*Available online at*
www.agrospheresmagazine.vitalbiotech.org

**ISSN (E): 2582 – 7022**

*Agrospheres*, (2022) *3*(7), 9-12

Article ID: 419

# Role of Mineral Nutrient in Plant Metabolism

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**Article History**
Received: 2. 07.2022
Revised: 14. 07.2022
Accepted: 18. 07.2022



## INTRODUCTION

Plants, like all other living things, need food for their growth and development. Plants produce organic matter from mineral elements absorbed from the soil and atmosphere. Thus, the essential elements are fundamentally important for plant physiology. Plants require 17 essential elements for completion of their life cycle, namely C, H, O, Ca, K, Mg, N, S, P, Cl, B, Cu, Fe, Mn, Mo, Ni and Zn. Deprivation of even one of these essential elements causes physiological disorders, e.g. cell death under B deprivation ( Koshiba *et al*. 2009 ). For plants to utilize these nutrients efficiently, light, heat, and water must be adequately supplied. Cultural practices and control of diseases and insects also play important roles in crop production

Essential Nutrients Elements needed by the plant without which it will not be able to survive are called essential nutrients.For an element to be regarded as an essential nutrient, it must satisfy the following criteria as propounded by Arnon and Stout (1939):

**Classification on the basis of functions in the plant:**

**1. GROUP I (C,H,O): Elements that provide basic structure to plant**

They are basic structural elements. They are major constituent of plants (carbohydrate, proteins and fats) and organic matter. These elements are also involved in enzymes process. They provide energy for growth and development by oxidative breakdown.

ISSN (E): 2582 – 7022

**2.GROUP II(N,P,S): Elements useful in energy storage, transfer and bonding**

These are accessory structural elements which are more active and vital for living tissues. Essential component of metabolically active compounds like amino acids, proteins, enzymes and non-proteinaceous compounds. They involve in energy storage (ATP & ADP).

**(a)Nitrogen(N):** available to plants as nitrate (NO3 - ) , and ammonium (NH4 + ) ions.

N is biologically combined with C, H, O, and S to create amino acids, which are the building blocks of proteins. Amino acids are used in forming protoplasm, the site for cell division and thus for plant growth and development. Since all plant enzymes are made of proteins, N is needed for all of the enzymatic reactions in a plant. N is a major part of the chlorophyll molecule and is therefore necessary for photosynthesis. N is a necessary component of several vitamins, N improves the quality and quantity of dry matter in leafy vegetables and protein in grain.

**(b)Phosphorous**

Available to plants as orthophosphate ions (HPO4 2- , H2 PO4 - ). In photosynthesis and respiration, P plays a major role in energy storage and transfer as ADP and ATP (adenosine di- and triphosphate) and DPN and TPN (di- and triphosphopyridine nucleotide). P is part of the RNA and DNA structures, which are the major components of genetic Information. Seeds have the highest concentration of P in a mature plant, and P is required in large Quantities in young cells, such as shoots and root tips, where metabolism is high and cell division is rapid. P aids in root development, flower initiation, and seed and fruit development.

**(c)Sulphur(S): available to plants as sulphate ions (SO4 2- )**

S is an essential constituent of S-containing amino acids viz. cysteine, cystine, methionine. It is involved in the metabolic activities of vitamins, biotin, thiamine and coenzyme A. It plays a major role in increasing the oil quality in oilseed crops.

**3.GROUP III (K, Ca, and Mg):**

Elements necessary for charge balance Regulators and carriers for the most part of plant metabolism. They involve in synthesis and translocation of carbohydrates, maintain ionic balance and induce enzyme activation.

**(a)Potassium (P)**

Available to plants as K+ ion Unlike N and P, K does not form any vital organic compounds in the plant. However, the Presence of K is vital for plant growth because K is known to be an enzyme activator that promotes metabolism. K assists in regulating the plant's use of water by controlling the opening and closing of Leaf stomata's, where water is released to cool the plant. In photosynthesis, K has the role of maintaining the balance of electrical charges at the Site of ATP production. K promotes the translocation of photosythates (sugars) for plant growth or storage in fruits or roots. Through its role assisting ATP production, K is involved in protein synthesis. K has been shown to improve disease resistance in plants, improve the size of grains and seeds, and improve the quality of fruits and vegetables.

**(b) Magnesium(Mg):**

Available to plant as Mg2+ ion Magnesium is a critical structural component of the chlorophyll molecule and is Necessary for functioning of plant enzymes to produce carbohydrates, sugars and fats. It is used for fruit and nut formation and essential for germination of seeds.

**(c) Calcium(Ca)**:

Available to plant as Ca2+ ion It is a constituent of calcium pectate in the cell wall and maintains the integrity of the M membranes. It is important for the growth of meristems and functioning of the root tips. It protects the root cells against ion imbalance, low pH and toxic ions like

**(d) Aluminum**

It plays a role in mitosis(cell division) and helps maintain the chromosome structure. It

neutralizes the charges on the acidic molecules of phosphoric acid and organic acids, viz citric acid, malic acid, oxalic acid, etc. which are injurious to plant growth.

