ORGANIC NUTRITION IN COCONUT GARDENS

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Coconut is an important commercial crop of the coastal region of India. Majority of the coconut plantations are in sandy, sandy loam, red loam and lateritic soils. They are inherently low in soil fertility and being light textured, are subject to heavy leaching during rainy season. Coconut being perennial crop demands supply of large amount of nutrients continuously. It is estimated that the coconut grown in one hectare removes about 74 kg N, 30 kg P_2O_5 and 137 kg K_2O per year.

Organic manures are important sources of plant nutrients which help in sustaining soil fertility and productivity especially in a perennial crop like coconut. Organic matter in addition to acting as a store house of plant nutrients, improves the physical, chemical and biological make up of the soils. In heavy soils its incorporation has the effect of loosening the physical structure and improving aeration thus making the soil easier to work, while in light soil it tends to bind the soil particles together and improve waterholding capacity. It acts as general amend- is an extremely desirable soil constituent.

The fertilizer recommended for an adult coconut palm in the West Coast of India is 500 g N, 320 g P_2O_5 and 1200 g K_2O per annum. This works out to about 1.0 kg Urea, 1.5 kg Mussoriephos or 2.0 kg Single superphosphate and 2.0 kg Muriate of potash. At the present rates the cost of chemical fertilizer and its application will be Rs. 4,025 per hectare or Rs. 23 per palm. Hence fertilizer input consumes nearly 40 per cent of the annual maintenance of coconut garden. Of late there is greater awareness among farmers towards the use and beneficial effect of organic manures. The cost escalation of fertilizer has compelled farmers to find alternate sources of manures at a lesser cost. Hence it is desirable to use either organic manures alone or in combination with inorganic fertilizers. Large quantity of organic manure will be needed if full requirement of N, P and K is to be met solely from these sources.

Different kinds of organic matters such as Farm yard Manure (FYM), cowdung, compost, green leaves, oilcakes, and coconut wastes etc. can be made use of to meet the nutrient requirement of coconut. Under present circumstances it seems conjunctive use of chemical fertiliser, organic manures and crop residues etc. is one of the best methods to derive more benefits. It should be kept in mind that use of chemical fertiliser has played a prominent role in food production of our country (Table 1). With one of the lowest per shrinking, nutrient management will

Table 1. Contribution of various inputs to increased food production (1960-1977)

Input	Additional food production Million tons
Irrigation	6.24
Fertilizers	19.90
Area-expansion	3.70
Shifting in cropping system	3.60

(Source - Randhawa, 1992)

continue to play a major role in the future agricultural productivity of our country.

Use of Minor products of Coconut as Manure

Improvement of soil fertility and soil physical properties through long term organic manuring is well documented. The cumulative effect of organic manures in the improvement of soil structure, porosity, hydraulic conductivity, water retention and decrease in bulk density is reported by many research workers. A study carried out at CPCRI, Kasaragod to know the effect of applying coir dust, coconut sheddings, forest leaves and cattle manure on some physical properties of littoral sand revealed that the incorporation of organic sources blended with inorganic nutrients continuously for 10 years was found to increase the water holding capacity and decrease the bulk density of the soil as compared to the application of inorganics alone. The saturated hydraulic conductivity was higher in soil treated with organics ... improvement in water holding capacity and available water is noticed on account of supplying nutrients through organic and inorganic sources. (Table2).

Coconut being a perennial tree crop produces large quantities of minor products such as leaves, flower stalks, spathes, petioles besides husk and pith. These materials are rich in plant nutrients and the recycling of these minor products of coconut will add considerable quantity of organic matter to the soil (Table 3).

Table 2. Effect of application of manures through organic and inorganic sources on soil physical properties

Source	Organic carbon %		Bulk density g/cc		Water holding capacity %	
	10 years		10 years		10 years	
	Before	After	Before	After	Before	After
Coir dust	0.088	0.221	1.81	1.59	20.6	27.5
Coconut sheddings	0.090	0.146	1.81	1.64	20.4	25.9
Forest leaves	0.088	0.169	1.77	1.61	18.9	26.0
Cattle manure	0.084	0.185	1.81	1.60	19.9	26.3
Control (NPK alone)	0.078	0.080	1.85	1.70	20.6	23.6

Source : Joshi et al. 1982

Table 3. Nutrient addition through recycling of coconut minor products (kg/ha)

