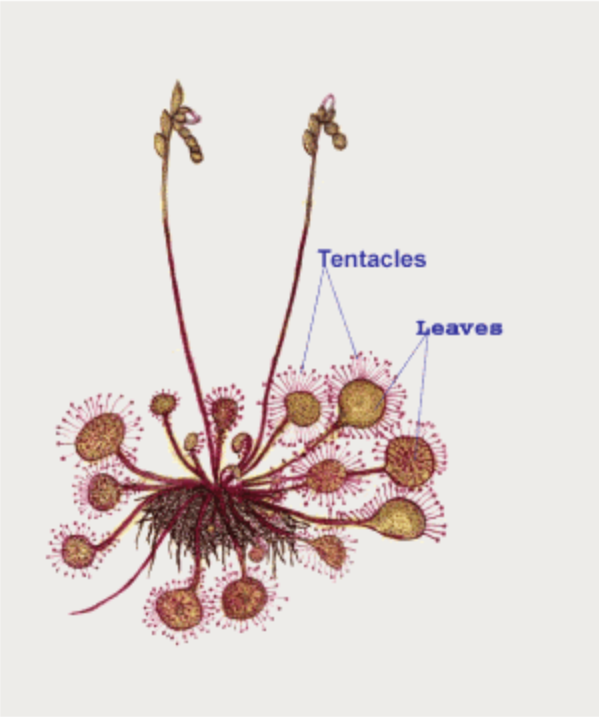
Chapter - 12 Mineral Nutrition

Question-1

Make well labeled sketch of *Drosera* plant.

Solution:



Question-2

Give an account of heterotrophic nutrition in plants.

Solution:

Heterotroph organism cannot manufacture their own food. They are usually of three types,

(i) Saprophytes,

(ii) Parasites,

(iii) Insectivorous plants or carnivorous plants.

(i) Saprophytes are non-green organisms which get their food from dead and decaying bodies. E.g. bacteria, fungi and some angiosperms. *Monotrapa* is known as Indian pipe. It grows in the soil rich in humus. Birds nest orchid or *Neottia* also grows in forest's humus rich soil.

(ii) Parasite get their food from the host plant or animal. Parasitic plants are mainly of two types based upon their association with the host plant. They may be complete or partial parasites. The example of these parasites are,

Total stem parasite – *Cuscuta reflexa* (Dodder or Amarbel) on the host Citrus, Duranta etc.

Total root parasite – *Orobanche, Rafflesia, Balanophora* (Frown rope) and *Strigia*.

Partial stem parasite – *Viscum (Mistletoe)* and *Loranthus and Cassytha*.

Partial root parasite – *Santalum album* (Sandlewood).

(iii) Insectivorous plants feed on insects to obtain nitrogen food requirement. They are called partly autotrophs and partly heterotrophs. E.g. *Nepenthes khasiana*. (Pitcher plant), *Drosera* (Sundew), *Dionea muscipula* (Venus fly trap), *Aldrovanda* (water flea trap) and *Utricularia* (Bladder wort).

Some green plants only prepare their own carbonaceous food as for nitrogenous compounds they capture insects and small animals and feed upon them absorbing only the nitrogenous compounds from their bodies. Such plants are called carnivores or insectivorous plants, E.g. Sundew, Venus fly trap, Pitcher plant. Etc.

In the pitcher plant the leaf becomes modified into a pitcher and the mouth of the young pitcher is covered by a lid. The inner surface of the pitcher contains various digestive glands, which secrete the digestive agent, which helps in the digestion of proteins only. Hair like structures is present below the mouth, which prevents the insects from coming out. Pitcher is partially filled with a fluid, and animals and small insects when enters the pitcher they get drowned and after their death digestion starts. Proteins are converted into peptones and peptones to amines. Only amines are absorbed by the pitcher and rest of the material.

The leaves of the sundew plants are covered with hairs that secrete sticky fluid at the trips. This sticky fluid glisten in light and hence this plants is called as sundew. An insect when visit this plant gets struck and the enzymes secreted by the heirs digest the insect and the product are absorbed by the leaf surface.

Question-3

Explain briefly the special modes of nutrition in plants.

Solution:

Special modes of nutrition in plants – There are two modes of nutrition in plants,

(a) Autotrophic nutrition and

(b) Heterotrophic nutrition.

