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Micronutrients in Agriculture

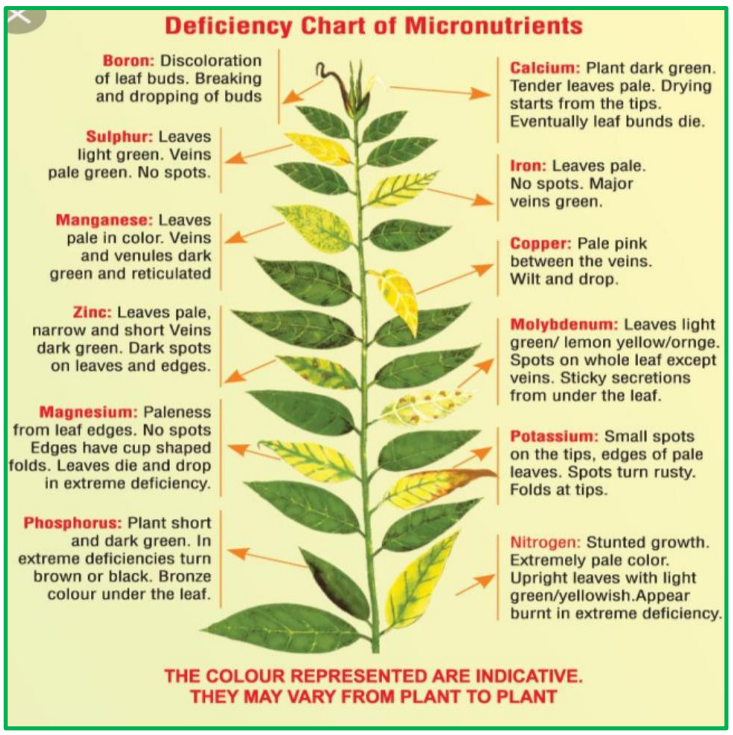
(*Barkha Kumari Verma, Dr. Vinod K. Yadav, Sanjeev Kumar and Gopal Khatik)
College of Agriculture, Agriculture University, Kota (Raj.)
*Corresponding Author's email: vermabarkha780@gmail.com

Abstract
This document was written with the title micronutrient in agriculture in mind, and it summarizes the study on micronutrients that was done to determine the essential limitations of micronutrients in plants and soil, as well as their inadequacies in plants. There are eight micronutrients in all (i.e. boron, chlorine, copper, iron, manganese, molybdenum, nickel and zinc). A combination of factors relating to parent material, soil type, and climate influence the status of micronutrients in soils and their availability to plants. Plant development, soil fertility, animal nutrition, and productivity all benefit from micronutrients in soils (Renwick & Walkar, 2008). Nutrient deficit has a direct impact on crop growth, resulting in poor crop response (Jagtap et al., 2018).

Key Words: micronutrient, boron, zinc, chlorine, iron, copper, molybdenum, manganese, functions, deficiency symptoms.

Introduction
Nutrients are modest amounts of vital nutrients required for normal human and plant growth. This group now includes iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), boron (B), molybdenum (Mo), nickel (Ni), and chlorine (CI). With the exception of Fe and Mn, which can reach 500 mg/kg in plants, the concentration of these minerals in plants is usually between 100 mg/kg (by dry weight). These nutrients are known as trace elements, but that does not make them any less vital than macronutrients. Micronutrients can boost grain yields by as much as 50% while also improving macronutrient efficiency. The total Cu content of Indian soil extended from 1.8 to 960 mg/kg and the available Cu content ranged from 0.10 to 378 mg/kg. More than 25 percent of Cu deficiencies are recorded high above Tamil Nadu soil (Shukla et al., 2014). A tiny amount of nutrients, particularly Zn, Fe, and Mn, utilized in leaf spray has been demonstrated to considerably boost crop yields (Sarkar et al., 2007). Nitrogenase, which catalyzes the first stage in the assimilation of N into proteins, and nitrate reductase, which catalyzes the first step in the assimilation of N into proteins, both require Fe and Mo-containing cofactors for their action. Borlotti et al. (2012) found that Fe shortage affects nodule start and development by decreasing nitrate reductase activity while leaving glutamine synthetase activity unchanged (Brear et al., 2013). Nodules are a key sink for Fe in legumes, accounting for 35 percent of total Fe (Burton et al., 1998; Brear et al., 2013; Burén et al., 2020). Lindsay and Norvell's (1978) approach were used to calculate micronutrient cations. The filtrate was analyzed for zinc, copper, manganese, and iron using an atomic absorption spectrophotometer after standardizing the instrument with proper standards. Ten grams of soil were shaken for 2 hours with 20ml of extracting solution consisting of 0.005 M DTPA (Di-ethylene triamine penta-acetic acid), 0.01 M $CaCl_2$, and 0.1M TEA (Tri-ethanol amine) buffered at 7.3.

Iron (Fe)



- Iron helps in the formation of chlorophyll.
- Iron helps in absorption of other nutrient element.
- Iron is a structural component of porphyrin molecules like cytochromes, hemes, hematin, ferrichrome and leghemoglobin.
- Iron is a constituent of enzyme systems and so it helps for carrying out diverse enzymatic reactions in plants alike cytochrome oxidase, catalase, peroxidase, acotinase, nitrogenase etc.

Deficiency of Iron

- A deficiency of iron causes chlorosis between the veins of leaves and the deficiency symptom show first in the young leaves of plants that eventually into overall plant thereby ending at completely bleached leaves.
- Deficiency of iron in plants generally results strong chlorotic symptoms at the base of young leaves along with some green netting.