**4.GROUP IV (Fe, Mn, Zn, Cu, B, Mo and Cl):**

Elements involved in enzyme activation and electron transfer these are Catalysts and activators. These elements involve in oxidation-reduction reactions, chlorophyll sysnthesis and also exist in organic combinations.

**Iron (Fe):** Iron is taken up as ferrous ions (Fe2+) by plants Iron is constituent of two groups of protein viz. (a) Heme proteins containing Fe porphyrin complex as a prosthetic group: Cytochrome oxidase, catalase, peroxidase , leghemoglobin, and (b) Fe-S proteins in which Fe is coordinated to the thiol group of cysteine or to inorganic S:Ferrodoxin. It activates a number of enzymes,including aminolivolinic acid synthetase coproporphyrinogen oxidase. It plays an essential role in the nucleic acid metabolism. It is necessary for synthesis and maintenance of chlorophyll in plants.

**(b) Manganese (Mg):It is absorbed by plants as manganous ions (Mg2+)**

It is an integral component of the water splitting enzyme associated with photosystem It is a constituent of superoxide dismutase(Mn-SOD).Role of Mn assumes critically Mn-SOD(present in mitochondria, peroxisomes and glyoxysomes) protects cells against the deleterious effects of superoxide free radical.

4.Mn has a role in tricarboxylic acid cycle(TCA) in oxidative and non-oxidative decarboxylation reactions.

**(c) Zinc(Zn): Plants absorb Zinc as Zn2+ ions.**

Zinc is constituent of three enzymes viz. carbonic anhydrase, alcoholic dehydrogenase, superoxide dismutase (SOD). Zn is involved in the sysnthesis of indole acetic acid,metabolism of gibberellic acid and synthesis of RNA. Because of its preferential binding to sulphydral group, Zn plays an important role in the Zn influences translocation and transport of P in plants.

**(d) Copper (Cu): Cu is absorbed by plant roots as cupric ions (Cu2+)**

Copper is important in imparting disease resistance in plants. It enhances the fertility of male flowers. Cu is constituent of number of enzymes viz plastocyanin, diamine oxidase, polyphynol oxidase, ascorbate oxidase superoxide dismutase (Cu-Zn-SOD) (e)

**(e) Boron (B): Boron is absorbed by plants mainly as boric acid ($H_3BO_3$).**

It is responsible for cell wall formation and stabilization, lignifications and xylem B plays a role in pollen germination and pollen tube growth It facilitates ion uptake by way of increasing the activities of plasma membrane bound H + -ATPase. It facilitates transport of K in gurad cells as well as stomatal opening.

**(f) Molybdenum(Mo)** :Molybdneum is absorbed by plants as molybdate ions($MoO_4^{2-}$) Biological nitrogen fixation is catalysed by the Mo-containing enzyme, nitrogenase which directly transfers electrons to $N_2$. Mo is involved in protein biosynthesis through its effect on ribonuclease and alanine Mo affects the formation and viability of pollens and development of anthers.

**(g) Chlorine(Cl)** 1. It is absorbed as chloride ions ($Cl^-$)

It plays a important role in osmoregulation (cell elongation, stomatal opening). Chlorine in abundance suppresses the plant diseases viz. grey leaf spot in coconut Chlorine supply improves the nutritional quality of vegetables by preferentially lowerin

## CONCLUSION

The essential nutrients, the chemical forms in which they are available to plants, their function in plants, symptoms of their deficiencies, and recommended nutrient levels in plant tissues of selected crops. Each type of plant is unique and has an optimum nutrient range as well as a minimum requirement level. Below this minimum level, plants start to show nutrient deficiency symptoms. Excessive

nutrient uptake can also cause poor growth because of toxicity. Therefore, the proper amount of application and the placement of nutrients is important.

## REFERENCES

Hansch, R. and Mendel, R.R. (2009) Physiological functions of mineral micronutrients (Cu, Zn, Mn, Fe, Ni, Mo, B, Cl) . *Curr. Opin. Plant Biol.* 12: 259 – 266 .

Huang, C.Y. , Roessner , U. , Eickmeier , I., Genc , Y. , Callahan , D.L. , Shirley, N. , et al . (2008 ) Metabolite profi ling reveals distinct changes in carbon and nitrogen metabolism in phosphate-defi cient barley plants (Hordeum vulgare L.) . Plant Cell Physiol. 49: 691 – 703.

López-Bucio , J., de la Vega , O.M. , Guevara-García , A. and Herrera Estrella , L. (2000) Enhanced phosphorus uptake in transgenic tobacco plants that overproduce citrate . Nat. Biotechnol. 18: 450 – 453.

Ma , J.F. (2005 ) Plant root responses to three abundant soil minerals: silicon, aluminum and iron. Crit. Rev. Plant Sci. 24: 267 – 281. Book: fundamental of soil science, Indian society of soil science chapter 1.