(a) Autotrophic nutrition – Green plants prepare their own food. They fall into two categories namely chemoautotrophic and photoautotrophic. *Nitrosomonas* and *Nitrosococcus* are chemosynthetic bacteria. All green plants are autotrophic.

(b) Heterotrophic nutrition – They may be parasitic, saprotrophic, symbionts and insectivorous plants.

(i) Parasites – They may be obligate parasite and semi parasites. Obligate parasites get their food from their host plants. They may be total root parasites or total stem parasites. *Orobanche* and *Rafflesia* are total root parasites while *Cuscuta reflexa* is a total stem parasite. Partial parasites may be partial stem parasites and partial root parasites. *Loranthus* and *Viscum* are partial stem parasites. Sandal wood tree is partial root parasites.

(ii) Saprophytes – E.g. *Monotropa, Neottia*. They grow in soil rich in humus and organic matter. *Monotropa* occurs in pine forests and its underground part forms endotropic *Mycorrhizae* to absorb food.

(iii) Symbiotic plants – E.g. Lichens. They are an association of algae and fungal partners. Algae provide food to the fungal partner. Fungal partner gives minerals and water to the algae.

(iv) Carnivorous plants – These plants trap insects to get nitrogen. Insectivorous plants are *Nepenthes*, Sundew, *Utricularia, Drosera* etc.

Question-4

What are parasites? How are they dependant on other plants for their food?

Solution:

Parasites drive their food from the host e.g. fungi and bacteria. They are non-chlorophyllus plants. They live at the expense of others. They show parasitism. They are classified into two types:

(i) Total parasites and

(ii) Partial parasites.

Classification of parasites:

Types of parasites	Sub-type	Examples
Total parasites	Total stem parasites	*Cuscuta* is a pale thin stem parastite on the host plants like *Citrus* and *Zizyphus* etc. *Haustaria* penetrate into host tissue and absorb water and minerals from host.
	Total root parasites	*Orobanche* grows on the root of potatoes, brinzal, turnip etc. *Balanophora* grows on forest trees.
Partial parasites	Partial stem parasites	*Viscum* parasitizes pear, apple and walnut trees. Its shoot remains attached by *Haustoria* to the host plant and absorbs water and minerals.
	Partial root parasites	*Santalum* grows on roots of *Dalbergia*. It has green leaves. It absorbs water and minerals from the host.

Question-5

What type of condition is created by leghaemoglobin in the root nodules of legumes?

Solution:

Anaerobic condition is created by leghaemoglobin in the root nodules of legumes.

Question-6

Define mineral nutrition.

Solution:

The process, which involves absorption and utilization of mineral elements by the plants for their growth and development, is called mineral nutrition.

Question-7

In which process nitrogenase enzyme is useful?

Solution:

Nitrogenase enzyme is useful in biological fixation of nitrogen.

Question-8

Differentiate between macro-elements and micro-elements.

Solution:

Macro-elements	Micro-elements
(i) They are present in plants in relatively large concentrations.	(i) They are present in plants in very small amounts.
(ii) Their concentration per gram of plant dry matter is atleast 1mg.	(ii) Their concentration is less than 1mg per gram of plant dry matter.
(iii) They build up the plant body and different cell constituents.	(iii) They do not have such roles.
(iv) Some of the macronutrients contribute to the development of osmotic potential in the cells.	(iv) They have no significant role in the development of osmotic potential in the cells.
(v) They do not become toxic in slight excess.	(v) Microelements are toxic in slight excess.

Question-9

Write the symptoms of mineral deficiency in plants.

Solution:

The most common type of deficiency symptoms developing in plants are

(i) Chlorosis: Loss or non-development of chlorophyll, resulting in yellowing of leaves.

(ii) Necrosis: Localised death of tissues.

(iii) Mottling: Appearance of patches of green and non-green areas on the leaves.

(iv) Stunted growth: Retardation of growth resulting in rosette appearance of the plant.

(v) Abscission: Premature fall of flowers and fruits.

(vi) Leaf curls: Curling of leaves due to unequal growth.

(vii) Wilting: Loss of turgor resulting in the drooping of leaves and young shoots.

(viii) Heart rot: Softening or rotting of internal tissues.

