# Chapter-12

# MINERAL NUTRITION

## POINTS TO REMEMBER

**Autotroph :** An organism that synthesize its required nutrients from simple and inorganic substances.

**Heterotroph :** An organism that cannot synthesise its own nutrients and depend on others.

**Necrosis :** Death of cells and tissues.

**Biological nitrogen fixation :** Conversion of atmospheric into organic compounds by living organisms.

**Nitrification :** Conversion of ammonia ($NH_3$) into nitrite and then to nitrate.

**Denitrification :** A process of conversion of nitrate into nitrous oxide and nitrogen gas ($N_2$).

**Leg-hemoglobin :** Pinkish pigment found in the root nodules of legumes. It acts as oxygen scavenger and protects the nitrogenase.

**Flux :** The movement of ions is called flux.

**Necrosis :** Death of tissues particularly leaf tissue due to deficiency of Ca, Mg, Cu, K.

**Mineral Nutrition :** Plants require minerall elements for their growth and development. The utilization of various absorbed ions by a plant for growth and development is called **mineral nutrition** of the plant.

**Hydroponics :** Soil-less culture of plants, where roots are immersed in nutrient solution without soil is called hydroponics. The result obtained from hydroponics may be used to determine deficiency symptoms of essential elements.

## Essential Elements

| Macronutrients | Micro-nutrients |
|---|---|
| Macronutrients are present in plant tissues in concentrations of 1 to 10 mg per gram of dry matter. | Micro-nutrients are needed in very low amounts : 0.1 mg per gram of dry matter. |
| C, H, O, N, P, K, S, Ca, Mg. | Fe, Mn, Cu, Mo, Zn, B, Cl, Si. |

**Chlorosis :** Yellowing of leaves due to loss of chlorophyll.

**Active Transport :** Absorption occuring at the expense of metabolic energy.

**Passive Transport :** Absorption of minerals with concentration gradient by the process of diffusion without the expense of metabolic energy.

## Role of Minerals Elements in Plants

### MACRO-NUTRIENTS

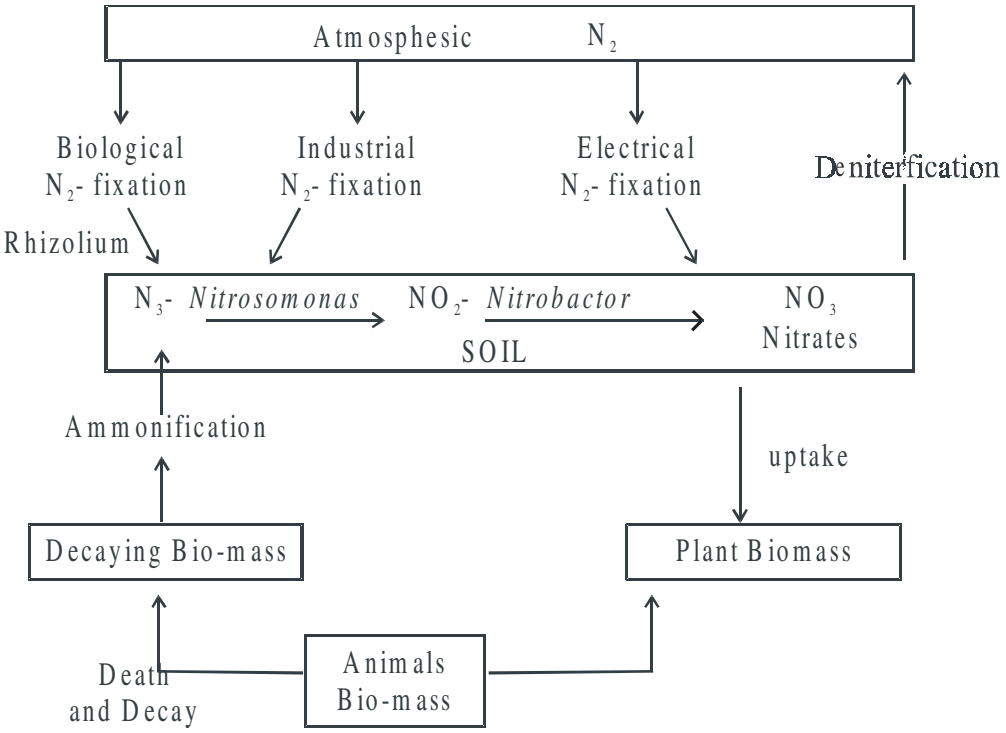
| Element | Obtained as | Functions | Deficiency symptoms |
|---|---|---|---|
| Nitrogen (N) | Mainly as $NO_3^-$ some as $NO_2^-$ or $NH_4^+$. | Constituent of proteins, nucleic acids, vitamins and hormones. | Stunted growth. Chlorosis |
| Phosphorus (P) | Phosphate ions ($H_2PO_4^-$ or $HPO_4^{2-}$) | Constituent of cell membrane. Required for the synthesis of nucleic acids, nucleotides, ATP NAD and NADP and for phosphorylation reactions. | Poor growth of plant. Leaves dull green. |
| Potasium (K) | $K^+$ | Helps to maintain an anion-cation balance in cells. Involved in protein synthesis, in opening and closing of stomata; activation of enzymes; maintenance of turgidity of cells. | Stunted growth; yellow edges of leaves; mottled appearance of leaves. Premature death. |
| Calcium (Ca) | $Ca^{++}$ | Required in formation of mitotic spindle; involved in normal functioning of cell membranes; activates certain enzymes; as calcium pectate in middle lamella of the cell wall. | Stunted growth, chlorosis of young leaves. |

