ESSENTIAL NUTRIENTS FOR PLANT GROWTH, NUTRIENT FUNCTIONS AND DEFICIENCY SYMPTOMS: A REVIEW

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ABSTRACT:

The criterion of essentiality of elements for plant nutrition was given by Arnon. There are 18 elements essential for the plant growth and development. The plant nutrient elements must fulfill the following three requirements for their essentiality in plant nutrition.

(i) In the absence or deficiency of an element, the plant cannot complete the vegetative or ripening stage of its life cycle.

(ii) The deficiency symptom is specific to the nutrient element and it can be removed or cured only by referring that particular element to the plant. (iii) The nutrient element must have a direct effect on the plant and its nutrition.

Functions and Deficiency Symptoms of Plant Nutrients: In general, about 95% or more of plant weight is constituted by carbon and moisture i.e., oxygen and hydrogen. Carbon, oxygen and hydrogen constitute about 45%, 43% and 6% of the total tissues respectively. Hence, C, and H are the main structural elements of plant tissues. Actually, C, O and H are not limited to plant growth. But out of the 18 essential plant nutrients, the remaining 13 elements are limited to plant development as a whole. C, O, H, N, P and S are the plant nutrients which take part in the synthesis of protein and then protoplasm. Hence, these elements help in the structure of proteins of plant tissues.

Keywords— Essentiality of elements for plant nutrition, Nutrient functions, Deficiency symptoms

INTRODUCTION:

Plant Nutrient Elements:

Like animals and human beings, the plants also need food for their proper growth and development. The food of plants is constituted by several chemical elements that are called **plant nutrients** or **plant food elements.** There are 18 plant nutrient elements.

Classification of Plant Nutrients:
Based on the requirement of the nutrients by the plants, the plant nutrient elements are classified as below:

1**. Major or Macro Nutrients**: The elements which are required by the plants in large quantities are called major or macro nutrients. These are: C, H, O, N, P, K, Ca, Mg and S. These are also classified into two groups:

(i) Primary Nutrients: N, P and K are required by the plants comparatively in very large amounts. Hence, these elements are called primary or main nutrient elements. The fertilizers of N, P and K are used by the farmers in large quantities. So, N, P, K are called **fertilizer elements**.
(ii) Secondary Nutrients: Plants require Ca, Mg and S also in large amounts but they have less function to do as compared to the main nutrients. Hence, these elements are called **secondary nutrients**. The importance of Ca, Mg and S is secondary to the manufactures of NPK fertilizers.

2. Minor, Micro or Trace Nutrients: Seven nutrient elements namely iron, manganese, zinc, copper, molybdenum, boron and chlorine are utilized by field crops in very small quantities. Hence, these elements are called **minor** or **macro nutrients**. The micro nutrients are also as essential as macro nutrients for the plant growth.