(xi) Die-back: Death of shoot apex.

(x) White bud: Chlorosis of young leaves and buds.

Question-10

Define mineral nutrition.

Solution:

Plants require a number of mineral nutrients for their growth and development which do not occur in the plant body in free of state. The utilization of these elements by the plant for its growth and development is called mineral nutrition.

Question-11

What do you understand by the term hunger signs?

Solution:

Specific deficiency symptoms of a particular mineral nutrient are called hunger signs.

Question-12

What are fertilizers?

Solution:

Fertilizers are the chemicals or mixture of chemicals, which are added to the soil to overcome the deficiency of minerals.

Question-13

Name a soil bacteria which is capable of converting ammonia to nitrates.

Solution:

Nitrosomonas is a soil bacterium, which is capable of converting ammonia to nitrates.

Question-14

How does nitrate get assimilated in plants?

Solution:

Nitrate is the most important source of nitrogen for plants. Though it can accumulate in the cell sap of several plants and take part in producing osmotic potential, it cannot be used as such by the plants in the synthesis of organic compounds. It is first reduced to ammonia before being incorporated into organic compounds. The process of nitrate reduction to ammonia is carried out in two steps, each mediated by a specific enzyme.

(i) Reduction of nitrate to nitrite: First the nitrate is reduced to nitrite by an enzyme called nitrate reductase. The enzyme contains FAD as prosthetic group, which receives hydrogen from reduced coenzyme for the reduction of the nitrate. The reduced coenzyme serves as hydrogen donor and molybdenum serves as an electron carrier in the process.

(ii) Reduction of nitrite: The nitrite ions are then reduced to ammonia by an enzyme called nitrite reductase. This enzyme does not require molybdenum but requires copper and iron for its activity. The enzyme nitrate reductase occurs inside the chloroplasts in the leaf cells and leucoplasts of other cells. The reduced coenzyme serves as a hydrogen donor in illuminated cells and NAD + H^+ in others for the reduction of nitrites. The process of reduction also requires ferredoxin, which occurs in higher plants mostly in the leaves. Therefore, nitrite ions formed in other parts of the plant are transported to leaves for their reduction to ammonia. Ammonia combines with some organic acids to produce amino acids. Amino acids then form various types of nitrogenous compounds.

Question-15

What protects nitrogenase ?

Solution:

Leghaemoglobin protects nitrogenase.

Question-16

Mention the criteria to determine the essentiality of an element.

Solution:

The criteria to determine the essentiality of an element are as follows:

(i) The element must be absolutely necessary for supporting normal growth and reproduction.

(ii) The requirement of the element must be specific and not replaceable by another element.

(iii) The element must be directly involved in the nutrition of the plant. For example, magnesium is an essential element because it is the constituent of chlorophyll and is essential for photosynthesis. It cannot be replaced by any other element for the same function. It is also required as a co-factor by many enzymes involved in cellular respiration and other metabolic pathways.

Question-17

What are the sources of essential elements for plants?

Solution:

All elements, which enter into plants, are ultimately derived from the atmosphere, water and soil. Carbon enters the plants from the atmosphere as carbon dioxide, while hydrogen is obtained mainly from water. Oxygen is supplied from the air or water and often in the form of inorganic ions. Although, free nitrogen is present in abundance in the atmosphere, it is inert and most plants are unable to use it directly. Due to atmospheric activities, free atmospheric nitrogen combines with oxygen and is brought down by rain to the soil. Certain microorganisms called nitrogen fixers, present in the soil, convert nitrogen gas to ammonic form such as nitrate or ammonium. These are absorbed by the plants through the roots and are assimilated as organic nitrogen. The plants in turn provide organic nitrogen to the heterotrophic organisms. All the other elements needed by the plants, are absorbed from the soil, which are ultimately derived from the parent rocks by disintegration and weathering.

Question-18

Name the enzyme that can reduce nitrogen to ammonia?

Solution:

The enzyme that can reduce nitrogen to ammonia is nitrogenase enzyme.

Question-19

What is hydroponics? Mention their uses.

Solution:

The system of growing plants on a large scale in soil less cultures is known as hydroponics. Hydroponics is useful in areas having infertile and dry soils. They grow free of soil pathogens and do not require weeding. They often provide consistently good yield of season vegetables and flowers.