| | | | |
|---|---|---|---|
| Magnesium (Mg) | $Mg^{++}$ | Activates enzymes in phosphate metabolism, constituent of chloro-phyll; maintains ribosome structure. | Chlorosis |
| Sulphur (S) | $SO_4^{++}$ | Constituent of amino-acids. Crysteine and methionine and proteins, co-enzymes, vitamins and ferredoxin. | Chlorosis |

## MICRO-NUTRIENTS

| Element | Obtained as | Functions | Deficiency symptoms |
|---|---|---|---|
| Iron (Fe) | $Fe^{+++}$ | Constituent of Ferredoxin and cytochrome; needed for synthesis of chlorophyll. | Chlorosis |
| Manganese (Mn) | $Mn^{+++}$ | Activates certain enzymes involved in photosynthesis, respiration and nitrogen metabolism. | Chlorosis, grey spots on leaves. |
| Zinc (Zn) | $Zn^{++}$ | Activates various enzymes like carbo-xylases. Required for synthesis of auxins. | Malformation of leaves. Dieback of shoots. |
| Copper (Cu) | $Cu^{+++}$ | Activates certain enzymes. | |
| Boron (B) | $BO_3^-$ or $B_4O_7^{2-}$ | Required for uptake of water and Ca, for membrane functioning, pollen germination, cell elongation carbohydrate translocation. | Death of stem and root apex. |
| Molybdenum (Mo) | $MoO_2^{2+}$ (molybdate) | Activates certain enzymes in nitrogen metabolism. | |
| Chlorine (Cl) | $Cl^-$ | Maintains solute concentration along with $Na^+$ & $K^+$; maintain anioncation balance in cells; essential for oxygen evolution in photosynthesis. | |

**Nitrogen Cycle :**




## QUESTIONS

### Very Short Answer Questions (1 mark each)

**1.** Name one symbiotic nitrogen-fixing bacteria.

**2.** Give two examples of photosynthetic micro-organisms, which also fix atmospheric nitrogen.

**3.** Name two organisms each which fix nitrogen asymbiotically and symbiotically.

**4.** Name the substance that imparts pink colour to the root nodule of a leguminous plant and also mention its role.

**5.** What is the term used for mineral deficiency symptom in plants in which leaves became yellow in different pattern ?

## Short Answer Questions-II (2 marks each)

**6.** Differentiate between two types of absorption of minerals in plants from soil.

**7.** Name the following :

(a) Bacteria which converts ammonia into nitrite.

(b) Bacteria which oxidises nitrite into nitrate.

**8.** How does Leghemoglobin protect the enzyme nitrogenase ?

## Short Answer Questions-I (3 marks each)

**9.** Write the deficiency symptoms of the following three elements :

(a) Phosphorus

(b) Magnesium

(c) Potassium

**10.** Describe the following three deficiency symptoms and co-relate them with concerned mineral deficiency :

(a) Chlorosis

(b) Necrosis

(d) Stunted plant growth

**11.** Explain the steps in biological nitrogen fixation in brief.

**12.** Describe the two main processes of synthesis of amino acids from Ammonium ion ($NH_4^+$) in plants.

## Long Answers (5 marks each)

**13.** Describe all the steps of nitrogen cycle in nature.

**14.** Describe with diagrams how root nodules are formed in leguminous plants.

## ANSWERS

### Very Short Answers (1 mark)

**1.** *Rhizobium*

**2.** *Anabaena, Nostoc*

**3.** Asymbiotically – *Azotobacter, Bacillus polymyxa*

Symbiotically – *Rhizobium, Anabaena.*

**4.** Leghemoglobin. It is an oxygen scavenger, which protects the enzyme nitrogenase.

**5.** Necrosis.

**Short Answers-II (2 marks)**

**6.** Refer to NCERT Book, Page no. 200 (12.3).

**7.** (i) Nitrifying Bacteria – *Nitrosomonas.*

(ii) Nitrifying Bacteria – *Nitrobacter*

**8.** Refer to page no. 203.

**Short Answers-I (3 marks)**

**9.** Refer to 'Points to Remember'.

**10.** Refer to 'Points to Remember'.

**11.** Refer to Page no. 201.

**12.** Refer to Page no. 204.

**Long Answers (5 marks)**

**13.** Refer to Page no. 201.

**14.** Refer to Page no. 203.

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