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Role of Micronutrients in Plant Nutrition

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Micronutrients are abundantly present in the soil but plants usually acquire them in relatively trace amounts; hence, regarded as tracer element. Their adequate concentrations in plants are generally below the 100 parts per million (ppm) level (Table 1). The essential micronutrients are zinc (Zn), iron (Fe), manganese (Mn), boron (B), chlorine (Cl), copper (Cu), molybdenum (Mo) and nickel (Ni). Trace element are essential for either plants or animals (i.e., a micronutrient), as primary and secondary macronutrients. It needs to satisfy three criteria: (1) the organism cannot grow and reproduce normally without the element, (2) its action must be specific and unable to be replaced by any other element, and (3) its action must be direct (Arnon and Stout, 1939). Plant metabolism, nutrient regulation, reproductive growth, chlorophyll synthesis, production of carbohydrates, fruit and seed development, etc., are such effective functions performed by micronutrients. These tracer elements when present at adequate level elevate the healthy growth in plant physiological, biochemical and metabolic characteristics while their deficiency promotes abnormal growth in plants. Prevalence of micronutrient deficiency has become more common in recent years and the rate of their reduction has further been increased by the perpetual demands of modern crop cultivars, high soil erosion, etc.

Table 1. Selected nutrient element adequate concentrations and ranges in plants (dry weight basis).

Element	Symbol	Range of Concentrations (ppm)	Adequate Concentration (ppm)
Iron	Fe	20-600	100
Zinc	Zn	10-250	20
Copper	Cu	2-50	6
Molybdenum	Mo	0.10-10	0.10
Nickel	Ni	0.05-5	0.05
Manganese	Mn	10-600	50
Boron	B	0.2-800	20
Chlorine	Cl	10-80000	100

Importance of micronutrients in crop production

- Increases quality and yield because most micronutrients act as cofactors in various enzymes taking part in the various metabolic activities of the plant like protein metabolism, carbohydrate metabolism, photosynthetic rate etc. therefore there will be increase in protein content, TSS and other quality parameters which results improving the

quality and other micronutrients like iron, it is important for chlorophyll formation, photosynthesis will also increase and thus increase in yield.

- In legumes, it influences N_2-fixation because micronutrients like Fe and Mo is an important constituent of Nitrogenous enzymes which helps in leghaemoglobin formation (O_2 scavenger).
- Effect of micronutrient concentrations in planting seed on the vigour of next season's crop.
- Major economic impact of micronutrient concentrations in a farming operation is through the increased efficiency of macronutrient fertilizer use.

