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COCONUT RESEARCH INSTITUTE

LEAFLET NO. 36

THE MANURING OF ADULT COCONUT PALMS

1. INTRODUCTION

Investigations carried out by the Coconut Research Institute have shown that the majority of coconut soils in Ceylon are deficient in the three major essential plant nutrients — nitrogen (N) phosphorus (P) and potassium (K). In certain areas, particularly in the wet zone, magnesium (Mg) has also been found to be deficient.

Potassium has proved to be the dominant requirement of coconut palms. The response to potassium is reflected not only in increased nut production, but also in better copra out-turns. It has no effect on the production of female flowers, but improves their setting.

Nitrogen and phosphorus increase the production of female flowers, and nuts, but they have little or no influence on copra out-turns and the setting of female flowers.

While significant yield responses have been obtained through the application of each of these deficient elements to the soil, best results have been achieved by applying fertilizer mixtures containing all three major plant nutrient elements N, P and K (and also Mg where deficient).

Field trials in the Chilaw district (which is one of the best coconut growing areas of Ceylon) have shown that annual yields of about 2,500 to 3,000 nuts per acre can be obtained without fertilizers. Application of complete NPK fertilizer mixtures stepped up production to over 5,000 nuts per acre per annum — an increase of 2,000 to 2,500 nuts per acre. At Madampe, in an experiment on young palms, plots which have not been treated with any fertilizers from the time of planting gave 2,400 nuts per acre (55 palms to the acre) in their 15th year. Plots treated with 4 1/2 lbs. per palm per annum of NPK fertilizer mixture (equal proportion of ammonium sulphate, saphos phosphate and muriate of potash) gave 4,200

nuts per acre while plots treated with 9 lbs. of the same fertilizer mixture gave 5,720 nuts per acre. In another experiment on under-planted young palms at Nattandiya, unmanured plots gave 2,500 nuts per acre in their 15th year, whereas plots treated with complete NPK coconut fertilizer mixture at the rate of 4 lbs. per palm per annum gave 4,200 nuts per acre. At Bandirippuwa, unfertilized plots have given annual yields of about 2,500 nuts per acre, while manuring increased annual yields to over 5,000 nuts per acre. Under comparatively more fertile soil conditions at Bingiriya where even without any fertilizer applications annual yields were in the order of 4,000 nuts per acre, production was increased to 5,500 nuts per acre by the application of NPK fertilizer mixture at the rate of 5 lbs. per palm. These experiments have demonstrated that the application of complete NPK fertilizer mixtures can bring about appreciable increases in coconut production even in the better coconut growing districts.

More striking responses to fertilizer application have been obtained in the poorer coconut growing districts of the wet zone. Field experiments at Veyangoda and Ahangama showed that in these areas without manuring, annual yields can be as low as 600-800 nuts per acre. Application of NPK fertilizer mixture at the rate of 3 1/2 lbs. per palm per annum increased the annual production to 2,500 nuts per acre — a 200% rise. In a simple trial at Pannipitiya, the additional application of magensium fertilizer — either in the form of magnesium suphate, or ground dolomitic limestone — was observed to further increase yield to 3,500 nuts per acre per annum. There is no reason to doubt that with high rates of fertilizer application and better soil management practice, coconut production in the Southern and Western provinces can be further increased. In fact, there are a few well managed lands in the areas which today boast of an annual production of over 5,000 nuts per acre.

2. ECONOMICS OF FERTILIZER USAGE

Fertilizer usage is to a large extent dependent on economic factors. This is particularly true of the coconut palm in which there is an inevitable time lag between the application of fertilizer and the realization of its beneficial effects. Optimum fertilizer dosage refers to that dosage which gives maximum profits, but not necessarily maximum yields. Under favourable economic conditions, the optimum fertilizer dosage would tend towards that which gives maximum yields. Hence when coconut prices are high, and fertilizers are available at subsidised rates, economic conditions are most conducive to the liberal application of fertilizers.

On the basis of recent experimental data, we recommend below an increase in the rates of fertilizer application up to 10 lbs. NPK mixture per palm per annum with a view to maximising production. With regular manuring and proper soil management practice a coconut land can yield 4,000 to 5,000 nuts per acre per annum provided that there is an adequate supply of soil moisture. At a market price of Rs. 130/- per 1,000 nuts, the increased

yields would bring about an additional net income of about Rs. 150/- per acre per year. However, when prices of coconuts fall, the financial resources available for manuring may be limited, and coconut cultivators may find it difficult to apply fertilizers at the recommended rates. Under such conditions, manuring even at lower rates (at least 5 lbs. per palm per annum) should be maintained. It should be noted that the beneficial effects of manuring may not be usually realised until after about 2 years of the first application.

A complete cessation of manuring should be avoided as this would only lead to a vicious circle of lower yields and less money available for manuring in the subsequent years.

