Essential Plant Micronutrients

There are sixteen chemical elements essential for plant's growth and survival called essential plant nutrients. They are classified in two groups: non-minerals and minerals. Hydrogen, oxygen, and carbon are non-minerals and are available from the air and water. The other 13 elements are minerals, available from the soil through plant roots. Minerals are further subdivided into two groups: macro and micronutrients. Nitrogen, phosphorus, potassium, calcium, magnesium and sulfur are needed in large amount by the plants, and are classified as macronutrients. Boron, copper, chloride, zinc, iron, manganese, and molybdenum are classified as micronutrients.[i]

Micronutrients are called so not because they are less important, they are in fact necessary for a plant's growth and development. They are divided into this group because they are needed in relatively smaller amounts than macronutrients. The Canadian prairies are known to have considerable levels of organic matter, harbouring enough micronutrients for crops. However, we must take care of the soil for this to be maintained. Because of the relatively high cost of micronutrient fertilization, accurate identification of deficiencies is key. Here are some tips to identify micronutrient deficiency symptoms in common crops.[ii]

Boron (B) assists with the uptake and regulation of other nutrients. It helps to produce sugar and carbohydrates. It is essential for seed and fruit development.

Deficiency symptoms include browning or blackening of new leaf tips and die-back of growing points. It can look very similar to calcium deficiency. Boron deficiency mostly occurs on lighter, sandy soils with less organic matter (<3.0%). Alfalfa and clover are the most sensitive crops to boron deficiency. According to research[iii], with the application of boron, alfalfa increased the percent of pods formed per inflorescence by up to 52% and the seed yield was increased by an average of 37%.

The deficiency of Boron can be corrected with the application of a small amount of Boron. In some crops, like alfalfa, foliar application recovers the deficiency symptoms[iv].

Copper (Cu) is essential for reproductive growth, root metabolism and utilization of proteins. Copper deficiency symptoms are common in deep sandy soils with low organic matter (<3.0% organic matter), peat (>15% organic matter) and heavy clay soils. Copper is not mobile in the soil.

Winter wheat, spring wheat, barley, oats and rye are sensitive to copper deficiency. Visual symptoms of copper deficiency in wheat include twisting and whitening of leaf tips and a later stage, the browning of the stem and head.

The most effective way to correct a copper deficiency is to broadcast and incorporate copper sulphate.[v]

Chloride (Cl) keeps the proper balance of ion charges within the plant, regulates turgor pressure and reduces disease susceptibility. It also helps in photosynthesis.

Chloride deficiency is not very common but is usually seen on sandy soils in high rainfall areas. Symptoms of wheat crop chloride deficiency are small necrotic areas on the upper leaves of crops. The most sensitive crops are winter wheat, spring wheat and barley.

There are few areas with chloride deficiencies so this micronutrient is not often included in fertilizer programs. Also, chloride is applied to the soils with potash (KCl), the dominant potassium fertilizer.[vi]

Zinc (Zn) is essential to produce many enzymes, and to balance the hormone levels in plants. It is not mobile in the soil. Zinc deficiency is usually seen in soils with a high pH.

Zinc deficiency will cause a plant to remain stunted, delay maturity, shorten internodes and can delay silking in corn. Some plants will show interveinal mottling on older leaves. Corn will show symptoms on middle leaves with light yellow tissues with reddish veins, but the midrib and leaf margins remain green. [vii] In a wheat crop, the third or fourth leaf will show a band of white or yellow tissue; latterly the leaf can collapse near its middle. Crops sensitive to zinc deficiency are corn, flax, potatoes, wheat, edible beans, and alfalfa.

The deficiency of zinc in cereals can be corrected by application of 25 Kg of zinc sulphate per acre, for three years. It can also be corrected by foliar application of a 0.5% solution of zinc sulphate (21% zinc).

Iron (Fe) is a component of many enzymes and is essential for photosynthesis. Iron deficiency appears in high pH (>7.5), high carbonate, high soluble salt, and poorly drained soils.

A deficiency will show with interveinal chlorosis of new leaves. Soybeans are very susceptible to iron deficiency. Flax, beans, barley, oats are also common sensitive crops to iron deficiency.

Iron deficiency can be corrected by the foliar application of a 0.5% solution of iron sulfate (FeSo4), a couple of times within a week interval. Application of manure or compost is also effective source of iron.

Manganese (Mn) is essential in chloroplast production. Soils with high pH and high organic matter can be low in manganese.

In wheat, a common symptom is interveinal chlorosis on the middle and lower leaves. In alfalfa, the middle stem leaves show grey to yellow mottling, leaving small regions around the margins and tips of leaves. Later this spot spread over the entire leaves and turns their color pinkish to brown.

Foliar application of manganese sulfate (MnSo4) is the way to control the deficiency of manganese.

Molybdenum (Mo) helps to increase dry weight and nitrogen content in several legume crops like soybeans.

The symptoms of molybdenum deficiency are very similar to those seen with a nitrogen deficiency. In the case of legume crops, it affects nitrogen fixation in their nodules.

The opposite of other micronutrients, molybdenum uptake by plants increases with increased soil pH. Deficiencies may be corrected by liming acid soils or adding a molybdenum seed treatment.[viii]

Plants require the proper balance of all essential plant nutrients for proper growth and optimum yield. It can be very difficult to diagnose nutrient deficiencies in the field, and soil tests, tissue tests, cropping history etc. must also be examined. If a deficiency is found, it is also important to determine if the costs of micronutrient application will be offset by the value of the expected yield increase you may see in the crop.[ix]

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[i] http://www.agr.state.nc.us/cyber/kidswrld/plant/nutrient.htm#Non- Mineral
[ii] http://www.gov.mb.ca/agriculture/soilwater/soilmgmt/fsm01s08.html#organic
[iii] http://agron.scijournals.org/cgi/content/abstract/98/4/907
[iv] http://www.agnet.org/library/bc/51002/
[v] http://www.agriculture.gov.sk.ca/Default.aspx?DN=acbda80d-c76d-41a8-a0ea-871144bfee2f
[vi] http://www.ecochem.com/t_micronutrients.html
[vii] Field problems of important crops-Punjab Agricultural University Ludhiana-India
[viii] http://www.ecochem.com/t_micronutrients.html
[ix] http://www.agriculture.gov.sk.ca/Default.aspx?DN=acbda80d-c76d-41a8-a0ea-871144bfee2f