12

Mineral Nutrition

TOPIC 1
Inorganic Nutrients

01 Match the following concerning essential elements and their functions in plants.

[NEET (Sep.) 2020]

	Column I		Column II
A.	Iron	1.	Photolysis of water
B.	Zinc	2.	Pollen germination
C.	Boron	3.	Required for chlorophyll biosynthesis
D.	Manganese	4.	IAA biosynthesis

Select the correct option.

	A	B	C	D
(a)	4	3	2	1
(b)	3	4	2	1
(c)	4	1	2	3
(d)	2	1	4	3

Ans. *(b)*

The correct option is (b). It can be explained as follows

Iron – essential for the formation of chlorophyll.

Zinc – needed for synthesis of auxin

Boron – have a role in pollen grain germination

Manganese – is involved in the splitting of water to liberate O_2 during photosynthesis.

02 In which of the following forms is iron absorbed by plants?

[NEET 2018]

(a) Free element
(b) Ferrous
(c) Ferric
(d) Both ferric and ferrous

Ans. *(c)*

According to NCERT, plants absorb iron mostly in the form of **ferric** (Fe^{3+}) ions. However, plants in acidic soil can absorb iron in ferrous (Fe^{2+}) as well as ferric (Fe^{3+}) form. It is an important constituent of proteins involved in the transfer of electrons like ferredoxin and cytochromes. It is reversibly oxidised from Fe^{2+} to Fe^{3+} during electron transfer. It activates catalase enzyme. It is essential for the formation of chlorophyll.

03 In which of the following, all three are macronutrients?

[NEET 2016, Phase I]

(a) Iron, copper, molybdenum
(b) Molybdenum, magnesium, manganese
(c) Nitrogen, nickel, phosphorus
(d) Boron, zinc, manganese

Ans. *(c)*

None of the option is correct w.r.t. question. The option (a) seems to be more appropriate.

None of the option consist of all three macronutrients, But option (c) have nitrogen and phosphorus which are macronutrients, but nickel is a micronutrients.

04 Which is essential for the growth of root tip? **[NEET 2016, Phase II]**

(a) Zn
(b) Fe
(c) Ca
(d) Mn

Ans. *(c)*

Calcium is needed to the growing root tip. It is required in the formation of middle lamella of the cell wall present in the form of calcium pectate. Thus, correct answer is (c).

05 Deficiency symptoms of nitrogen and potassium are visible first in

[CBSE AIPMT 2014]

(a) senescent leaves
(b) young leaves
(c) roots
(d) buds

Ans. *(a)*

Deficiency of both nitrogen and (N) potassium (K) is first visible in senescent (older) leaves, due to the deficiency symptoms of N chlorosis occurs while, the deficiency of K causes the inhibition of protein synthesis and scorching of older leaves.

06 Which one of the following is correctly matched?

[CBSE AIPMT 2012]

(a) Passive transport of nutrients – ATP
(b) Apoplast – Plasmodesmata
(c) Potassium – Readily immobilisation
(d) Bakane of rice seedlings – F Skoog

Ans. *(c)*

Active transport of nutrients require ATP. Symplast includes translocation through plasmodesmata. Bakane disease of rice was found by Hori (1918) to be caused due to *Gibberella fujikuroi*. None of the options is correct. Option (c) may be correct if statement be read as "Potassium readily mobilisation" instead of "potassium readily immobilisation.

07 Which one of the following elements in plants is not remobilised? **[CBSE AIPMT 2011]**

(a) Calcium
(b) Potassium
(c) Sulphur
(d) Phosphorus

Ans. *(a)*

Element like calcium are a part of structural component of the cell and hence, are not released. The deficiency symptoms tend to appear first in the young tissues whenever, the elements are not demobilised.

08 Which one of the following is not a micronutrient? **[CBSE AIPMT 2010, 03]**

(a) Molybdenum (b) Magnesium
(c) Zinc (d) Boron

Ans. *(b)*

Magnisium is an essential macrountrient found from 0.2-0.4% dry matter and is necessary for normal plant growth.

Magnesium has an important role in photosynthesis because it forms the central atom of chlorophyll.

