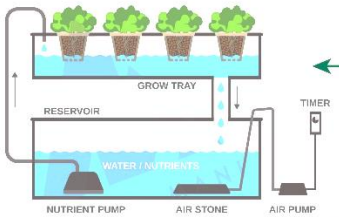
12. MINERAL NUTRITION

Biology Smart Booklet

Theory + NCERT MCQs + NEET PYQs

MINERAL NUTRITION



Hydroponics:-

Technique of Growing Plants in a defined Nutrient Solution without Soil

Methods to Study the mineral requirements of Plants

Criteria for Essentiality

- For normal growth and reproduction
- Requirement of an element must be specific
- Deficiency of an elements can not be meet by another elements
- Must be directly involved in metabolism
- Only 17 elements are essential for plants growth and metabolism

Essential Mineral Elements

Macronutrients

- Required in large amounts
- C, H, O, N, P, S, K, Ca and Mg

Micronutrients (Trace elements)

- Required in small amounts
- Fe, Mn, Cu, Mo, Zn, B, Cl and Ni

- C,
- H,
- O,
- N

Components of bio-molecules and structural elements of cells	Components of energy – related chemical compounds
Elements that activate or inhibit enzymes	Elements that can alter the osmotic potential

- Mg in chlorophyll and P in ATP
- K+ opening and closing of Stomata

(i) Mg^{2+},
(ii) Zn^{2+},
(iii) Mo activates Nitrogenase during N2 metabolism

Metabolism of Nitrogen (N_2 cycle)

ATMOSPHERIC NITROGEN FIXATION

- Ammonification
- Nitrification
- Denitrification

$2NH_3 + 3O_2 \xrightarrow{\text{Nitrosomonas, Nitrococcus}} 2NO_2^- + 2H^+ + 2H_2O \quad 2NO_2^- + O_2 \xrightarrow{\text{Nitrobacter}} 2NO_3^-$

BIOLOGICAL NITROGEN FIXATION

- Prokaryotes: $N_2 \xrightarrow[\text{Nitrogenase Enzyme}]{\text{energy}} NH_3$
- Free – Living (Aerobic – Azobacter and Beijerinickia), (Anaerobic – Rhodospirillum and Bacillus), (Cyanobacteria – Anabaena and Nostoc)
- Symbiotic (Legume – bacteria relationship) — Rhizobium species – forms association with roots of legumes called Nodules
  - Nitrogenase energy
  - Leg – haemoglobin

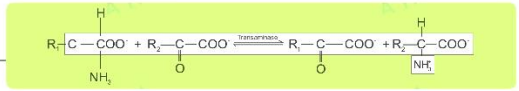
Pseudomonas + Thiobacillus

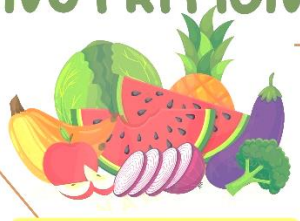
- Nitrogenase Catalyzes the Con version of N2 to NH3

$N_2 + 8e^- + 8H^+ + 16ATP \rightarrow 2NH_3 + H_2 + 16ADP + 16Pi$

Fate of Ammonia

- Reductive Amination: α-Ketoglutaric + NH_4^+ + NADPH $\xrightarrow{\text{Glutamate dehydrogenase}}$ Glutamate + H_2O + NADP
- Transamination





ROLE OF ELEMENTS

K

- Absorbed as Mg^{2+}
- Activates enzymes in respiration and photosynthesis
- In synthesis DNA and RNA
- Component of chlorophyll ring structure

Ca

- Absorbed as Ca^{2+}
- Essential in meristematic and differentiation (root tips)
- Activates enzymes & regulate metabolic activities
- Accumulate in older leaves

P

- Absorbed as K^+
- Essential in meristematic
  1. Tissues
  2. Buds
  3. Leaves
  4. Root tips
- Maintains cation – anion balance and turgidity of cells

N

- Required in greater amounts
- Absorbed as
- Essential for
  - All plants parts
  - Meristematic tissues
  - Metabolically actives cells

S

- Obtained as SO_4^{2-}
- Present in Cysteine and Methionine.
- Contained by
  - Coenzymes
  - Vitamins
  - Ferredoxin

Fe

- Obtained as Fe^{3+}
- Required in large amount
- Component of ferrodoxin and cytochromes
- Activates Catalase enzyme (Chlorophyll formation

MN

- Absorbed as Mn^{2+}
- Activates enzymes involved in Photosynthesis respiration and Nitrogen metabolism
- Water Splitting to liberate O2 during Photosynthesis

Zn

- Obtained as Zn^{2+}
- Activates enzymes
- Required in auxin synthesis

Cl

- Absorbed as Cl^-
- Along with Na^+ and K^+ determines the solute concentration balance

Mo

- Obtained as MoO_2^{2+}
- Contained by – Nitrogenase –
- Nitrate
- reductase

B

- Absorbed as BO_3^{3-} $B_4O_7^-$
- Essential for – Ca^{2+} Ca^{2+} absorption & Utilization
- Membrane function
- Pollen germination
- Cell differentiation
- Glucose translocation.