3. CHOICE OF FERTILIZERS

We have no evidence yet to suggest that the efficiency of fertilizer utilization by the coconut palm is governed by the form in which it is applied (*e.g.* organic, or inorganic fertilizers).

In a simple observation trial at Bandirippuwa comparing a mixture of sediment poonac, bone meal and ash with a mixture of ammonium sulphate, saphos phosphate and muriate of potash, it was found that the considerably cheaper inorganic fertilizer mixture is as effective as the former organic mixture. In another experiment at Bandirippuwa, no difference was found between various sources of nitrogen (ammonium sulphate, calcium cynamide, ground nut cake) even after 30 years of biennial fertilizer application. On a sandy loam soil type at Marandawila (Bingiriya) inorganic sources of nitrogen (ammonium sulphate) and phosphorus (Saphos phosphate) proved to be as effective as more expensive organic sources (fish guano, bone meal). Except when available cheap locally (e.g. cattle or goat manure, rotten dry fish) we see no justification therefore for the use of organic manures which are generally more expensive.

It is sometimes argued that organic manures help to improve the physical condition and moisture holding capacity of soils. But when compared with the amount of soil with which it is mixed the quantity of organic manure is so small that it would not make any material contribution towards this end. This could be best achieved by turning into the soil bulky green manures grown on the spot (see leaflet No. 17) and by systematic burying of husks (see leaflet No. 5) The important factors to be considered in selecting the type of fertilizers to be used on coconuts are (a) price (b) cost of transport and handling, and (c) storage qualities. In comparing the cost of manures, the unit value (cost per ton divided by percentage of manurial ingredient) shoud be considered. It should be borne in mind that even if its unit value is small a low percentage manure may prove to be very expensive owing to the high cost of transport and other charges in handling bulky manures. Storage quality is judged from the tendency of the fertilizers to absorb moisture. Those with a high capacity for absorbing moisture such as urea and ammonium

nitrate are unsuitable for use in fertilizer mixtures except where they are applied to the soil within a short time (24 hours) of mixing.

The choice of fertilizer component in the mixtures recommended below is based on the above considerations, and their ready availa bility in the market. Subsitutes may be used provided that they conform to these requirements.

4. FERTILIZER MIXTURES

Recent field experiments at Bandirippuwa and Ratmalagara have shown yield responses at the annual application of 1.0 lbs. N (4.8 lbs. ammonium sulphate) 0.4 lbs. P_2O_5 (1 1/2 lbs. Saphos phosphate) and 1.5 lbs. K_2O (3 lbs. muriate of potash, 50% K_2O) per palm. These results are in close agreement with estimates of plant nutrients removed from the soil annually by a coconut palm — 1.2 lbs. N, 0.5 lbs. P_2O_5, and 1.8 lbs. K_2O. In formulating the fertilizer mixtures given below, it has been assumed that the above results are of general applicability to most coconut soils which are deficient in N, P and K. We have taken the liberty of utilising the available experimental data for making fertilizer recommendations to soil types other than those on which we have experimented. These recommendations should therefore not be considered conclusive, and as further experimental data become available, they will be subject to modi-fication.

(a) **Recommended fertilizer mixtures (available under the fertilizer subsidy Scheme)**

(i) **C.R.I. Mixture "A"** (10.3% N, 6.85% P_2O_5, 15% K_2O).

Sulphate of ammonia (20.6%N)	— 4	parts by weight.
Saphos phosphate (27.5% P_2O_5)	— 2	parts by weight.
Muriate of potash (60% K_2O)	— 2	parts by weight.

(ii) **C.R.I. Mixture "B"** (10.3% N, 6.1% P_2O_5, 16.6% K_2O)

Sulphate of ammonia (20.6% N)	— 4½	parts by weight.
Saphos phosphate (27.5% P_2O_5)	— 2	parts by weight.
Muriate of potash (60% K_2O)	— 2½	parts by weight.

(iii) **C.R.I. Mixture "C"** (10.3% N, 5.5% P_2O_5, 18% K_2O)

Sulphate of ammonia (20.6% N)	— 5	parts by weight.
Saphos phosphate (27.5% P_2O_5)	— 2	parts by weight.
Muriate of potash (60% K_2O)	— 3	parts by weight.

These fertilizers may be obtained mixed, or the individual components may be purchased separately and mixed thoroughly before application. Alternatively the dosage recommended below for each palm may be applied without prior mixing in accordance with the proprtions indicated above.