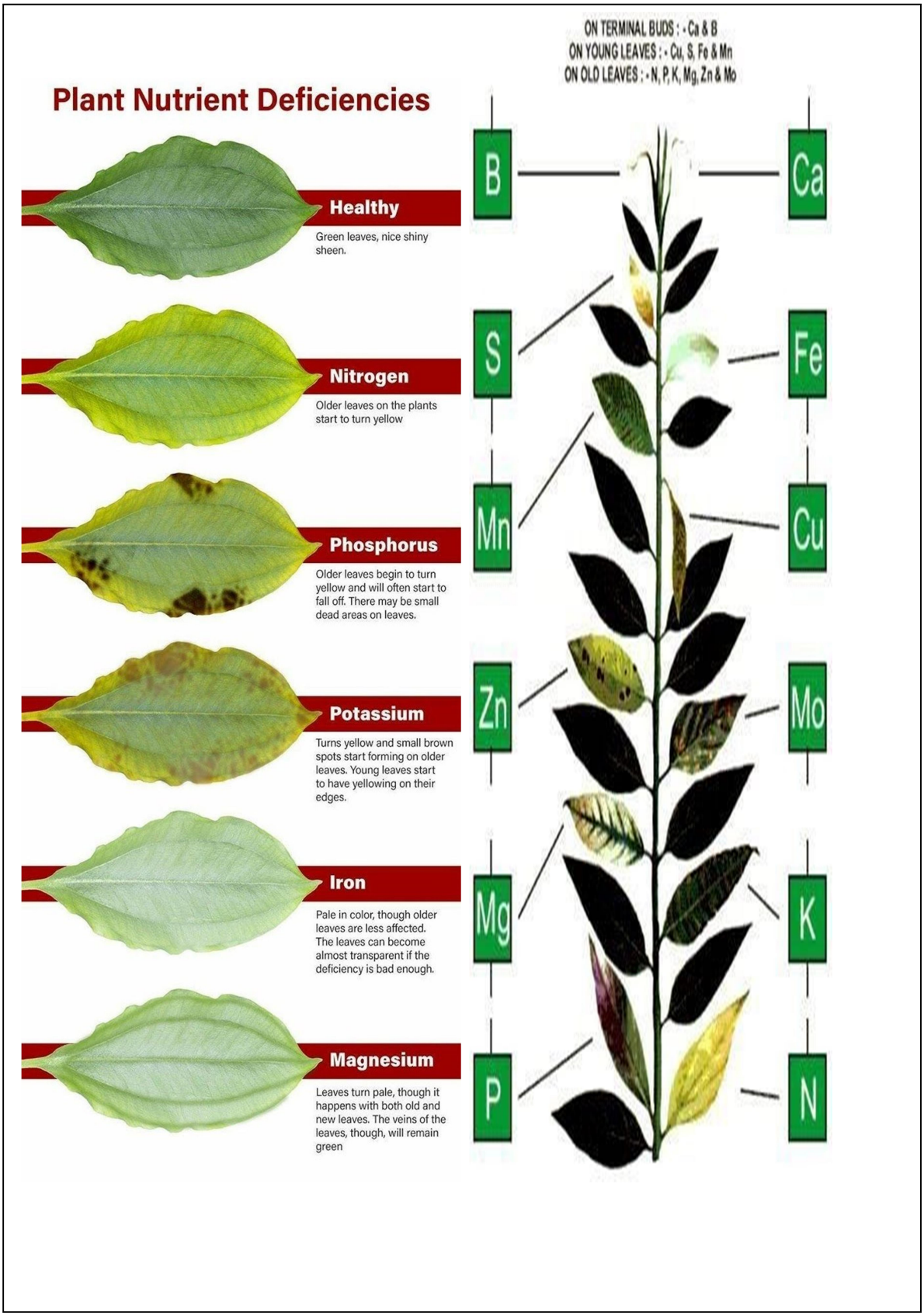
Criteria of Essentiality of Plant Nutrients: The criterion of essentiality of elements for plant nutrition was given by Arnon. There are 18 elements essential for the plant growth and development. The plant nutrient elements must fulfill the following three requirements for their essentiality in plant nutrition.
(i) In the absence or deficiency of an element, the plant cannot complete the vegetative or ripening stage of its life cycle.
(ii) The deficiency symptom is specific to the nutrient element and it can be removed or cured only by referring that particular element to the plant.
(iii) The nutrient element must have a direct effect on the plant and its nutrition.