09 Manganese is required in **[CBSE AIPMT 2009]**

(a) nucleic acid synthesis
(b) plant cell wall formation
(c) photolysis of water during photosynthesis
(d) chlorophyll synthesis

Ans. *(c)*

In plants, manganese is absorbed in the form of manganous ions (Mn^{2+}). It activates many enzymes involved in photosynthesis, respiration and nitrogen metabolism. The best defined function of manganese is in the splitting of water or photolysis of water to liberate oxygen during photosynthesis.

10 Which one of the following elements is not an essential micronutrient for plant growth? **[CBSE AIPMT 2007]**

(a) Mn (b) Zn (c) Cu (d) Ca

Ans. *(d)*

Ca is essential macronutrient for plant growth. It is constituent of middle lamella, activator of enzymes, connected with chromosome formation and many aspects of metabolism.

11 A plant requires magnesium for **[CBSE AIPMT 2007]**

(a) holding cells together
(b) protein synthesis
(c) chlorophyll synthesis
(d) cell wall development

Ans. *(c)*

Magnesium is an important constituent of chlorophyll molecule. Thus, a plant requires magnesium for chlorophyll synthesis.

12 The deficiencies of micronutrients, not only affects growth of plants but also vital functions such as photosynthetic and mitochondrial electron flow. Among the list given below, which group of three elements shall affect most, both photosynthetic and mitochondrial electron transport? **[CBSE AIPMT 2005]**

(a) Co, Ni, Mo (b) Ca, K, Na
(c) Mn, Co, Ca (d) Cu, Mn, Fe

Ans. *(d)*

Micronutrients are minerals obtained from the soil and present in plant tissues at concentrations usually less than $3\,\mu mol\,g^{-1}$ dry matter. Cu (copper), Mn (manganese) and Fe (iron) are those micronutrients which affect both photosynthesis and mitochondrial electron transport because they are the main constituents of various electron carriers.

13 Boron in green plants assists in **[CBSE AIPMT 2003]**

(a) sugar transport
(b) activation of enzymes
(c) acting as enzyme cofactor
(d) photosynthesis

Ans. *(a)*

Boron is required by plants for (i) uptake and utilisation of Ca^{2+}, (ii) pollen germination and cell differentiation (iii) carbohydrate translocation.

14 Grey spots of oat are caused by deficiency of **[CBSE AIPMT 2003]**

(a) Fe (b) Cu
(c) Zn (d) Mn

Ans. *(d)*

Grey spots of oat are caused by the deficiency of manganese (Mn). It is a trace element, required in very small amount. Manganese exists in the soil in the form of bivalents, trivalents.

15 The major portion of the dry weight of plants comprises of **[CBSE AIPMT 2003]**

(a) carbon, hydrogen and oxygen
(b) nitrogen, phosphorus and potassium
(c) calcium, magnesium and sulphur
(d) carbon, nitrogen and hydrogen

Ans. *(a)*

The four most common elements in living organisms are H, C, O, N. These are also called as framework element.

16 Passive absorption of minerals depend on **[CBSE AIPMT 2001]**

(a) temperature
(b) temperature and metabolic inhibitor
(c) metabolic inhibitor
(d) humidity

Ans. *(a)*

Metabolic inhibitors affect active absorption. Humidity does not affect absorption of minerals as much as temperature.

The movement of mineral ions into the root cells by the process of simple diffusion is called as **passive absorption.** This is spontaneous process and does not require energy.

17 Zinc as a nutrient is used by the plants in the form of **[CBSE AIPMT 2000]**

(a) Zn (b) Zn^{2+}
(c) ZnO (d) $ZnSO_4$

Ans. *(b)*

Zinc is taken up by the plants in the form of Zn^{2+}. It is required for biosynthesis of chlorophyll in some plants. Deficiency of Zn is shown by a reduction in internodal growth as a result plants display a rosette habit of growth in which the leaves form a circular cluster radiating at or close to the ground.