Cu

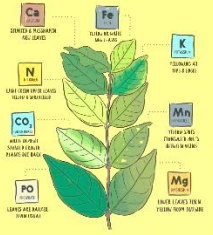
- Absorbed as Cu^{2+}
- Required for Plant's Proper metabolism to function

DEFICIENCY SYMPTOMS OF ESSENTIAL ELEMENTS

- Deficiency of essential element causes growth retardation.
- Deficiency occurs when element concentration is below critical concentration

Deficiency Symptoms

- Chlorosis (Deficiency of N, K, Mg, S, Fe, Mn, Zn and Mo)
- Necrosis (Deficiency of Ca, Mg, Cu and K)
- Abscission (Deficiency of Micro-Nutrition especially Mg)
- Stunted Growth (Deficiency of N, S, Mo, etc.)
- Inhibition of Cell division (Deficiency of N, K, S and Mo)



MECHANISM OF ABSORPTION OF ELEMENTS

(i) Inward movement of ions into the cells – Inflex:
(ii) Outward movement of ions into the cells –Efflux

First Phase

(Passive uptake of ions into the apoplast of cells.)

Second Phase

Active uptake of into the symplast of cells

Translocation of Solutes

Minerals salts are translocated through xylem along with the ascending stream of water (Transpiration Pull)

Soil as Reservoir of Essential Elements

Roles of Soil

Supplies mineral and holds water	Harbors Nitrogen fixing bacteria and other microbes
Supplies air to the roots	Acts as a matrix that stabilizes the plant

TOXICITY OF MICRONUTRIENTS

- Moderate increase in micronutrients leads to toxicity.
- Any mineral ion concentration in tissue that reduces the dry weight of tissue by 10% is considered toxic

Eg:- MANGENSE (Mn)

- Excess: Induce deficiency of Fe, Mg and Ca
- Inhibit: Ca translocation in Shoot apex
- Toxicity: Toxicity symptoms are actually deficiency symptoms of Fe, Mg and Ca. (Brown Spot around chlorotic veins)

MINERAL NUTRITION

Mineral Nutrition

Carbohydrates, proteins, lipids, water, and minerals are required for all living creatures to survive. Plants, too, require nutrients for growth and development.

Essential Mineral Elements

Mineral needs vary depending on the plant. There is a criterion for determining whether or not an ingredient is necessary.

It contains the following items:

- The element must be required for proper development and reproduction. If such a component is missing, the Plants won't be able to finish their life cycle.
- The element's need must be precise, and no other element should be able to substitute it.
- The element must play a direct role in plant metabolism.

Functions of Mineral Nutrients:

- Carbon, hydrogen and oxygen enter into the cell wall and protoplasm and form the plant body.
- The minerals present in the cell sap maintain the osmotic pressure of the cell.
- Calcium, sodium and potassium maintain the permeability of cell membrane.
- The cations and anions affect the pH of the cell sap.
- A few salts and minerals balance the harmful effect of other nutrients.
- Several elements act as catalyst for biochemical reactions.

Macronutrients

These nutrients are required by the plants in large quantities. These include carbon, hydrogen, nitrogen, oxygen, phosphorus, Sulphur, potassium, etc.

Micronutrients

These nutrients are required by the plants in small quantities. These include iron, copper, manganese, molybdenum, chlorine, etc.

Role of Macro and Micronutrients

Mineral Nutrients	Functions
Nitrogen	Important constituent of nucleic acid, protein, hormones and vitamins.
Phosphorus	Promotes root growth and fruit ripening.
Potassium	It acts as an activator for several enzymes.
Calcium	Facilitates the formation of middle lamella of plants and acts as an enzyme activator.

Magnesium	Plays a vital role in the metabolism of carbohydrates, lipids.
Sulphur	Major constituent of amino acids and vitamins.
Iron	Plays an important role in the energy conversion reaction reactions of respiration and photosynthesis, activates nitrate reductase and aconitase.
Manganese	Essential for chlorophyll synthesis, initiate photolysis of water.
Copper	Plays an important role in photophosphorylation.
Molybdenum	It helps in the synthesis of ascorbic acid.
Chlorine	Helps in the photolysis of water in photosystem-II.

Deficiency of Mineral Nutrients

Mineral Nutrients	Deficiency Symptoms
Nitrogen	Impaired plant growth, chlorosis, delayed flowering, and fruiting.
Phosphorus	Premature leaf fall, necrosis.
Sulphur	Delayed flowering and fruiting, premature leaf fall.
Potassium	Mottled chlorosis, inhibition of protein synthesis and photosynthesis.
Calcium	Chlorosis, distortion of leaf shape.
Magnesium	Interveinal chlorosis, depression of internal phloem.
Iron	Chlorosis, inhibition of protein synthesis and chloroplast formation.
Chlorine	Wilting of leaves, brown edges, leaf spots.
Copper	Causes "die back" disease in leaves, Reduction in vegetative and reproductive growth.

Autotroph

An organism that synthesize its required nutrients from simple and inorganic substance; **Example:** plants, blue green algae (cyanobacteria)

Heterotroph

An organism that cannot synthesise its own nutrients and depend on others. **Example:** Bacteria, protists, members of animalia.

Biological nitrogen fixation

Conversion of atmospheric nitrogen into organic compounds by living organisms.

Chlorosis

Yellowing of leaves due to loss of chlorophyll.

Nitrification and Denitrification

Conversion of ammonia (NH_3) into nitrite and then to nitrate. 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 enzyme from oxidation.

Flux

The movement of ions is called flux. Influx is inward movement of ions into the cells and efflux is the outward movement of ions.

Inhibition of cell division: Deficiency of N, K, S. and Mo.

Necrosis

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

Delayed Flowering: due to deficiency of N, S, Mo.

Mineral Nutrition

Plants require mineral 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.

Active Transport

Absorption occurring 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.

Nitrogen Cycle

Nitrogen Fixation: The process of conversion of nitrogen to ammonia is called nitrogen fixation. In nature lightening and ultraviolet radiation provide energy to convert atmospheric nitrogen into nitrogen oxide (No, NO_2 and N_2O).

