

ON EXCHANGE V

Role of Nutrient Elements and their Deficiency Symptoms with Reference to Arecanut

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Mineral nutrition is an important phase of plant physiology because an adequate supply of certain mineral elements is essential for successful growth and development. They have many functions in plant body. Among their more important roles are constituents of plant tissues, catalysts in various reactions, osmotic regulators, constituents of buffer systems, and regulators of membrane permeability. The elements required in fairly large quantities are nitrogen, phosphorus, potassium, calcium, magnesium and sulphur and are called the major or macro-nutrients. Elements required in smaller quantities include iron, manganese, zinc, copper, boron, molybdenum and aluminium which are called the minor (trace) or micro-nutrients. Absence or inadequacy of any one of these nutrients affects plant growth and their yield. Deficiency of elements lead to manifestation of characteristic symptoms. The recognition of micro-elemental deficiency, and supplementing deficient element in the form of fertiliser through soil or as a foliar spray as correctives are of recent origin. Role of major nutrient elements and their deficiency symp-

toms with reference to arecanut seedlings, grown in sand culture are described in this note. Whereas the micro-nutrient deficiency symptoms are yet to be investigated.

Nitrogen

Nitrogen is a major constituent of several of the most important substances that occur in plants. It is of outstanding importance among the essential elements in that nitrogen compounds comprise from 40-50 per cent of the dry matter of protoplasm, the living substance of plant cells. For this reason nitrogen is required in relatively large quantities in connection with all growth processes in plants. Without an adequate supply of nitrogen appreciable growth cannot occur and plants will remain stunted and comparatively undeveloped when nitrogen is deficient. The need of nitrogen for arecanut is apparently high because, the vegetative growth and production of leaves depend essentially on nitrogen nutrition. Most of the soils in arecanut growing tracts lack in adequate quantities of nitrogen excepting those soils rich in organic matter status. If nitrogen is not regularly supplied,

symptoms of its deficiency appear. Yellowing of older leaves, reduction in size of leaves, poor growth, defoliation and die-back result in the severe cases of deficiency. On the other hand, if nitrogen in excess of actual requirements encourages vegetative growth, delays maturation and ripening of nuts, and may also interfere in the formation of floral buds.

Phosphorus

This element like nitrogen is closely concerned with many vital processes in plants. It is a constituent of nucleic acids, and nuclei in which these occur are essential parts of all living cells. Phosphorus is involved in many of the biochemical reactions concerned in the metabolism of carbohydrates, fats and proteins in which phosphorelated compounds act as intermediaries, often in the roles of conservers and supplier of energy for specific reactions, such as occur in respiration and fermentation processes. Further it helps in the germination of seeds and seedling metabolism. Phosphorus is necessary for cell division, differentiation of flower buds, fruit set and hastening their maturity. Phosphate also function as buffers to maintain satisfactory conditions of acidity and alkalinity in the plant cells.

The requirement of phosphorus is considerably less than nitrogen and potassium. It is absorbed by the plants as orthophosphate ion from the soil. Sufficient amount of total phosphorus present in the soil becomes unavailable owing to its fixation on account of high amounts of Fe and Al contents of arecanut soils in southern parts of the country. This fixation depends on soil acidity, organic matter status and iron-aluminium contents in soil. Thus the requirement of phosphorus in arecanut growing areas becomes more.

Plants lacking phosphorus may develop dead necrotic areas on the leaves, and over all stunted appearance and the leaves may have a characteristic dark to blue green colouration. Its deficiency symptoms appear first on the older leaves as irregular yellowing patches. It further spread to the entire foliage and leaves producing a mottled appearance and the leaves drop off easily.

Potassium

Although a deficiency in potassium may affect such varied processes as respiration, photosynthesis, chlorophyll development and water content of leaves, a specific role for potassium in plants is, as yet, unknown. However, it is essential as an activator for enzymes involved in the synthesis of certain peptide bonds. The accumulation of carbohydrates, often observed during the early stages of potassium deficiency, may be due to impaired protein synthesis.

Under deficiency, the leaves of the plant become rough and puckered and margins curl downward. Dead tissues around the margins and between the veins of the leaves is an accurate indicator of potassium deficiency. Young leaves, in extreme cases turn yellow and finally brown. As the deficiency becomes severe, small brown specks occur on the older leaves followed by the yellowing and breaking down of the margins. Some times a characteristic spotting of bluish tinge or red colour on the leaves is developed which is supposed to be the formation of phloroglucinol.

Calcium

The main function of Calcium is as a constituent of cell wall, the middle lamella of which consists largely of calcium pectate. This formation appears to be of fundamental importance since, if calcium is replaced by

any other of the essential elements, such as potassium or magnesium, the organic materials and mineral salts in the cells are readily leached through the walls. It directly affects the formation of mitochondria which may affect respiration.

