- It is an important constituent of some aminoacids (cystine and methionine) and several vitamins (biotin, thiamine, coenzyme A)
- Disulphide linkages (sulphur bridges) help to stabilize the protein structure.

Microelements

Iron:- Plants obtain iron in the form of ferrous ions $\left(Fe^{2+}\right)$

- It is essential for the synthesis of chlorophyll.
- It is a very important constituent of cytochromes.

Manganese:- It is absorbed in the form of manganese ions $\left(Mn^{2+}\right)$

- It helps in the splitting of water to liberate oxygen during photosynthesis.
- It is an activator of IAA oxidase enzyme.

Zinc:- Plants obtain zinc as Zn^{2+} ions.

- It is the activator of carbonic anhydrase enzyme.
- It is needed for the synthesis of IAA (a natural auxin)

Copper:- Copper is absorbed in the form of cupric ions $\left(Cu^{2+}\right)$

- It is a part of plastocyanin and thus play a role in electron transport chain of photosynthesis
- It is also a component of cytochrome-c-oxidase, the most important respiratory enzyme in aerobic organisms.

Boron:- It is absorbed by the plants as BO_3^{3-} or $B_4O_7^{2-}$

- It facilities the translocation of sugars in plants.
- Boron is required for pollen germination.

Molybdenum:- Plants obtain it in the from of molybdate ions $\left(MoO_2^{2+}\right)$

- As a component of nitrate reductase, it is involved in nitrogen uptake
- It plays a very significant role in nitrogen fixation since it is a part of the enzyme dinitrogenase.

Chlorine:- It is absorbed in the form of chloride anion $\left(Cl^{-}\right)$

- It is involved in photolysis of water and oxygen evolution during photosynthesis.
- It is an important osmotically active solute as it determines the solute concentration and the anion-cation balance in cells.

- **MECHANISM OF ABSORPTION OF IONS** Except Carbon, Hydrogen and Oxygen the remaining essential elements are absorbed from the soil in ionic ***form by the roots.*** Ion absorption studies were carried out by Hoagland, Knops, Epstein and others.
- The mode of absorption of ions can be classified into two types.

  1) Passive absorption, 2) Active absorption
- Passive absorption : It is the transport propelled by physical driving forces:, Metabolic energy absorption is also known as 'non-metabolic' type of ion absorption.
- Active absorption : The ion uptake by plants involving the utilization of metabolic energy is defined as 'Active Absorption'

  For example Nitella (an algal member) absorbs pottassium ions (K^+) to a concentration several times more than the surrounding water.
- The carrier proteins are two types :

  i) Some carriers transport an ion from outside to inside or inside to outside. They are called as 'uniporters' and the transport is called as uniport.

  e.g : H^+ - ATPase, Na^+ - ATPase

  ii) Sometimes, the transport of an ion is coupled with that of other ion. It is called 'co-transport'.
- Co-transport may be of two types :

  a) Some carriers transport two types of ions (anions and cations) in the same direction. They are called as 'symporters' and the transport is referred as 'symport'.

  e.g : The movement of H^+ coupled with either NO_3^- or Cl^- or PO_4^-

  b) Sometimes, the movement of two types of ions is brought about in opposite directions. Such a carrier is called 'antiporter' and the transport is said to be 'antiport'.
- e.g : Inward movement of H^+ associated with outward movement of Na^+
- The movement of, protons alone to outside (uniport) is called Primary active transport.
- Proton concentration gradient results in proton motive force and the flow back of protons into cytosol is associated with co transport of other substances against their own concentration gradient and this is called Secondary active transport.
- **Bio-fertilizers :** materials which improve the fertility of the soil and increase crop productivity are called fertilizers. The fertilizers are of three types:

- 1) Organic fertilizers 2) Inorganic fertilizers and 3) Biofertilizers.
- Bio-fertilizers denotes the nutrient input for plant growth which is of biological origin
- a) Rhizobium inoculants : Rhizobium inoculants are being increasingly used to enhance the productivity of legume crops.
- b) Azospirillum : In maize, sorghum, wheat, barley and finger millet, Azospirillum lives as an associated symbiont.
- The technic of seed-dressing with bacteria (e.g : Azotobacter, Azospirillum, Rhizobium etc.) is called 'Bacterization.
- c) Cyanobacteria : Cyanobacteria (blue green algae) such as Anabaena and Nostoc either independently or in symbiotic association fix atmospheric nitrogen.
- Venkataraman (1961) used the term 'algalization' to denote the process of use of blue-green algal culture in field as bio-fertilizer.
- d) Azolla : Azolla is a water fern. In Azolla leaves, the blue green algae Anabaena azolle lives as an endosymbiont and fixes nitrogen.
- e) Mycorrhizae : The association between fungal members and roots of vascular plants is called **mycorrhizae**.
- Such roots associated with a fungus are called **mycorrhizal** roots.
- The mycorrhizal associations are of three types. They are :
- i) Ectomycorrhiza : If fungi are present on the surface of the roots of vascular plants, they are called ectomycorrhiza.

  ii) Endomycorrhiza : If fungi penetrate into the cortical cells of the root and present intracellularly, they are called endomycorrhiza.

  iii)Ectendomycorrhiza : lf fungi are present on the surface as well as present intracellularly in cortical cells, they are called ectendomycorrhizae.
- Endomycorhiza form vesicles and arbuscules inside the host. So they were called Vesicular arbuscular mycorrhizae (VAM)
- All endomycorrhizac do not from arbuscules but form only vesicles. Hence, recently VAM are called AM (Arbuscular mycorrhizae) fungi.
- The use of AM inoculum improves plant growth, yield and increases resistance against environmental stresses and pests.

