Nutrient deficiency symptoms and its Management in Coconut

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Coconut (Cocos nucifera) is known as Kalpa Vriksha as each and every part of it finds its application in our daily life. Owing to its perennial nature, a major quantum of nutrients is being removed from the system through biomass accumulation. Moreover, as each part of the plant is being removed from the system for human use, the nutrients present in the different palm parts are also being removed from the production system. Hence owing to the exhaustive removal of nutrients from the soil, occurrence of nutrient deficiency symptoms is very rampant in coconut. If the deficiency symptoms are not addressed by the adoption of timely management practices, yield deterioration will occur and also the palm health will be adversely affected.

As per the criteria of essentiality proposed by Arnon and Stout (1939), seventeen essential elements are required universally for all the plants in the planet earth. Apart from the structural nutrients Carbon, Hydrogen and Oxygen, the major nutrients for plant nutrition are Nitrogen(N),Phosphorus(P) and Potassium(K) and the secondary nutrients include Calcium(Ca), Magnesium(Mg) and Sulphur (S). The micronutrients for crop production include Iron(Fe), Manganese(Mn), Copper(Cu), Zinc(Zn), Boron(B), Molybdenum(Mo) and Chlorine(Cl).

Nitrogen is a constituent of amino acids, proteins and nucleic acids. As the major source of nitrogen in the soil is organic matter, the deficiency symptoms are commonly seen in light sandy soils which are poor in organic matter and also in areas where water-logged condition is prevalent. Under water logged conditions, there will be loss of nitrogen as ammonia through volatilisation. Nitrogen is considered deficient when the quantity is below280Kg/ha in soils.

When the available phosphorus content in the soil is between 15-25 kg/ha, the soil is considered as sufficient with regard to its availability. In Kerala, the deficiency of phosphorus is not commonly encountered and the content is usually greater than 25 kg/ha. The deficiency symptoms are usually seen in palms grown in extremely acidic as well as in calcareous soils.

Potassium is the nutrient which is removed in highest proportion from coconut and hence is the key nutrient in coconut production. It is important in formation of palm trunk, imparts resistance to pest and disease attack along with regulating water balance of the plant. It enables the plant to withstand drought. It also has a role in the production of female flowers and nut setting. Seventy eight per cent of potassium is removed from the palm, when the nuts are harvested. Potassium is considered deficient when the quantity is below 110Kg/Ha in soils

Being the central ion in chlorophyll, magnesium, the secondary nutrient in plant nutrition, has a definite role in the pigment system and influences the photo synthetic capacity of the plant. It also enhances the production of female flowers and activates several enzyme systems in the plant system.

Calcium is associated with the membrane transport and hence it is very essential for the cellular function of the plant.

Sulphur is required for the formation of oil and improves the quality of oil and copra. It also improves the nut characters such as its texture and oil content.

Boron is an essential micronutrient for coconut, which helps in the multiplication of meristematic tissues. It helps the metabolism of protein, synthesis of pectin, maintenance of water relation, translocation of sugars, tissue respiration, fruiting process, growth of pollen tube and in the development of flowers and fruits. Wide spread deficiency of boron is noticed in the coconut growing areas which may be attributed to the continuous removal through cropping, and due to the non-replenishment of the same along with regular fertilizer application.

Iron is a micronutrient acting as a catalyst in chlorophyll formation. It is also involved in electron transport and respiration. The deficiency of iron is usually seen in calcareous soils. Excess liming will induce chlorosis resulting from iron deficiency.

Not only major nutrients, secondary nutrients and micronutrients are also important for the sustained coconut production. Hence it is imperative understand the importance of each and every nutrient for coconut production and the symptoms associated with the deficiency of individual nutrients.

The nutrient requirement for coconut is 500g N, 320g P and 1200g K per palm per year (Package of Practice Recommendations, CPCRI, 2016). The proper balance of NPK in the soil is essential for the use efficiency of these nutrients. Hence the availability of the one may affect the availability and utilization of the others. The symptoms of deficiency and its management with regard to the nutrients important for coconut productivity are outlined below.

Nutrient Symptoms Management

Nitrogen

The general symptom of nitrogen deficiency is the reduction in chlorophyll content with golden yellow coloration of older leaves near the petioles and light brown colour near the end, which later dries out. Yellowing starts from the tip of the leaf and leaflets and progresses along the midrib. The peculiarity of nitrogen deficiency is that mid rib also turns yellow at times of deficiency. The deficiency can be managed through the application of nitrogenous fertilizers depending on the soil test data. Apart from the addition of nitrogenous fertilisers, the soil should be enriched with organic matter by the addition of organic manure, green manure and green leaf manuring. Incorporation of organic matter will improve the physio chemical properties of the soil and improve the nutrient and water holding capacity.