Ammonification: The decomposition of organic nitrogen of dead plants and animals into ammonia is called ammonification.

Nitrification: Ammonia is first oxidized to nitrite by bacteria Nitrosomonas or Nitrococcus which is further oxidized to nitrate with help of bacteria Nitrobactor. These processes are called nitrification.

$$2NH_3 + 3O_2 \xrightarrow{\text{Nitrosomonas}} 2NO_2^- + 2H_2O + 2H^+$$

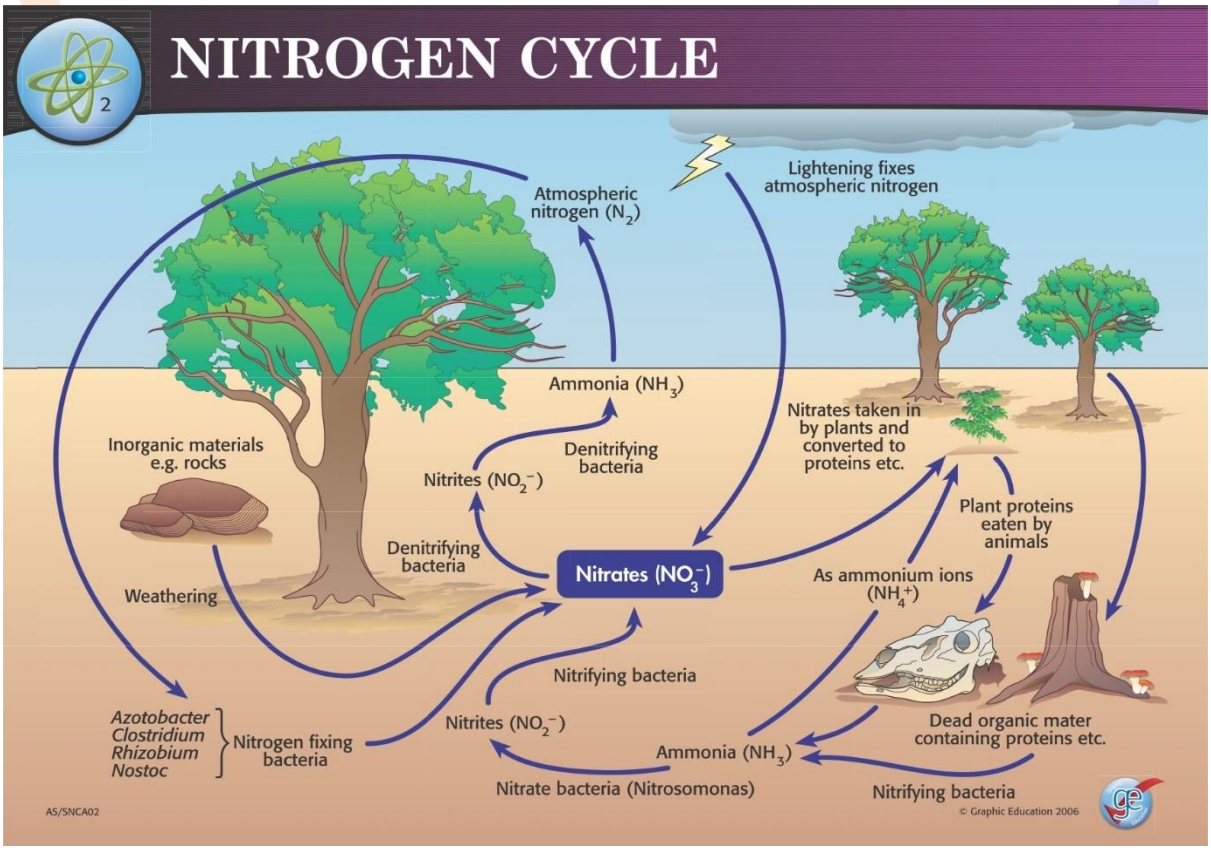
$$2NO_2^- + O_2 \xrightarrow{\text{Nitrobactor}} 2NO_3^-$$

Denitrification: Nitrates formed is absorbed by plants and transported to leaves. Nitrates is converted into free nitrogen by the process called denitrificaion by bacteria Pseudomonas and Thiobacillus.

Biological Nitrogen Fixation: Reduction of nitrogen to ammonia by living organism is called Biological Nitrogen Fixation. The enzyme nitrogenase is present in prokaryotic organism called nitrogen fixer.

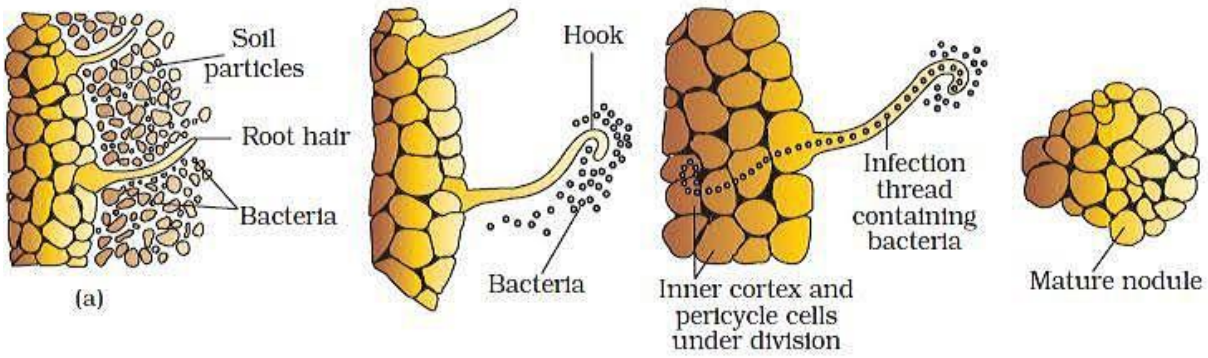
Role of microbes in nitrogen cycle

- Rhizobium, Azotobacter, Rhodospirillum; Fix atmospheric nitrogen
- Nitrosomonas and/ or Nitrococcus: Conversion of ammonia to nitrite
- Nitrobacter: Conversion of nitrite into nitrate.
- Pseudomonas and Thiobacillus: reduce nitrate into nitrogen.