RATES OF FERTILIZER APPLICATION FOR ADULT PALMS ON DIFFERENT SOILS

	Soil Type	*C.R.I. Mixture*	*lbs. fertilizer mixture per palm per annum*
1.	Lateritic loams and lateritic gravels (boralu) series, or cabook soils) of the wet zone in the Southern, Western, Central and Sabaragamuwa provinces (districts of Colombo) Kalutara, Galle, Matara, Kandy, Matale) South, Ratnapura, Kegalle).	"C"	10
2.	Lateritic loams and lateritic gravels of the) intermediate rainfall zone in the North-) Western province (districts of Chilaw, Puttalam, Kurunegala).	"B"	9
3.	Cinnamon sand soils of Chilaw/Negombo) districts, coastal marine sands and lagoon) sandy deposits of Puttalam, Chilaw,) Negombo, Batticaloa, Mannar and Jaffna) districts, and the sandy soils of the South-) ern and Weetern coastal belts.	"C"	10
4.	Deep reddish brown loams, sandy loams,) and clay soils of the district of Chilaw,) Puttalam, Hambantota, Mannar, Anura-) dhapura, Vavuniya, Mullativu, Dambulla,) and Melsiripura in the intermediate and) dry zones.	"A"	8
5.	Limestone derived chocolate brown loamy) soils of Matale, Nalanda, Dambulla, and) Jaffna district.	"A"	8
6.	Deep alluvial loams in valleys and flood) plains of rivers and estuarine and lagoon) clay soils.	"A"	8

Coconut lands which have been neglected and not manured for a continuous period of 5 years or more should be given one and a half times the recommended fertilizer dosage during the first two years.

In addition to the NPK fertilizer mixtures recommended above, it is necessary that coconut palms be treated with magnesium fertilizers as well. The application of ground dolomitic limestone at the rate of 5 lbs. per palm once in 3 years in the wet zone, and 3 lbs. per palm once in 3 years in other areas, particularly on lateritic and sandy soils is recommended as a routine measure. This subject is dealt with in greater detail in our Advisory Leaflet No. 43 on magnesium deficiency.

(b) SUBSTITUTE MIXTURES.

Urea (46% N) which is a more concentrated and cheaper source of nitrogen may be used instead of ammonium sulphate in coconut fertilizer mixtures. How-ever, owing to its high capacity for absorbing moisture, urea cannot be used in fertilizer mixtures which need to be stored. It should be either mixed with the other components just before application or it should be applied separately.

8 lbs. CRI. Mixture 'A' (cost Rs. 1/48) is equivalent to:

1¾ lbs.	Urea
2 lbs.	Saphos phosphate
2 lbs.	Muriate of potash (60% K_2O)
5¾ lbs.	(cost Rs. 1/26)

9 lbs. CRI. Mixture 'B' (cost Rs. 1/68) is equivalent to:

2 lbs.	Urea
2 lbs.	Saphos phosphate
2½ lbs.	Muriate of potash (60% K_2O).
6½ lbs.	(cost Rs. 1/44).

10 lbs. CRI. Mixture 'C' (cost Rs. 1/88) is equivalent to

2¼ lbs.	Urea
2 lbs.	Saphos phosphate
3 lbs.	Muriate of potash (60% K_2O)
7¼ lbs.	(cost Rs. 1/62)

Both costs of fertilizer transport and costs of fertilizer per palm are lower for mixtures using urea instead of ammonium sulphate.

Occasionally we are requested by planters to recommend organic manure mixtures. As previously mentioned organic mixtures which are considerably more expensive offer no advantage over the cheaper inorganic fertilizer mixtures recommended above. However,

given below is a formulation for those who are keen on using an organic mixture:—

Crushed fish	...	8 lbs.
Blood meal	...	5 lbs.
Bone meal	...	1½ lbs.
Muriate of potash (60% K_2O)		2½ lbs.
		17 lbs. per palm per annum

This mixture will cost about Rs. 4/20 per palm, and about 70–100% more will have to be incurred on transport charges. It is not recommended as a standard mixture under the subsidy scheme.

5. FERTILIZER PLACEMENT

It appears that the main reason for adopting the system of circular trench manuring is that it has been a traditional practice. In a recent field experiment carried out on a lateritic gravelly soil at Nattandiya, it was found that the much cheaper method of surface application of fertilizer round the palm and digging it over into the soil is as effective as the traditional circular trench system. This experiment also showed that broadcast application of fertilizer in the entire area of the plantation is less efficient than placement round the palm.

Experiments with radioactive isotopes have shown that even on light, well drained soils which offer no impediment to the development of extensive root system, the density of active absorbing root surface is highest in the area immediately surrounding adult coconut palms up to a distance of about 5 1/2 feet from the bole. Placement of fertilizer in close proximity to the rooting zone would help to maximise the efficiency of fertilizer uptake by the palm,. The experiments with radioactive isotopes showed that fertilizer application in the entire area round the palm up to a distance of 5 1/2 feet from the bole can lead to 100% more efficient fertilizer utilisation by the palm than application in centres of squares or in a 3 ft. wide ring 3 ft. away from the palm (the latter method has been hitherto commonly practised). It was also found that application in full circles is about 40% more efficient than half circle application.

