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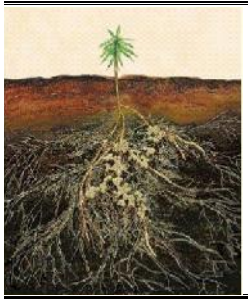

Mineral nutrition for plant health

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Mineral nutrient is generally used to refer to an inorganic ion obtained from the soil and require in plant growth. The process of absorption, translocation and assimilation of nutrients by the plants is known as mineral nutrition. Plants, like all other living things, need food for their growth and development. Plants require 17 essential elements of which, carbon, hydrogen and oxygen are derived from the atmosphere and soil water. The remaining 13 essential elements (nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, iron, zinc, manganese, copper, boron, molybdenum, and chlorine) are supplied either from soil minerals and soil organic matter or by organic or inorganic fertilizers. Beside these elements four more elements (Sodium, Cobalt, Vanadium and Silicon) are absorbed by some plants for special purposes. Essential nutrients are classified on the basis of quantity of nutrients in the plant as basic nutrients (C, H, O), macro nutrients (> 1ppm) *viz.*, N,P, K (Primary nutrients) and Ca, Mg, S (Secondary nutrients) while, Mn, Mo, Fe, Cu, Zn, B, Cl as micronutrients (< 1ppm).

Role of nutrients in plants :

Nitrogen :

– N is biologically combined with C, H, O, and S to create amino acids, which are the building blocks of proteins. Amino acids are used in forming protoplasm, the site for cell division and thus for plant growth and development.

– Since all plant enzymes are made of proteins, N is needed for all of the enzymatic reactions in a plant.

– N is a major part of the chlorophyll molecule and is therefore necessary for photosynthesis.

– N is a necessary component of several vitamins.

– N improves the quality and quantity of dry matter in leafy vegetables and protein in grain crops.

Deficiency symptoms :

– Stunted growth may occur because of reduction in cell division.

– Pale green to light yellow colour (chlorosis) appearing first on older leaves, usually starting at the tips.

– Depending on the severity of deficiency, the chlorosis could result in the death and/or dropping of the older leaves. This is caused by the translocation of N from the older to the younger tissues.

– N deficiency causes early maturity in some crops, which results in a significant reduction in yield and quality.

– The leaves become stiff and erect specially in case of cereals and shows a characteristics V shaped yellowing at the tip to lower leaves.

Control measures : Use of balanced fertilization in the soils containing nitrogen and foliar spray of urea on the plants.

Phosphorus :

– In photosynthesis and respiration, P plays a major role in energy storage and transfer as ADP and ATP (adenosine di- and tri-phosphate).

– P is part of the RNA and DNA structures, which are the major components of genetic information.

– Seeds contain highest concentration of P.

– P aids in root development, flower initiation, and seed and fruit development.

– P has been shown to reduce disease incidence in some plants and has been found to improve the quality of certain crops.

Deficiency symptoms :

– P is relatively mobile in plants and can be transferred to sites of new growth, causing symptoms of dark to blue-green coloration to appear on older leaves of some plants. Under severe deficiency, purpling of leaves and stems may appear.

– Lack of P can cause delayed maturity and poor seed and fruit development

– Because P is needed in large quantities during

the early stages of cell division, the initial overall symptom is slow, weak, and stunted growth.

Control measures: Application of phosphates fertilizers in the soil.

Potassium :

– Unlike N and P, K does not form any vital organic compounds in the plant. However, the presence of K is vital for plant growth because K is known to be an enzyme activator that promotes metabolism.

– K assists in regulating the use of water by controlling the opening and closing of leaf stomata.

– K promotes the translocation of photosynthates for plant growth or storage in fruits or roots.

– K has been shown to improve disease resistance in plants, improve the size of grains and seeds and also improves the quality of fruits and vegetables.

Deficiency symptoms :

– The most common symptom is chlorosis along the edges of leaves (leaf margin scorching).

– In some crop lodging occurs due to K deficiency.

Control measures : Use of potassic fertilizers in the soil.

Calcium :

– Ca has a major role in the formation of the cell wall membrane and its plasticity, affecting normal cell division by maintaining cell integrity and membrane permeability.

– Ca is an activator of several enzyme systems in protein synthesis and carbohydrate transfer.

– Ca is essential for seed production in peanuts.

– Ca indirectly assists in improving crop yields by reducing soil acidity when soils are limed.

Deficiency symptoms :

– Ca is not mobile and the symptoms first appear on the younger leaves and leaf tips.

– Ca deficiency is not often observed in plants because secondary effects of high acidity resulting from soil calcium deficiency usually limit growth, precluding expressions of Ca deficiency symptoms

– Without adequate Ca, which in the form of calcium pectate is needed to form rigid cell walls, newly emerging leaves may stick together at the margins which causes tearing as the leaves expand and un-furl.

– In some crops, younger leaves may be cupped and crinkled, with the terminal bud deteriorating.

– Buds and blossoms fall prematurely in some crops.

Control measures : Use of calcium carbonate and calcium hydroxide in the soil and gypsum.

Magnesium :

– It is a major constituent of the chlorophyll molecule and actively involved in photosynthesis.

– Mg is a co-factor in several enzymatic reactions that activate the phosphorylation processes.

