Chapter 12
Mineral Nutrition

Question 1:
All elements that are present in plant need not be essential to its survival. Comment.

Solution 1:
All elements that are present in a plant need not be essential to its survival because they are not directly involved in the composition of their body. However, if the concentration of micronutrients such as Fe, Mn, Cu, Zn, Cl, etc., rise above their critical values, they appear to be toxic for the plant.

Question 2:
Why is purification of water and nutrient salts so important in studies involving mineral nutrition using hydroponics?

Solution 2:
Hydroponics is a method of growing plants in the absence of soil in a nutrient solution. Since, the amount of solution is limited, there are chances of depletion of oxygen and mineral levels in the solution. Hence, the purification of water and nutrient salts is important in order to maintain and optimum growth in the plants.

Question 3:
Explain the examples macronutrients, micronutrients, beneficial nutrients, toxic elements and essential elements.

Solution 3:
Macronutrients are generally present in plant tissues in large amount (in excess of 10 m mole kg”1 of dry matter). The macronutrients include carbon, hydrogen, oxygen, nitrogen, phosphorus, sulphur, potassium, calcium and magnesium.
Micronutrients or trace elements, are needed in very small amount (less than 10 m mole kg”1 of dry matter). These include iron, manganese, copper, molybdenum, zinc, boron, chlorine and nickel.
Any mineral ion concentration in tissues, that reduces the dry weight of tissues by about 10% is considered a toxic element. For example, Mn inhibits the absorption of other elements.
Beneficial nutrients are plant nutrients that may not be essential, but are beneficial to plants. Sodium, silicon, cobalt and selenium are beneficial to higher plants.
Essential elements are macronutrients including carbon, hydrogen, oxygen, nitrogen,

phosphorous, sulphur, potassium, calcium and magnesium, which are required directly for the growth and metabolism of the plants and whose deficiency produces certain symptoms in the plants.

Question 4:

Name at least five different deficiency symptoms in plants. Describe them and correlate with the concerned mineral deficiency.

Solution 4:

The kind of deficiency symptoms shown in plants include chlorosis, necrosis, stunted plant growth, premature fall of leaves and buds, and inhibition of cell division.

(i) Chlorosis is the loss of chlorophyll leading to yellowing in leaves. This symptom is caused by the deficiency of elements N, K, Mg, S, Fe, Mn, Zn and Mo.

(ii) Necrosis or death of tissue, particularly leaf tissue, is due to the deficiency of Ca, Mg, Cu, K.

(iii) Lack or low level of N, K, S, Mo causes an inhibition of cell division.

(iv) Some elements like N, S, Mo delay flowering if their concentration in plants is low.

(v) Delayed flowering is caused by the deficiencies of N, S, and Mo.

(vi) Stunted plant growth is a result of the deficiencies of Cu and S.

Question 5:

If a plant shows a symptom which could develop due to deficiency of more than one nutrient, how would you find out experimentally, the real deficient mineral element?

Solution 5:

Every elements show certain characteristic deficiency symptoms in the plants. The deficiency of any one element cannot be met by supplying some other element. So, We need to note all the available symptoms in different parts of the plant. Then we have to compare the noted information with the available standard symptom table and find out the mineral deficiency.

Question 6:

Why is that in certain plants deficiency symptoms appear first in younger parts of the plant, while in other they do so in mature organs?

Solution 6:

For elements that are actively mobilised within the plants and exported to young developing

tissues, the deficiency symptoms tend to appear first in the older tissues. For example, the deficiency symptoms of nitrogen, potassium and magnesium are visible first in the senescent leaves. In the older leaves, biomolecules containing these elements are broken down, making these elements available for mobilising to younger leaves. The deficiency symptoms tend to appear first in the young tissues, whenever the elements are relatively immobile and are not transported out of the mature organs. For example, elements like sulphur and calcium are a part of the structural component of the cell and hence are not easily released.

Question 7:

How are the minerals absorbed by the plants?