Copper (Cu)

- Copper forms various compounds with amino acids and proteins in the plant.
- Copper has some indirect effects on nodule formation.
- It similarly acts as “electron carrier” in enzymes which carry about oxidation-reduction reactions in plants.

Deficiency of Copper

- Unavailability of copper in plant leaves generally results in curled leaf edges and bended petioles.
- Shortage of cupper can be expressed as overall light chlorosis along with permanent loss of turgor pressure in younger parts of plants.
- Recently, matured plant leaves tend to exhibit netted, green veining with areas bleaching to a whitish gray coloration.
- Some leaves develop sunken necrotic spots and has enough tendency to bend down.

Disorders

- Gummosis and exanthema disease of citrus
- Dieback and reclamation disease of citrus due to deficiency of copper
- Male flower sterility

Chlorine

Chlorine is a member of the 17th periodic table group, which includes halogens, which are not found as elements but only as compounds.

Role of Chlorine

- Major role in osmo-regulation and charge compensation in higher plants.
- Maintain tugor pressure in plants.

Deficiency of Chlorine

- Most common symptoms of deficiency of chlorine are wilting and chlorosis of younger leaves. Chlorosis can occur on smooth flat depressions in interveinal areas of leaf blades.
- In some advanced cases, there often appears a characteristic bronzing on upper areas of mature leaves.
- Symptoms of chlorine deficiency include A blue-green shiny appearance of young leaves. Wilting, follow excessive branching of lateral roots. Bronzing of leaves. Chlorosis and necrosis in tomatoes and barley

Boron (B)

Boron is an essential chemical element of shops that belongs to 13th group of periodic table. Boron was first deduced from Arabic word" buraq" which was the name of borax.

- The primary role of boron is associated with the calcium metabolism.
- Boron increase the solubility of calcium as well as mobility of calcium in the plant.
- It helps in the absorption of nitrogen.
- Boron is necessary for proper pollination and fruit or seed setting.
- It helps for the formation of nodules in leguminous plants.
- Boron regulates carbohydrate metabolism.
- It facilitates transportation of K in guard cells as well as stomatal opening.

Deficiency of Boron

- Terminal buds become discoloured and die.

Diseases

1. Browning or hollow stem of cauliflower.
2. Top sickness of tobacco.
3. Heart rot of sugar beet.
4. Fruit cracking of tomato.
5. Hard fruit of citrus.
6. Hen and chicken disease of grapes.

Zinc (Zn)

Zinc is a highly valuable chemical constituent of plants that belongs to 12th group and 4th period of periodic table. Zinc is an essential chemical component of plants that aids in carbohydrate transformations as it regulates the consumption of sugars. Major source is sphalerite. In plants its required for biosynthesis of hormones(auxin).

Deficiency of Zinc

Generally it has been observed that zinc deficient plants tend to lose the integrity of cell membrane thereby increasing the cell permeability in various different crop species. This loss of membrane integrity under zinc deficient conditions can severely affect the accumulation and uptake of sodium at toxic levels in plants.

- Inter venial chlorosis
- Reduction in the size of younger leaves that result in brown, rusty and stunted plants.

Disorders

- White bud of maize
- Khaira disease of rice.
- Little leaf of cotton.
- Mottled leaf of citrus.
- Resetting in leaves.

Molybdenum (Mo)

Molybdenum is belonging to 6th group of periodic table. It is known to be the 54th most abundant element of earth's crust. Major source is olivine. It helps in effective utilization of soil nitrogen as molybdenum is known to be an important element of enzyme that is involved in metabolism of nitrogen.

Deficiency of Molybdenum

Different plant species deficient of molybdenum exhibit dotted spots on leaves with some symptoms of chlorosis in veins. In number of plants, there is upward leaf cupping along with mottling spots inside the larger interveinal chlorotic areas under simple deficiency.

Manganese (Mn)

- Manganese involves in number of plant processes such as activation of antioxidative enzymes, respiration and photosynthesis.
- It harmonically works with natural enzyme system that aids in breakdown of carbohydrates and involved in effective metabolism of nitrogen. Soil is a known reservoir of manganese.
- It helps in chlorophyll formation and involved in hill reaction.

Deficiency of Manganese

- Plant leaves deficient of manganese are known to exhibit light chlorosis in between leaf veins throughout the plant.
- Some initial deficiency symptoms are quite similar to iron deficiency. These deficiency symptoms start with activation of bright chlorosis of newer leaves and acquired veins of ripen leaves more specifically when they are determined by conducted light.
- it may also develop purplish coloration and lustrous appearance on upper surface of leaves. Some grain plants like barley, wheat and oats are extremely vulnerable to deficiency of manganese.
- Intensive blackening of leaf veins.

Disorder

- Pahala blight of sugarcane.
- marsh spot of pea

Soil Conditions Conducive to Micronutrient Deficiency

Certain field conditions conduce micronutrient deficiency. Micronu-trients, under such conditions, are likely to limit crop growth. Such conditions are:

1. Highly leached acidic sandy soils,
2. Soils with an impeded drainage or a high water-table;
3. Soils with a very high content of organic matter (such as peat andmuck soils of Kerala);
4. Calcareous and saline-alkaline soils very high in pH (situated in Uttar Pradesh, Punjab and Bihar
5. 5.Soils which have been very intensively cropped and to which high doses of commercial fertilisers have been applied; and
6. Soils that have been overlimed, i.e., high doses of lime have been added at one time.

Methods of Applying Micronutrients

Micronutrients could be applied to the soils or directly to the crops in various ways. The common methods are:

- Soil Application of Materials Containing Micronutrients
- Spraying of Nutrients on Plant Foliage
- Addition of Micronutrients Through Mixed Fertilisers
- Seed Soaking
- Seed Coating

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