Soil Fertilty



- AB Stewart laid the foundations of soil fertility research in India.
- Lawes was the first person to manufacture a fertilizer, he manufactured SSP.
- First fertilizer factory setup in India at Ranipur in the year 1906.
- Quantity of plant nutrients depleted annually from Indian soils is 8-10 MT of $N+P_2O_5+K_2O$.
- In recent soil sample analysis in India 43% deficient in Zinc, 33% deficient in B, 15% deficient in Iron, 6% deficient in Manganese, 4% deficient in Copper.
- Nutrient deficiencies are found to be in the order N = P > Zn = S > B > K = Fe > Mn > Cu.
- Mineral nutrient refers to inorganic ion obtained from the soil and required for plant growth.
- The process of absorption, translocation and assimilation of nutrients by the plants is known as mineral nutrition.
- Plants need 16 elements for their growth and completion of life cycle.
- Ni is the nutrient considered essential for plant growth in

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addition to 16 nutrients.

- In addition, four elements viz., sodium, cobalt, vanadium and silicon are absorbed by some plants for special purposes.
- All these essential elements are not required for all plants, but all have been found essential for one plant or the other.
- All carbon atoms and most of the oxygen atoms are derived from carbon dioxide which is assimilated principally in photosynthesis.
- Approximately one-third of oxygen atoms in organic material in higher plants are derived from soil water and two-thirds from carbon dioxide of the atmosphere.
- C, H, O are not minerals.
- Rest of the elements are absorbed from the soil and these are are called mineral elements since they are derived from minerals.
- Arnon and stout (1939) proposed criteria of essentiality which was refined by Arnon (1954).

Criteria of essentiality of an element are

- Plants cannot complete vegetative or reproductive stage of life cycle due to its deficiency.
- When this deficiency can be corrected or prevented only by supplying this element.
- When the element is directly involved in the metabolism of

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the plant.

- According to criteria of essentiality, sodium is considered as nonessential.
- However, sodium increases yield of several crops like sugar beets, turnips and celery.
- Nicholas (1961) proposed the term functional nutrient for any mineral element that functions in plant metabolism whether or not its action is specific.
- Sodium, cobalt, vanadium and silicon are also considered as functional nutrients in addition to 16 essential elements.
- C, H and O which constitute 96 per cent of total dry matter of plants are considered as basic nutrients.
- C and O constitute 45 per cent each of the total dry matter.
- N, P and K are called primary nutrients.
- Ca, Mg and S are known as secondary nutrients.
- Secondary nutrients are inadvertently applied to the soils through N, P and K fertilizers which contain these nutrients.
- Nutrients which are required in small quantities are known as micronutrients or trace elements (Fe, Zn, Cu, B, Mo and Cl).
- Micronutrients are very efficient and minute quantities produce optimum effects.
- N, P, S, B, Mo and Cl are non-metals.
- Nutrients required in large quantities are known as

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macronutrients (N, P, K, Ca, Mg and S).

FUNCTIONS OF NUTRIENTS

- C, H and O are the elements that provide basic structure to the plant.
- N, S and P are useful in energy storage, transfer and bonding.
- N, S and P are accessory structural elements which are more active and vital for living tissues.
- K, Ca and Mg are necessary for charge balance. They act as regulators and carriers.
- Fe, Mn, Zn, Cu, B, Mo and Cl are involved in enzyme activation and electron transport. They act as catalysers and activators.
- Basic nutrients C, H and O are constituents of carbohydrates and several biochemical compounds.
- Nitrogen is a constituent of proteins, enzymes, hormones, vitamins, alkaloids, chlorophyll etc.
- Phosphorus is a constituent of sugar phosphates, nucleotides, nucleic acids, coenzymes and phospholipids.
- Process of anabolism and catabolism of carbohydrates proceed when organic compounds are esterised with phosphoric acid.
- Potassium is not a constituent of any organic compound.
- Potassium is required as a cofactor for 40 or more enzymes.
- Potassium controls movement of stomata and maintains

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electroneutrality of plant cells.
➢ Sulphur is a constituent of several amino-acids and fatty acids.
➢ Calcium is a constituent of cell wall as calcium pectate.
➢ Calcium is required as a cofactor in hydrolysis of ATP and phospholipids.
➢ Magnesium is a constituent of chlorophyll.
➢ Magnesium is required in several enzymes involved in phosphate transfer.
➢ Iron is a constituent of various enzymes like cytochrome, catalase and plays the part of a vital catalyst in the plant.
➢ Iron is a key element in various redox reactions of respiration, photosynthesis and reduction of nitrates and sulphates.
➢ Manganese is a constituent of several cation activated enzymes like decarboxylases, kinases, oxidases etc.
➢ Manganese is essential for the formation of chlorophyll, reduction of nitrates and for respiration.
➢ Copper and Zinc are involved in cation activated enzymes.
➢ Boron helps in carbohydrate transport.
➢ Boron is necessary for the germination of pollen, formation of flowers and fruits and for the absorption of cations.
➢ Molybdenum is required for the assimilation of nitrates as well as for the fixation of atmospheric nitrogen.
➢ Chlorine is involved in reaction relating to oxygen

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evolution.
➢ Co, Se are the elements that need to be applied to forage crops from the viewpoint of animal nutrition.
➢ Cobalt is essential for the synthesis of vitamin B12.

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