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

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

SUNFLOWER

Boron nutrition has a very different meaning and importance for sunflower. The fact that sunflower is extremely sensitive to boron deficiency and extremely resistant to boron toxicity increases the researches on boron nutrition in this plant. Among the field crops, it is among the most sensitive species to boron deficiency, along with colza and cotton, which have oil seeds like itself. For this reason, in sunflower cultivation, it is important to always closely monitor the boron nutrition status of the soil and plant, to keep it under control with analyzes, and to include boron in the fertilization program accordingly. In general, it is known that sunflower producers frequently include boron application in their fertilization programs.

Boron deficiency in sunflower can be seen everywhere, especially in areas where leaching is excessive due to precipitation or irrigation; because as pointed out, the boron requirement of sunflower is really high. In general, it is known that as a result of boron deficiency in sunflower plant, pollination and seed formation decrease drastically, growth (especially root growth) decreases dramatically, sensitivity to high light intensity increases, and photooxidative damage, known as light burning, occurs in the plant, especially in the floral receptacle. In the experiments carried out under controlled conditions, a striking pause in root elongation was found in sunflower within 3-6 hours after the complete removal of the existing boron from the growth medium. In the experiments, it is observed that the roots are affected before the greener part growth is visibly affected due to boron deficiency.

In case of severe boron deficiency, roots remain short and graying and darkening are observed as root elongation slows down or even stops. As a result of the stoppage of root elongation, the number of short lateral roots and the average root thickness increase. On the other hand, the roots of sunflower plants that are fed adequately with boron appear thinner, whiter and healthier. However, as the roots cannot be monitored under field conditions, the symptoms that occur in the above-ground parts are noticed and evaluated as the first symptoms.

Indeed, with the exacerbation of boron deficiency, green parts are also affected by boron deficiency as well as roots. It is stated that one of the most important reasons behind this rapid pause in root elongation in boron deficiency may be the oxidative breakdown and decrease of the plant hormone auxin (indole-3-acetic acid) under boron deficiency.

As in many plant species, the transportation of boron within the plant, in other words transportation from old tissues to developing organs, is very limited in sunflower. Therefore, the growing points of the plants (root tips, the fastest growing parts of the green parts, etc.) in the sunflower plant are extremely sensitive to boron deficiency. Boron deficiency in green parts first shows itself at the growth point and in the newly developing leaves. It is typical that growth stops with boron deficiency at the growth point. Thickening of the leaf tissue, shrinkage of the leaves, deformities and downward curling, color changes such as tanning and darkening, and signs of necrosis also occur.

In addition, due to the slowing down of internode elongation, stunting in the stem and structural weakening of the stem due to decreased lignin production can be observed. In the sunflower plant affected by boron deficiency, the flowers have deformities and irregularity in fertilization and seed formation due to problems with pollen germination.

On the other hand, sunflower plants with boron deficiency show extreme sensitivity to high light intensity and prolonged exposure to sunlight (Figure 1). If the plants with boron deficiency are under high light intensity or exposed to long sunny days, the symptoms of boron deficiency in the leaves develop faster and a photo-oxidative destruction known as "light burning-damage" occurs. However, as seen in Figure 1, the aforementioned photo-oxidative leaf damage does not occur when the plants have sufficient boron nutrition. Due to the high light intensity, serious photo-oxidative damage (light burning) is observed in the floral receptacle of the sunflower plant as a result of boron deficiency.

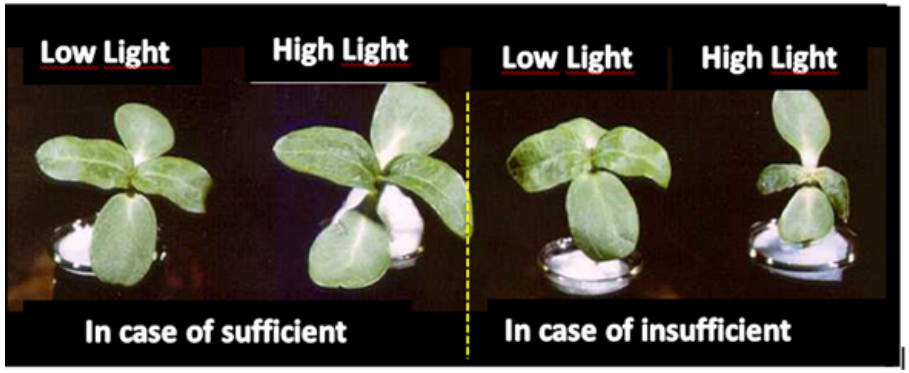

Figure 1. *Growth and leaf damage of sunflower plant grown with different boron applications under low and high light intensity (Photo: İ. Çakmak)*

The critical deficiency concentration values reported in the literature for boron deficiency in sunflower are around 20 to 25 mg kg^{-1} for the youngest leaves. In case of applying boron fertilization to soils, recommended safe boron doses are mostly in the range of 2 to 4 kg B ha^{-1}. In foliar boron fertilization, solutions containing 300 mg of boron per liter can be considered.

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