Calcium is intimately concerned in the activities of growing points, and is of special importance in root development. It provides a base for the neutralization of organic acids or it inhibits their biosynthesis which may regulate some potassium activated ions responsible for nitrogen absorption. Calcium is absorbed by the plants as calcium ion from soil solution. Poor development of roots and areal parts, death of growing point, stunting of shoots, necrotic yellowing of leaf tips are the common symptoms of calcium deficiency.

Magnesium

Magnesium is the constituent of the chlorophyll molecule without which photosynthesis would not occur. Many of the

enzymes involved in carbohydrate metabolism require magnesium as an activator. It is also an activator for those enzymes involved in the synthesis of the nucleic acids (RNA and DNA) from nucleotide polyphosphates.

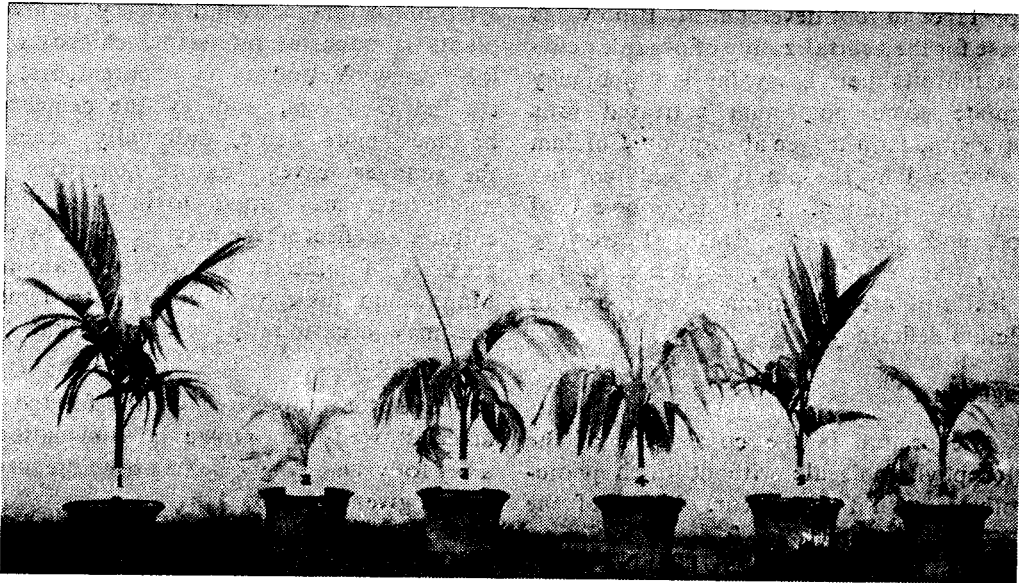
Since magnesium is a constituent of the chlorophyll molecule, the most common symptom of magnesium deficiency in green plants is extensive interveinal chlorosis of the leaves. Yellowing is apparent first in the basal leaves, and as the deficiency becomes more acute, eventually reaches the younger leaves. Excess quantities of magnesium may prove toxic in solution culture, an effect which may be offset by the presence of sufficient amounts of calcium. Magnesium toxicity in soils is not common but may occasionally occur in alkali or serpentine soil.

Symptoms appeared on the foliage of arecanut seedlings, grown in sand culture, a key for visual diagnosis has been prepared and is given below :

KEY TO CERTAIN NUTRIENT DEFICIENCIES OF ARECANUT SEEDLINGS GROWN UNDER SAND CULTURE.

- Complete mineral nutrition (Control) :** Growth normal, foliage dark green in colour.
- Nitrogen deficient (-Nitrogen) :** Growth severely restricted, general yellowing of foliage; leaves small, lower ones lighter yellow than upper ones, yellowing followed by a drying to a lighter brown colour, usually very little abscission of leaves.
- Phosphorus deficiency (-Phosphorus) :** Leaf-lets marginal scorched, lower leaves yellow between veins but often showing a tendency to develop a purplish colouration on the leaf sheath. Vegetative growth less than normal.
- Potassium deficiency (-Potassium) :** Leaf-lets bluish green and slight interveinal chlorosis, curling of leaf margins downward, dead tissues around the margins and between the veins of the leaves is an accurate indicator of potassium deficiency; stunted in growth.

- Calcium deficiency (-Calcium)** : Growth fairly good, mosaic type chlorosis on the foliage, death of growing point.
- Magnesium deficiency (-Magnesium)** : Lower leaves chlorotic but usually show no spotting until later stages. Chlorosis starts at the leaf tip progressing downwards and inwards along the margins and between the veins, leaf margins curve upwards, midrib and veins green.



Symptoms of mineral element deficiencies as shown by Arecanut seedlings. All the elements were supplied to (1) The deficient elements are : (2) nitrogen, (3) phosphorus, (4) potassium, (5) calcium, and (6) magnesium.

Acknowledgement

The authors are grateful to Shri K. Shama Bhat, Arecanut Specialist for facilities during the pot-culture experimentation

and to Shri K. V. Ahamed Bavappa, Director, Central Plantation Crops Research Institute, Kasaragod, for his keen interest and valuable suggestions.