Steps of nodule formation

- Rhizobium bacteria present in soil contact a susceptible root hair.
- Infection of the root hair cause it to curve and deformed due to chemical secretion.
- An infection thread is produced carrying the bacteria into the cortex of the root.
- The bacteria get modified into rod-shaped bacteria and cause inner cortical and pericycle cells to divide plant produce cytokinin and auxin to stimulate cell division and enlarge to form nodules.
- Division and growth of cortical and pericycle cells lead to nodule formation.



Mechanisms of N_2 fixation

It requires 3 components:

- A strong reducing agent like $FADH_2$, $NADPH_2$.
- Nitrogenase enzyme.
- ATP (as energy service).

Steps:

- Formation of Diamide.
- Formation of Hydrazine (N_2H_4).
- Formation of Ammonia.

NCERT LINE BY LINE QUESTIONS

12.1 Methods to study the mineral requirements of plants:

1. Hydroponics has been successfully employed as a technique for commercial production of **(PG. 195, E)**
(A) Vegetables such as tomato (B) Seedless cucumber
(C) lettuce (D) all of these

2. Hydroponics was first time demonstrated by **(PG. 194, E)**
(A) Julius von Sachs, a prominent German botanist in 1860.
(B) Julius von Sachs, a prominent French botanist in 1860.
(C) Melvin Calvin, a prominent French botanist in 1960.
(D) None of these

3. Hydroponics helps in **(PG. 195, E)**
(A) identification of essential elements
(B) discovery of deficiency symptoms of essential elements
(C) growing some commercial crops like tomatoes
(D) all of these

12.2 Essential Mineral elements

4. Plants growing near nuclear test sites take up **(PG. 195, E)**
(A) Selenium (B) Strontium (C) gold (D) none of these

5. Hydroponics are techniques that are able to detect the minerals even at a very low concentration upto **(PG. 195, E)**
(A) 10–8g/ml (B) 10–9g/ml (C) 108g/ml (D) 10–6g/ml

12.2.1 Criteria for essentiality

6. The criteria for essentiality of an element are: **(PG. 195, E)**
(A) The element must be absolutely necessary for supporting normal growth and reproduction
(B) The requirement of the element must be specific and not replaceable by another element.
(C) The element must be directly involved in the metabolism of the plant.
(D) all of these

7. Macronutrients are not **(PG. 196, E)**
(A) Generally present is plant tissues in large amounts in excess of 10m mole/kg of dry matter.
(B) Carbon, Hydrogen & oxygen are mainly obtained from CO_2 and H_2O.
(C) Phosphorous, sulphur, potassium, calcium are macronutrient.
(D) Manganese, which is absorbed from soil as mineral nutrition.

8. How many essential elements are classified into macronutrient and micronutrient.
(A) 9 (B) 17 (C) 8 (D) 10

9. How many essential elements are called non-mineral elements **(PG. 196, E)**
(A) 3 (B) 5 (C) 7 (D) 9

10. Match the column-I & II **(PG. 196, E)**

Column I	**Column II**
(A) Mo	(i) RubisCo
(B) Mg^{2+}	(ii) Alcohol dehydrogenase
(C) Zn^{2+}	(iii) Nitrogenase

(A) A-i, B-ii, C-iii (B) A-iii, B-i, C-ii
(C) A-ii, B-iii, C-i (D) A-iii, B-ii, C-i

11. Mg^{2+} act as **(PG. 196, E)**

(A) activator for enzymes phosphoenol pyruvate carboxylase during photosynthetic carbon fixation.
(B) inhibitor for Ribulose bisphosphate carboxylase-oxygenase during photosynthetic carbon fixation.
(C) inhibitor for enzyme phosphoenol pyruvate carboxylase during photosynthetic carbon fixation
(D) b and c both

12. Which of following does play important roles in opening and closing of stomata **(PG. 196, E)**
(A) Potassium (B) Phosphorous
(C) Calcium (D) magnesium

13. Which of following is part of chlorophyll and ATP respectively. **(PG. 196, E)**
(A) Manganese, phosphorous (B) Magnesium, phosphorous
(C) Manganese, Potassium (D) Magnesium, Potassium

14. Which of following is used to categorize essential elements. **(PG. 196, E)**
(i) components of biomolecules (ii) Activate or inhibit enzymes.
(iii) Osmotic potential of a cell role.
(iv) Components of energy-related chemical compounds.
(A) i, ii only (B) iii & iv only (C) i, iii & iv (D) all of these

12.2.2 Role of Macro-and Micronutrients

15. Anion-cation balance in cell maintained by **(PG. 197, E)**
(A) Potassium (B) phosphorous (C) Nitrogen (D) Sulphur

16. Which of following involved is protein synthesis **(PG. 197, E)**
(A) Phosphorous (B) Potassium
(C) Calcium (D) Iron

17. Choose incorrect about function of calcium in plants **(PG. 197, E)**
(A) It accumulate in newly formed leaf.
(B) Synthesis of cell wall.
(C) formation of spindle fibres
(D) none of these

