



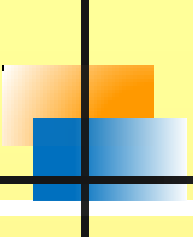
PLANT NUTRITION



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□ Plant Nutrition

- **Nutrition is the process by which an organism obtains food, which is used to provide energy and materials for its life sustaining activities.**
- **The chemical substances that provide nourishment to living organisms are called nutrients. Depending on the mode of nutrition, the organisms are classified as autotrophs and heterotrophs.**
- **About 60 elements are found in different plants. Some plant species accumulate selenium, some other gold, while some plants growing near nuclear test sites take up radioactive strontium.**

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- **The elements, which absolutely essential for plant growth and metabolism are called essential elements. There are 17 essential elements, which can be divided into macro elements and micro-elements, based on their quantitative requirements.**
 - **Macro-elements are required in large amounts for plant tissues (i.e., in excess of 10 m mole/kg of dry matter). The macro-elements include carbon, hydrogen, oxygen, nitrogen, phosphorus, sulphur, potassium, calcium and magnesium, of these carbon, hydrogen and oxygen are mainly obtained from CO₂ and H₂O, while the others are absorbed from the soil as mineral nutrition.**
 - **Micro-nutrients or trace elements are required in very small amounts (i.e., less than 10 m mole/kg of dry matter). These include iron, manganese, copper, molybdeum, zinc, boron, chlorine and nickel.**

Modes of Nutrition in Plants

Autotrophic

Photo-autotrophic

→ All green plants

→ Purple, red and green bacteria

Chemo-autotrophic

→ Nitrifying bacteria

→ Iron bacteria

→ Sulphur bacteria

Heterotrophic

Parasitic

Total

Stem

Cuscuta

Root

Orobanche

Saprophytic

→ *Monotropa*

→ *Neottia*

→ *Agaricus*

→ *Rhizopus*

Symbiotic

→ Lichen

→ Root nodules

→ Mycorrhiza

Partial

Stem

Viscum

Loranthus

Root

Santalum

Insectivorous

→ *Drosera*

→ *Utricularia*

→ *Nepenthes*

→ *Dionea*



☐ Nitrogen

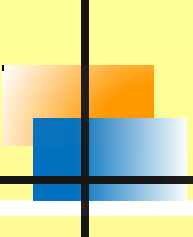
- Nitrogen is obtained from the soil in the form of nitrites (NO_2^-), nitrates (NO_3^-) and ammonium (NH_4^+) salts.

Functions

- Nitrogen is constituent of amino acids, proteins, amides, nucleic acids, enzymes, some co enzymes, chlorophyll and alkaloids. It is, therefore, essential for cell division, full vegetative and reproductive growth, metabolic activities of cell, photosynthesis etc.

Deficiency Symptoms

- Chlorosis, which starts from older leaves and progresses to younger leaves.
- The leaves show mottled appearance of purple or red anthocyanin pigments over the vein, example-tomato, apple.
- Lateral buds remain dormant.

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- **There is little tillering in cereals.**
 - **Flower formation is either suppressed or only a few flowers are formed, which lead to the formation of small fruits and less viable seeds.**
 - **In potato, smaller and fewer tubers are produced.**

☐ Phosphorus

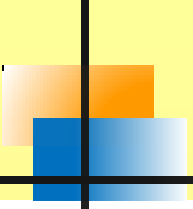
- **It is obtained from the soil in the form of phosphate (H_2PO_4^-).**

Functions

- **It is a component of nucleic acid, phospholipids, ATP, nucleoprotein, NAD, NADP and a number of coenzymes.**
- **Since the young cells are the seat of maximum metabolic activities, maximum phosphorus is found in the meristems, fruits and seeds.**

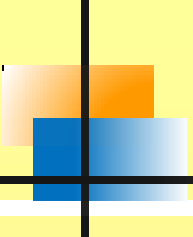
Deficiency Symptoms

- **Stunted growth.**
- **Premature leaf fall.**

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- Chlorosis appears later, which is of mottled type and is shown first by older leaves.
 - Necrosis in lamina, petiole and skin of soft fruits.
 - Lateral buds show prolonged dormancy, but active buds are not affected.
 - Vascular tissues are poorly developed.

□ Sulphur

- It is absorbed from the soil in the form of sulphate (SO_4^{2-}) through small quantities of sulphur dioxide can be got from the air by foliar absorption.
- Functions
- For the formation of sulphur containing protein.
- It is a component of two vitamins (B and biotin).
- In onion and garlic, sulphur occurs in the form of glucosides, which provide characteristic odour to these plants.