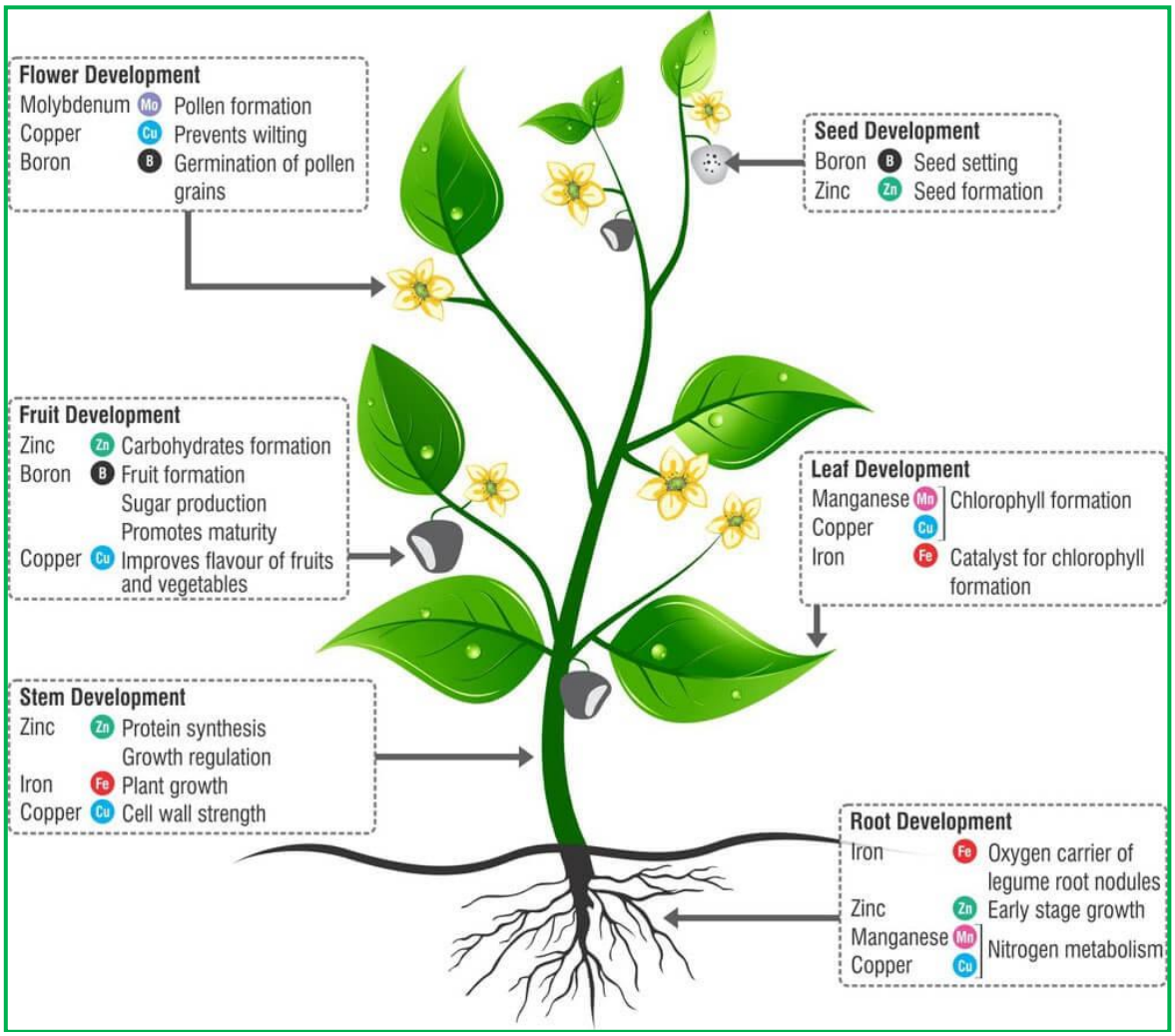

Fig. 1 Function of micronutrients

Role of micronutrients in plant nutrition

1. Iron

- Iron available to plants in form of Fe^{+2} .
- Iron helps in the synthesis of chlorophyll.
- It is a constituent of enzyme system i.e. cytochrome oxidase, catalase, nitrogenase reaction in plants.
- It is a structural component of porphyrin molecules like cytochromes, ferrichrome and hemoglobin which are important for respiration and photosynthesis in plants.
- It is also structural component of non hemine compounds like ferredoxins.

2. Manganese

- Manganese available to plants in form of Mn^{+2}.

- Manganese is an integral component of the water splitting enzyme associated with photosystem II and involved in formation of O_2 in photosynthesis.
- It involves in oxidation-reduction process and chlorophyll formation.
- It is a substitute for Mg^{+2} in many of the phosphorylating reactions.

3. Zinc

- Zinc available to plants in form of Zn^{+2}.
- Zinc is constituent of carbonic anhydrase, alcoholic dehydrogenase and superoxide¬ dismutase.
- Zinc is essential for reproduction of certain plants and formation of growth hormones.¬ It involve in auxin metabolism.
- Zinc influence translocation and transport of P in plants.

4. Copper

- Copper available to plants in form of Cu^{+2}.
- Copper is essential for the synthesis of vitamin A.
- It is act as a catalyst in respiration and "electron carrier" in enzyme which is important for redox reactions in plants.
- Copper is important in imparting disease resistance to the plants.

5. Boron

- Boron available to plants in forms of H_3BO_3.
- It is essential in actively growing region of plants such as root tips.
- Boron is important for cell development in meristematic tissue.
- Boron helps in nodule formation in legumes.
- It involves in translocation of sugars and starches in plant.
- Boron helps in pollination and fruit / seed setting in plants.
- It is important for synthesis of proteins and amino acids.
- Boron facilitates transport of K in guard cells as well as stomata opening.

6. Molybdenum

- Molybdenum available to plants in forms of MoO_4^{-2}.
- Molybdenum is essential component of nitrate reductase and nitrogenase enzymes.
- It is involved in absorption and translocation of Fe in plant.

7. Nikel

- Nickel is associated with nitrogen metabolism by way of influencing urease activity.
- It facilitates transport of nutrients to the seeds or grains.

8. Chlorine

- Chlorine available to plants in forms of Cl^-.
- Chlorine is essential for biochemical reactions.
- It involves in the evaluation of O_2 in photosynthesis.
- It improves disease resistance in plant by increase osmotic pressure in cell sap.