18. How many of enlisted elements are/is major constituents of nucleic acids. Potassium, Phosphorous, Calcium, Magnesium, Nitrogen **(PG. 197, E)**
(A) 2 (B) 3 (C) 4 (D) 1

19. Plant obtain sulphur in the form of **(PG.197, E)**
(A) Sulphide (B) Sulphate (C) Sulphite (D) a & b

20. Plant obtain iron in the form of **(PG. 197,E)**
(A) ferrous (B) ferrate (C) ferric ions (D) a & b

21. Magnesium help in maintaing structure of **(PG. 197, E)**
(A) cell wall (B) cell membrane
(C) Ribosome (D) Lysosome

22. In how many amino acid does sulphur present. **(PG. 197, E)**
(A) 0 (B) 1 (C) 2 (D) 5

23. Main constituent of biotin is **(PG. 197, E)**
(A) Sulphur (B) Same as main constitute of thiamine
(C) Retinol (D) a & b both

24. Plant obtain calcium is form of **(PG. 197, E)**
(A) calcium ions (B) calcium solid
(C) calcium (D) none

25. Which of following is present in ferredoxin. **(PG. 197, E)**
(A) Sulphur (B) Iron (C) Both a & b (D) None

26. Coenzyme A consist of **(PG. 197, E)**
(A) Magnesium (B) Sulphur (C) Iron (D) Potassium

27. Which of following does plant obtain as monovalent ion **(PG. 197, E)**
(A) Manganese (B) Zinc (C) Copper (D) Chlorine

28. Which of following does not take part is nitrogen metabolism **(PG. 197, E)**
(A) Nitrogenase (B) Nitrate reductase
(C) Molybdenum (D) nitrate oxygenase

29. Redox reaction is performed by **(PG. 197, E)**
(A) Copper (B) Iron (C) Both a & b (D) none of these

30. Synthesis of auxin need **(PG. 197, E)**
(A) Zinc (B) Copper (C) Iron (D) Chlorine

31. The best defined function of manganese is **(PG. 198, E)**
(A) Splitting of water that liberate oxygen during photosynthesis
(B) Combination of OH– and H+ that leads to formation of water.
(C) aerobic respiration (D) fermentation

32. Choose correct set about Boron **(PG. 198, E)**
(i) It absorbed as B72- (ii) It absorbed as B4O33-
(iii) It required for uptake & utilization of ZN2+
(iv) Pollen germination (v) Carbohydrate translocation.
(A) I, ii, iii, iv, v (B) iii, iv, v
(C) iv, v (D) none of these

33. Boron is required for uptake & ultilization of **(PG. 198, E)**
(A) Ca2+ (B) Mn2+ (C) Mg2+ (D) all of these

12.2.3 Deficiency symptoms of essential elements

34. Whenever the supply of an essential elements becomes limited, plant growth is **(PG. 198, E)**
(A) accelerated (B) retarded (C) no effect (D) optimum

35. Critical concentration is **(PG. 198, E)**
(A) The concentration of the essential element below which plant growth is retarded.
(B) the concentration of the non-essential element below which plant growth is accelerated.
(C) The concentration of the essential element above which plant growth is accelerated.
(D) The concentration of the essential element below which plant growth is accelerated.

36. Deficiency symptoms is **(PG. 198, E)**
(A) Morphological changes that indicate certain element deficiencies
(B) It is not varying from element to element
(C) Never disappear when the deficient mineral nutrient is provided to plant.
(D) all of these

37. For elements that are actively mobilized within the plants, and exported to young developing tissues, the deficiency symptoms tend to appear **(PG. 198, E)**
(A) first in meristematic tissue (B) first in older tissue
(C) first in leaf (D) all of these

38. Which of following element deficiencies are visible in senescent leaves **(PG. 198, E)**
(A) Nitrogen (B) Potassium
(C) Magnesium (D) all of these

39. Chlorosis is **(PG. 199, E)**
(A) loss of chlorophyll leading to yellowing of leaves

(B) caused by deficiency of elements like N, K, Mg, S, Mn, Fe, Zn, MO and Cu.
(C) A & B both (D) none of these

40. Deficiency of Ca, Mg, Cu, K lead to **(PG. 199, E)**
(A) Chlorosis (B) Necrosis
(C) inhibition of cell division (D) no of these

41. Inhibition of cell division is not related to deficiency of **(PG. 199, E)**
(A) S (B) Cu (C) K (D) Mo

42. Given below are list of element N, K, Mg, Ca, Cu, B, Fe, Mn, Zn, Mo
How many of them are related to necrosis, chlorosis and inhibition of cell division respectively. **(PG. 199, E)**
(A) 8, 4, 4 (B) 4, 8, 4 (C) 4, 4, 8 (D) none of these

12.2.4 Toxicity of Micronutrient

43. The requirement of micronutrients is always in …….concentration their moderate decrease cause the …… and a moderate increase cause …… **(PG. 199, E)**
(A) high, deficiency symptoms, toxicity
(B) low, deficiency symptoms, toxicity
(C) low, toxicity symptoms, deficiency symptoms
(D) high toxicity, symptoms, deficiency symptoms

44. Any mineral ion concentration is tissues that reduced the dry weight of tissues by about how much present is considered toxic. **(PG. 199, E)**
(A) 10% (B) 20% (C) 2% (D) more than 50%

