Chapter 4 : Mineral Nutrition in Plants

1. Introduction

Plants require certain elements for their normal growth when any of these elements are not available to plants, it will develop definite deficiency symptoms.

2. Role of Nutrients

Following are listed some important roles that nutrients play:-

- **Balancing Function**: Some salts or minerals act against the harmful effects of the other nutrients hence balance the effect of each other.
- **Maintenance of Osmotic Pressure**: In few minerals the cell sap is present in organic or inorganic form, to control the organic pressure of the cell.
- **Influencing The pH of The Cell Sap**: Different anions and cations have different influences on the pH of the cell sap.
- **Construction of The Plant Body**: Some of the elements which help to construct the plant body are Carbon, Nitrogen and Oxygen. They help by entering the protoplasm and constitution of the wall.
- **Catalysis of The Biochemical Reaction**: Zinc, magnesium, calcium, and copper act as metallic catalysts in biochemical reactions.
- **Effects of Toxicity**: Under specific conditions, minerals like arsenic and copper have a toxic effect on the protoplasm.

3. Plant Nutrients Classifications

Macronutrients		**Micronutrients (Trace Elements)**
Primary Nutrients	**Secondary Nutrients**	
• Nitrogen (N) • Phosphorus (P) • Potassium (K)	• Calcium (Ca) • Magnesium (Mg) • Sulfur (S)	• Zinc (Zn) • Iron (Fe) • Manganese (Mn) • Molybdenum (Mo) • Copper (Cu) • Boron (B)

3.1. Macronutrients

Macronutrients are the nutrients required by plants in larger proportions. These may include sulfur, nitrogen, carbon, phosphorus, calcium, potassium, and magnesium.

⇨ **Primary Nutriments**

3.1.1. Nitrogen (N)

❖ **Function :**

✓ Promotes rapid vegetative growth.

✓ Gives plants healthy green colour.

❖ **Deficiency Symptoms :**

✓ Stimulated growth, pale yellowish colour.

✓ burning tips and margins of leaves starting at the bottom of the plant.

3.1.2. Phosphorus (P)

❖ **Function :**

✓ Stimulates early growth and root formation.

✓ Hastens maturity.

✓ Promotes seed production.

✓ Makes plants hardy.

❖ **Deficiency Symptoms :**

✓ Small root growth, Spindly stalk, Delayed maturity.

✓ Purplish discoloration of leaves.

✓ Dying of tips of older leaves, Poor fruit & seed development.

3.1.3. Potassium (K)

❖ **Function :**

✓ Improves plant ability to resist disease & Cold.

✓ Aids in the production of carbohydrates.

❖ **Deficiency Symptoms :**

✓ Slow growth

✓ Margins on leaves develop a scorched effect on the older leaves.

✓ Weak stalk, shriveled seed & fruits.

⇨ **Secondary Nutrients**

3.1.4. Calcium (Ca)

❖ **Function :**

✓ Aids in the movement of carbohydrates in plants

✓ Essential to healthy cell walls & root structure

❖ **Deficiency symptoms :**

✓ Terminal bud dies under severe deficiency

✓ Margins of younger leaves scalloped

✓ Blossoms shed prematurely

✓ Weak stalk & stem structure

3.1.5. Magnesium (Mg)

❖ **Function :**

✓ An ingredient of chlorophyll.

✓ Aids in the translocation of starch within the plant.

✓ Essential for formation of oils & fats.

❖ **Deficiency symptoms :**

✓ Yellowing of leaves between veins starting with lower leaves.

✓ Leaves abnormally thin.

✓ Tissue may dry & die.

✓ Leaves have tendency to curve upward.

3.1.6. Sulfur (S)

❖ **Function :**

✓ Aids in the formation of oils and parts of protein molecules.

❖ **Deficiency symptoms :**

✓ Young leaves light green to yellowish in colour.

✓ In some plants, older tissue may be affected also.

✓ Small spindly plants.

✓ Retarded growth and delayed maturity.

✓ Interveinal chlorosis on corn leaves.

3.2. Micronutrients

Micronutrients are the nutrients required by plants in very small proportions. Some of them are Boron, iron, chlorine, and molybdenum are some of the examples of micronutrients.

3.2.1. Zinc (Zn)

❖ **Function :**

✓ An essential constituent of several enzymes.

✓ Controls synthesis of indole acetic acid (IAA) an important growth regulator.

✓ Zinc is most often needed by crops like Grapes, Citrus, Pomegranate, Apple, Beans, Tomato, Onion, Cotton and Rice

❖ **Deficiency symptoms :**

✓ Decreased stem length and resetting of terminal leaves

✓ Reduced fruit bud formation

✓ Mottled leaves and stripping of corn leaves

3.2.2. Iron (Fe)

❖ **Function :**

✓ Essential for formation of chlorophyll.

✓ releases energy from sugars & starches.

❖ **Deficiency Symptoms :**

✓ Leaves yellowish or white. (young leaves first)

✓ Veins green, affected leaves curl up.

3.2.3. Copper (Cu)

❖ **Function :**

✓ Promotes formation of vitamin A, excess is very toxic

❖ **Deficiency symptoms :**

✓ Started growth, die back of terminal shoots in trees

✓ Poor pigmentation, wilting & eventual death of leaf tips.

✓ Formation of gum pockets around central pith in oranges

3.2.4. Manganese (Mn)

❖ **Function :**

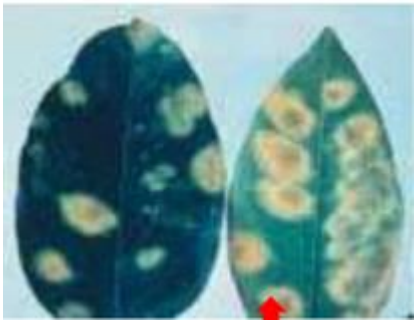
✓ Serves as an activator for enzymes in growth processes.
✓ Assist iron in chlorophyll formation.
✓ Generally required with zinc in foliar spraying of Citrus.

❖ **Deficiency symptoms :**

✓ Interveinal chlorosis of young leaves.
✓ Gradation of pale color next to veins.
✓ Development of gray specks (oats).
✓ Interveinal white streaks (wheat) or Interveinal brown spots (barley).

3.2.5. Molybdenum (Mo)

❖ **Function :**



✓ Required for N Utilization.
✓ Needed to transform NPN into amino acids.
✓ & legumes can not fix atmospheric N symbiotically without Mb.

❖ **Deficiency Symptoms :**

✓ Stunting & lack of vigor. Very similar to N deficiency due to the key role of Mb plays in N utilization.
✓ Whiptail in cauliflower & yellow spotting in citrus.

3.2.6. Boron (B)

❖ **Function :**

✓ Aids in assimilation of calcium, amount required is extremely small.

❖ **Deficiency Symptoms :**

✓ Death of terminal growth causing lateral buds to develop & produce "witches broom" effect.
✓ Thickened, curled, wilted & chlorotic leaves.
✓ Soft & neurotic spots in fruit & tubers.
✓ Reduced flowering or improper pollination.