Question-20

Which are the two macronutrients that usually play the most important role in limiting plant growth globally.

Solution:

Nitrogen and calcium are the two macronutrients that usually play the most important role in limiting plant growth globally.

Question-21

Write some general functions of mineral elements in plants.

Solution:

The general function of mineral elements in plants are,

(i) Constituents of plant body: Various mineral elements become permanent constituents of molecules found in the protoplasm and cell wall. Elements like carbon, hydrogen and oxygen are used up in the formation of carbohydrates, which are important constituents of the cell. Nitrogen is an essential component of all amino acids, proteins, nucleic acids, chlorophyll, auxins, cytokinins and vitamins. Magnesium is an essential part of the chlorophyll molecule and also activates certain enzymes. Sulphur is a constituent of some essential amino acids and some proteins. Phosphorus is a constituent of many important organic compounds such as ATP, NAD, NADP, DNA, RNA and phosphorylated sugars and lipids.

(ii) Osmotic potential of cells: The osmotic potential of a cell is maintained by the inorganic salts present in the cell sap. Osmotic potential is required for water absorption and maintenance of the cell's turgidity.

(iii) Acidity and buffer action: The mineral elements absorbed from the soil, affect the H^+ ion concentration and thus influence pH of the cell sap. They also constitute a major buffer system for the plants.

(iv) Permeability of cytoplasmic membranes: The permeability of cytoplasmic membranes is affected by the presence of various cations and anions in the external medium. Monovalent cations commonly increase the membrane permeability, while divalent cations decrease the same.

(v) Toxic effects: Many mineral elements in their ionic form produce a toxic effect on the protoplasm.

(vi) Catalytic effects: Several mineral elements participate in the catalytic systems of plants. For example, calcium, magnesium, manganese, sodium, potassium and chlorine serve as co-factors of enzymes.

(vii) Antagonistic effects: Some of the mineral elements antagonize or balance the harmful effects of certain other elements. For example, manganese in barley plant is toxic in the absence of silicon, but is harmless in the presence of silicon.

Question-22

Name a free living nitrogen fixing aerobic bacteria.

Solution:

Clostridium is free-living nitrogen fixing aerobic bacteria.

Question-23

What are the two steps involved in physical nitrogen fixation?

Solution:

Physical nitrogen fixation includes two steps. They are,

(i) Natural nitrogen fixation and

(ii) Industrial nitrogen fixation

(i) Natural nitrogen fixation: Atmospheric nitrogen combines with oxygen under the effect of lightning and thunder in the clouds to form nitric oxide. The nitric oxide is then oxidised with oxygen to form nitrogen peroxide. During rains, the nitrogen peroxide combines with water to form nitrous acid and nitric acid. On the ground, the acids react with the alkaline radicals to form water-soluble nitrates and nitrites, which are directly absorbed by the plants.

(ii) Industrial nitrogen fixation: Ammonia is produced industrially by direct combination of nitrogen with hydrogen at high temperature and pressure. Later, it is converted into various types of fertilizers including urea.

Question-24

Which cyanobacterium has symbiotic association with Azolla.

Solution:

Anabaena is a cyanobacterium has symbiotic association with Azolla.

Question-25

What are essential elements?

Solution:

Plants require a large number of elements, probably more than 40 of which about 16 are most essential for the growth and development of plants. These 16 elements are termed as essential elements.

Question-26

Name the best known symbiotic nitrogen fixing bacteria.

Solution:

Rhizobium is the best -known symbiotic nitrogen-fixing bacteria.

Question-27

What are the framework elements of a plant ?

Solution:

Carbon, hydrogen and oxygen are called framework elements.

Question-28

Why is leghaemoglobin so called? What is its function?

Solution:

It is a pink coloured pigment found in root nodules of legumes. This pigment is closely related to haemoglobin that is why it is called leghaemoglobin. It is an oxygen scavenger like haemoglobin. It combines with oxygen and protects enzyme nitrogenase, which functions under anaerobic conditions.

Question-29

What is the term given to the elements which are used by the plants in large quantities ?

Solution:

Macronutrient is the elements, which are used by the plants in large quantities.

Question-30

Name the three factors essential for conversion of dinitrogen molecule to ammonia.