45. Choose correct statements **(PG. 199, E)**
(i) The prominent symptom of manganese toxicity is appearance of brown spots surrounded by chlorotic venis.
(ii) Manganese compete with magnesium for binding with enzymes.
(iii) Manganese inhibit calcium translocation in Root apex
(iv) Excess of manganese may in fact induce deficiencies of iron, magnesium & calcium
(A) i, ii, iii, iv (B) i, ii, iv only
(C) i, iii only (D) iv only

12.3 Mechanism of absorption of elements

46. Choose the correct about mechanism of absorption of elements by palnts. **(PG. 200, E)**
(A) An initial rapid uptake of ions into the 'outer space' of cells i.e. apoplast is passive.
(B) The passive movement of ions into the apoplast usually occurs through ionchannels, the trans-membrane protein.
(C) The entry or exist of ions to and from the symplast is an active process.
(D) all of these

12.4 Translocation of Solutes:

47. Mineral salts are transported through **(PG.200, E)**
(A) Xylem (B) Phloem (C) Pericycle (D) a & b

12.5 Soil as Reservoir or essential elements

48. Soil supplies **(PG. 200, E)**
(A) Mineral salt (B) Nitrogen-fixing bacteria
(C) hold water (D) all of these

49. which of following may be supplied by fertilizers **(PG. 200, E)**
(A) Macronutrients (B) Micronutrient
(C) both A & B (D) none

12.6 Metabolism of Nitrogen

50. Nitrogen is a constituent of **(PG. 200, E)**
(A) hormones (B) Chlorophyll (C) Proteins (D) All of these

51. How many from following statement are correct. **(PG. 201, E)**
(i) Plants compete with microbes for limited nitrogen that is available in soil.
(ii) Nitrogen is limiting nutrient for agricultural ecosystem
(iii) Nitrogen is not limiting nutrient for natural ecosystem.
(iv) Nitrogen is absorbed mainly as NO2-
(v) Nitrogen is example of macronutrient of plant as manganese because these present is plant tissue in large amounts (in excess of 10 mmole kg^{-1} of dry matter)
(A) 4 (B) 2 (C) 3 (D) 5

52. Two nitrogen atoms joined by **(PG. 201, E)**
(A) Three ionic bond (B) three covalent bond
(C) three coordination (D) a & b both

53. Nitrogen fixation is conversion of (N2) into **(PG. 201, E)**
(A) NO_2 (B) N_2O (C) NH_3 (D) A and C both

54. Oxidation of ammonia into nitrite is carried out by **(PG. 201, E)**
(A) *Nitrosomonas* (B) *Nitrobacter* (C) *Pseudomonas* (D) *Thiobacillus*

55. *Nitrococcus* is responsible for **(PG. 201, E)**
(A) Oxidation of ammonia (B)Oxidation of nitrite
(C) Reduction of nitrate (D) formation of NO3-

56. Nitrification is related to **(PG. 201, E)**
(A) $2NH_3+3O_22NO_2-+2H++2H_2O$ (B) $2NO_2-+O_22NO_3^-$
(C) Photoautotrophic bacteria (D) A & B both

57. Plant absorb **(PG. 201, E)**
(A) nitrate (B) nitrite (C) Ammonia (D) All of these

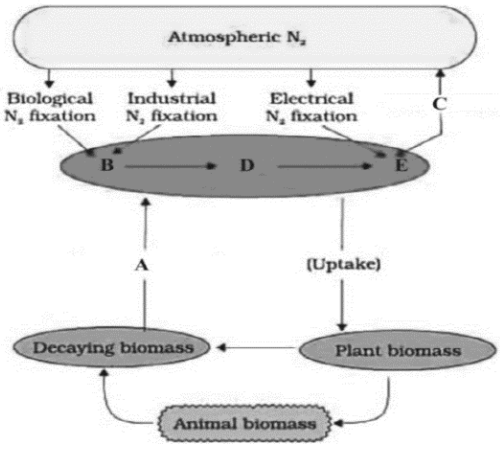
58. Formation of amine group of amino acid in leaf is achieved by **(PG. 201, E)**
(A) oxidation of nitrite (B) reduction of nitrite
(C) oxidation of nitrate (D) reduction of nitrate

59. Denitrification is process of **(PG. 201, E)**
(A) Reduction of nitrate (B) Reduction of nitrite only
(C) Oxidation of nitrite only (D) oxidation of nitrate only

60. Denitrifying bacteria are **(PG. 201, E)**
(A) *Thiobacillus* & *Nitrosomonas* (B) *Nitrococcus* & *Nitrosomonas*
(C) *Pseudomonas* & *Thiobacillus* (D) None of these

61. *Pseudomonas* is responsible for **(PG. 201, E)**
(A) Ammonification (B) Nitrification
(C) Denitrification (D) All of these

62. Identify A, B, C, D, E



	A	B	C	D	E
A	Ammonification	NO2-	Denitrification	NO3-	NH3
B	Ammonification	NH3	Denitrification	NO2-	NO3-
C	Denitrification	NO3-	Ammonification	NH3	NO2-
D	Denitrification	NH3	Ammonification	NO3-	NO2-

(PG. 201, E)