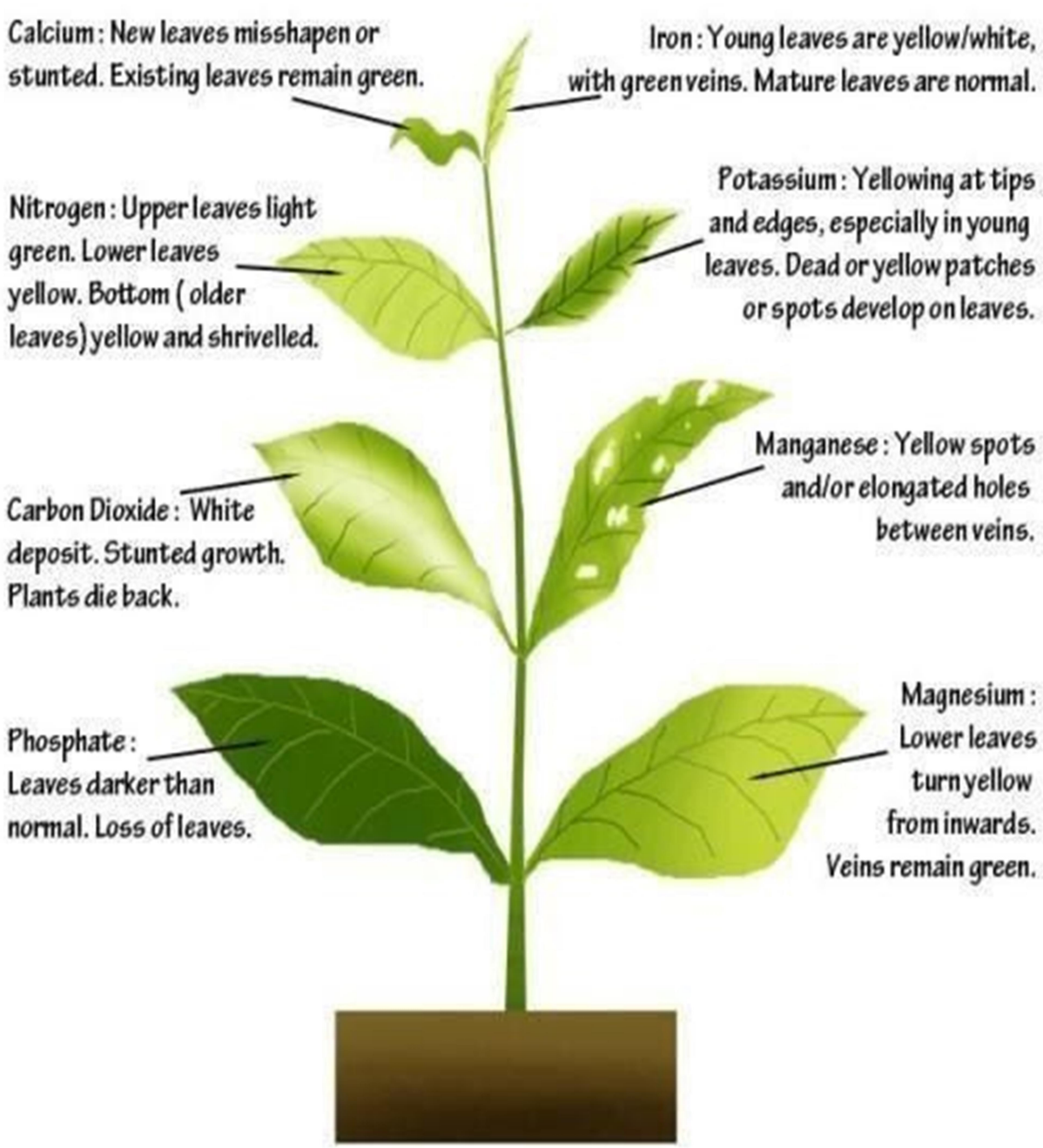
Sources of Plant Nutrients:
The sources of plant nutrients are:
Organic manures.
Commercial fertilizers.
Green manure crops.
Soil amendments.
Some weedicides and fungicides.

Organic manures: The bulky as well as concentrated organic manures like FYM, compost, night soil, sludge, oil - cakes and blood meal etc. Supply organic matter to the soil in large quantities. They also supply plant nutrients in small quantities.

Commercial fertilizers: Inorganic commercial fertilizers such as ammonium sulphate, superphosphate, muriate of potash and calcium ammonium sulphate etc, and organic commercial fertilizers such as urea and calcium cyanamide (nitrolim) supply essential nutrients to the plants through soil.

Green manure crops: Green manure crops add organic matter as well as plant nutrients to the soil. If legumes are sown as green manure crops, they add 60 to 80 kg of nitrogen per hectare of the soil.


Plant Nutrient Deficiencies
ON TERMINAL BUDS : - Ca & B
ON YOUNG LEAVES : - Cu, S, Fe & Mn
ON OLD LEAVES : - N, P, K, Mg, Zn & Mo
Healthy
Green leaves, nice shiny sheen.
Nitrogen
Older leaves on the plants start to turn yellow
Phosphorus
Older leaves begin to turn yellow and will often start to fall off. There may be small dead areas on leaves.
Potassium
Turns yellow and small brown spots start forming on older leaves. Young leaves start to have yellowing on their edges.
Iron
Pale in color, though older leaves are less affected. The leaves can become almost transparent if the deficiency is bad enough.
Magnesium
Leaves turn pale, though it happens with both old and new leaves. The veins of the leaves, though, will remain green
B
Ca
S
Fe
Mn
Cu
Zn
Mo
Mg
K
P
N



Signs Of Nutrient Deficiency

NUTRIENT DEFICIENCIES:

The following is a brief description of the symptoms of some of the most common nutrient deficiencies in beans.

Nitrogen. Lower leaves are chlorotic or pale green. Within the plant, any available nitrogen (N) from the soil or from nitrogen fixation within nodules on the roots goes to the new growth first. Soybeans prefer to take up N from the soilsolution as much as possible, since this requires less energy than the nitrogen fixation process. Both sources of N are important for soybeans since they are a big user of N.

