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Role of Major Nutrients and Keys for Identifying their Deficiency Symptoms in Plants

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INTRODUCTION

Not all plant problems are caused by insects or diseases. Sometimes an unhealthy plant is suffering from a nutrient deficiency or even too much of any one nutrient. Plant nutrient deficiencies often manifest as discoloration or distortion of the leaves and stems. Plants need 17 essential nutrients for their successful survival viz., Structural elements (C, H, O-Obtained from environment), Macro elements (N, P, K, Ca, Mg, S) and Microelements (Zn, Cu, Fe, Mn, B, Mo, Ni) obtained from soil. Macro elements are required in large quantity compared to micro elements for completion of life cycle of the crop. So, much attention has been given to those elements which are required in abundant quantity for plants survival and successful completion of its life cycle.

A useful step in identifying nutrient deficiency symptoms is to determine whether the deficiency is the result of a mobile or immobile nutrient based on where the symptoms first appear in the plant. Mobile nutrients include Nitrogen (N), Phosphorus (P), Potassium (K) and Magnesium (Mg). Mobile nutrients are able to move out of older leaves to younger plant parts when supplies are inadequate. Because of their mobility inside the plant, visual deficiencies will first occur in the older or lower leaves. If the deficiency continues, then the symptoms will spread throughout the plant. In contrast, the relatively immobile nutrients do not readily move within the plant. As such, their deficiency symptoms first appear in new growth or young leaves and can be localized. Some of the common immobile nutrients include Calcium (Ca), Sulfur (S), Zinc (Zn), Copper (Cu), Iron (Fe), Manganese (Mn), Boron (B) and Molybdenum (Mo).

Visual identification of nutrient deficiency symptoms can be a practical tool for evaluating the nutrient status of the plant in addition to soil and tissue analysis. A prominent deficiency symptom and role of particular major nutrient elements has been overviwed individually.

Nitrogen:-

Role

- Nitrogen is an essential element of all the amino acids in plant structures which are the building blocks of plant proteins, important in the growth and development of vital plant tissues and cells.
- Nitrogen is a component of nucleic acid that forms DNA-a genetic material, significant in the transfer of certain crop traits and characteristics that aid in plant survival.
- Nitrogen is essential in plant processes such as photosynthesis. Thus, plants with sufficient nitrogen will experience high rates of photosynthesis and typically exhibit vigorous plant growth and development.
- Chlorophyll being an organelle essential for carbohydrate formation by photosynthesis and a substance that gives the plant their green color, nitrogen is a component of chlorophyll, that aids in enhancing these features.

Symptoms

- Nitrogen is mobile in the Plant, so lower/Older leaves will start yellowing from the tip toward the mid rib. (Note: On younger leaves this could be confused with Sulphur deficiency).
- Plants and leaves light green or yellow; No necrotic spotting.
- Stems may also yellow and may become spindly.
- Deficiency inhibits the cell division as it is component of genetic material, hence vegetative growth is retarded.

Phosporous

Role

- Stimulates root development necessary for the plant to get nutrients from the soil. The roots are also necessary for the support of the plant. When the roots are well developed, they are able to penetrate the ground and gather all the nutrients required by the plant for development.
- Phosphorus is required for photosynthesis and also in the storage and transportation of the nutrients throughout the plant.
- Plants are expected to produce fruit after a given time if all the circumstances are right. Phosphorous is responsible for crop maturity at the right time. Plants that lack phosphorous take time to mature and when they do, the fruits or seeds they bear are few and poor in quality.
- Legumes help in fixing nitrogen in the soil through their roots. This function cannot be carried out well without phosphorous which boost the development of the roots.
- The substances required for the formation and development of genes cannot perform well without the availability of phosphorous. The transfer of the genes from one generation to the next is only possible when phosphorous is available.

Symptoms

- Phosphorus is mobile in the plant, so lower/older leaves will affect. Purpling of the leaf margins or base of stems.
- Plants dark green, often developing purple or red color
- Older leaves develop a characteristic dark to bluish green colouration. Under severely deficient conditions, the bluish

green leaves can develop reddish brown or purple tints.

Potassium

Role

- Potassium regulates the opening and closing of stomata thus regulating the uptake of CO2 thus enhancing photosynthesis.
- It triggers activation of important biochemical enzymes for the generation of Adenosine Triphosphate (ATP). ATP provides energy for other chemical and physiological processes.
- It plays a role in osmo-regulation of water and other salts in plant tissues and cells.
- Potassium also facilitates protein and starch synthesis in plants.
- It activates enzymes responsible for specific functions.

Symptoms

- Potassium is mobile in the plant so lower/older leaves will affect.
- Marginal chlorosis and necrosis starting from leaf tip and advancing along the leaf margins is a classical symptom of K deficiency.
- In acute deficiency conditions, red strips develop on the lower stem and lower leaf sheaths.

Calcium

Role

- Calcium, in the form of calcium pectate, is responsible for holding together the cell walls of plants. When calcium is deficient, new tissue such as root tips, young leaves and shoot tips often exhibit distorted growth from improper cell wall formation.
- Calcium is also used in activating certain enzymes and to send signals that coordinate certain cellular activities.
- With rapid plant growth, the structural integrity of stems that hold flowers and fruit, as well as the quality of the fruit produced, is strongly coupled to calcium availability.
- Involved in nitrogen metabolism.
- Aids translocation of photosynthates from leaves to fruiting organs.

Symptoms

- As it is immobile in nature, symptoms are seen on young/ newer leaves.
- In early stages of deficiency symptoms, young leaves becomes pale green and develops white to yellow lesions.
- Under severely deficient conditions, the tips of youngest leaves are joined together and do not separate from the whorl, which gives the plant ladder like appearance and there is also appearance of yellow to white lesions become enlarging.
- Sometimes emerging leaves may die.

Magnesium

Role

- Magnesium is also required for the production of ATP through photophosphorylation process in chloroplasts.
- Plants under low Mg supply also show high susceptibility to increasing air temperature (e.g., heat stress).
- In acidic soils, Mg nutritional status of plants is important in mitigating toxic effects of aluminum (Al) in plants.
- Increases Iron utilization in plants.
- Influences earliness and uniformity of maturity.
- Facilitates the translocation of carbohydrates (sugars and starches).

Symptoms

- Magnesium is mobile in the plant so lower/older leaves will show symptoms.
- Yellow to white interveinal chlorosis.
- Reddish Purple from leaf edge moving inward.

Sulphur

Role

- Integral part of amino acids (cysteine, cystine and methionine), which are the building blocks of protein. About 90 per cent of plant S is present is present in these amino acids.
- Synthesis of oils, this is why adequate sulphur is so crucial for oilseeds.
- Promotes nodule formation on legumes.
- Aids in seed production.
- Necessary in chlorophyll formation (though it isn't one of the constituents).

Symptoms

- Sulphur is immobile in the plant so affect upper/newer leaves.
- New leaves, including their veins become pale yellow, but older leaves remain green.
- Typically no chlorotic spotting or striping.

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