12.6.2 Biological Nitrogen Fixation

63. Nitrogenase enzymes found exclusively is **(PG. 202, E)**
(A) prokaryotes (B) eukaryotes
(C) both a & b (D) aquatic

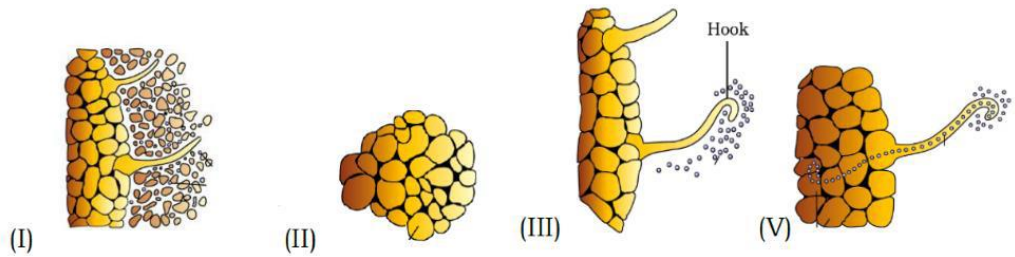
64. Choose correct option. **(PG. 202, E)**
(A) Azotobacter is free-living N2-fixing aerobic microbe.
(B) Beijerinckia is free-living N2-fixing anaerobic microbe.
(C) Rhodospirillum is aerobic and freeliving N2-fixes
(D) Azotobacter is free-living N2-fixing anerobic microbe.

65. *Frankia* is associated with …… to form root nodule. **(PG. 202, E)**
(A) leguminious plants root
(B) Root of non-legumes (Alnus)
(C) A & B both (D) none of these

66. *Rhizobium* is
(A) Rod-shaped (B) Coccos shaped
(C) Spirillum shaped (D) comma-shaped

67. *Rhizobium* is
(A) Rod-shaped (B) symbiotic
(C) associated with alfalfa (D) all

68. Arrange the sequence of nodule formation by *Rhizobium* and root of host plant.
(PG.203, E)



(A) I→III→V→II (B) I→III→II→V (C) II→III→V→I (D) II→V→III→I

69. Which of following is incorrect about root nodule formation **(PG. 203, E)**
(A) Rhizobia multiply & colonise the surrounding of roots & get attached to cortical cells.
(B) Root nodule formation initiate in cortex of root.

(C) The bacteria are released from the infection thread in to the cells which leads to the differentiation of specialized N2-fixing cells.
(D) Nodules establishes a direct vascular connection with host for exchange of nutrients.

70. The enzyme nitrogenase **(PG. 203, E)**
(i) Mo-Fe protein
(ii) Catalyses the conversion of atmospheric nitrogen to ammonia
(iii) highly sensitive to molecular oxygen
(iv) require anaerobic condition
(A) i, ii, iii, iv are correct (B) i, iii & iv are only correct
(C) ii, iii are incorrect (D) I, ii are only correct.

71. Leg-haemoglobin is not **(PG. 203, E)**
(A) leguminous haemoglobin (B) oxygen producer
(C) oxygen scavengers
(D) Make red-pink color appearance of root nodule

72. Production of one molecule of ammonia require **(PG. 204, E)**
(A) 16 ATP (B) 8 ATP (C) 8e– (D) a & c both

73. How many electron required to convert (N_2) into $2NH_3$ **(PG. 204, E)**
(A) 4e– (B) 8e– (C) 16e– (D) 2e–

74. The energy require for N2 fixing comes from **(PG. 204, E)**
(A) Nitrogenase activity of microbes
(B) Respiration of host cell
(C) Carbon assimilation of host cell
(D) All of these

75. Reductive amination require **(PG. 204, E)**
(i) Ammonium ion (ii) NADP
(iii) Glutamate dehydrogenase (iv) Water
(v) α-ketoglutaric acid
(A) i, ii, iii, v only (B) i, iii, v only
(C) ii & iv only (D) all of these

76. Transamination is **(PG. 204, E)**
(A) Transfer of amino group from one amino acid to keto group of a keto acid.
(B) Transfer of keto group from one amino acid to amino group of a keto acid
(C) Transfer of kept group from keto acid to amino group of an amino acid.
(D) Transfer of amino group from keto acid to keto group of an amino acid.

77. Which of following is Amino donor. **(PG. 204, E)**
(A) NH_3 (B) $R_2 - \underset{\underset{O}{\|}}{C} - COO^-$
(C) $H - \underset{\underset{O}{\|}}{C} - COO^-$ (D) $R_2 - H \,|\, C \,|\, N_3^+ - COOH$

78. Asparagine & glutamine are **(PG. 204, E)**
(A) two amide
(B) formed from two amino acid i.e. aspartic acid and glutamate respectively
(C) contain less nitrogen than amino acid.
(D) transported by phloem

79. Ureides have **(PG. 204, E)**
(A) high carbon to nitrogen ratio (B) high nitrogen carbon ratio
(C) N/C = 1 (D) none of them

NEET PREVIOUS YEARS QUESTIONS

1. In which of the following forms is iron absorbed by plants? **[2018]**
(a) Ferric (b) Ferrous (c) Both ferric and ferrous (d) Free element

2. Which of the following elements is responsible for maintaining turgor in cells? **[2018]**
(a) Magnesium (b) Sodium (c) Calcium (d) Potassium

3. In which of the following, all three are macronutrients? **[2016]**
(a) Boron, zinc, manganese (b) Iron, copper, molybdenum
(c) Molybdenum, magnesium, manganese (d) Nitrogen, calcium, phosphorus

4. Minerals known to be required in large amounts for plant growth include : **[2015]**
(a) Calcium, magnesium, manganese, copper (b) Potassium, phosphorus, selenium, boron
(c) Magnesium, sulphur, iron, zinc (d) Phosphorus, potassium, sulphur, calcium

5. Deficiency symptoms of nitrogen and potassium are visible first in: **[2014]**
(a) Senescent leaves (b) Young leaves (c) Roots (d) Buds

6. Thiobacillus is a group of bacteria helpful in carrying out **(NEET-2019)**
(1) Nitrogen fixation (2) Chemoautotrophic fixation (3) Nitrification (4) Denitrification