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- **Sinigrin and sinalbin are glucosides in black and white mustards respectively.**
 - **Enhances the number of nodules and nitrogen fixing bacteria in legumes.**
 - **Formation of chlorophyll.**

Deficiency Symptoms

- **Leaves show chlorosis.**
- **Reduction in juice content of citrus fruits.**
- **Fruit formation, in general, is retarded.**
- **Tea yellow in tea plant.**
- **Premature germination of lateral buds, killing of young branches.**
- **Smaller and chlorotic leaves.**
- **Necrosis of leaf margin and tip.**
- **Inward rolling of leaf margin and rapid defoliation.**



□ Potassium

- **It is absorbed in the form of K^+ ions.**

Functions

- **It is the most abundant cation in plants.**
- **Required for the metabolic activities of cells in young growing parts like root tips and young leaves but seeds are an exception.**
- **Essential for the functioning of about forty enzymes which take part in glycolysis, Krebs cycle, photosynthesis, starch synthesis, synthesis of nucleic acids and chlorophyll and the activity of ATP in many reactions.**
- **It maintains hydration, permeability and reactive state of protoplasm.**
- **Produces turgor pressure inside cells for their movements.**
- **Stomatal opening and closing is linked to its influx and efflux from the guard cells.**



Deficiency Symptoms

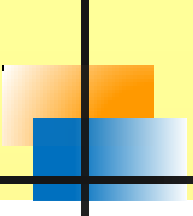
- **Leaves show chlorosis.**
- **Necrosis at the leaf tip, margin or irregular patches.**
- **Citrus leaves become bronzed and twisted.**
- **Growth is stunted due to reduced apical activity.**
- **Apical buds may die. Loss of apical dominance is a characteristic deficiency symptom of K^+ ions and it leads to bushy growth.**
- **Cereals may show lodging.**

☐ Magnesium

- **It is absorbed as Mg^{2+} ions.**

Functions

- **It is a component of chlorophyll and magnesium pectate.**
- **Essential for the formation of carotenoids.**
- **Required by a large number of enzymes connected with phosphate transfer.**

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- For binding of ribosomes.
 - Higher concentration of Mg^{2+} ions are found in seeds and growing areas of root and stem.

Deficiency Symptoms

- Chlorosis. Yellow, red and purple tints are often found in the chlorotic areas, especially towards the margins.
- Followed by necrosis.
- Defoliation may occur.
- Reduced vegetative and reproductive growth.
- Phloem and pith become reduced or remain undeveloped.
- Tomato fruits having pale orange colour, reduced pulp and woolly flesh.

☐ Calcium

- It is absorbed as Ca^{2+} ions.



Functions

- **Calcium is a component of calcium pectate, which is found in the middle lamella.**
- **Acts as an activator of enzymes like ATPase, some kinases, phospholipases, α -amylase and succinate dehydrogenase.**
- **Takes part in lipid metabolism.**
- **Required in the maintenance of cell membrane.**
- **Essential for control of carbohydrate metabolism.**
- **Plays some role in binding nucleic acids and proteins in chromosomes.**
- **Counteracts toxicities of other metallic ions.**

Deficiency Symptoms

- **Fragility of chromosomes.**
- **Roots become translucent and stop apical growth.**
- **Young leaves show marginal and apical withering.**
- **Flower and fruit stalks break-premature falling.**



□ Iron

- **Absorbed from soil in both Fe^{2+} and Fe^{3+} ions.**

Functions

- **Iron is a constituent of cytochromes, ferredoxin, nitrogenase, catalase peroxidase, hematin etc.**
- **Essential for the development of chloroplast and chlorophyll.**
- **Many of iron containing enzymes take part in electron transfer in both photosynthesis and respiration.**
- **Structure of polyribosomes is dependent upon iron containing compounds.**
- **Activator of nitrate reductase.**
- **Synthesis of proteins and DNA.**

Deficiency Symptoms

- **Chlorosis – inter veinal chlorosis.**



☐ Manganese

- **It is absorbed as Mn^{2+} ions.**

Functions

- **Activator of enzymes like oxidases, peroxidases, dehydrogenase, kinase and dicarboxylases.**
- **Maintenance of lamellar structure of chloroplast.**
- **Essential for photolysis of water and evolution of oxygen.**

Deficiency Symptoms

- **Chlorotic patches are in the form of specks or reticulations in dicots and stripes in monocots.**
- **Necrosis may follow.**
- **Leaves show premature fall or do not develop at all.**
- **Both stem and root experience stunted growth. Their apices may die back.**
- **Flower are often sterile.**
- **Grey spot disease in oat develops due to manganese deficiency.**



□ Zinc

- **It is obtained as Zn^{2+} ions.**

Functions

- **Constituent of carbonic anhydrase. Zinc is essential for supply of CO_2 to the chloroplast and for the evolution of CO_2 during respiration.**
- **Production of IAA (auxin).**

Deficiency Symptoms

- **Inter veinal chlorosis.**
- **Followed by necrosis.**
- **Terminal bud dies and leads to leaf rosettes.**



Boron

- It is absorbed in the form of borate ions (BO_3^{3-} or $\text{B}_4\text{O}_7^{2-}$).

