

8. IMPORTANCE OF SOIL TEST BASED FERTILIZER RECOMMENDATION FOR ARECANUT AND COCOA

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Soil test based fertilizer recommendation is the method in which recommendations are made based on conclusions on the status of soil nutrients as per the soil test. It should not be misunderstood that soil testing and fertilizer recommendation are one and the same. The soil test results in a realistic picture of plant available nutrients in the soil, whereas fertilizer recommendation depends on the interpretation of the results, to determine the fertilizer /nutrient needed by the crop. Different soil test laboratories, agricultural department staff, farm supply dealers *etc.* use different soil test fertilizer recommendation approaches. This may result in contrasting fertilizer recommendations leaving our farmers confused what these differences mean in a farming operation. In this context, it becomes important to follow the most suited approach in soil test based fertilizer recommendation.

Arecanut

The crop, Arecanut, is predominantly grown in red gravelly laterite soil of clayey texture. Arecanut also can be grown in fertile clayey loam soils with special care on microsite improvement. Sticky clay, sandy, brackish and calcareous soils are not suitable for arecanut cultivation. Laterites, red loamy soils and alluvial soils are suitable.

Laterite soil is primarily found in the tropical regions which receive heavy rainfall. High rainfall encourages the leaching of soil where lime and silica are leached away and a soil rich in oxides of aluminium and iron predominate. Due to the presence of iron oxides the colour of laterite soil is basically red. This soil is base poor and hence it is acidic.

Laterite soils are generally poor in its nutrient holding capacity, water holding capacity, organic matter. However, the laterite soil developed in the western part of Karnataka state, humus is present. Laterite soil belt in arecanut growing regions is characterised by high rainfall, undulating topography, presence of kaolinitic type of clay

mineral, leaching of K^+ and Ca^{2+} , fixation of phosphorus and zinc. It is not advisable to grow arecanut on clayey soils and paddy converted lands due to water stagnation, poor soil aeration and lack of fine root production.

Nutrient management

In laterite soils, general recommendation of fertilizer application includes 100 g N, 40 g P_2O_5 and 140 g K_2O per palm per year. In addition, application of 12 kg each of green leaf and compost per palm is also recommended. In heavy soils, general recommendation of nutrients is 50 g N, 40 g P_2O_5 and 140 g K_2O along with green manures. Application of only organics or chemical fertilizer may lead to imbalance in nutrition of arecanut. Thus, nutrient management strategies need to be planned for arecanut taking in to account the soil fertility status. It is advisable to consider nutrient deficiency/toxicity before the development of visual symptoms with the help of plant and soil analysis.

Table 1: The optimum range of nutrients in laterite soils for arecanut

Nutrients	FAO (ppm)	Optimum level (ppm)
P	8-15	15
K	100-150	192
Ca	801-1600	925
Mg	101-200	179
Zn	0.5-1.0	5.5
Cu	0.2-0.5	26
Fe	2.1-4.0	37
Mn	1.0-2.0	88
B	0.5-1.0	1.37

These optimum ranges of nutrients are arrived at, based on the research conducted in arecanut. If the soil test values fall below this range, application of nutrients is recommended.

If soil test values of phosphorus and potassium are below 30 kg P_2O_5 and 300 kg K_2O per ha in arecanut basins, P and K are reaching deficit level and yields might reduce if nutrients are not applied sufficiently at this stage.

Table 2: Leaf nutrient limits for arecanut

Nutrient	Limits (%)
N	2.70
P	0.23
K	1.12
Ca	0.61
Mg	0.20
Fe	146
Mn	56.5
Zn	45.8
Cu	2.6

These leaf nutrient limits are arrived based on a targeted yield of 3.5 kg kernel per palm.

Method and time of nutrient application

Fertilizers and organic manures should be applied when the soil has sufficient moisture but not during heavy rainfall and dry periods. In unirrigated crop, fertilizers can be applied just before monsoon coinciding the months of May-June and after monsoon (September-October). When the crop is irrigated the pre-monsoon application can be advanced to February-March. As far as possible the fertilizers should be applied during nut formation period during December-May. The organic manures are applied during September-October in basins around the base of each palm.

In the first year of planting $1/3^{\text{rd}}$ of the recommended dose of fertilizer should be given. In the second year, $2/3^{\text{rd}}$ of the recommended dose and from third year onwards, full dose of fertilizer should be given.

Basin opening is important for application of manures and fertilizers wherever soil hardens after monsoon to provide soil aeration. Soil aeration is most important for production of fine roots, which are required for uptake of nutrients and water. Majority of the feeding roots of arecanut are concentrated with in 30 cm depth and 60 cm distance from the trunk. Only fine roots of less than 1 mm thickness will take up water and

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nutrients. The basins of the palms may be covered with thick layer of soil or forked for incorporation of manures and fertilizers with the soil.



Basin opening



Crop basin



Fertilizer application

In soils with pH less than 6.0, the fertilizer may be applied in the form of urea, rock phosphate and muriate of potash. In soils with pH above 7.0, single super phosphate or Di Ammonium Phosphate (DAP) can be used as source of phosphorus. Diammonium phosphate (DAP) contains both nitrogen (18% N) and phosphorus (46% P₂O₅).

It is important to note that organic manure application alone cannot meet K demand of arecanut as organic manures contain very less K except *Gliricidia* and arecanut husk. For high yielding arecanut palms with kernel or *chali* yield more than 2.5 kg per palm per year, double dose of fertilizers especially N and K can be applied. Lime application is needed only if soil pH is below 5.

