Soil Application:
1.4-2 kg ha^{-1} B can be applied before or during sowing.

Foliar Application:
30 grams of B dissolved in 100 liters of water can be applied 10-15 days before blossoming, at the beginning of ball formation period.

COTTON

Cotton, which is an important fibrous plant grown in many countries of the world, is very affected by boron nutrition in terms of both yield and fiber quality. Cotton is one of the cultivated plants that need more boron. In case of boron deficiency, it has been frequently reported that there are significant problems in the growth and development of cotton. Boron deficiency in cotton is mostly seen in plants grown in alkaline calcareous soils. There is a risk of boron toxicity in crops irrigated with irrigation water with high boron concentrations.

The phloem activity of boron is also very low in the cotton plant, and boron deficiency shows its effects on plant organs such as fast growing young leaves, growth and development points of green parts, and fiber. Similarly, the roots are very sensitive to boron deficiency. Deformity, shrinkage, and the appearance of brown and yellow spots on young leaves are generally common symptoms (Figure 1). In case of boron deficiency, a dark green color of the leaves under the young leaves and inward shrinkage of the leaf margins are among the common symptoms. (Figure 2) In plants with boron deficiency, shortening of fruit branches, weakening of fruit set, loss of vitality and death of terminal buds and shortening of internodes are also reported in the literature. In case of boron deficiency, cracks may occur at the base of fruit or seed capsule and shedding of seed capsule may occur. In some studies, frequently seen seed capsule and flower shedding is attributed to the decrease in carbohydrate transport to fruit and flower regions as a result of boron deficiency. However, these negative effects are thought to be more related to the problems in the formation and physical integrity of cell walls caused by boron deficiency.

Figure 1. *Development of young leaves in cotton in boron deficiency (left) and adequate boron nutrition (right) conditions (Çakmak et al. 2022, unpublished results).*

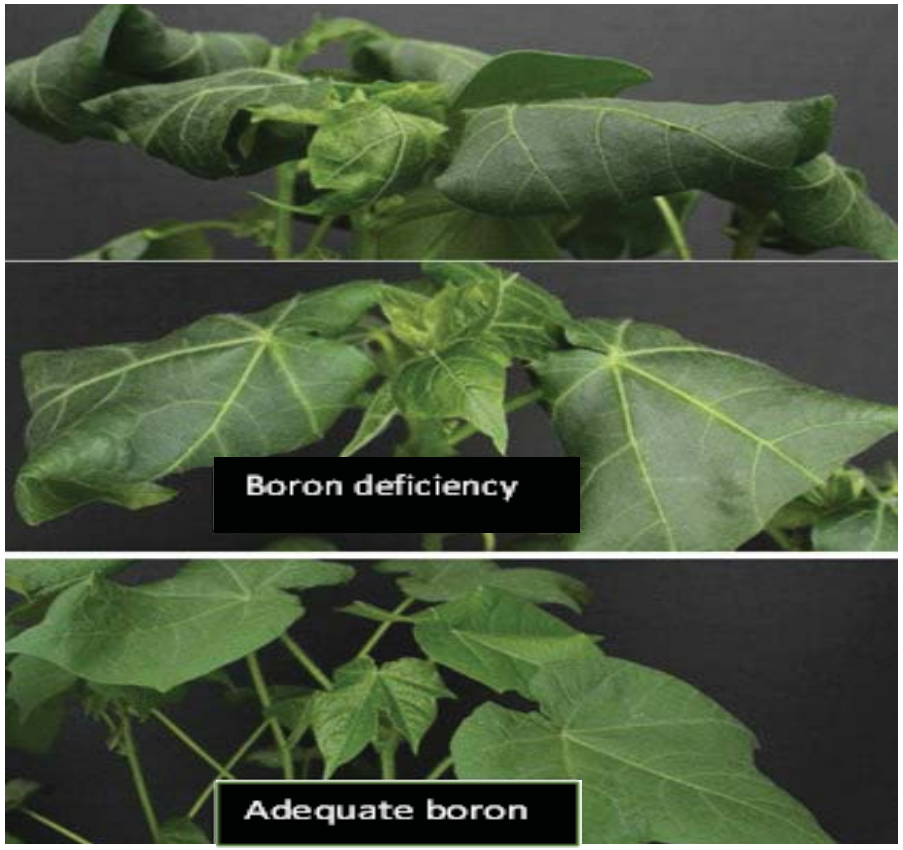

Figure 2. *Boron deficiency and sufficient boron in cotton (Çakmak et al. 2022, unpublished results).*

The formation of brown rings on the petioles in boron deficiency in cotton is another striking symptom of deficiency (Figure 3). It has been seen and reported that these rings are more numerous than plants fed with boron. Behind these symptoms is thought to be the result of insufficient transport of photosynthesis products from the leaves. However, it is possible that this problem here is also related to the effects of boron on cell wall strength and functions. Indeed, there are very few studies investigating boron deficiency-related changes in petiole vascular bundles, which function as an important support organ in cotton. For example, it has been estimated that there may be a relationship between the cell wall pectin content in the petioles of cotton and the plant boron content. In cotton plant, this ring formation and density in the petiole can be an important sign of boron deficiency for cotton, and producers can predict whether the plants have boron deficiency by looking at the petioles.

Figure 3. *Ring formation in cotton petiole in boron deficiency conditions (Li et al. 2017).*

Boron deficiency has important effects on root growth as well as on green parts. As seen in many plant species, boron deficiency in cotton plants leads to serious negativities both on root growth and root morphology. (Figure 4) Gradual darkening of the roots with boron deficiency was noted as a remarkable symptom. These changes have also been seen in sugar beet and sunflower plants before. Most likely, this darkening (melaninization) occurs as a result of the oxidation of phenolic compounds that begin to accumulate in the root tissues as a result of boron deficiency.

Figure 4. *Increasing boron application in cotton plant, Boron deficiency, Sufficient boron (Çakmak et al. 2022, unpublished results).*

Depending on the sampled plant organ and plant age, the critical boron concentration values of the plants vary widely. In general, it is reported that sufficient boron concentration in leaves varies between 20 and 80 mg kg^{-1}. The most common dose of boron fertilizers made from soil is reported as 2 kg B ha^{-1} and foliar application is recommended to be applied to the leaf 2-3 times intermittently. Soil analysis must be done before boron fertilization to determine the boron needs of the soil.