Components	N	P_2O_5	K_2O
Nuts	9.7	4.4	21.5
Spadices	1.0	0.8	4.2
Spathes	0.8	0.3	0.9
Leaves with sheaths	9.2	5.0	4.2
Total	20.7	10.5	30.8

Source : Pillai and Davis, 1963

By systematically recycling these materials it is possible to plough back about 20.7 kg N, 10.5 kg P_2O_5 and 30.8 kg K_2O per ha annually. The coconut leaves and husk can be used as a mulch around the basin. Husk may be kept in one or two layers at the bottom of the pit with concave, surface up before planting. It can also be buried in trenches 0.5 m wide and 0.4 m deep in between two coconut rows. Husk is a rich source of potassium and it can absorb 6-8 times, water by its weight. One hundred husk will be able to provide one kg of K_2O with in a period of about 3 to 4 years. In addition to potash it can also supply 270 g N and 150 g of P_2O_5 during the same period. The effect of husk burial is seen from third year onwards and beneficial effect last for 5-6 years. This is due to time lag in degradation of husk by micro-organisms in soil. Coir pith is another excellent material containing large proportion of cellulose and lignin. They decompose rather slowly. Coir pith being a rich potash source also helps to retain moisture in the soil for a longer period.

Since coconut husks and pith contain high quantity of lignin and have wide C:N ratio it is advisable to compost them before use. With addition of a little nitrogen, these materials can be converted into good manure. The cellulose, hemicellulose and lignin components of husk or pith undergo decomposition. The ligno-cellulosic nature of the husk and pith has a negative effect on its efficient use as a source of organic manure and under natural conditions it takes a longer time for decomposition. There is a possibility to reduce the period of decomposition by inoculating efficient saprophytic fungi such as *Chaetomium cellulolyticum, Pleurotus* spp. *Trichoderma* spp and *Poria revanulae*. This material may be made readily available to palms.

Coir pith can be composted using *Pleurotus*, a lignin degrading fungus and Urea for 30 days. The C:N ratio is narrowed down to 24:1 from 112:1 (Table 4).

Thus, there is a possibility of using inoculated coir pith as a manure to coconut. To compost a ton of coir dust, 5 bottles of *Pleurotus* spawn and 5 kg of Urea are required. First, 100 kg coir pith is to be spread in shaded place and one bottle of *Pleurotus* spawn is sprinkled over it. This is to be alternated with a layer of 100 kg coir pith + 1 kg Urea uniformly. This alternate layers of coir pith + *Pleurotus* and coir pith + Urea are staked upto a metre height. Water is to be sprinkled over the heap and allowed to degrade for a month before it could be used as organic manure.

Green Manuring: A better and

Table 4. Chemical composition of Coir pith with and without composting

Sl. No.	Chemical constituent	Raw Coir pith	Composted Coir pith
1.	Lignin	30	4.80
2.	Cellulose	26.5	10.10
3.	Organic Carbon	29.0	24.9
4.	N	0.26	1.06
5.	P	0.01	0.06
6.	K	0.78	1.20
7	C:N	112:1	24:1

Source : Nagarajan et al., 1987

easier method to raise the organic matter content in soils is to grow suitable green manure crop during the rainy season and incorporate it into soil towards the end of monsoon. This practice adds organic matter to soil, stimulates activity of microorganisms, makes available plant nutrients from deeper layers and also improves structure of soils. Some of the suitable crops which can be grown in the interspaces of coconut are Cowpea, Sunnhemp, Crotalaria, Mimosa, Calopogonium and Pueraria. These crops can be grown either in the interspaces or in the basin of coconut. When green manure crops are grown in the basin they provide about 15-20 kg green matter per basin and supplement about 100-150 g nitrogen per palm. If these crops are grown in the interspaces of coconut about 3 to 14 tons of green matter will be added, which will be equivalent to 20 to 111 kg N, 4-21 kg P_2O_5 and 15-67 kg K_2O per ha per year (Table 5).

If the raising of green manure crops in the basin is not feasible it would be desirable to plant green manure crops like glyricidia along the boundaries and field bunds. A well grown bush could easily give about 12 to 24 kg green matter. Glyricidia loppings are rich in nitrogen. On a dry weight basis they contain 4.0% N, 0.30% P_2O_5 and 2.0% K_2O. Due to low lignin content and ideal C:N ratio (10:1) the leaves decompose easily after incorporation.