Iron. Iron chlorosis, occurs in calcareous soils with high soil pH. The classic symptom is chlorosis (yellowing) between the veins of young leaves. Iron is not mobile within the plant. A side effect of iron deficiency can be N deficiency, since iron is necessary for nodule formation and function. If iron is deficient, N fixation rates may be reduced. Iron deficiencyoccurs on calcareous soils because at high levels of calcium, iron molecules become tightly bound to the soil particle and unavailable for plant uptake. In addition to high pH, plant stress can favor the development of iron chlorosis, and therefore the severity can vary significantly from year to year in the same field.

General considerations-

Mobile Nutrients: These nutrients can be transfer from older tissues to youngest tissues within the plant. Symptomsare noticeable first on lower, oldest leaves.

Nitrogen , Phosphorus, Potassium , Magnesium

Immobile Nutrients: These nutrients are not easily transfer within the plant. Therefore, symptoms occur first onupper, youngest leaves.

Boron, Calcium , Copper , Iron, Manganese, Molybdenum, Sulfur, Zinc

Possible causes of nutrient deficiencies:

Low soil levels of the nutrient. Poor inoculation (in the case of nitrogen deficiency).Unusually low or high soil pH levels. Roots are unable to access sufficient amounts of the nutrients. This can be due to poor growing conditions, excessively wet or dry soils, cold weather, or soil compaction. Root injury due to mechanical, insect, disease, or herbicide injury.Genetics of the plant.

Figure 1A. Iron chlorosis in soybeans. The upper leaves become chlorotic.

Figure 1B. Closeup of iron chlorosis in soybeans.

Magnesium. Lower leaves will be pale green, with yellow mottling between the veins. At later stages, leaves mayappear to be speckled bronze. This deficiency may occur on very sandy soils.

Manganese. Stunted plants with interveinal chlorosis. Can be a problem in soils with high pH (>7), or on soils that are sandy or with a high organic matter content. Manganese activates enzymes which are important in photosynthesis, aswell as nitrogen metabolism and synthesis. Symptoms are hard to distinguish from iron chlorosis.

Figure 2. Manganese deficiency symptoms are similar to symptoms of iron chlorosis in soybeans.

Molybdenum. Plants turn a light green color due to lack of nitrogen fixation. This deficiency is not common, but canoccur on acidic, highly weathered soils.

Figure 3. Molybdenum deficiency in soybeans. Symptoms are similar to nitrogen deficiency.

Phosphorus. Phosphorus deficiency may cause stunted growth, dark green coloration of the leaves, necrotic spots on the leaves, a purple color to the leaves, and leaf cupping. These symptoms occur first on older leaves. Phosphorus deficiency can also delay blooming and maturity. This deficiency may be noticeable when soils are cool and wet, due todecrease in phosphorus uptake.

Potassium. Soybean typically requires large amounts of potassium. Like phosphorus deficiency, potassium deficiency occurs first on older leaves. Symptoms are chlorosis at the leaf margins and between the veins. In severe cases, all butthe very youngest leaves may show symptoms.

Figure 4. Potassium deficiency: chlorosis of the lower leaves.

Sulfur. Stunted plants, pale green color, similar to nitrogen deficiency except chlorosis may be more apparent on upperleaves. Plant-available sulfur is released from organic matter. Deficiency is most likely during cool wet conditions or on sandy soils with low organic matter content.

CONCLUSION:-

It can be concluded that all nutrient elements focused in this study (N, P, K, S, Ca, Mg, Fe, Zn) influence crop quality. This is manifested by changes or differences in quality attributes of different crops with different rates of nutrient elements applied or available to various crops. The common quality attributes that are influenced as reported by many authors include protein and carbohydrate content of the sink organs of plants, fruit colour, flavour and vitamin related attributes for example Beta-carotene, grain hardness and moisture content at storage of crops such as maize and wheat, potato tuber density and internal colour. Undersupplying and oversupplying of nutrients may lead to reduced crop quality. This can result from the nutrient being a raw material for synthesis of a product but also from its involvement in enzymatic activities, for instance low N (as a raw material) will lead to reduced amount of proteins whereas low K will lead to reduced amount of proteins due to reduced activation of enzymes that metabolize carbohydrates for synthesis of amino acids and proteins.

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