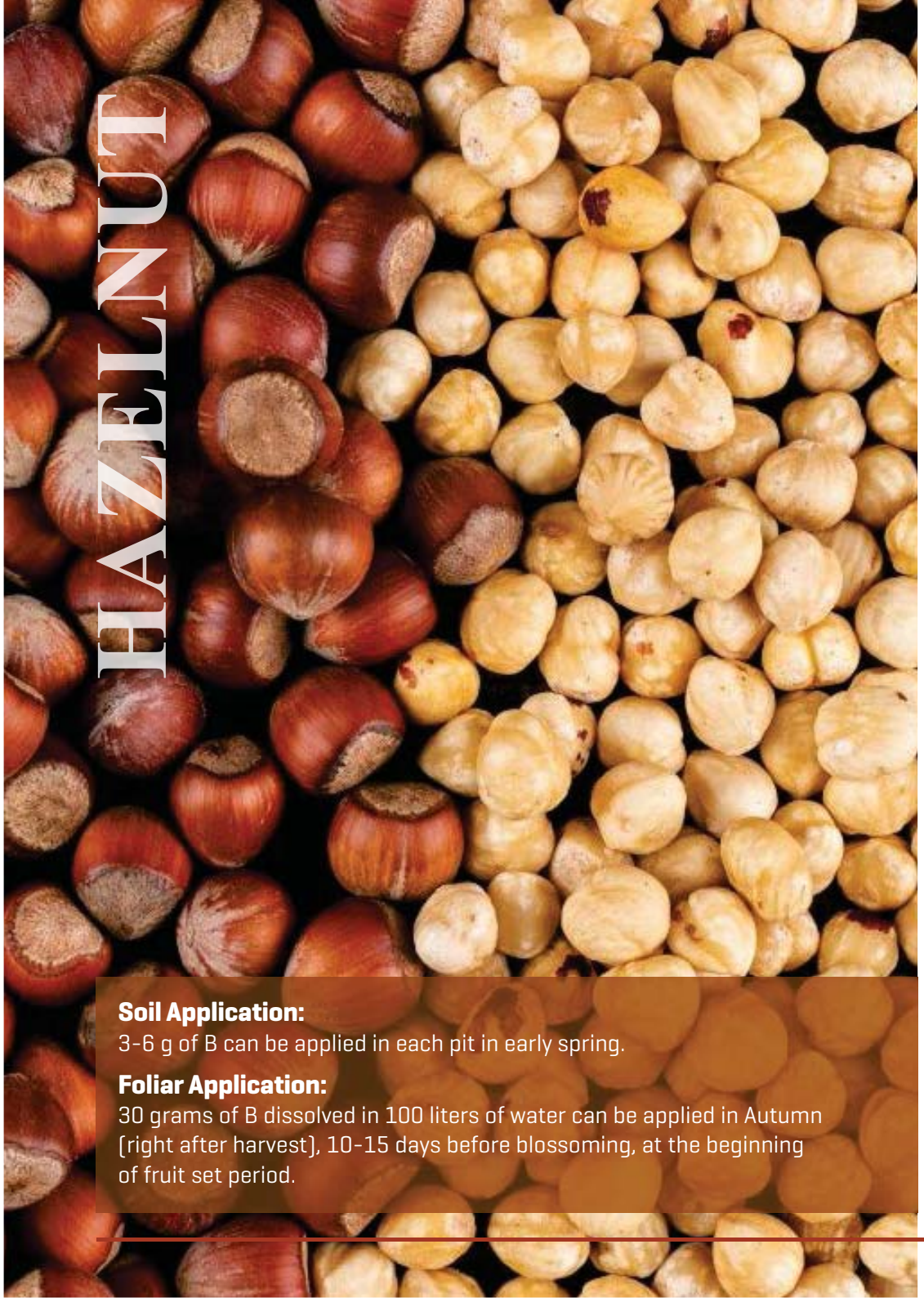

Soil Application:
3-6 g of B can be applied in each pit in early spring.

Foliar Application:
30 grams of B dissolved in 100 liters of water can be applied in Autumn (right after harvest), 10-15 days before blossoming, at the beginning of fruit set period.

HAZELNUT

Hazelnut is a perennial plant and generally prefers slightly acidic soils rich in organic matter and responds positively to the application of agricultural lime if the pH of the soil is below 5.5. Hazelnuts prefer abundant and regular rainy climatic conditions and thus, the soils are often acidic. In these conditions, boron can be easily washed from the soil profile, which leads to boron deficiency.

Although it does not significantly affect vegetative growth and does not cause any deficiency symptoms in the leaves, it is known that insufficient boron nutrition seriously affects pollination and fruit set in hazelnuts and causes yield losses. This situation, also called hidden hunger, is a situation that makes it difficult to fight boron deficiency. For this reason, it is useful to monitor the boron nutritional status of the plant periodically by leaf analysis in hazelnut.