Phosphorus

The deficiency symptoms are manifested as purple discoloration, due to the accumulation of anthocyanin pigments and the leaves stay upright. In addition, there will be restricted root growth. Soil test-based application of phosphatic fertilisers

to provide the requisite amounts of available phosphorous

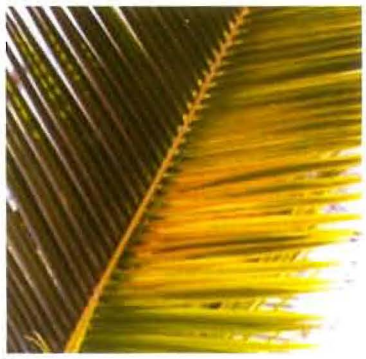
Potassium

The deficiency is common in light sandy soils as well as in laterite soils. High levels of calcium and magnesium in soil results in depletion of this nutrient from the root zone. Excessive liming is another reason for the occurrence of potassium deficiency. Also intercropping with potassium exhaustive crops such as tapioca, fodder grass and pineapple without proper addition of fertilisers can result in the exhaustive depletion of potassium. Orangish yellow discoloration starts from the tip of the leaflets, progressing along the, margin towards the base. The mid rib remains green. Leaf tip becomes withered and became necrotic, necrotic spots also appear on the discoloured part of the leaflet. Later the necrotic spots coalesce together giving a scorched appearance. The appearance of a green triangle with the base in the lowest leaflets and apex towards the tip is a characteristic feature of potassium deficiency in coconut. The symptoms can be managed by the addition of soil test-based potash fertilizer application.

In order to avoid the possibility of the removal of potassium ions through leaching, it is essential to increase the exchange capacity of the soil. Hence proper addition of organic manures should be ensured to increase the exchange capacity of the soil.

Magnesium

Yellowing is the predominant symptom of magnesium deficiency. In the older leaves starting from the tip and extends towards the base and later the younger leaves also turn yellow. Magnesium deficient leaves have distinctly green leaf centres and bright lemon yellow to orange margins. Yellowing occurs principally in those parts of the leaf which are exposed to sunlight, the shaded part remains green. Application of dolomite @ 1 kg per palm 2 weeks prior to fertilizer application and applying magnesium sulphate @ 500 gram per palm during the second dose of fertilizer application can manage its deficiency.



Calcium

Calcium is an immobile element in plant and the deficiency symptoms first appear on the youngest leaves. Young leaves exhibit narrow white bands at their margins. Later there will be rusty appearance in leaf margin. Along with this there will be rolling up of leaves. Sometimes there will be death of buds. Application of lime or dolomite @ 1 kg per palm depending on the lime requirement of the soil two week prior to fertiliser application can supply calcium apart from correcting soil reaction.

Boron

Symptoms appear on the leaves, roots inflorescence and nuts. There will be root thickening, darkening and short ramifications, later the root tips die off, causing overall growth reduction. Since boron is an immobile element in plant, the first symptoms appear on the youngest leaf. Meristematic tissues are seriously affected by boron deficiency. Leaf symptoms appear as fasciation, failure of the leaves to split, 'crown choke disorder'. There will be crinkling and reduction in elongation of young leaves.

Pollen production, pollen grain germination and

Table 1. Fertiliser application schedule for coconut palms

Stage of palm	1/3rd dose (May-June) (gram palm-1)			2/3rd dose (September-October)(gram palm-1)		
	Urea	Mussoriephos	Muriate of potash	Urea	Mussoriephos	Muriate of potash
First year	-	-	-	110	150	170
One year after planting	120	170	190	240	340	375
Two year after planting	240	340	380	480	680	750
Third year onwards	365	500	565	730	1000	1125

Table2. Rating of primary nutrients in soil			
Nutrient(kg/ha)	Low	Medium	High
Nitrogen	<280	280-560	>560
Phosphorus	<10	10-25	>25
Potassium	<110	110-280	>280

Table 3. Rating of secondary and micronutrients		
Nutrient	Deficiency	Sufficiency
Calcium	<300 ppm	>300 ppm
Magnesium	<120 ppm	>120 ppm
Sulphur	<5 ppm	5-10 ppm
Zn (0.1 N HCl for acid soils)	<1ppm	>1ppm
DTPA Zn (soils with pH>7	<0.6ppm	>0.6 ppm
Cu (0.1 N HCl for acid soils	<1ppm	>1 ppm
Cu-DTPA(soils with pH>7	<0.12ppm	.>0.12 ppm
Hot water-soluble Boron	<0.5ppm	0.5-2.0 ppm
Iron	<5ppm	>5ppm
Manganese	<1ppm	>1ppm

pollen tube development will be affected. There will be poor nut setting and button shedding will be rampant. In certain conditions, occurrence of 'Hen and chicken disorder, in a particular bunch is also noticed, ie., there will be occurrence of big and small nuts together in a bunch. Soil pH has to be corrected before the application of borax.