18 The plants grown in magnesium deficient but urea sprayed soil would show **[CBSE AIPMT 2000]**

(a) deep green foliage
(b) early flowering
(c) yellowing of leaves
(d) loss of pigments in petals

Ans. *(c)*

Nitrogen is the constituent of amino acids, proteins, nucleic acids, nucleotides, coenzymes, hexosamines etc. Deficiency of nitrogen rapidly inhibits the plant growth and yellowing of the leaves (chlorosis) magnesium has the specific role in the activation of enzymes, taking part in photosynthesis and respiration. It also forms a part of

the ring structure of the chlorophyll molecule. Deficiency of Mg causes chlorosis, i.e. yellowing of leaves.

Thus a plant growing in magnesium-deficient soil would show chlorosis inspite of being sprayed with urea (nitrogen).

19 Which of the following is not caused by deficiency of mineral nutrition? **[CBSE AIPMT 1997]**

(a) Necrosis
(b) Chlorosis
(c) Etiolation
(d) Shortening of internodes

Ans. ***(c)***

The plants grown in dark are said to be **etiolated**. They lack chlorophyll and, therefore, appear yellow. Thus, it is not caused by deficiency of mineral nutrient.

Chlorosis is resulted due to the partial failure of development of chlorophyll which causes an abnormal colour to plant tissues.

Uncontrolled death of tissues/cells is called as necrosis.

Shortening of internodes is due to the deficiency of Zn^{2+} ions.

20 The core metal of chlorophyll is **[CBSE AIPMT 1997]**

(a) iron (b) magnesium
(c) nickel (d) copper

Ans. ***(b)***

Chlorophyll molecule, is made up of porphyrin ring which is a structure with alternating single and double bonds containing four small pyrrole rings. It has magnesium atom at the centre.

21 Which one of the following is not an essential element for plants? **[CBSE AIPMT 1996]**

(a) Potassium (b) Iron
(c) Iodine (d) Zinc

Ans. ***(c)***

Essential elements are those element which are absolutely necessary for supporting normal growth and reproduction of plants, the elements are specific in their action and are directly involved in the nutrition of the plant. Potassium is macroelement, zinc and iron are microelement. Iodine and sodium are essential for animals and are not required by most of the plants however, iodine is found in certain marine algae.

22 Which one of the following is a micronutrient for plants? **[CBSE AIPMT 1996]**

(a) Calcium
(b) Magnesium
(c) Manganese
(d) Nitrogen

Ans. ***(c)***

Micronutrients are needed in very small amounts by plants, e.g. Manganese, copper, molybdenum, zinc, boron and chlorine.

23 Phosphorus and nitrogen ions generally get depleted in soil because they usually occur as **[CBSE AIPMT 1989]**

(a) neutral ions
(b) negatively charged ions
(c) positively charged ions
(d) both positively and negatively charged but disproportionate mixture

Ans. ***(b)***

In the soil, phosphorus and nitrogen are present as negatively charged ions, e.g. $H_2PO_4^-$, NO_2^-, NO_3^- ions. These are usually supplied by fertilisers as urea.

24 The four elements making 99% of living system are **[CBSE AIPMT 1994]**

(a) CHOS (b) CHOP
(c) CHON (d) CNOP

Ans. ***(c)***

Carbon, hydrogen, oxygen and nitrogen are called as big four of the cell. C is 18%, O is 65%, H is 10% and N is 2.5%. These are principal non-metal elements and form 95% of total cellular materials.

25 Mineral associated with cytochrome is **[CBSE AIPMT 1991]**

(a) Cu (b) Mg
(c) Fe and Mg (d) Fe and Cu

Ans. ***(d)***

Cytochromes are iron-porphyrin (haem) proteins discovered by **Mac Cunn.** Cytochromes are infact, the conjugated proteins, composed of a protein molecule and a non-protein group, i.e. inorganic factor iron. It is to be noted, that cell cytochromes have iron only, though cyt-a_3 possesses both Fe and Cu. Fe has a role in picking up of electrons and Cu hands over the electrons to oxygen.

TOPIC 2
Nitrogen Metabolism

26 Match the Column -I with Column-II. **[NEET 2021]**

	Column I		Column II
A.	*Nitrococcus*	1.	Denitrification
B.	*Rhizobium*	2.	Conversion of ammonia to nitrite
C.	*Thiobacillus*	3.	Conversion of nitrite to nitrate
D.	*Nitrobacter*	4.	Conversion of atmospheric nitrogen to ammonia

Choose the correct answer from options given below.

