

Liming of Acidic Soils Affects Boron Nutrition of Plants Negatively

The most important problem of acidic soils is the presence of very high amounts of aluminum (Al^{+3}) and hydrogen (proton) ions (H^+) in the soil in ionic form. Soil acidity is one of the soil problems that prevents or inhibits root growth most rapidly and strongly. In soils with aluminum toxicity, deficiencies of cationic nutrients such as calcium and magnesium are also frequently observed in plants. In order to reduce the soil acidity problem in question, the application that the producers take into account the most is the liming of the soils, that is, the application of calcium carbonate ($CaCO_3$) to the soils. With this application, soil pH is significantly optimized, and the solubility of Al in ionic form is reduced and it is ensured to precipitate in the soil.

However, soil liming may have some negative effects as well as invaluable benefits. One of the major disadvantages of liming in soil is the decrease in the availability of boron and zinc to the roots in the soil with the sudden increase in pH as a result of liming. Boric acid [$B(OH)_3$], which is dominant in acidic (low pH) soils, turns into borate [$B(OH)_4$]⁻ anions in the soil with the increase in the value of pH. Borate anions bind to soil surfaces, especially clay minerals and Al-hydroxides formed as a result of liming, or by adsorption, showing a strong decrease in boron uptake by plants.

Negative effects on the plants as a result of liming of the soil were observed in the 1930s and it was reported that this problem was caused by the problems in the boron nutrition of the plants. It has been reported that with liming, the boron concentration in the leaves of the plants decreased significantly (as a result of the conversion of useful boron to [$B(OH)_4$]⁻ and its fixation in the soil) and reductions in the growth of both annual and perennial plants. These findings show that liming, without considering boron fertilization or examining the boron nutrition status of plants, may be harmful for plants.



In order to achieve the expected benefits from liming, the boron status of the soil and plants should be examined and followed. In some studies, it was found that the benefits expected from liming were achieved significantly with boron fertilization combined with liming, and the boron nutrition status of plants was also improved. For example, in plants such as sunflower, pea and bean, it has been found that liming dissolves in the soil, the boron available to plants decreases and there is a similar decrease in plant growth.

These results indicate that it is important to make lime applications, which are widely applied in low pH soils with aluminum toxicity, with boron fertilizers, taking into account the soil analysis. In this regard, as with the main mineral fertilizers, lime applications with the addition of boron may also be considered. In this context, it is strongly recommended to consider colemanite as the most suitable boron source.

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