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Significance of Trace Elements in Crop Production

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Abstract

Trace elements are the elements that are vital to plant growth but are only required in minute amounts. Trace elements are nutrients which are important for a proper functioning of plants. Trace elements are administered to the plant in various nutrients *i.e.*, boron (B), molybdenum (Mo), manganese (Mn), copper (Cu), zinc (Zn) and iron (Fe). The combination of these trace elements and main elements is important to achieve continuous growth and healthy growth of plants. Trace elements have various functions for plants which includes; contribution to the development of chlorophyll granules, contribution to the formation of enzymes, improvement for the photosynthesis of plants and improves metabolic process, involved in cell elongation and firmness of cell membranes. The system is dynamic, not static, and biogeochemical cycling is now widely acknowledged for the evaluation of trace elements, it must be emphasised.

Keywords: *cell membrane, enzymes, photosynthesis, trace elements*

Trace elements are also called as micro-nutrients/elements because of the little amounts found in normal soils. Trace is the elements which are vital for crop production but are required only in minute amounts for proper growth and development. In absence of trace elements plants are unable to complete its normal life cycle and the deficiency of those can be cured with application of fertilizers and soil. They are found as impurities in both main and secondary minerals, and the amount of them in soils depends on the makeup of the parent substance (Forstner, 1995). Plants take essential elements through their roots from the soil

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and through their leaves from the air. Root hairs are the most important organ for absorption of elements from the soil and structure of it affects the process of absorption and the rate of absorption (Pandey & Sinha, 2009). The right sampling, analysis, use of appropriate reference materials, and selection of analytical methods are essential components of an accurate assessment of the environmental condition of a particular element (Swaine, 1985). The system is dynamic, not static, and biogeochemical cycling is now widely acknowledged for the evaluation of trace elements, it must be emphasised. (Trudinger and Swaine, 1979).

Plants uptake nutrients from the soil through their roots mainly by three fundamental processes:

1. Simple Diffusion
2. Fasciliated diffusion
3. Active transport
    1. Simple Diffusion: When O_2, CO_2 and NH_3 (non polar molecules) flow along the concentration gradient which moves passively through the lipid bilayer membrane without the use of transport protein.
    2. Fasciliated diffusion: When the ions and the solutes flows along the concentration gradient with the use of transport proteins.
    3. Active transport: When the ions and the molecules are absorbed against the concentration gradient (requires metabolic energy mainly ATP) through the membrane.

Trace elements are characterized on the basis of its concentrations required for normal growth and development which is lower than 1mg L^{-1}. Trace elements are **Boron(B), Chlorine (Cl), Copper(Cu), Iron(Fe), Manganese(Mn), Molybdenum(Mo), Zinc(Zn)** and **Nickle(Ni).** The requirements of these elements are fulfilled by absorbing it from the soil and externally through the fertilizer applications. Iron helps in the manufacture of chlorophyll and other biochemical processes, Boron helps to regulate plant metabolism and also in cell development, Manganese plays a very important role for chlorophyll production as manganese is the main constituent of chlorophyll, Chlorine is involved in photosynthesis and photolysis of water during photosynthesis, Copper helps plants to metabolize nitrogen, Molybdenum helps plants to use nitrogen, Zinc is used in development of enzymes and

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hormones. Molybdenum is also used by the leaves and needed by the legumes to form seeds (Jain, 2017).

Boron (B): Main source from which plants get boron is from rocks and marine sediments in the form of borate ions.

Boron is required for reproduction and germination of pollens and also involved in the translocation of sugar. It is concerned with nitrogen metabolism.

Deficiency symptoms:

- Flowers- sterile and less number of flowers is produed
- Fruits- deformed fruits are formed which become useless
- Leaves- terminal leaves become necrotic and pre mature leaf shedding occurs
- Stem- abnormal tillering (curling, pimpling) and die-back of apex is observed in stems
- Plant height- plant become dwarf and stunted in height
- Leaves- leaves showed deformities like cupping and curling

Molybdnum (Mo): Main source of molybdenum is mineral oils and coal ashes. It is necessary for nodule formation in legumes for fixation of atmospheric nitrogen. Mo deficiency is corrected by the application of 0.5 to 1kg of sodium or ammonium molybdate per hectare.