	A	B	C	D
(a)	2	4	1	3
(b)	1	2	3	4
(c)	3	1	4	2
(d)	4	3	2	1

Ans. ***(a)***

(A)-(2), (B)-(4), (C)-(1), (D)-(3)

Nitrification is the process of conversion of ammonia into nitrites and nitrites into nitrates. It is facilitated by microorganism like *Nitrococcus* and *Nitrobacter.*

Rhizobium is involved in biological nitrogen fixation, i.e. it converts atmospheric nitrogen to ammonia. These are symbiotically associated with the roots of leguminous plants.

Thiobacillus are involved in conversion of nitrate to nitrogen gas by the process called denitrification

27 In *Glycine max*, the product of biological nitrogen fixation is transported from the root nodules to other parts as **[NEET (Oct.) 2020]**

(a) ammonia
(b) glutamate
(c) nitrates
(d) ureides

Ans. ***(c)***

In *Glycine max* (Soyabean), the product of biological nitrogen fixation is transported from the root nodules to other parts as nitrate.

28 The product(s) of reaction catalysed by nitrogenase in root nodules of leguminous plants is/are **[NEET (Sep.) 2020]**

(a) nitrate only
(b) ammonia and oxygen
(c) ammonia and hydrogen
(d) ammonia only

Ans. *(c)*

The products of reaction catalysed by nitrogenase in root nodules of leguminous plants are ammonia and hydrogen. The reaction is as follows

$$N_2 + 8e^- + 8H^{++} + 16ATP \longrightarrow 2NH_3 + H_2 + 16ADP + 16P_i$$

Symbiotic *Rhizobium* bacteria invade the roots of leguminous plants and form root nodules in which they fix nitrogen, supplying both to the bacteria and the plants.

29 Which of the following bacteria reduces nitrate in soil into nitrogen? **[NEET (Odisha) 2019]**

(a) *Nitrobacter* (b) *Nitrococcus*
(c) *Thiobacillus* (d) *Nitrosomonas*

Ans. *(c)*

Thiobacillus reduces nitrate in soil into nitrogen. The process is called denitrification.

On the other hand, *Nitrosomonas* and *Nitrococcus* oxidise ammonia into nitrite. The bacterium, *Nitrobacter* oxidises nitrite to nitrate. These processes together are known as nitrification.

30 *Thiobacillus* is a group of bacteria helpful in carrying out **[NEET (National) 2019]**

(a) chemoautotrophic-fixation
(b) nitrification
(c) denitrification
(d) nitrogen-fixation

Ans. *(c)*

Thiobacillus bacteria help to carry out denitrification during nitrogen cycle. This bacteria brings about the reduction of nitrate to free nitrogen (N_2). *Nitrosomonas* and *Nitrobacter* are chemoautotrophs that cause nitrification.

31 Select the mismatch. **[NEET 2017]**

(a) *Frankia* — *Alnus*
(b) *Rhodospirillum* — Mycorrhiza
(c) *Anabaena* — Nitrogen fixer
(d) *Rhizobium* — Alfa-alfa

Ans. *(b)*

Among the given options, only option (b) is mismatched. *Rhodospirillum* is a free living nitrogen fixing bacteria.
Mycorrhiza is the symbiotic association of a fungus with the root of a higher plant.

32 During biological nitrogen fixation, inactivation of nitrogenase by oxygen poisoning is prevented by **[CBSE AIPMT 2015]**

(a) leghaemoglobin
(b) xanthophyll
(c) carotene
(d) cytochrome

Ans. *(a)*

During biological nitrogen fixation, inactivation of nitrogenase by oxygen poisioning is prevented by leghaemoglobin.

It is a red-pigment that is filled outside the peribacteroid space in the cytosol of nodule cells. It is similar to haemoglobin of red blood cells. It has the ability to combine very rapidly with oxygen and thus acts as a very efficient O_2 scavenger.

