation. The quickest response to boron deficiency is a reduction in root growth, which can happen within hours after exposure to B-deficient conditions (Marschner, 2012). Root and shoot growth are severely reduced under low B supply; while during moderate B supply, which is common under field conditions, root growth is adversely affected at early growth stages, with minimal visible changes in shoot growth (Fig. 1).

Fig. 1. Growth of canola plants under various B application rates (Ceylan and Cakmak, 2017).

A reduction in root growth has a negative effect on water and nutrient uptake, especially in soils with limited water supply. In addition to a reduction in root growth, limited B availability impacts other physiological functions in root cells and the uptake of other nutrients, like K.

Boron and K Uptake

Boron plays a key role in increasing the activity of a specific enzymatic system in roots that significantly contributes to nutrient uptake. This system creates a gradient in root cells (i.e., across the root cell membranes), and works as the driving force for active uptake and transport of some of the mineral nutrients, especially K. When B supply is low, this driving force necessary for K uptake is significantly reduced (Fig. 2). These results highlight the critical role of B in root K uptake.

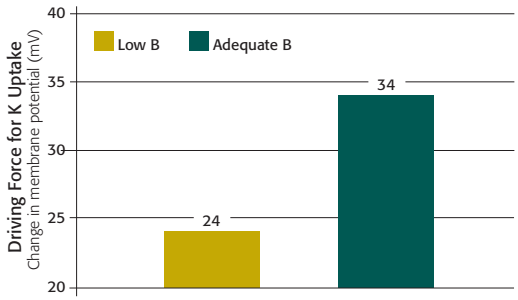

Fig. 2. Changes in driving force necessary for K uptake in sunflower plants in low and adequate B conditions (derived from Schon et al., 1990).

Nutrient interactions in plants are generally measured in terms of growth response and/or change in shoot nutrient concentration. Ceylan and Cakmak (2017) measured the rate of K absorption by canola roots in low and adequate B environments. In this study, depletion (decrease) in K amount from the growth medium was measured over time (Fig. 3). Results showed that plants absorbed K rapidly when B supply was adequate, while under limited B supply (keeping all growing conditions similar), K uptake capacity was limited. Consequently, root K concentration was 5.1% at low and 6.1% at adequate B supply, and shoot tissue K concentration was 5.9% with low and 6.6% with adequate B supply. These results highlight the synergy between boron nutrition and K uptake. Similar studies conducted in different crops have also documented the role of B in K uptake (see suggested readings).

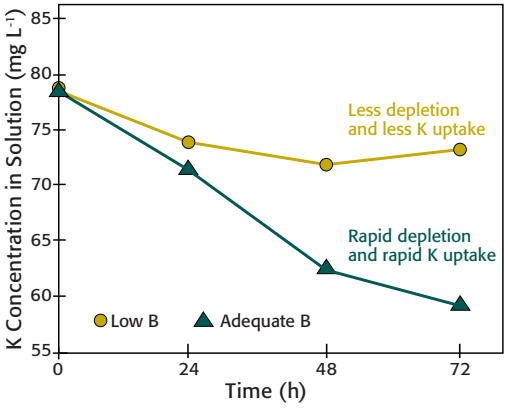

Fig. 3. Depletion of K from growth medium of 28-days-old canola plants grown with low and adequate B supply (Ceylan and Cakmak, 2017).

Conclusions

Boron plays an important role in plant cell walls, root growth and nutrient uptake. With low B supply, reduced cell wall stability rapidly diminishes root elongation, leading to significant root growth reduction. Low B supply also reduces the activity of enzymatic systems directly responsible for K uptake.

Aspire® is a one-of-a-kind premium potash that contains K and B in every granule. Using this product results in a more uniform application of B compared to traditional blends, and can greatly reduce a B deficiency. Additionally, the K will be utilized more effectively with proper B nutrition.

Further Readings

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