



BORON

BORON IN SOILS

The major reserve of boron (B) in most agricultural soils is the soil organic matter. Boron is released as it decomposes, with its availability fluctuating according to soil microbial activity and mineralisation rates.

Once released from soil minerals and organic matter, boron exists as non-ionic (undissociated) boric acid [H_3BO_3 or $\text{B}(\text{OH})_3$]. This is the form in which boron is taken up by plants.

As boric acid does not carry a positive or negative charge, it is not attracted to soil colloids and remains in the soil solution. This makes boron one of the most mobile nutrients in the soil. It can be rapidly leached. Light textured soils in high rainfall areas are often low in boron.

In clay soils in semi-arid regions, e.g. the Victorian Mallee, boron can accumulate in the sub-soil and may reach toxic concentrations.

BORON IN PLANTS

Boron plays a role in cell wall development and is important in pollination, fruit development and the translocation of sugars. An adequate supply of boron is important at flowering and in seed set, e.g. in legumes. Fruit quality is affected in many crops if boron is deficient.

In contrast to its mobility in the soil, boron is relatively immobile within plants. It is not readily relocated from old to young plant tissue. Plants are therefore dependent on continuous uptake of boron during the growing season. In this respect, the behaviour of boron in plants is very similar to calcium (as both are immobile) and the deficiency symptoms can be confused.

DEFICIENCY SYMPTOMS

Because boron is relatively immobile in plants, deficiency begins at the growing points. Frequently occurring symptoms include:

- Chlorosis (yellowing) and death of the growing points.
- Distortion, thickening and cracking of stems. The stems may be hollow or brittle.
- The formation of rosettes, growth of auxiliary buds (side shooting), bushy growth and multiple branching.
- The thickening, twisting and failure of roots to spread out or develop properly. In some cases the roots may show excessive branching. Root crops often fail to develop edible portions or are affected by the presence of dark coloured corky areas. Cuttings may fail to take root.
- The dropping of buds or blossom. Fruits and seed may also be affected. Brown sunken areas may develop in fruit.

Boron deficiency occurs more commonly in dry weather. Microbial activity (mineralization of soil organic matter) is reduced, and the movement of boron in the soil solution to plant roots is restricted.

The range between deficient and toxic levels of boron is very narrow.

TOXICITY SYMPTOMS

The early symptoms of boron toxicity are usually marginal and tip chlorosis of the older leaves. As the toxicity becomes more severe, leaf necrosis progresses from the tip or margins and gradually covers the whole leaf, resulting in premature leaf drop.

While boron may be present in toxic concentrations in the soil, e.g. clay sub-soil in semi-arid regions. One of the more common causes of toxicity is over-fertilisation. Toxicity can also be associated with poor placement of boron fertiliser. Strawberry, peach, grape, bean, pea, and cucumber are sensitive to boron toxicity.

BORON FERTILISERS

Various boron fertilisers are available, including the products listed below:

- **Boric Acid** (16.5 – 17.5% B).
- **Sodium Tetraborate**

Sodium borate fertilisers are water-soluble, allowing quick responses to be achieved. They include:

- **Borax** (11.3 % B) is a fine crystalline product. It is no longer in common use, fully granulated products such as Granubor being preferred for dry application to the soil, and more soluble products such as Solubor for application in solution (soil and foliar sprays).
- **Granubor** (14.3 % B) is a granulated fertiliser for dry application to the soil. This product is marketed by Incitec Pivot Fertilisers. Granubor can be used on its own or in blends with other fertilisers.
- **Solubor** (20.5 % B) is a fine soluble powder for application in solution through fertigation systems or boom-sprays to the soil or foliage. Solubor is more soluble than Borax, especially in cold water, and is the recommended choice for application in solution.

Ulexite (9.9 % B) contains boron in soluble (sodium borate) and insoluble (calcium borate) forms, which is released more slowly in the soil. Ulexite is mainly used in forestry where fertilisers are applied infrequently, i.e. several years may lapse between applications. Granubor is preferred in annual crops, and where annual/seasonal applications are made in perennial tree crops and vines.

APPLICATION

Boron is often recommended in routine fertiliser programs for high value crops with an established requirement for boron. Root crops, vegetables and many fruit trees are susceptible to boron deficiency.

Deficiency also occurs in timber species, e.g. *Pinus radiata*.

Given boron's mobility in the soil and susceptibility to leaching, annual, or more frequent applications of boron are required in most situations. Frequent applications at low rates also minimise the risk of toxicity.

In annual crops, there are limits to the amount of boron that can be safely applied with/near the seed or transplants at establishment without burning the roots and inducing toxicity. It is best to apply boron at other times or in other ways, e.g. pre-plant or as foliar sprays during the growing season, than to band or drill it into the soil with or near the seed or transplants.

If the position of the crop rows is known in vegetable crops, planting fertilisers containing boron can be applied in a broad band along the intended position of the row, and then be incorporated into the soil before planting.

For soil application in tree crops, boron should be spread or sprayed evenly over the root zone, i.e. under the whole canopy and just beyond the area of the tree canopy, but no closer than 30 cm to the trunk. Toxicity may occur if boron is applied unevenly or it is concentrated in small areas.

In horticulture, e.g. tree and vegetable crops, foliar sprays, e.g. of Solubor, are often used to supply boron instead of applying boron fertilisers to the soil.

Foliar sprays may also be used to supplement soil applications, taking care to reduce the rates at which boron is applied in each manner, to avoid over-application.

Boron application rates are extremely variable. There is often a thin line between deficiency, sufficiency and toxicity. The rates required in crops with a high demand for boron, e.g. crucifers, may be toxic to other crops.

Seek professional advice before use. A more detailed Agritopic is available from Incitec Pivot Fertilisers on Boron, along with Use Directions for Granubor.

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