7. In Glycine max, the product of biological nitrogen fixation is transported from the root nodules to other parts as : **(NEET-2020 COVID)**
(1) Ammonia (2) Glutamate (3) Nitrates (4) Ureides

8. Which of the following elements helps in maintaining the structure of ribosomes? **(NEET-2020 COVID)**
(1) Magnesium (2) Zinc (3) Copper (4) Molybdenum

9. Match the following concerning essential elements and their functions in plants: **(NEET-2020)**

(a)Iron	(i)	Photolysis of water
(b)Zinc	(ii)	Pollen germination
(c)Boron	(iii)	Required for chlorophyll biosynthesis
(d)Manganese	(iv)	IAA biosynthesis

Select the correct option:

	(a)	(b)	(c)	(d)
1)	(iv)	(i)	(ii)	(iii)
2)	(ii)	(i)	(iv)	(iii)
3)	(iv)	(iii)	(ii)	(i)
4)	(iii)	(iv)	(ii)	(i)

10. The product(s) of reaction catalyzed by nitrogenase in root nodules of leguminous plants is/are **(NEET-2020)**
1) Ammonia and hydrogen 2) Ammonia alone
3) Nitrate alone 4) Ammonia and oxygen

11. Match List – I with List – II **(NEET-2021)**

	List – I		List – II
a)	Nitrococcus	i)	Denitrification
b)	Rhizobium	ii)	Conversion of ammonia to nitrite
c)	Thiobacillus	iii)	Conversion of nitrite to nitrate
d)	Nitrobacter	iv)	Conversion of atmospheric nitrogen to ammonia

	a	b	c	d
1)	i	ii	iii	iv
2)	iii	i	iv	ii
3)	iv	iii	ii	i
4)	ii	iv	i	iii

12. Match List-I with List-II **[NEET-2022]**

List - I	**List – II**

a) Manganese	i) Activates the enzyme catalase
b) Magnesium	ii) Required for pollen germination
c) Boron	iii) Activates enzymes of respiration
d) Iron	iv) Functions in splitting of water during photosynthesis

Choose the correct answer from the potions given below:

1) (a) – (iii), (b) – (iv), (c) – (i), (d) – (ii)
2) (a) – (iv), (b) – (iii), (c) – (ii), (d) – (i)
3) (a) – (iv), (b) – (i), (c) – (ii), (d) – (iii)
4) (a) – (iii), (b) – (i), (c) – (ii), (d) – (iv)

13. Which one of the following produces nitrogen fixing nodules on the roots of Alnus?

[NEET-2022]

1) Rhizobium 2) Frankia 3) Rhodospirillum 4) Beijernickia

NCERT LINE BY LINE QUESTIONS – ANSWERS

1	2	3	4	5	6	7	8	9	10
D	A	D	B	A	D	D	B	A	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
D	A	B	D	A	B	A	A	B	C
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
C	C	B/D	A	C	B	D	D	C	A
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
A	C	A	B	A	A	B	D	A	B
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
B	D	B	A	B	B	A	D	C	D
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
B	B	C	A	A	D	A	B	B	C
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
C	B	A	A	B	A	D	A	A	A
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	
B	B	B	B	B	A	A	A	B	

NEET PREVIOUS YEARS QUESTIONS-ANSWERS

1 (a) **2** (d) **3** (d) **4** (d) **5** (a) **6** (4) **7** (4) **8** (1) **9** (4) **10** (1) **11** (4) 12 (2) 13 (2)

NEET PREVIOUS YEARS QUESTIONS-EXPLANATIONS

1. (a) Iron is absorbed by plants in the form of ferric ions.

2. (d) Plants require potassium ions (K+) for protein synthesis and for the opening and closing of stomata,
which is regulated by proton pumps to make surrounding guard cells either turgid or flaccid.

3. (d) Nitrogen, phosphorus, potassium, calcium, sulfur and magnesium are the macronutrients.

4. (d) Phosphorus is required for all phosphorylation reactions and constitution of cell membrane, nucleic acids and some proteins. Potassium is related with protein synthesis, closing and opening of stomata and activation of enzyme. Calcium regulates metabolic activities, function of cell membrane and stabilizes the structure of chromosomes. Sulphur is the main constituent of the amino acids, cystine and methionine, coenzymes and vitamins.

5. (a) The parts of the plants that show the deficiency symptoms also depend on the mobility of the element in the plant. For element 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, nitrogen, potassium and magnesium are visible first in the senescent leaves.

9. (a) Iron required for chlorophyll biosynthesis
(b)Zinc is useful in biosynthesis of IAA
(c)Boron requires for pollen germination
(d)Manganese is component of OEC it involves in photolysis of water

10. $N_2 + 8H^+ + 8e^- + 16ATP \xrightarrow{\text{Nitrogenase}} 2NH_3 + 2H^+ + 6ADP + 16Pi$

11. • Nitrogen fixation is conversion of atmospheric N_2 to NH_3 (ammonia). It is carried out by N_2 fixers such as *Rhizobium.*
• NH_3 is converted to NO_2^- (nitrite) by nitrifying bacteria such as *Nitrococcus.*
• Then NO_2^- is converted to NO_3^- (nitrate) by nitrfying bacteria called *Nitrobacter.*
• *Thiobacillus*

12. *Mn* ⇒ Functions in splitting of H_2O during photosynthesis

Mg ⇒ Activates enzymes of respiration

$B \Rightarrow$ Required for Pollen germinations

$Fe \Rightarrow$ Activates Enzyme catalase

13 *Frankia* produces nitrogen fixing nodules on the roots of Alnus