

Boron



Fundamentals:

- Elemental Form: Boron (B)
- Plant Nutrient Form: elemental boron (B)
- Plant Uptake Form: boric acid (H_3BO_3) mainly

Importance and Roles in Plants:

Boron is one of the micronutrients and required by plants in extremely tiny amounts. Within plants, boron is essential to germination of pollen grains in the anther, which is the male part of a flower's reproductive system (diagram 1). Following pollination, boron is also involved in growth of pollen tubes down from the stigma, through the style and into the ovary.

Two chemical processes involving boron within plants are the translocation of sugars as well as the formation of proteins. Further, boron is necessary to the development of nitrogen-fixing root nodules in legumes.

Deficiency Symptoms:

A deficiency of boron in fruit and vegetables can take several different forms. In fruit crops, boron deficiency symptoms might include poor fruit set, lack of properly developed fruit and aborted fruit. In vegetables, there may be "Hollow Heart", which is self-descriptive, and soft or dead spots in tubers (diagram 2). In apples, boron deficiency might also take the form of a symptom called "Corky Core". In corn, plants may be deformed, and kernels may not develop properly on the cob (diagrams 3 and 4)

In general, plants may be stunted. The growing point and younger leaves are affected initially. Leaves may be curled or thickened, and leaves may look "crimped",

which is similar to how calcium deficiency looks. And, because boron leaches easily,



Diagram 2: Boron deficient cauliflower



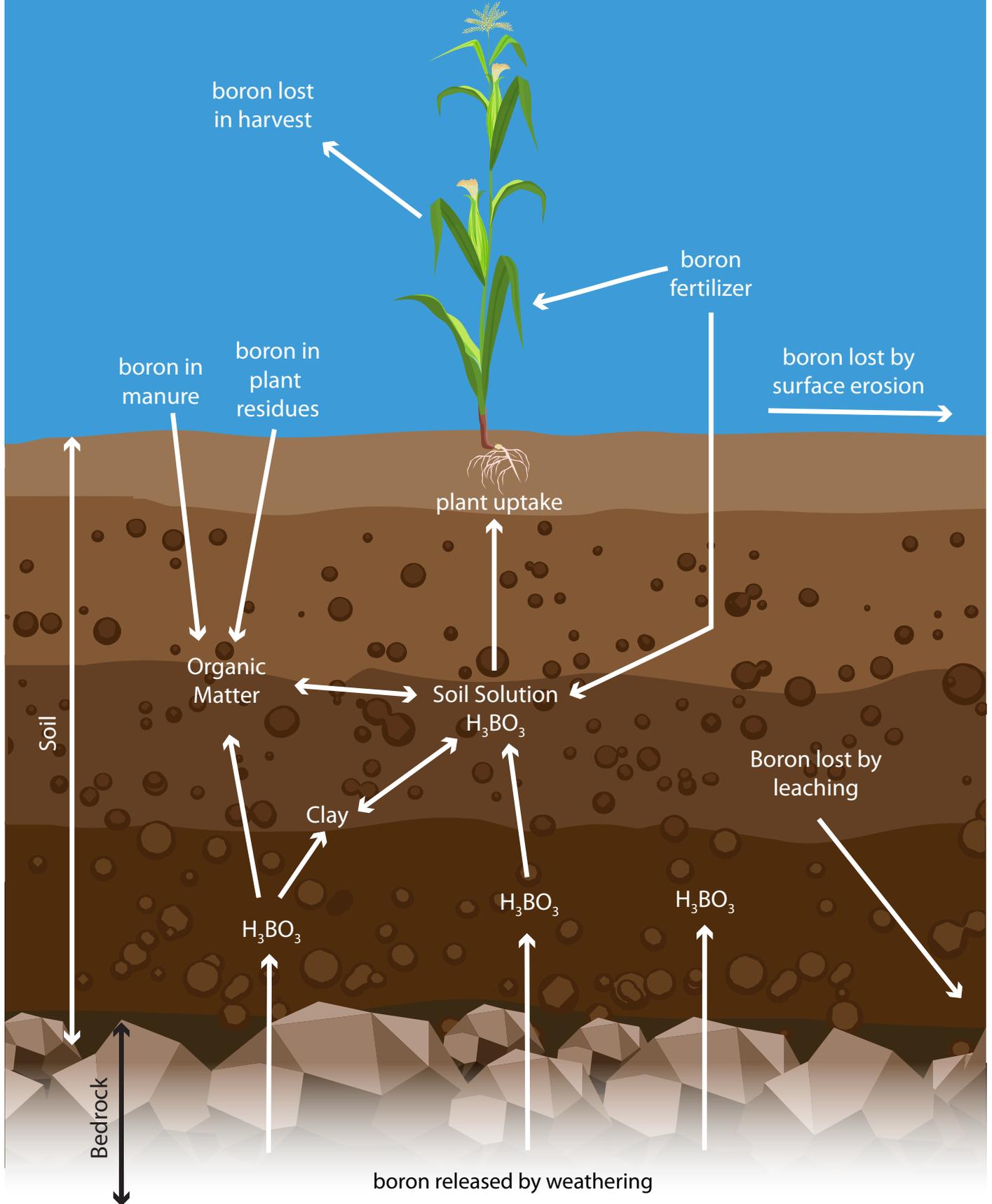
Diagram 3: Boron deficient corn plant



Diagram 4: Boron deficient ears

especially in coarse soil, deficiencies are commonly found in areas of high rainfall.