– Mg assists the movement of sugars within plant.

Deficiency symptoms :

– It is a part of chlorophyll molecule.

– Deficiency symptom of interveinal chlorosis first appears in older leaves. Leaf tissue between the veins may be yellowish, bronze, or reddish, while the leaf veins remain green. In severe cases, symptoms may appear on younger leaves and cause premature leaf drop.

– Symptoms occur most frequently in acid soils and soils receiving high amounts of K fertilizer or Ca.

Control measures : Application of magnesium sulphate as foliar spray.

Sulphur :

– S is essential in forming plant proteins because it is a constituent of certain amino acids.

– S aids in seed production, chlorophyll formation, nodule formation in legumes, and stabilizing protein structure.

Deficiency symptoms :

– Younger leaves are chlorotic and light colored veins.

– Growth rate retarded and maturity is delayed.

– Symptoms may be similar to N deficiency and are most often found in sandy soils that are low in oganic matter.

Control measures : Foliar application of sulphur or sulphate.

Boron :

– B is necessary for the synthesis of one of the bases for RNA formation and in cellular activities.

– B has been shown to promote root growth.

– B is essential for pollen germination and growth of the pollen tube.

– B has been associated with lignin synthesis, activities of certain enzymes, seed and cell wall formation and sugar transport.

Deficiency symptoms :

– Generally, B deficiency causes stunted growth,

first showing symptoms on the growing point and younger leaves. The leaves tend to be thickened and may curl and become brittle.

In many crops, the symptoms are well defined and crop-specific, such as hollow hearts (peanuts), crooked and cracked stem (celery), black hearts (beets), distorted and lumpy fruit (papaya), splitting of calyx (carnation), midribs crack and turn brown (Chinese cabbage), pith in hollow stem (cabbage, broccoli, and cauliflower).

Control measures : Foliar spray of boric acid or borax (0.2-0.5%) and boron application in soil.

Copper :

– It is essential in several plant enzyme systems involved in photosynthesis.

– It is a part of the chloroplast protein plastocyanin, which forms part of the electron transport chain.

Deficiency symptoms :

– Reduced growth, distortion of the younger leaves, and possible necrosis of the apical meristem.

– In trees, multiple sprouts occur at growing points, resulting in a bushy appearance. Young leaves be-come bleached, and eventually there is defoliation and dieback of twigs.

– In forage grasses, young leaf tips and growing points are affected first. The plant is stunted and chlorotic.

Control measures : Foliar application of copper sulphate (0.2 - 0.5%).

Iron :

– It is essential for the heme enzyme system in plant metabolism (photosynthesis and respiration). The enzymes involved include- catalase, peroxidase, cyto-chrome oxidase, and other cytochromes.

– It is part of protein ferredoxin and is required in nitrate and sulfate reductions.

– Fe has been strongly associated with protein metabolism.

Deficiency symptoms :

– Interveinal chlorosis in younger leaves. The youngest leaves maybe white, because Fe, like Mg, is involved in chlorophyll production.

– Usually observed in alkaline or over-limed soil

Control measures : Foliar application of Ferrus sulphate (1 - 2%)

Manganese :

– It is involved in the oxidation-reduction process in photosynthesis.

– It is necessary in Photosystem II, where it participates in photolysis.

– It activates indole acetic acid oxidase.

Deficiency symptoms :

– Symptoms first appear as chlorosis in young tissues.

– In monocots, greenish-grey specks appear at the lower base of younger leaves. The specks may eventually become yellowish to yellow-orange.

– In legumes, necrotic areas develop on the cotyledons, a symptom known as marsh spots.

Control measures: Foliar application of Mangnese sulphate (0.5 - 1.5%)

Molybdenum :

– It is a necessary component of two major enzymes in plants, nitrate reductase and nitrogenase, which are required for normal assimilation of N.

– Mo is required by some soil micro-organisms for nitrogen fixation in soils

Deficiency symptoms :

– Deficiency symptoms resemble those of N because the function of Mo is to assimilate N in the plant. Older and middle leaves become chlorotic, and the leaf margins roll inwards.

– In contrast to N deficiency, necrotic spots appear at the leaf margins because of nitrate accumulation

– Deficient plants are stunted, and flower formation may be restricted

– Mo deficiency can be common in nitrogen-fixing legumes.

Control measures: Foliar application of ammonium molybdate (0.2 %)

Zinc :

– Zn is required in the synthesis of tryptophan, which in turn is necessary for the formation of indole acetic acid in plants.

– It is an essential component of several metallo

enzymes (dehydorgenases), therefore, is necessary for several different function in plant metabolism

– The enzyme carbonic anhydrase is specifically activated by Zn

– Zn has a role in RNA and protein synthesis

Deficiency symptoms :

– Interveinal chlorosis occurs on younger leaves, similar to Fe deficiency.

– In vegetable crops, colour change appears in the younger leaves first. The new leaves are usually abnormally small, mottled and chlorotic.

– In citrus, irregular interveinal chlorosis occurs with small, pointed, mottled leaves. Fruit formation is significantly reduced.

– In legumes, stunted growth with interveinal chlorosis appears on the older, lower leaves. Dead tissue drops out of the chlorotic spots.

Control measures: Foliar application of Zinc sulphate (0.5 - 1%)

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