Deficiency symptoms:

- Leaves- leaves showed light yellow chlorosis and necrosis of the leaf tissues occurs
- Grains- failure in formation of grain occurs in oats
- Whiptail of brassica- leaf shows appearance of translucent areas near the midrib and becomes necrotic, leaves showed upward curling.
- Scald of legumes- leaf shows pailing, wilting, marginal rolling or scoching

Zinc (Zn): Main source of zinc is soil, because it is present in soil in very small quantity. Zinc leaf concentration on the dry matter basis ranges from 20-100mg/kg. Zinc is essential

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for chlorophyll formation, RNA and auxin synthesis. Zinc deficiency can be cured by applying 10-30kg/ha.

Deficiency symptoms:

- Leaves- leaves become leathery, chlorosis or necrosis, streaks between the veins are found in older leaves
- Leaf margins- leaf margins are distorted, become twisted or wavy and looked sickle shaped
- Fruit- Size of fruits are reduced
- Seeds- seed production is reduced
- Khaira of paddy
- White bud of maize
- Rosette of fruit trees/ little leaf
- Frenching of citrus

Copper (Cu):

Main source of copper is soil which is due to the residue of it present in the soil. It has important role in respiration, photosynthesis and carbohydrate/ nitrogen balance. Excess of potassium, phosphorus and high pH of soil can induce copper deficiency directly to the pants. Deficiency of it can be cured by the application of $CuSO_4$ @ 5-10kg/ha.

Deficiency symptoms:

- Leaf- cupping of the leaf or chlorosis between the veins of new leaves
- Grains- grain formation is restricted
- Stem- stem length between the leaves become shortened
- Flower- flower colour is lightened
- Reclamation disease/white tip disease- leaf tips become chlorotic advancement with the failure in seed setting in cereals, oats, legumes.
- Die back of fruit trees/ Exanthema- common in apple, citrus, pear and plum

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Manganese (Mn):

Manganese is essential for chlorophyll formation, abundance of manganese causes iron deficiency in plants. It is also involved in pollen germination, pollen tube germination and resistance to root pathogens. 15-30kg $MnSO_4$ as soil dressing and $MnSO_4$ (0.5%) plus half the quantity of lime as foliar spraying are found effective in curing Mn deficiency.

Deficiency symptoms:

- Leaves- leaves shows interveinal chlorosis with sunken spots between the veins, upward curling of the leaf occurs
- Height- pant height is reduced and stunted
- Toxicity of Mn causes burning of the tips and margins and reddish brown spots on older leaves
- Roots- poorly developed roots are observed which leads to plant death
- Grains- blind head is produced as grain formation is reduced
- Pahala blight of sugarcane
- Speckled yellow of sugar beet
- Marsh spot of pea
- Grey spec of oat barley, wheat, maize and rye

Iron (Fe):

Iron is the most important constituent of many enzymes and acts as catalyst for many functions. Its deficiency can be cured by the application of ferrous sulphate(0.5%) plus half quantity of lime as foliar spray. Fe-EDTA(Ethylene adenine tetra acetic acid) is most commonly used.

Deficiency symptoms:

- Leaves- leaves showed chlorosis which is similar to manganese deficiency
- Lime induced chlorosis- this disease is commonly observed in fruit trees but sometimes in cereals, beet and spinach

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Chlorine (Cl):

Chlorine is involved in photolysis of water and evolution of oxygen during photosynthesis.

Deficiency symptoms:

- Roots- roots with chlorine deficiency become reduced in length and thickened near the tips
- Leaves- Bronze colouration of the leaves is observed with reduced size of leaves
- Cabbage lacks its distinctive smell shows chlorine deficiency in it

Nickel (Ni):

Cofactor of enzyme urease which is involved in nitrogen fixation

Deficiency symptoms:

- Leaves- necrosis of the leaf tips along with the whole leaf chlorosis occurred
- Stems- Shortening of the internodes
- Leaves developed a condition called "mouse ear" (leaflets are small with rounded tips.

Conclusion: The input of metals from various sources- parent material, atmospheric deposition, fertilizers, agrichemicals, organic wastes, and other inorganic pollutants- minus losses in metals eliminated in crop production leads to the total trace element concentration. Leaching and potentially volatilization of the substance. These trace elements bioavailability is influenced by plant characteristics and chemical factors that govern the speciation of trace metals. In the soil-crop Ecosystems, plant accessibility, and trace metal mobility in soils are all fairly similar. In both situations, soil mineral precipitation and dissolution, ion exchange, The dynamics of trace metals in soil are influenced by adsorption and desorption processes, the production of soluble heavy-metal complexes, the dynamics of organic matter, and soil conditions.

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