Importance of bio-fertilizers

- The use of bio-fertilizers offer several advantages.
- They include :
- i) By the application of bio-fertilizers, the use of harmful chemical fertilizers can be curtailed substantially.
- ii) There is no environmental pollution problem in the use of bio-fertilizers. They are eco-friendly in nature.
- iii) Bio-fertizers are economical.
- iv) Bio-fertilizer production requires no energy input in the form of fossil fuels.
- v) Crop produce will not contain any toxins.
- vi) Some bio-fertilizers are resistant to heavy metals and so they can be used in fields near polluted areas.

LEVEL-I

109. Frame work elements are
   1) Carbon, Hydrogen, Oxygen
   2) Nitrogen, Phosphorus, Sulphur
   3) Calcium, Magnesium, Potassium
   4) Iron, Zinc, Copper
110. Macronutrient which is absorbed in the form of Anion Cation and molecular form is
   1) Copper 2) Potassium
   3) Nitrogen 4) Phosphorus
111. Activator of IAA oxidase enzyme is
   1) Iron 2) Manganese
   3) Zinc 4) Copper
112. Macronutrient and Micronutrient which maintain anion-cation balance in cells are
   1) Phosphorus and Iron
   2) Calcium and Manganese
   3) Potassium and chlorine
   4) Magnesium and Zinc
113. Nutrient required for pollen germination
   1) Iron 2) Copper
   3) Molybdenum 4) Boron
114. Incorrect statement related to a micronutrient iron
   1) It is absorbed in the form of ferrous ions
   2) It regulates stomatal movements
   3) It is essential for the synthesis of chlorophyll
   4) It is a constituent of cytochromes

LEVEL-II

115. Assertion(A) : Manganese and Copper etc., are called micro elements

Reason (R) : The elements are required for plant growth and development in large quantities.

116. Assertion(A) : Nitella shows active absorption in mineral uptake

Reason (R) : It involves the utilizationof metabolic energy

117. Assertion(A) : The yield in Sorghum can be increased by employing Azospirillum

Reason (R) : It has the ability to fix atmosphere nitrogen and also secretes growth promoting substance

118. Assertion(A) : "Woodward" established that soil is essential for plant growth

Reason (R) : The plants survived best in watery extract of the soil.

119. Assertion(A) : Inward movement of H^+ associated with outward movement of Na^+ is antiport

Reason (R) : The transport of an ion is coupled with that of other ion is called cotransport

120. Match the following

Nutrient	Function
A. Calcium	I. Translocation of solutes
B. Potassium	II. Nitrogen fixation
C. Boron	III. Stomatal movement
D. Molybdenum	IV. Cell division
	V. Photolysis of water

	A	B	C	D		A	B	C	D
1)	IV	III	I	II	2)	IV	V	I	II
3)	I	IV	III	II	4)	IV	III	I	V

121. Pick out the incorrect statement

1) All micro elements are essential for plant growth

2) All mineral elements are available in soil

3) All macro elements are cations

4) All essential elements are not mineral in origin

LEVEL-III

122. Assertion(A) : In plants Carbon, Hydrogen and Oxygen are absorbed from the soil in ionic form by roots

Reason (R) : Ion absorption studies were carried out by Hoagland Knops, Epstein etc.

123. Assertion(A) : Recently vesicular arbuscular mycorrhizae are called arbuscular mycorrhizae fungi

Reason (R) : All endomycorrhizae do not form arbuscules but form only vesicles

124. Assertion(A) : Employment of Glomus increases the growth and yield of maize.

Reason (R) : Glomus increase the phosphate absorption by the roots&promotes growth

125. Assertion(A) : Biofertilizers are eco-friendly in nature.

Reason (R) : By the applicationof bio-fertilizers , the use of harmful chemical fertilizers can be curtailed substantially

126.

	Scientist	**Work**
I.	John woodward	necessity of soil for plant growth
II.	Julius sachs and W.Knops	Hydorponics
III.	de Saussure	Essentiality of elements
IV.	Perry stout	Essentiality of element

1. III & IV are correct
2. I, II & IV are correct
3. I, II, III & IV are correct
4. only III is correct

127.

Biofertilizer		**Crops**
I. Azospirillum	-	Sorghum
II. Rhizobium	-	Arachis hypogea
III. Mycorrhiza	-	Maize, wheat
IV. Azolla	-	Finger millet

1. I & II are correct 2. I, II & III are correct
3. II & IV are correct 4. All correct

128. Assertion(A): Salt resistance plants survive in saline habitats by maintaining low internal Na levels

Reason (R): Salt resistant plants get rid off excess Na by ATP energized antiporter

The correct answer is (EAMCET - 2008)