Solution 7:

Mechanism of absorption of minerals can occur in two main phases.

(i) In the first phase, an initial rapid uptake of ions into the 'free space' or 'outer space' of cells, the apoplast, is passive.

(ii) In the second phase of uptake, the ions are taken in slowly into the 'inner space' the symplast of the cells.

The passive movement of ions into the apoplast usually occurs through ion-channels, the trans-membrane proteins that function as selective pores. On the other hand, the entry or exit of ions to and from the symplast requires the expenditure of metabolic energy. The movement of ions is usually called the inward movement into the cells is influx and the outward movement, efflux.

Question 8:

What are the conditions necessary for fixation of atmospheric nitrogen by Rhizobium. What is their role in Nitrogen-fixation?

Solution 8:

The first essential condition for nitrogen fixation is legume-bacteria relationship. Root nodules contain the necessary enzymes for nitrogen fixation and thus enable rhizobium to fix nitrogen. The enzyme nitrogenase facilitates the conversion of nitrogen into ammonia which is the first stable product of nitrogen fixation. Ammonia is then converted into glutamic acid. Glutamic acid is then utilised by plants to make amino acids; which are then utilised to make protein.

Question 9:

What are the steps involved in formation of a root nodule?

Solution 9:

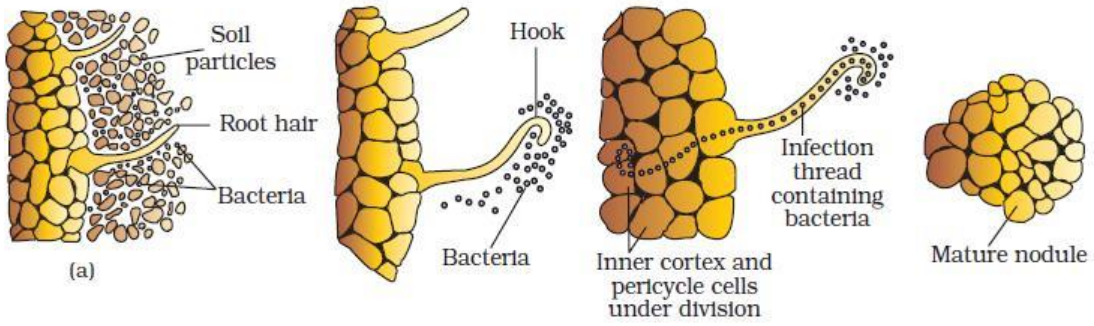
Steps in nodule formation involves a sequence of multiple interactions between Rhizobium and roots of the host plant. Principal stages in the nodule formation are:

(i) Rhizobia multiply and colonise the surroundings of roots and get attached to epidermal and root hair cells.

(ii) The root-hairs curl and the bacteria invade the root-hair.

(iii) An infection thread is produced carrying the bacteria into the cortex of the root, where they initiate the nodule formation in the cortex of the root. Then the bacteria are released from the thread into the cells which leads to the differentiation of specialized nitrogen fixing cells.

(iv) The nodule thus formed, establishes a direct vascular connection with the host of exchange of nutrients.



Question 10:

Which of the following statements are true? If false, correct them

(i) Boron deficiency leads to stout axis.

(ii) Every mineral element that is present in a cell is needed by the cell.

(iii) Nitrogen as a nutrient element, is highly immobile in the plants.

(iv) It is very easy to establish the essentiality of micronutrients because they are required only in trace quantities.

Solution 10:

(i) Boron deficiency leads to stout axis. – True

(ii) Every mineral element that is present in a cell is needed by the cell. – False.
Correct statement - Out of all the mineral elements, only 17 are considered as essential elements.

(iii) Nitrogen as a nutrient element, is highly immobile in the plants - False.
Correct statement - Nitrogen is highly mobile in plants.

(iv) It is very easy to establish the essentiality of micronutrients because they are required only in trace quantities. - True