Diagram 5: Boron Cycle



Boron Fertilizers:

A variety of boron products are carried by TerraLink Horticulture. Producers can choose between Solubor (20.5% soluble powder), Solubor DF (17.5% dry flowable), Eco Boron (10% liquid), Granubor II (14% B granular), Plant-prod Borax (15% B soluble powder), TigerClaw CBM foliar liquid (0.4% B, 5% Ca and 0.7% Mo) and TigerClaw TopSet foliar liquid (9% boron and 0.6% Mo).

Behaviour in the Soil:

Boron exists in the soil solution as boric acid (H_3BO_3) and as the borate anion (BO_3). Plant uptake is mainly as the boric acid molecule. Boron typically is found with organic matter in the soil, being held on very tightly by it. Having said this, it is also known that boron can be adsorbed within clay minerals, in iron and aluminum-hydroxy compounds.

As boron is easily leached, coarse-textured soils (such as sandy soils) are thus likely to be low in this micronutrient. In general, boron tends to be low in the Pacific-Northwest part of North America, which is also in general a high-rainfall area.

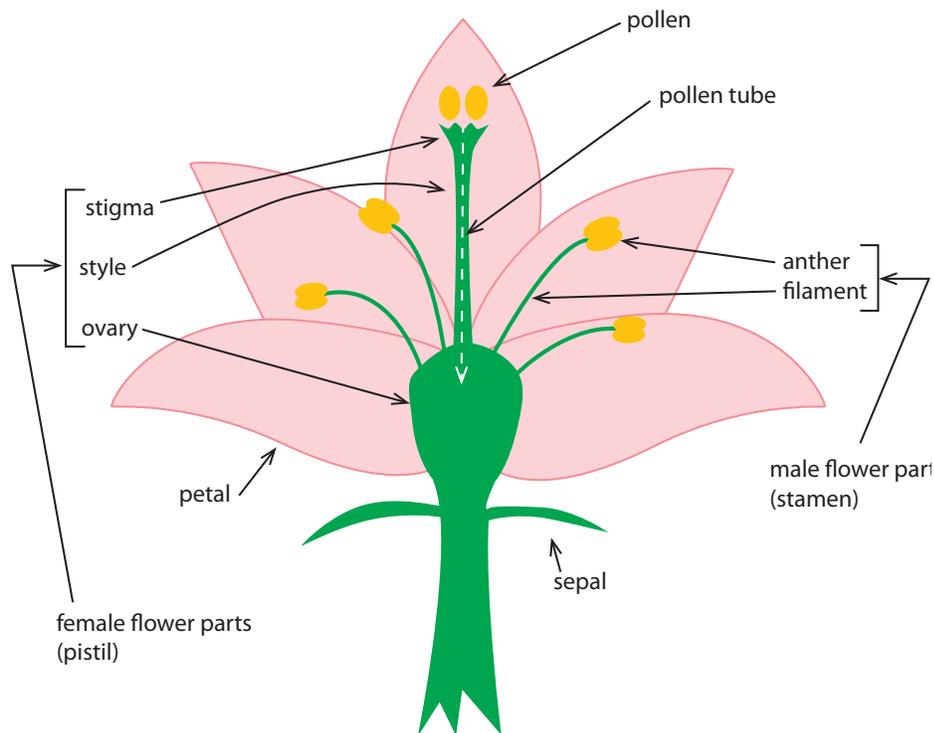
Like all plant nutrients, boron is affected by soil acidity (pH). A pH range of between 5 and 7.5 is optimum for plant uptake. This is suitable for highbush blueberries, as well in fact for most other major crops.

Interaction with other Nutrients:

Boron interacts with just a few other nutrients, to our knowledge. First, there can be reduced adsorption of boron in corn when grown in an acid soil high in phosphorus. This can be a common situation in the Fraser Valley, just one more reason why it is a very good idea for producers to arrange for routine soil tests.

Second, scientific work in faba beans reported in 2006 showed nitrogen and boron acted synergistically when neither nutrient was lacking, when grown in sandy soil. Sandy soils can

Diagram 1: Flower Reproductive Parts



be found in Sumas and in Chilliwack in the Fraser Valley. And finally, boron can apparently become toxic when there are very low soil calcium levels – probably an uncommon occurrence in the Fraser Valley.

Boron Cycling:

Like so many other plant nutrients, the element boron originates in the Earth's rocky crust (see diagram 5). Over extreme geologic time scales it is released by weathering, entering the soil as typically boric acid (H_3BO_3). From this state, boron can be lost by leaching and surface erosion, as well as being lost to the soil-plant system in harvested fruit and vegetables. Boron is added to the soil typically in plant residues, animal manure and granular or liquid fertilizer. Boron is also commonly applied to plants as a foliar spray, upon which some of the boron is taken into the plant and some rinsed off into the soil.

From the soil solution, boric acid is either taken up by plant roots, but it can also be adsorbed into clay minerals, where

it may combine with aluminum and iron hydroxy compounds (see section on Behaviour in the Soil). And, much of the boron in the soil ends up tightly combined with organic matter, which is why less boron is lost by leaching from organic soils than from coarse soils.

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Image Credit:

University of Minnesota Extension. Sutradhar, A. K., Daniel E. Kaiser, D. E. and Carl J. Rosen, C. J. 2016.

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