Dolomite can be added @ 1 kg per palm two weeks prior to fertilizer application. Apply borax@ 160 gram in 4 split doses along with organic manure @ 25 kg per palm. Ensuring soil moisture will improve the faster recovery of symptoms through improved boron use efficiency. Soil compaction has to be managed by providing better aeration.

Iron

Yellowing starts from the younger leaves and gradually uniform chlorosis will be observed in the entire crown of the palm. There will not be any necrosis. The deficiency can be managed by the application of ferrous sulphate @ 0.2% depending on the intensity of the symptom and the soil test data.

Manganese

Being an immobile element in plant, the deficiency symptoms are usually initiated at the youngest leaves of the palms grown in calcareous

soil. There will be narrow longitudinal brown necrosis parallel to veins and margins gradually leading to curling of younger leaves. New leaves emerge chlorotic with longitudinal necrotic streaking, towards the tip of the leaf. The base of the leaf shows the curling or frizzling which is characteristic of severe manganese deficiency. Foliar spraying of 0.5% manganese sulphate can also be done.

Copper

The deficiency of copper is usually encountered in soil rich in organic matter. The symptoms include severe bending of the rachis of the youngest leaves, accompanied by yellowing and desiccation of the leaf tip. Graduated colouring from green through yellow to brown is characteristic to the deficiency of copper. The deficiency can be managed by the application of copper sulphate@ 25g per palm per year.

Zinc

Zinc deficiency is characterized by formation of small leaves. Leaflets become chlorotic, narrow and reduced in length. In acute deficiency, flowering is delayed. Zinc deficiency will also lead to button shedding. The deficiency can be managed by the application of zinc sulphate@ 100g per palm per year.

Sulphur

Yellowing initiates on the youngest leaves with older leaves remaining green. Leaves droop as the stem becomes weak. In older palms, the number

of leaf and size are reduced. Apron of dead fronds develops around the stem due to weakness of the rachis. Nuts may fall prematurely. Copra becomes rubbery and will be of poor market quality.
Magnesium sulphate application (20%S) can supply the sulphur requirement, under conditions of deficiency in soil.

Nutrient management strategies for combating deficiency symptoms and maintaining palm health

Adoption of systematic nutrient management strategies from the time of planting onwards can ensure better palm health and productivity. In this regard, the strategies emphasising integrated nutrient management will be more appropriate. Integrated Nutrient Management (INM) refers to maintenance of soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimisation of the benefits from all possible sources of plant nutrients including chemical fertilisers, organic manures and biofertilizers in an integrated manner. Each of the components have a complementary effect on the other there by enhancing the overall efficiency of the system. Being a perennial plantation crop with a productive period spanning 6 to 7 decades, for the optimum growth and productivity of coconut, adoption of systematic nutrient management strategies are required. The nutrient requirement of coconut is 500g nitrogen, 320g Phosphorus and 1200g potassium per palm annually. The schedule of application of nutrients is as follows (Table 1).

The first split dose of 1/3 quantity in rainfed production system may be applied in May –June with the onset of monsoon, two weeks after correcting soil pH through liming.The second split dose of 2/3 fertilisers is applied during September-October or depending upon the availability of rainfall and adequate soil moisture. Sowing cowpea seeds @ 100g in one basin during June and incorporation of the biomass, just at the commencement of flowering by one or two plants can supply 25 kg biomass and 120-150g nitrogen. Organic manure application @ 25kg per palm can be applied at the time of covering the basin. In order to meet the requirement of magnesium, magnesium sulphate@500g per palm per year can be applied at the time of second dose fertiliser application. In Irrigated gardens the total quantity of fertilizers can be given in four equal splits at three month intervals.

Retirement

Shri K M Vijayan, Senior Field Officer, retired from the services of Coconut Development Board on 4th January 2021. He served the Board for 30 years.

Shri K K Subhash, Assistant Library & Information Officer, retired from the services of Coconut Development Board on 31st July 2021. He served the Board for 30 years.

Though table 2 gives an indication of the magnitude of nutrients to be applied to coconut annually, the exact quantity should be adjusted in accordance with the soil test data. Table 3 gives the rating of primary, secondary and micronutrients in the soil.

Considering the soil and leaf nutrient status of coconut growing areas, ICAR-CPCRI developed two nutrient mixtures viz., 'Kalpa Poshak' and 'Kalpa Vardhini' for the growth of young palms and for the productivity of bearing palms respectively. Kalpa Poshak has to be applied up to three years @ 40g per palm in the first year and 100g per palm annually in the second and third year. Kalpa Vardhini has to be applied @ 500g per palm annually in two splits. Incremental yield to the extent of thirty-three per cent has been recorded with the application of Kalpa Vardhini. It should be remembered that these nutrient mixtures are to be added apart from the general recommendations and that at 10days after the application of major nutrients.

Coconut, the tree of life can be sustained as a remunerative crop to farmers by the adoption of timely soil health management practices, which encompasses the diagnosis and correction of nutrient deficiency symptoms. This should be taken in a time bound manner, without deterioration of soil and palm health. ■

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