As stated above, it is known that in hazelnut orchards where abundant rainy climatic conditions prevail, boron becomes poor in the soil due to washing. Liming is a common agricultural practice in hazelnut orchards when the soil pH is lower than 5 or 5.5, which the hazelnut can tolerate. Due to the sudden increase in pH in the soil with liming, boron, which is useful for plants in the soil, is rapidly adsorbed/fixed, and boron turns into a form that plants cannot take. It is useful to know that liming causes boron deficiency in hazelnut orchards. The fact that hazelnut has a superficial root system, which does not go deeper than 50 cm, causes it to be more sensitive to boron deficiency due to both washing and lime applications.

Fruit characteristics such as fruit weight, empty fruit rate and fruit yield are among the important parameters that determine both yield and quality and economic value in hazelnut. The fact that boron affects generative development rather than vegetative growth in hazelnut shows how important boron nutrition is in hazelnut. For example, there is evidence that boron deficiency negatively affects the size of fruit and hazelnut kernels in hazelnuts. In a study conducted in Turkey in a location where the available boron in the soil is very low, a decrease in the empty fruit rate and significant increases in yield were obtained with boron fertilization via the soil (Özkutlu et al. 2018).

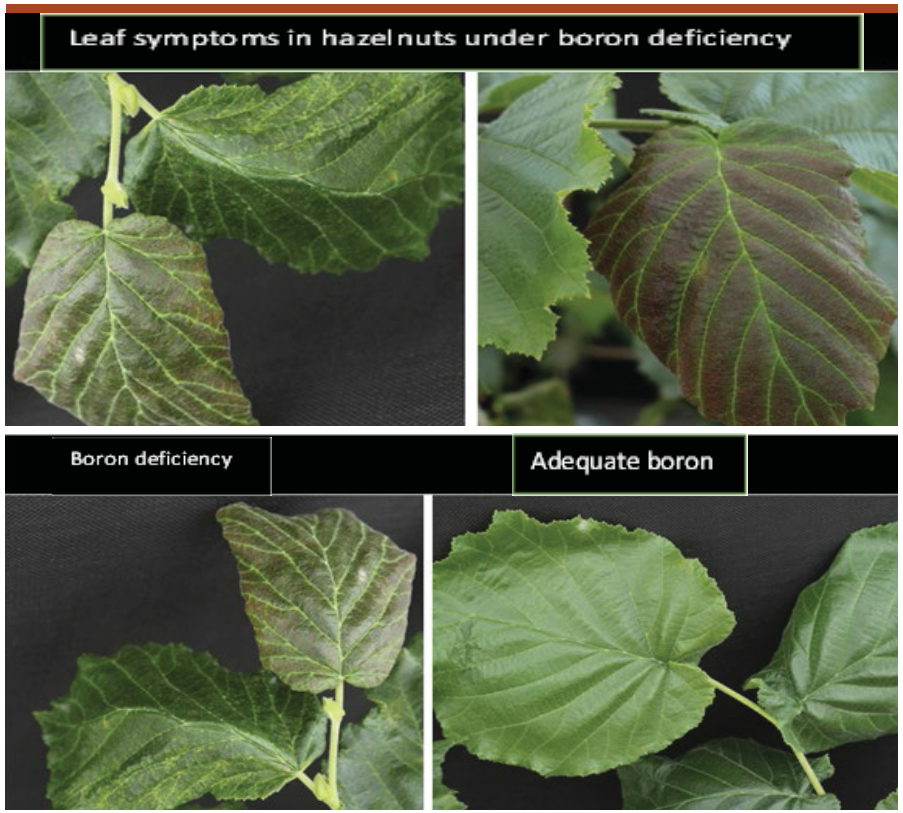

Figure 1. *Plant growth under conditions of deficient and adequate boron nutrition (Çakmak et al. 2022, unpublished results).*

Boron deficiency is rarely encountered in hazelnut orchards at a level to cause significant symptoms in vegetative organs (i.e. leaves). Boron deficiency causes yield losses by affecting mostly generative development, so this kind of deficiency problem is defined as "hidden deficiency". In case of severe boron deficiency in hazelnuts, the young leaves become darker in color, turn into a dark claret red, and deformation symptoms such as curling and shrinking occur (Figure 1). In addition, due to the shortening of the internodes, shortening of the branches and shrinkage of the leaves are also observed. At the very advanced level of deficiency, drying at the growth points and death occur.

As in the growth of green parts, root growth is severely affected by boron deficiency. (Figure 2) Probably, this situation is related to the inability to carry the boron on the one hand and photosynthesis products on the other hand from the green parts to the roots.

Figure 2. *Green parts and root growth in young hazelnut plants depending on boron nutrition (Çakmak et al. 2022, unpublished results).*

In hazelnut, it is generally accepted that if the boron concentration in the leaves where the growth is completed in the range of 25-30 mg kg^{-1}, it is considered as critical, and below 25 mg kg^{-1} as a deficiency (Reuter and Robinson, 1997). The expected boron concentration in hazelnut leaves with adequate boron nutrition is in the range of 30-75 mg kg^{-1}. For soil boron fertilization in hazelnuts, the commonly recommended dose in Turkey is 6 g pure boron per hazel tree. In the case of foliar boron fertilization, 300 mg L^{-1} boron application is often a recommended dose. It is useful to repeat this application several times. Soil analysis must be done before boron fertilization to determine the boron needs of the soil.