Use of oil cakes: Different varieties of oil cakes are produced in the country. The amount of nitrogen varies with the type of oil seed. It ranges from 2.5 to 7.9 per cent. In addition to nitrogen, all oil cakes contain small percentage of P_2O_5 (0.8 to 2.9) and Potash (1.2 to 2.2-Table 6).

Oil cake are the quick acting organic manures. Though, they are insoluble in water, their nitrogen becomes quickly available to plants. Some of the easily available oil cakes are coconut, castor, pongamia, neem, cotton seed and sesamum. Application of 4 to 5 kg per palm of neem cake is recommended for coconut. Neem cake not only acts as organic manure but also increases desirable microorganisms which suppress the harmful micro organisms and nematodes causing diseases.

Table 6. Nutrient levels in different oil cakes and plant products (in %)

S. No.	Manures	Nitrogen	Phosphorus	Potash
1.	Coconut cake	3.0-3.20	1.70-2.00	1.70-2.00
2.	Groundnut cake	4.5-7.00	1.50	1.30
3.	Neem cake	5.0-5.50	1.0-1.50	1.0-1.50
4.	Pongamia cake	3.90	0.90	1.20
5.	Castor cake	4.50-5.50	1.80	1.0-1.40
6.	Sesamum cake	6.0-6.50	1.5-2.10	1.0
7.	Paddy straw	0.30-0.50	0.08-0.50	0.5-0.70
8.	Arecanut husk	1.00-1.25	0.30-0.50	1.0-1.25
9.	Coconut husk	0.27	0.15	1.77
10.	Areca leaf	0.75-1.00	0.09-0.20	1.0
11.	Wood ash	--	0.50-2.00	3.0-5.0
12.	Coconut pith	0.50	0.09	0.84

Table 5. Yield of green matter, nutrient content and amount of nutrients added by different green manure crops

Name of the crop	G.M.Yd. T/ha (1970-72)	Nutrient composition %			Nutrient addition kg/ha		
		N	P	K	N	P_2O_5	K_2O
1. *Calopogonium mucunoides*	7.14	2.63	0.23	2.80	40.50	7.92	51.91
2. *Pueraria javanica*	14.35	3.30	0.24	1.63	99.33	16.54	59.06
3. *Stylosanthes gracilis*	12.81	2.42	0.23	1.63	63.64	13.54	51.61
4. *Mimosa invisa*	12.62	3.96	0.34	2.00	111.67	21.62	67.90
5. *Sesbania speciosa*	5.18	2.70	0.17	1.12	31.32	4.51	15.64
6. *Centrocema pubescens*	6.90	2.54	0.24	1.75	43.43	9.21	36.02
7. *Crotalaria anagyroides*	3.39	2.81	0.27	2.12	20.51	4.51	18.62

Source: Arecanut Monograph

Fish manure: Fish manure or fishmeal contains 4 to 10 per cent N, 3 to 9 per cent P_2O_5 and 0.3 to 1.5 per cent K_2O. Fish manure is available either as dried fish, or as fishmeal or powder. The manurial constituents present in it vary with the type of fish.

Animal excreta and its recycling: Annual production of wet dung and urine from the cattle and buffalo population of around 290 million in India works out to 1228 million tons and 800 million litres respectively, which with proper conservation can provide 3.44, 1.31 and 2.21 million ton of N, P_2O_5 and K_2O respectively. (Table 7).

Table 7. Theoretical potential of total dung and urine excretion by cattle and buffaloes in India.

Source	Annual Production	Availability of nutrients (MT)		
		N	P_2O_5	K_2O
Wet dung	1228 MT	1.84	1.23	0.61
Urine	800 Million litres	1.60	0.08	1.60
Total		3.44	1.31	2.21

Source: Randhawa, 1992

Table 8. Nutrient potential of biological and industrial wastes

Type of waste	Quantity available in MT	Total nutrient '000 tons per year		
		N	P_2O_5	K_2O
Cattle dung	280	2813	1999	2069
Crop residue	273	1283	1966	3904
Forest litter	19	100	37	100
Rural compost	285	1431	861	1423
City refuse	14	98	84	112
Sewage sludge	0.5	5	3	3
Press mud	3.0	33	79	55
Domestic waste water	6351*	317	140	190
Industrial waste water	66*	3	1	1.3

* Million cubic metres

Source: Randhawa, 1992

It is also estimated that nutrient potential of about 19 million tons exists in various kinds of rural and urban wastes (Table 8).

