

NCERT Solutions for Class-XI Biology

Chapter-12

1. 'All elements that are present in a plant need not be essential to its survival'. Comment.
1. Plants tend to absorb different kinds of nutrients from soil. However, a nutrient is inessential for a plant if it is not involved in the plant's physiology and metabolism. For example, plants growing near radioactive sites tend to accumulate radioactive metals. Similarly, gold and selenium get accumulated in plants growing near mining sites. However, this does not mean that radioactive metals, gold, or selenium are essential nutrients for the survival of these plants.
2. Why is purification of water and nutrient salts so important in studies involving mineral nutrition using hydroponics?
2. Impure water and salts contain a large number of soluble minerals and impurities. When such water and salts are used as solution culture for growing plants in hydroponics then the impurities will interfere with the experiment and will not give correct result about the essentiality of a mineral element. Therefore, purified water with defined mineral nutrients are used in hydroponics.
3. Explain with examples: macronutrients, micronutrients, beneficial nutrients, toxic elements and essential elements.
3. **Macronutrients:** They are the nutrients required by plants in large amounts. They are present in plant tissues in amounts more than 10 m mole kg⁻¹ of dry matter. Examples include hydrogen, oxygen, and nitrogen.
Micronutrients: They are also called trace elements and are present in plant bodies in very small amounts, i.e., amounts less than 10 m mole kg⁻¹ of dry matter. Examples include cobalt, manganese, zinc, etc.
Beneficial nutrients: They are plant nutrients that may not be essential, but are beneficial to plants. Sodium, silicon, cobalt and selenium are beneficial to higher plants.
Toxic elements: Micronutrients are required by plants in small quantities. An excess of these nutrients may induce toxicity in plants. For example, when manganese is present in large amounts, it induces deficiencies of iron, magnesium, and calcium by interfering with their metabolism.
Essential elements: These elements are absolutely necessary for plant growth and reproduction. The requirement of these elements is specific and non-replaceable. They are further classified as macro and micro-nutrients.
4. Name at least five different deficiency symptoms in plants. Describe them and correlate them with the concerned mineral deficiency.
4. Five different deficiency symptoms in plants are:
 - (i) Chlorosis – It is the loss of chlorophyll leading to yellowing of leaves. This is caused due to the deficiency of N, K, Mg, S and Fe etc.

(ii) Necrosis – Killing or death of tissue particularly leaf is called necrosis. This is caused due to the deficiency of Ca, Mg, Cu and K etc.

(iii) Whiptail – Degeneration of lamina but not of petiole and midrib, caused by deficiency of molybdenum.

(iv) Die back – It is the killing of shoot apex i.e. stem tip and young leaves. This is caused due to the deficiency of K and Cu.

(v) Little leaf disease – Small sized leaves, caused by zinc deficiency.

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?

5. In plants, the deficiency of a nutrient can cause multiple symptoms. For example, the deficiency of nitrogen causes chlorosis and delayed flowering.

In a similar way, the deficiency of a nutrient can cause the same symptom as that caused by the deficiency of another nutrient. For example, necrosis is caused by the deficiency of calcium, magnesium, copper, and potassium.

Another point to be considered is that different plants respond in different ways to the deficiency of the same nutrient.

Hence, to identify the nutrient deficient in a plant, all the symptoms developed in its different parts must be studied and compared with the available standard tables.

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

6. The parts of the plants that show the deficiency symptoms depend on the mobility of the element in the plant. 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 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.

7. How are the minerals absorbed by the plants?

7. The absorption of soil nutrients by the roots of plants occurs in two main phases – apoplast and symplast.

During the initial phase or apoplast, there is a rapid uptake of nutrients from the soil into the free spaces of plant cells. This process is passive and it usually occurs through transmembrane proteins and ion-channels.

In the second phase or symplast, the ions are taken slowly into the inner spaces of the cells. This pathway generally involves the expenditure of energy in the form of ATP.

8. What are the conditions necessary for fixation of atmospheric nitrogen by Rhizobium. What is their role in N_2 -fixation?

8. The conditions necessary for nitrogen fixation by Rhizobium are :
- (i) Presence of enzyme nitrogenase.
 - (ii) A protective mechanism for the enzyme nitrogenase against O_2
 - (iii) A non-heme iron protein-ferredoxin as an electron carrier.
 - (iv) The hydrogen donating system (viz, pyruvate, hydrogen, sucrose, glucose etc).
 - (v) A constant supply of ATP.
 - (vi) Presence of thiamine pyrophosphate (TPP), coenzyme-A, inorganic phosphate and Mg^{++} as co-factors.
 - (vii) Presence of cobalt and molybdenum,
 - (viii) A carbon compound for trapping released ammonia.

In the process of biological nitrogen fixation by free living and symbiotic nitrogen fixers, the dinitrogen molecule is reduced step by step to ammonia (NH_3) by the addition of pairs of hydrogen atoms. The pyruvic acid mainly serves as an electron donor but in some cases hydrogen, sucrose, glucose, etc., have also been shown to operate. In leguminous plants, the glucose-6-phosphate molecule probably acts as a substrate for donating hydrogen. The overall process occurs in presence of enzyme nitrogenase, which is active in anaerobic condition. The enzyme nitrogenase consists of two sub-units – a non-heme iron protein (or dinitrogen reductase) and an iron molybdenum protein (Mo-Fe protein or dinitrogenase).

The Fe-protein component reacts with ATP and reduces Mo-Fe protein which then converts N_2 to ammonia. The ammonia is either directly taken by host or is converted to nitrates with the help of nitrifying bacteria (e.g., Nitrosomonas).

9. What are the steps involved in formation of a root nodule?
9. Multiple interactions are involved in the formation of root nodules. The Rhizobium bacteria divide and form colonies. These get attached to the root hairs and epidermal cells. The root hairs get curled and are invaded by the bacteria. This invasion is followed by the formation of an infection thread that carries the bacteria into the cortex of the root. The bacteria get modified into rod-shaped bacteroides. As a result, the cells in the cortex and pericycle undergo division, leading to the formation of root nodules. The nodules finally get connected with the vascular tissues of the roots for nutrient exchange.
10. Which of the following statements are true? If false, correct them:
- (a) Boron deficiency leads to stout axis.
 - (b) Every mineral element that is present in a cell is needed by the cell.
 - (c) Nitrogen as a nutrient element, is highly immobile in the plants.
 - (d) It is very easy to establish the essentiality of micronutrients because they are required only in trace quantities.
10. (a) True.
- (b) False. Every mineral element that is present in a cell is not needed by the cell.
 - (c) False. Nitrogen as a nutrient element is highly mobile in plants.
 - (d) False. It is very difficult to establish the essentiality of micronutrients because they are required only in trace quantities.



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