MINERAL NUTRITION

Mineral nutrition is the study of source, mode of absorption, distribution aridmetabolism of various. inorganic substances (minerals) by plants for their growth, development, structure, physiology and reproductilon.

Methods to Etudytbe Mineral Requirement of Plants

■ Hydroponic is the technique of growing plants in nutrient solution in complete absence of sail. This method is used to determine the nutrients essential fof plants.

• Essential eltbrnerlitS are identified and their deficiency symptoms are discovered by hydroponics methods_

Various forms and function of essential nutrients

a) **Nitrogen-** required by plants in greatest amount, it is absorbed by plants as NQ}, NO3 and NH# . It is one of the major constituent of proteins, nucleic acids and vltami ns,

In) **Phosphorus**_ Absorbed lzry plaints from soil in form of phosphate ions. It is the COnttituenft of cell membrane, all nucleic acids and nucleiXides require phosphows-

ci Potassium —absorbed as potassium ions (K' }. Help to maintain cation-anion balance In cells. It Is involved in protein synthesis.. opening and closing of stomata.

d] alcijm— absorbed by plants from soil in form of Calcium in Used in synthesis of cell wall. It .activates certain enaymes.

e) Magnesium- absorbed by plants in form of IvIg^{2+} ions. It activates *the* enzymes for respiration, photosynthesis, and involved in DNA and !RNA. Constituent of chlorophyll.

f) Sulphur• plants obtain sulphur in form of sulphate (5.0_4^{2-}). Present in amino acids (cystiaine, metnioninel and is main constituent of coenzymes and vttam ins.

ig) iron- obtains In form of ferric Iron Fe"). It Is I mportant constituents of 'protein involved in transport system.

h} Manganese- absorbed In form of AA n^{2} ' ions. Main function is splitting of water to !liberate Hydrogen and Oxygen during photosynth es is.

obtained as lin^{2+} ions_ Activate enaymes like Garb lases. Needed in formation of Auxi n_

.l) Copper— absorbed as cupric ions {Cu"). Involved in various metabolic activities and redox reactions.

kf Boron- a list pitied as $B01^{-}$ or 8_4O_7 ions. Required for uptake of calcium, cell elong,ation and pollen germi nation_

Chlorine — it is absorbed in form of Cl ions. Deterimine the solute concentration and splitting of water during photosynthesis.

Deficiency Syryiptoms of Essential elements

The concentration of essential elements helow which plant growth is retarded is called critical concentration.

In absence of any particular element shows certain morphological changes. These morphological changes are called deficiency symptoms.

The parts of plant that show deficiency symptoms depend upon mobility of elements in the plants. Elements that are actively mobililed liNi..IVI,g,1411 shows deficiency in older regions . On the other hand, symptoms appear first in young region if the elements are relatively immobile Ca) and not transported Out of mature tissues_

Kinds of deficiency syndrome are as follows-

Deficiency Disease	Symptoms	Deficient elemen15
Chlorosis	Yellowing of leaves clue to loss of chlorophyll	NI, K, Mg, $,. Fe, MN, Zn, Mo
Necrosis	Death of tissue (leaf)	Car Mg, Cu.. K
Stunted plant growth	Less height of plant	Fe, K
Premature fall of leaves and buds	Falling of leaves and buds	lo', Mg, Cu
Inhibition of cell division	Less elongation In stern	Low level of N, K, S, halo

- Mechanism rrf absorption of -elements takes place in two phases. In first phase,. rapid intake of ions occurs in free space or outer space of the cells, apoelast- In second phase, Ions are taken slowly Into Inner space„ the syrnolast of the cells.
- Passive movement of ions in apoplas˜t occurs through ion channels and trans-membrane protein. On the other hand,. irmeirient of ions into slim plast occurs by experkditure of energy by active process.
- The movement of ion is called flux_ The inward movement is called influx and outward movement is called efflux..

Nietabolism of Nitrogen

■ Nitrogen is the most prevalent elements in living world Along with C, H And a It is the main constituent of pr ins nucleic acids,. fats, hormones, enzymes etc,

▪ The process of conversion of nitrogen to arnmorda is called nitrogen fixation. In nature lightening and ultraviolet radiation provide energy to corwert atmospheric nitrogen Into nitrogen oxide (NO. NO_2 and 11_70)

• The decomposition of organic nitrogen of dead plants and animals into ammonia iS called arnrnonification.

■ Ammonia is fi rs˜t oxidized to nitrite by bacteria Nitrosornonds or Nirrococceis_ Which is further godized to nitrate with help of bacteria Nitrobpdp.r. These process at called nitrification.

2111H,+ 30 —QM); +21-1. +2H,0

2NO +O -3,2110,

■ Nitrates formed is absorbed by plants and transported to leaves. Nitrates is converted into free nitrogen by the process called tlenitrifica ion by bacteria *PSPurICIFFM14115* and Thfobadiu.s.

■ Reduction of nitrogen to ammonia by living organ ism is cal leO Biological Nitrogen Fixation. The enzyme nitrog.enase, present Irti prokaryotic organism called nitrogen fixer.

N=N

• Nitrogen fixing microbes may be symbiotic (1Rhi zobium l Or free hying INos˜toc. Azotobactor, Ariabaena).

▪ Symbiotic biological nitrogen fixation includes legume. bacteria relationship in which rod shaped Ehlzobium lives with symbiotic relation with nodules of Leguminous plants.

▫ Central portion of nodule Is pink or red due to presence of leguminous haemoglobin or leghaernoglobin..

Plo• ule contain all necessary bioc hemical components like enzyme nitrogenase and leshaernoglobin

Enzyme n ltrogense is a Mo-Fe protein and catalyzes the conyersion of atmospheric nitrogen Into ammonia.

The reaction is as follows-

111 +Be⁻ + BIT -E +FI + IEpADP +MP

The enzyme nitrogenase is highly sensitive to molecular oxygen and needs anaerobic condition. To protect this enzyme from oxygen„ the ncdu les contain an oxygen scavenger called lag-haemoglobin_

4' The ammonia synthesized by nitrogenase enzyme require large amount of energy (1.I3ATP) for each 1111, produced.

Fat of ammonia- at physiological pH, ammonia is converted Into amnion limn ions). It is toxic for plants In larger concentration and ammonium ion is converted into arnirbo acids by two rnethodsa.

Reductive animation- in this process ammonia reacts with a-ketogi titanic acid to form glutamic acid.

a – ketoglutaric acid+ NH: +NADPS glutamate + H,0 + NADP

Transaminatlon Involves the transfer of amino group from amino acids to keto group of keto acid. Clutamic acid Is the main amino acid from which transfer of NH3 takes place and another a mines_ acid is formed by trantarnination_ Two i m portant amides asparagine and .glutamine found in plants in proteins. They are formed from alspartic acid and giutarnic acid by addition of another amino groups to It.