Functions

- Favours absorption of calcium.
- Produces root nodules in legumes.

Deficiency Symptoms

- Causes disintegration of softer tissues.
- Browning of cauliflower.
- Heart rot of sugar beet.
- Reduces transpiration due to defuncting of stomata.

Copper

- It is mostly absorbed as Cu^{2+} ions through the element can also exist as Cu^+ ion.

Functions

- It can take part in electron transport system in both respiration and photosynthesis.
- In photosynthesis, the copper containing enzyme is plastocyanin.
- It is the connecting link between photo-system-I and II.



Deficiency Symptoms

- **Appearance of dark green colour in young leaves followed by chlorosis.**
- **In exanthema, the tree barks show deep slits from which gum exudes.**
- **The reclamation disease is named so because of its widespread presence in reclaimed lands of Europe. Tips of leaves undergo chlorosis. Hence, also known as the leaf-tip disease.**

□ Molybdenum

- **Absorbed from soil as molybdate ion (MO_2^{2+}).**

Functions

- **Essential for nitrogen fixation.**



Deficiency Symptoms

- **Yellow spot disease of citrus fruits.**
- **Whiptail disease in crucifers like cabbage.**
- **Flowers show premature fall.**
- **In cauliflower, the inflorescence loses its compact form.**

☐ Chlorine

- **It is absorbed as Cl^- ions.**

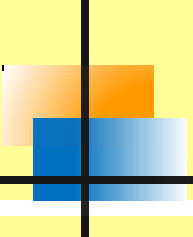
Functions

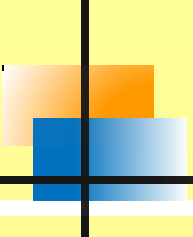
- **Its precise role is not well known.**
- **However, with Na^+ and K^+ , it helps in determining solute concentration and anion-cation balance in the cells.**
- **Chlorine plays an important role in photosynthesis. It takes part in the water splitting reaction, thus releasing oxygen.**

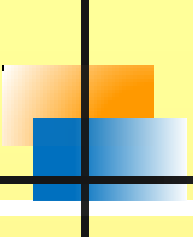


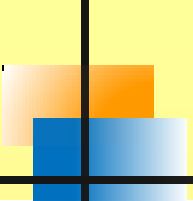
Deficiency Symptoms

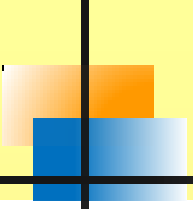
- **Leaves become wilted.**
- **Chlorosis and then necrosis.**
- **Leaves develop bronze colour.**
- **Root growth is stunted.**
- **Fruit formation is retarded.**

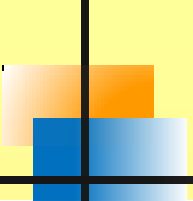
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- **An essential element is one which is indispensable for growth and is irreplaceable.**
 - **Copper is micro-element.**
 - **N, P, K are critical elements.**
 - **Boron is absorbed by plants from soil directly.**
 - **Calcium is not an essential micro-nutrient for plant growth.**
 - **A plant requires magnesium for chlorophyll synthesis.**
 - **C, H, O, N, P group contain primary elements.**
 - **Exanthema in citrus is caused due to deficiency of Cu.**
 - **Attractive colour of apples may be induced by reducing the supply of N.**
 - **Aeroponics is also called as soilless cultivation of plants.**
 - **Calcium of macro-nutrient.**
 - **Calcium is an inorganic nutrient.**
 - **Yellowing of tea leaves occurs due to deficiency of Sulphur.**
 - **Necrosis of leaves is not done by Sodium.**
 - **Brown heart disease is due to deficiency of boron.**

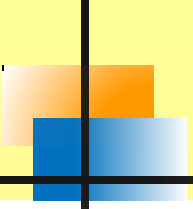
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- **In premature yellowing of leaves of a pulse crop might cause decrease in the yield. It can be treated by application of iron and magnesium to promote synthesis of chlorophyll.**
 - **Sodium essential for animal is not needed by the majority of the plants except some species of salt marsh.**
 - **Organisms which obtain energy by the oxidation of reduced inorganic compound are called chemoautotrophs.**
 - **Photolithotrophs obtain energy from radiations and hydrogen from inorganic compounds.**
 - **The insectivorous plants can grow well in the deficiency of nitrogen.**
 - **Boron is used for seed germination.**
 - **Arsenic , copper and mercury causes toxic effect upon protoplasm.**
 - **The elements that take part in catalytic reactions are zinc , manganese copper.**
 - **VAM are symbiotic fungi.**

