

The Role of Boron in Potassium Uptake by the Roots

Various factors play a role in the uptake of potassium (K) from the nutritional medium of plants. Perhaps the most studied of these factors is the positive effect of nitrate ion on the potassium uptake. There is a synergistic relationship between the nitrate and the potassium during root absorption. Although not as much as nitrate, there are published studies showing that boron has positive effects on the root potassium uptake of plants.

Indeed, many studies have shown that plants deficient in boron have less K in their tissues, especially in the roots, than plants well-fed with boron. For example, studies on different plants such as alfalfa, soybean, corn, sunflower and tomato indicate that plants absorb less K from the nutritional medium and accumulate less K in the tissues under boron deficiency conditions.

There are reports showing that the role of boron in the K uptake of roots is related to the H^+ -ATPase enzyme activity localized in the stem cells plasma membranes. According to the results of the research, when there is a sufficient level of boron nutrition, the enzyme activity of H^+ -ATPase increases and more protons (H^+) are secreted from the stem cells. With this increase in H^+ -ATPase activity, an electro-chemical potential difference occurs on the membranes and this potential difference plays a role as a driving force for the potassium element to be taken into the cell. The boron effect here is thought to be a very specific effect to boron.





Indeed, when boron was added to an environment with boron-deficient stem cells, it was found that the specified membrane potential difference increased within minutes.

The greater the potential difference, the greater the increase in K uptake of the plant is expected. The effect of boron on the H⁺-ATPase enzyme activity is not fully understood. It is likely that boron provides the structural and functional integrity of both the ATPase enzyme protein and cell membranes. As it is known, boron functions as a structural element in plant cells, especially in the stability of cell walls and membranes. There are research findings showing that boron also positively affects the phosphorus uptake of roots through similar mechanisms.

Because of these positive effects of adequate boron nutrition on potassium uptake by the roots, even if soils are rich in potassium, significant reductions in potassium uptake by the roots are likely to occur if plants are under boron deficiency. Therefore, it may be beneficial to enrich the potassium fertilizers with boron and to use them in areas where boron deficiency may occur potentially. Due to the synergistic effects between the nitrate and the potassium during root uptake, the plants must first have a good boron nutritional status in order for the plants to be able to absorb nitrate (nitrogen) more effectively from the environment.

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