33 The first stable product of fixation of atmospheric nitrogen in leguminous plants is **[NEET 2013]**

(a) NO_2^- (b) ammonia
(c) NO_3^- (d) glutamate

Ans. *(b)*

The process of conversion of nitrogen (N_2) to ammonia is termed as nitrogen fixation.

$$N_2 \rightarrow N_2H_2 \rightarrow N_2H_4 \rightarrow 2NH_3$$
(Nitrogen) (Dimide) (Hydrazine) (Ammonia)

$$2NH_3 + 3O_2 \longrightarrow 2NO_2^- + 2H^+ + 2H_2O$$
$$2NO_2 + O_2 \longrightarrow 2NO_3^-$$

In reductive animation ammonia reacts with α-ketoglutaric acid and forms glutamic acid

$$\alpha\text{-ketoglutaric acid} + NH_4^+ + NADPH \xrightarrow[\text{Dehygrogenae}]{\text{Glutamate}} \text{Glutamate} + H_2O + NADP$$

34 Which one of the following helps in absorption of phosphorus from soil by plants? **[CBSE AIPMT 2011]**

(a) *Rhizobium* (b) *Frankia*
(c) *Anabaena* (d) *Glomus*

Ans. *(d)*

Glomus is a genus of arbuscular mycorrhizal fungi, which form symbiotic relationships with plant roots. It is a longest Genus of AM fungi but it is currently defined as non-monphylactic. Mo, Zn and B are micronutrients.

35 The function of leghaemoglobin in the root nodules of legumes is **[CBSE AIPMT 2011]**

(a) oxygen removal
(b) nodule differentiation
(c) expression of *nif* gene
(d) inhibition of nitrogenase activity

Ans. *(a)*

Leghaemoglobin is an oxygen scavenger. It protects the nitrogen fixing enzyme nitrogenase from oxygen.

36 Nitrifying bacteria **[CBSE AIPMT 2011]**

(a) convert free nitrogen to nitrogen compounds
(b) convert proteins into ammonia
(c) reduce nitrates to free nitrogen
(d) oxidise ammonia to nitrates

Ans. *(d)*

Nitrifying bacteria (one of the chemosynthetic bacteria) which oxidise ammonia to nitrites and obtain energy for the preparation of food. This oxidation occurs in two steps. In the first step, ammonia is oxidised to nitrite by nitrite bacteria (e.g. *Nitrosomonas* and *Nitrococcus*). In the second step, nitrite is oxidised to nitrate by nitrate bacteria (e.g. *Nitrocystis* and *Nitrobacter*).

37 An element playing important role in nitrogen fixation is **[CBSE AIPMT 2010]**

(a) molybdenum (b) copper
(c) manganese (d) zinc

Ans. *(a)*

Molybdenum is absorbed as molybdate by plants. It is involved in nitrogen metabolism including nitrogen fixation. It is a component of enzyme nitrogenase and acts as enzyme activator. Its deficiency causes chlorosis and necrosis, whiptail of cauliflower and premature leaf fall.

Copper is absorbed by the plant in ionic form. Its deficiency causes necrosis, die back in *Citrus*, reclamation in legumes.

Manganese is absorbed by the plants as bivalent ion. It acts as enzyme activator. Its deficiency causes interveinal chlorosis as well as

yellowing of starch and their subsequent degenerate.

Zinc is needed for biosynthsis of IAA and also acts as enzyme activator. Its deficiency causes chlorosis, little leaf,rosette, white bud of maize and mottling of leaves.

38 The common nitrogen-fixer in paddy fields is **[CBSE AIPMT 2010]**

(a) *Rhizobium*
(b) *Azospirillum*
(c) *Oscillatoria*
(d) *Frankia*

Ans. ***(b)***

Azospirillum is a nitrogen fixing bacterium in paddy fields. It is very useful soil and root bacterium. It is associative symbiotic N_2-fixing bacteria. When it is added to the soil, it multiplies in millions and can supply 20-40 Kg of nitrogen per hectare per season. It also producess growth promoting substances like Indole Acetic Acid (IAA), gibberellins *(GA$_3$)* and promotes root proliferation. These substances improve the plant growth and yield.