General guidelines for Fertilizer recommendation for arecanut (g per palm per year)

Fertilizer	First year of planting	Second year	From third year onwards
Nutrient			
Nitrogen (N)	33	66	100
Phosphorous (P ₂ O ₅)	13	26	40
Potash (K ₂ O)	46	92	140
Fertilizers (Source of Phosphorus is rock phosphate or single super phosphate)			
Urea	72	144	220
Rock phosphate (RP)	65	130	200
Single super phosphate (SSP)	83	167	250
Muriate of Potash (MOP)	77	154	230
Fertilizers (Source of phosphorus is Diammonium Phosphate (DAP))			
Urea	61	121	182

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DAP	29	58	87
Muriate of potash	77	154	230

Organic matter recycling

On an average, 5.0 to 8.5 tonnes of leaf wastes are available from one ha of areca garden per year. Direct application of these wastes in the garden will take long time for decomposition and will not meet the nutrient demand of the crop immediately. Hence, these materials can be composted using earthworms effectively and used as organic manure in areca gardens.

To prepare vermicompost, areca wastes are chopped into small pieces of 10 cm and heaped. The heap is sprinkled with water daily and kept for two weeks. Then the chopped material is arranged in beds of one metre width and convenient length. Cement tanks or trenches can be used for this purpose. A layer of 10-15 cm waste material is alternated with 2 cm layer of cowdung over which earthworms are released at the rate of 1000 numbers per square metre. The wastes are converted into fine granular, odourless vermicompost within 60 days. About 80% recovery of vermicompost from these wastes is expected. During this period, the earthworm population is doubled.

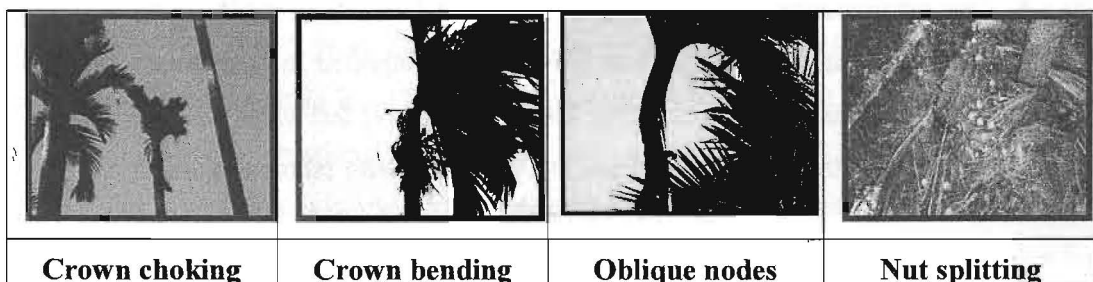
Vermicompost is rich in N, P, Ca, Mg and micronutrients. About 4 kg of vermicompost per palm per year meets the N and P nutrient demand of arecanut. Potassium needs to added through other sources like MOP, arecanut husk or *Gliricidia*. Two species of earthworms *Eudrilus eugeniae* and *Eisenia foetida* can be used.

Nutritional disorders

Common nutritional disorders in arecanut are crown choking, crown bending, oblique nodes and nut spitting. These problems are seen in paddy converted lands and areas with excess soil fertility and water stagnation leading to lack of fine root development. Soil and leaf analysis for the nutrient status will help in overcoming these problems. Crown choking can be identified at initial stages with appearance of dark green colour of leaves and reduction in size of old leaves. Zinc deficiency is mainly responsible for development of disorders. Soil application of zinc sulphate @ 10 g per palm is ideal if disorder symptoms are in initial stages. In case of severe reduction in leaf size and crown choking, spraying of 0.5 % zinc sulphate (5 g per litre of water) mainly on fresh foliage can be

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done so that new leaves will emerge normally. Nut splitting is due to less potassium and boron deficiency. The problem can be managed with identifying the cause and regular application of required nutrients.



Cocoa

Cocoa requires deep and well- drained soil for easy penetration of its roots and anchorage which retains moisture during dry season and permits movement of air. It is predominantly grown on clay loam and sandy loam soils. It thrives well on wide range of soil types with pH ranging from 4.5-8.0 with optimum being 6.5-7.0. The ideal soil for cocoa should have 1.5 m depth, 3.5% organic matter, >9 C/N ratio, >12 me/100 g soil base exchange capacity and >35% base saturation.

Fertilizer application

Annual application of 100 g N, 40 g P₂O₅ and 140 g K₂O per tree in two equal splits, first dose in April- May and the second dose in September- October *i.e.* pre and post monsoon applications is recommended. Fertilizer may be applied uniformly around the base of the tree up to a radius of 30 cm (1 ft.) during the first year, forked and incorporated into the soil. For grown up plants the best method is to rake and mix the fertilizers with soil in shallow basins of around 75 cm (2.5 ft.). This radius may be increased gradually upto 150 cm (3 ft.) after third year. Additional application of potassium in split doses is suggested in plants giving >1 kg dry beans.

Fertilizer	I year	II year	III year onwards
Nitrogen	33	66	100
Phosphorous	13	26	40
Potash	46	92	140
Urea	72	144	220

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Rock phosphate	65	130	200
Muriate of Potash	77	154	230
Shallow basins	1 ft	2.5 ft	3 ft

For production of 2 kg dry beans of cocoa, a cocoa plant takes up 479 g N, 36 g P and 429 g K. Our recommendation of 100:40:140 g NPK falls short of fulfilling the nutrient demand of cocoa plant. Except P, N and K need to be supplied in greater quantities to meet the nutrient demand. This should be based on the soil test value and the nutrient status of soil. Hence, the importance of soil test based fertilizer recommendation.