Recommendations:

On the bais of these recent experiments we now recommend that for maximum economy and efficiency of utilization, fertilizers should be applied in the entire area round the palm up to a distance of 5 1/2 feet from the bole in full circles on the soil surface and then dug over into the soil with mammoties or mammoty forks. Unless weed growth is exessive, it is not necessary to weed round the palm before fertilizer application. The area on which fertilizer has been applied may be given a surface mulch of dried fronds and husks. This will help to keep down subsequent weed growth.

Basin, or trench manuring should be adopted on very steep lands which are subject to considerable surface run off due to inadequate soil and moisture conservation measures. This will help to reduce the risk of fertilizers being lost through surface wash off.

6. TIME OF APPLICATION

Fertilizers should always be applied in wet weather, preferably early during the South West and North East monsoons. In areas where the South West Monsoon is uncertain such as Puttalam and Batticaloa, it is advisable to apply fertilizers during the north east monsoon. On light sandy soils, on steep slopes without adequate soil conservation measures, and on poorly drained soils liable to be water-logged, fertilizers should be applied after the heavy rains are over.

7. FREQUENCY OF MANURING

Generally, fertilizer applications to adult palms should be carried out annually. In areas where both monsoons prevail, and particularly on coarse sandy soils, biannual manuring during each monsoon may be adopted with advantage. This would help to reduce loss of fertlizer through leaching, and hence increase the efficiency of fertilizer utilisation by the palms. For biannual manuring use half the annual fertilizer dosage.

8. SELECTIVE MANURING

Low bearing palms may be classified into two groups — (a) those which are generally poor or irreparably damaged, and (b) those which have been impoversihed by environmental factors, such as infertile soils, or pests and diseases. The latter group of low bearers will respond to manures better than heavy bearers. Where circumstances do not permit the manuring of an entire estate or field, selective manuring of such backward palms is recommended. Palms which are proved to be genetically poor, or irreparably damaged (as may be judged from their lack of response to systematic manuring) should be uprooted.

9. IMPORTANCE OF CULTIVATION

It is essential that adequate attention be paid to the various soil management practices leading to soil and moisture conservation if the maximum benefits of manuring are to be achieved. The following points should be particularly noted:—

(a) Control execessive weed growth by disc harrowing or manual labour towards the end of the rainy seasons. This would help to reduce loss of soil moisture through transpiration by actively growing weeds. and also reduce moisture losses by evaporation as a result of the dry mulch of dead weeds which would cover the soil surface. Harrowing or soil turning should not be done in the middle of a long spell of dry weather.

(b) Gravelly and heavy textured soils will benefit from annual ploughing to a depth of about 8 inches in alternate rows. Ploughing should always be carried out early in the rainy season and against the slope of the land. This helps to conserve more rainwater falling on the land by increasing the moisture holding capacity of the soil through better infiltration. Rainwater falling on smooth hard soil surfaces tend to flow away along the surface of the land instead of penetrating into the soil.

There is no danger of regular cultivation causing adverse effects due to root damage as the coconut root system is such that rootlets are developed from the damaged root ends. Furthermore cultivation will help to develop a deeper root system thereby making available to the palm a bigger volume of soil for nutrient and moisture absorption.

Ploughing should not be done on soils where the vegetative cover is sparse (e.g. coastal marine sands.) and the water table is near the ground level. Ploughing should not be done at the tail end of rainy seasons, or in dry weather.

(c) Systematic burying of husks should be carried out as a moisture conservation measure in accordance with the detailed instructions given in our Advisory Leaflet No. 5.

(d) An adequate system of catch water drains (contour drains) or bunds, and other soil and moisture conservation maesures should also be taken.

(e) Lands with poor vegetative cover (such as the marine coastal sands), and those with problems of execesive weed growth can benefit from the establishment of leguminous cover crops. Details regarding the establishment of cover crops are given in our Advisory leaflet No. 17.

10. LIMITATIONS OF SOIL ANALYSIS

Often requests are made by coconut planters for the analysis of soil samples with the object of getting specific fertilizer recommendations for individual fields. As already mentioned, practically all our coconut soils are deficient in the basic major plant nutrients N, P, and K, and no soil analysis is necessary to confirm this. Our general fertilizer recommendations for different soils have been made on the basis of available experimental data. Soil analysis cannot be used for making specific recommendations to individual lands, as such tests can provide reliable, quantitative information regarding optimum fertilizer requirements for a particular soil only after they have been calibrated aginst the results of field experiments on each individual soil type. We do not have such calibrated soil analytical data, and it is unlikely that we will have them in the near future. In the circumstances, we consider that no useful purpose is served by carrying out soil analysis for routine advisory purposes.

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