Solution:

The three factors essential for conversion of dinitrogen molecule to ammonia are

(i) Strong reducing agent (NADP)

(ii) Energy rich compound (ATP)

(iii) Enzyme nitrogenase.

Question-31

Give names of four major essential elements other than carbon, hydrogen and oxygen.

Solution:

Nitrogen, sulphur, phosphorus and potassium are the four major essential elements other than carbon, hydrogen and oxygen.

Question-32

Explain the process of nitrate assimilation.

Solution:

The nitrates absorbed by the plants are reduced to nitrites, and nitrites are reduced to ammonia which is used for the synthesis of amino acids. The nitrates are reduced to nitrites by nitrate reductase enzyme. This enzyme is a flavoprotein and contains molybdenum. The nitrite ions are reduced to ammonia by nitrite reductase enzyme. This enzyme required copper and iron. It also requires ferredoxin as an electron donor which is located in the leaves only. Therefore the nitrites formed in other parts of the plant are transported to leaves where they are reduced to ammonia.

Question-33

What are saprophytes? Give one example.

Solution:

Saprophytes are non-green and heterotrophic plants which derive their nutrition from dead and decaying organic matter. Example: Neottia

Question-34

What do you mean by the term chlorosis ?

Solution:

The term chlorosis means lack of development of chlorophyll in the leaves.

Question-35

Describe an important functions of each of the elements, phosphorus, boron and sulphur in green plants and also write the deficiency symptoms of any two of them.

Solution:

Phosphorus – It is the constituent of cell membrane, protein, nucleic acids, nucleotides, NADP and energy rich compounds.

Boron – It helps in uptake and utilization in calcium. It helps in germination of pollen and celldifferentiation.

Sulphur - It is the constituent of protein, vitamins, thymine, biotin, and ferredoxin.

Deficiency symptoms

Phosphorus – Poor plant growth, dull green leaves and chlorosis.

Boron - It causes brown heart disease.

Sulphur – It causes chlorosis.

Question-36

Why do chlorosis occur in plants ?

Solution:

Chlorosis occur in plants due to the nitrogen deficiency in plants.

Question-37

Write the differences between mottling and interveinal chlorisis.

Solution:

Mottling	Interveinal chlorisis
It is the patchy appearance of green and non-green areas of a leaf.	The yellowing of leaf between the veins.
It is caused due to the deficiency of zinc and molybdenum.	It is due to the deficiency of iron and molybdenum.

Question-38

Pick out from the following list two minerals which are not needed by the magnity of plants but very much needed by almost are animals. Calcium, sodium, potassium, iron , Iodine.

Solution:

Iodine and sodium are not needed by every plant but they are needed by animals.

Question-39

What are macronutrients ?

Solution:

Elements which are required by the plants in large quantities are known as micronutrients.

Question-40

"Sundew plant has a rosette of leaves modified to trap insects". Explain.

Solution:

Drosera is called sundew plant because of the sticky substance drops glister on the leaf margins. This plant possesses a rosette of leaves. The leaves are provided with hairs. The glands on the leaves secrete sticky substance. When an insect sits on the leaf, the hairs entrap this and the insect dies. It is digested and absorbed there. This is how the sundew plants trap the insects for their survival.

Question-41

Name the important macronutrients ?

Solution:

Carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, potassium, magnesium, calcium and iron are the macronutrients because they are required in large quantities by the plants.

Question-42

Name any parasitic plant and explain how does it absorb its nutrition?

Solution:

Cuscuta reflexa is a parasitic plant and it grows on other plants. It is devoid of leaves and possesses a wire stem. Its seeds geminate in the soil. On finding a suitable host, it twines around it and loses connection with the soil. It sends out parasitic roots to penetrate the host tissue. They establish connection with its xylem and phloem and the *Cuscuta* thrives.

Question-43

What are mobile elements?

Solution:

N,P, Mg and K move from old leaves towards the young leaves and are called mobile elements.

Question-44

Which part of the plant body normally absorbs mineral nutrients?

Solution:

Root is the part of the plant body normally absorbs mineral nutrients.

Question-45

What is the function of enzyme nitrate reductase ?

Solution:

The enzyme nitrate reductase converts nitrate to nitrite.