Some of the above estimate may be far in excess of their actual availability for recycling in our systems. However, in view of their recognised role in the sustainability of crop production every bit of organic waste is worth conserving.

In coconut gardens there is excellent scope to utilize the interspaces to grow fodder grasses and maintain cattle and poultry birds and recycle the byproducts. In one such model developed at Central Plantation Crops Research Institute, Kasaragod, it has been found that fodder grasses namely Napier and Guinea can be successfully grown with an annual production of 50 tons per annum. About 5 to 6 cattle can be maintained on the grass raised per hectare of garden. In this system annual dung and urine collection will be about 15 MT and 3600 litres respectively and by systematical recycling it can be possible to meet full demand of nitrogen and partial demand of P_2O_5 and K_2O of coconut + fodder system (Table 9).

In this model a small scale poultry and rabbitry is also included. When poultry birds are maintained under deep litter system for every 200 birds in one year it is possible to get one ton of manure. The cattleshed washings and slurry received from biogas plant can also be recycled to derive more benefits. Nutrient levels of some of the animal based organic manure are given in Table 10.

Inter and Mixed Cropping Systems

In the coconut gardens especially in Kerala, it is a common practice to grow various inter and mixed crops. Among these, perennial crop like Cocoa and annual crops like Groundnut, Soybean and Cowpea are more beneficial by not only enhancing monetary returns to the farmer but also enrich the soil organic status. Soil fertility and microbiological investigations conducted so far on coconut based cropping systems suggest scope for rationalising fertilizer recommendations. It is estimated that the amount of organic matter added to the soil through shed leaves and prunings of cocoa ranged from 818 to 1985 kg per ha per year. As much as 50 kg N, 11 kg P_2O_5 and 35 kg K_2O per ha could be returned to the soil every year through leaf fall of cocoa. Intercropping of soybean found to add 1560 kg of organic matter in the form of fallen leaves and stalks. By intercropping groundnut with coconut and incorporating haulms in coconut basins it would supply about 195 g nitrogen

Table 9. Nutrient availability through recycling of organic wastes in Mixed Farming System

Material	Quantity per ha	Nutrient available kg/ha		
		N	P_2O_5	K_2O
Cowdung	15 tons	286	103	36
Urine	3600 litres	40	-	54
		326	103	90

Table 10. **Nutrient levels in animal based organic manure (in %)**

Manures	Nitrogen	Phosphorus	Potash
Cow dung	0.50-1.50	0.15-0.75	0.50
Farm yard manure	0.50-2.00	0.25-0.75	0.50-1.40
Sheep droppings	1.95-2.30	0.25-0.40	0.50
Poultry manure	2.50-6.00	1.50-2.00	0.90-1.32
Fish manure	4.00-10.00	3.50-5.00	0.5-1.20
Cattle urine	0.50-0.80	0.01-0.02	0.5-0.70
Bone meal	2.00-3.50	20.0-25.0	—

per palm. Hence when different crops are grown in the interspaces of coconut, based on soil test data the fertilizer application especially nitrogen can be scaled down proportionately.

The maintenance of organic matter in the soil is important in coconut growing humid tropical areas and this calls for careful husbandry. To derive maximum benefit from organic manure application it is necessary to keep certain precautions in mind. To get good quality manure, attention is to be given towards its collection, storage and utilization. If the manure is stored in open it is exposed to leaching action by rain water thereby significant portion of nutrients are lost. Nutrients may also be lost due to volatilization of nitrogen in the form of ammonia. Importance of mixing manure with soil immediately after spreading is to be understood. Manure that is spread on surface but not mixed with soil loses its potential when large quantity of organic manure is needed, it is beneficial to compost the waste material so as to get good manure at low cost.

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Laccadive Micro : This is a tall late bearing palm from the Lakshadweep island, producing very large number of female flowers with a high setting percentage resulting in higher yield. Since the number of nuts per bunch is very large, the size of individual nuts is small. However, the large number compensates for the size and hence the total outturn of copra per tree per year is 100% more than the West Coast Tall. For ball copra production this is an ideally suited variety and has the highest oil content in copra. Where the farm level transactions are in the form of nuts, this is a highly profitable type.