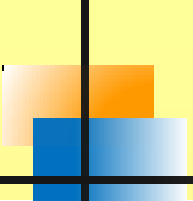
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- **Inorganic nutrient are present in soil in the form of electrically charged ions.**
 - **Willstatter (1906) proved first that the magnesium is the essential element for chlorophyll.**
 - **Slight deficiency of phosphorous is considered to be useful to the plants against desiccation because it induces greater mechanical tissues and higher root/shoot ratio.**
 - **Sulphur is an important nutrient for optimum growth and productivity in pulse crops.**
 - **The deficiency of molybdenum causes mottling and necrosis in plant.**
 - **Lecithin function as carrier in active ion absorption.**
 - **A trace element is an element that is present in very minute amounts in protoplasm.**
 - **Ash informs which element is essential and in which amount it is necessary for a particular plant.**

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- **Saprophytes belonging to angiosperms are known as humus plants.**
 - **A heterotroph is an organism that derives its energy from organic molecules.**
 - **The carnivorous plants live in water logged or boggy habitats which are deficient in nitrates.**
 - **There exists a close association between the alga and the fungus within a lichen. The fungus provides protection , anchorage and absorption for the alga.**
 - **The ability of the Venus flytrap to capture insects is due to rapid turgor pressure changes.**
 - **Liebig (1804) proved for the first time that the plants contain a large number of minerals and micro-elements.**
 - **Essential micro-nutrients are also known as trace elements.**
 - **Microelements are those essential elements which are required by the plants in concentration less than 1 mg/g of dry matter.**

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- **The concentration of a macro-element per gram of dry matter in plants is at least.**
 - **Hydroponics is a system of growing plants in soilless cultures or sodium cultures.**
 - **A partial parasite is one which takes both water and minerals from the host but manufactures its own carbohydrate food.**
 - **A facultative parasite is one which is normally a saprophyte but can also become a parasite.**
 - **Obligate parasites are those organisms which live only on living hosts.**
 - **Organisms which obtain their food from non-living material in their environment are called saprophytes.**
 - **The deficiencies of micro-nutrients not only affect growth of plants but also vital functions such as photosynthetic and mitochondrial electron flow. Copper, Manganese and iron affect most , both photosynthetic and mitochondrial electron transport.**

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- **A nutritionally wild type organism which does not require any additional growth supplement is known as prototroph.**
 - ***Nepenthes* is an example of insectivorous plant.**
 - ***Dionaea* is an insectivorous plant which has rosette of prostrate leaves with winged petiole. The lamina consists of two round halves having teeth like margins devised for catching prey.**
 - ***Monotropa* is a saprophytic angiosperm.**
 - **The deficiency of an essential element in the soil without doing soil tests can be known by noting the typical morphological symptoms of deficiency shown by plants growing in it.**
 - **An element without which a plant will not grow and complete its life cycle is known as essential element.**
 - **If by radiation all nitrogenase enzymes are inactivated then there will be no fixation of nitrogen in legumes.**
 - **The most common ion found freely in the cell is phosphorus.**

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- **The framework elements of plants are carbon, hydrogen oxygen.**
 - **The common symptoms produced due to the deficiency of phosphorus ,calcium and magnesium are appearance of dead necrotic spots.**
 - **The brown colour of leaves of cabbage is due to the deficiency of boron.**
 - **Rapid deterioration of root and shoot occurs due to the deficiency of calcium.**
 - **Viscum is a partial stem parasite.**
 - **Lead , nickel, iodine and sodium is not essential for a normal plant.**
 - **Complete suppression or delay in flowering occurs due to the deficiency of nitrogen.**
 - **Etiolation is not caused by deficiency of mineral nutrition.**
 - **Plant growth is stunted due to the deficiency of nitrogen and potassium.**

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- **The non-essential element present in several grasses , sedges, diatoms etc. is silicon.**
 - **Biotin contains one of the following elements sulphur.**
 - **NPK denotes nitrogen , phosphorous and potassium.**
 - **Root nodules are pinkish in colour internally.**
 - **Pink colour is due to the presence of pigment leghaemoglobin.**
 - **Deficiency of sulphur causes chlorosis in plants.**
 - **Elements like calcium, magnesium and potassium perform antagonistic or balancing functions.**
 - **Elements like calcium , magnesium and potassium counter act the toxic effects of other mineral elements by maintaining ionic balance.**



Thanks...