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NABARD GRADE-A EXAM

SOIL SCIENCE NOTES

PLANT/SOIL NUTRIENTS



FOR NABARD GRADE A EXAM

NABARD Gr. A Exam – Agriculture & Rural Development Notes

Soil Science: Soil/Plant Nutrients

Soil is a major source of nutrients needed by plants for their growth.

To complete their life cycle, plants need 17 essential nutrients in varying amounts. Of these nutrients, three are found in air and water: Carbon (C), Hydrogen (H), and Oxygen (O). Combined, C, H, and O account for about 94% of a plant's weight. The other 6% of a plant's weight includes the remaining 14 nutrients, all of which must come from the soil.

The three main nutrients needed by plants are nitrogen (N), phosphorus (P) and potassium (K). Together they make up the trio also known as **NPK**.

Other important plant nutrients are calcium, magnesium, and sulphur. Plants also need small quantities of iron, manganese, zinc, copper, boron, and molybdenum, known as trace elements, because only traces are needed by the plant.

Relative amounts (out of 100) of the essential nutrients required by most plants.

Primary Nutrients

Carbon (C)	45
Oxygen (O)	45
Hydrogen (H)	6
Nitrogen (N)	1.5
Potassium (K)	1
Phosphorus (P)	0.2

Secondary Nutrients

Calcium (Ca)	0.5
Magnesium (Mg)	0.2
Sulfur (S)	0.1

Micronutrients

Iron (Fe)	0.01
Chlorine (Cl)	0.01
Manganese (Mn)	0.005
Boron (B)	0.002
Zinc (Zn)	0.002
Copper (Cu)	0.0006
Molybdenum (Mo)	0.00001

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*Amounts unknown for Nickel (Ni) and Cobalt (Co)

Major Elements

1. Nitrogen (N)

- Nitrogen is a key element in plant growth. It is found in all plant cells, in plant proteins and hormones, and in chlorophyll.
- Atmospheric nitrogen is a source of soil nitrogen. Some plants such as legumes fix atmospheric nitrogen in their roots; otherwise, fertiliser factories use nitrogen from the air to make ammonium sulphate, ammonium nitrate and urea. When applied to soil, nitrogen is converted to mineral form, nitrate, so that plants can take it up.
- Soils high in organic matter such as chocolate soils are generally higher in nitrogen than podzolic soils. Nitrate is easily leached out of soil by heavy rain, resulting in soil acidification. You need to apply nitrogen in small amounts often so that plants use all of it, or in organic form such as composted manure, so that leaching is reduced.
- Responsible for rapid foliage growth and green colour, easily leaches from soil & mobile in plant.

2. Phosphorus (P)

- Phosphorus helps transfer energy from sunlight to plants, stimulates early root and plant growth, and hastens maturity.
- All manures contain phosphorus; manure from grain-fed animals is a particularly rich source.
- Promotes root formation and growth, affects quality of seed, fruit, and flower production, increases disease resistance, does not leach from soil readily, mobile in plant, moving to new growth.

3. Potassium (K)

- Potassium increases vigour and disease resistance of plants, helps form and move starches, sugars, and oils in plants, and can improve fruit quality.
- Muriate of potash and sulphate of potash are the most common sources of potassium.
- Helps plants overcome drought stress, improves winter hardiness, increases disease resistance, improves the rigidity of stalks, leaches from soil, mobile in plant.

4. Calcium (Ca)

- Calcium is essential for root health, growth of new roots and root hairs, and the development of leaves.
- Lime, gypsum, dolomite, and superphosphate (a mixture of calcium phosphate and calcium sulphate) all supply calcium. Lime is the cheapest and most suitable option.
- Moderately leachable, limited mobility in plant, essential for growth of shoot and root tips.

5. Magnesium (Mg)

- Magnesium is a key component of chlorophyll, the green colouring material of plants, and is vital for photosynthesis (the conversion of the sun's energy to food for the plant).
- Magnesium deficiency can be overcome with dolomite (a mixed magnesium-calcium carbonate), magnesite (magnesium oxide) or Epsom salts (magnesium sulphate).
- Leaches from sandy soil, mobile in plant.

6. Sulphur (S)

- Sulphur is a constituent of amino acids in plant proteins and is involved in energy-producing processes in plants. It is responsible for many flavour and odour compounds in plants such as the aroma of onions and cabbage.
- Sulphur deficiency is not a problem in soils high in organic matter, but it leaches easily.
- Superphosphate, gypsum, elemental sulphur, and sulphate of ammonia are the main fertiliser sources.
- Leachable, not mobile, contributes to odour and taste of some vegetables.

Trace elements or Micronutrients

1. Iron (Fe)

- Iron is a constituent of many compounds that regulates and promotes plant growth.
- Accumulates in the oldest leaves and is relatively immobile, necessary for the maintenance of chlorophyll.

2. Manganese (Mn)

- Manganese helps with photosynthesis & enzyme activity.

3. Copper (Cu)

- Copper is an essential constituent of enzymes in plants.

4. Zinc (Zn)

- Zinc helps in the production of a plant hormone responsible for stem elongation and leaf expansion. Also needed for enzyme activity.

5. Boron (B)

- Boron helps with the formation of cell walls in rapidly growing tissue.
- Deficiency reduces the uptake of calcium and inhibits the plant's ability to use it.
- Important in enabling photosynthetic transfer and very immobile in plants.

6. Molybdenum (Mo)

- Molybdenum helps bacteria and soil organisms convert nitrogen in the air to soluble nitrogen compounds in the soil, so is particularly needed by legumes. It is also essential in the formation of proteins from soluble nitrogen compounds.
- Also needed for enzyme activity.

7. Chlorine (Cl)

- Also needed for enzyme activity.

8. Cobalt (Co)

- Needed by plants recently established.
- Essential for nitrogen fixation.

9. Nickel (Ni)

- Needed by plants recently established.
- Essential for seed development.

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