39 Nitrogen fixation in root nodules of *Alnus* is brought about by **[CBSE AIPMT 2009, 08]**

(a) *Bradyrhizobium* (b) *Clostridium*
(c) *Frankia* (d) *Azorhizobium*

Ans. ***(c)***

Nitrogen is the most critical element. Certain non-leguminous plants also form nodules to fix nitrogen. The best known example in temperate region is alder (*Alnus* sp). The bacteria involved in nodule formation is an Actinomycetes the *Frankia.*

Clostridium is anaerobic, saprotrophic free-living nitrogen fixing bacteria.

Bradyrhizobium sp are symbiont in plants of *Paraspania* and soyabean.

The *Azorhizobium* forms both stem and root nodules in *Sesbania* (aquatic plant).

40 Which of the following is a flowering plant with nodules containing filamentous nitrogen fixing microorganism? **[CBSE AIPMT 2007]**

(a) *Casuarina equisetifolia*
(b) *Crotalaria juncea*
(c) *Cycas revoluta*
(d) *Cicer arietinum*

Ans. ***(a)***

The *Casuarina* tree has nitrogen fixing root nodules that harbor a filamentous actinomycete nitrogen fixing organism called *Frankia*.

41 A free living, nitrogen fixing cyanobacterium which can also form symbiotic association with the water fern *Azolla* is **[CBSE AIPMT 2004]**

(a) *Tolypothrix*
(b) *Chlorella*
(c) *Nostoc*
(d) *Anabaena*

Ans. ***(d)***

Anabaena is a free living, nitrogen fixing cyanobacterium which can form symbiotic association with water fern *Azolla*.

42 Enzyme involved in nitrogen assimilation **[CBSE AIPMT 2001]**

(a) nitrogenase
(b) nitrate reductase
(c) transferase
(d) transaminase

Ans. ***(a)***

In the process of biological nitrogen fixation, the dinitrogen molecule is reduced by the addition of pairs of hydrogen in the presence of enzyme nitrogenase. Enzyme nitrate reductase and nitrite reductase come into picture at later stage
(for nitrate assimilation).

43 In plants inulin and pectin are **[CBSE AIPMT 2001]**

(a) reserved food material
(b) wastes
(c) secretory material
(d) insect attracting material

Ans. ***(a)***

Inulin a polymer of fructose, is used as a food store, particularly in roots and tubers of family–Compositae. Pectin is a mucopolysaccharide which is found in cell wall of plants. During the time of food ripening, the pectin becomes hydrolyse and gives rise the constituents of sugar.

44 Which aquatic fern performs nitrogen fixation? **[CBSE AIPMT 2001]**

(a) *Azolla* (b) *Nostoc*
(c) *Salvia* (d) *Salvinia*

Ans. ***(a)***

The leaves of *Azolla* contain colonies of *Anabaena azollae* which have the capacity to fix atmospheric nitrogen.

45 Which of the following is a free living aerobic non-photosynthetic nitrogen fixer? **[CBSE AIPMT 1997]**

(a) *Rhizobium*
(b) *Azotobacter*
(c) *Azospirillum*
(d) *Nostoc*

Ans. ***(b)***

Azotobacter is a free living, aerobic non-photosynthetic, i.e. saprophytic bacteria. It retains the capability of fixing atmospheric nitrogen, i.e. fixation of atmospheric dinitrogen into ammonia.

46 Which of the following can fix atmospheric nitrogen? **[CBSE AIPMT 1995]**

(a) *Albugo*
(b) *Cystopus*
(c) *Saprolegnia*
(d) *Anabaena*

Ans. ***(d)***

Blue-green algae (BGA) are the only organisms, capable of performing oxygenic photosynthesis and fixation of nitrogen, e.g. *Anabaena*, *Nostoc* which produce a specialized type of cell, called **heterocyst** within which N_2 fixation occurs.

47 Minerals absorbed by roots move to the leaf through **[CBSE AIPMT 1988]**

(a) xylem
(b) phloem
(c) sieve tubes
(d) None of these

Ans. ***(a)***

Mineral ions accumulated in the root hairs passes into the cortex and finally reach the xylem from where these are carried along with water to other parts of the plant along the transpiration stream. Like organic solutes, minerals can move upwards, downwards (bidirectional movement) as well as laterally.