THE MANURING OF ADULT COCONUT PALMS

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1. Introduction

Recommendations for manuring must necessarily be conditioned by economic factors. This is particularly true of the coconut palm in which there is an inevitable time lag between the application of manure and the realisation of its beneficial effects. Optimum fertiliser dosage refers to that dosage which gives maximum profits (but not necessarily maximum yields). Under favourable economic conditions, the optimum fertiliser dosage would tend towards that which gives maximum yields. The present high prices obtained for copra, and the availability of cheap fertilisers under the subsidy scheme, are therefore most conducive to the liberal application of fertilizers for obtaining higher yields. The recommendations made below are in keeping with this view.

In any research programme associated with manurial problems, the fundamental questions which need to be answered first are:—

(i) Is manuring necessary, and if so, what are the dominant requirements with respect to the major plant nutrients nitrogen, phosphoric acid, and potash?

(ii) What are the optimum levels of fertiliser application?

(iii) In what forms should they be applied (e.g. organic or inorganic)?

(iv) How often should they be applied (e.g. annual or biennial)?

(v) Where should they be placed (e.g. broadcast, or in circular trenches at the base of the palms)?

No unequivocal answer can be expected to any of these questions — it must necessarily vary with the different soil and climatic conditions under which coconuts are cultivated. The provision of scientifically established answers to these problems necessitates the adoption of field experimental methods in colloboration with laboratory studies. Unfortunately field experimentation with the coconut is expensive and time consuming, so that the progress of research is inevitably slow. Experiments so far carried out do not provide answers to all the above questions and pending the results of further experiments it is our policy to provide tentative advice and suggestions based on the experimental data already available, scientific hypotheses and experience.

2. Choice of Fertilizers

We have no evidence yet to suggest that the efficiency of fertiliser utilisation by the coconut palm is governed by the form in which it is applied (e.g. organic or inorganic manures).

In a simple observation trial at Bandirippuwa Estate comparing a mixture of sediment poonac, bone meal and ash vs. a mixture of sulphate of ammonia, saphos phosphate and muriate of potash, it was found that the considerably cheaper artificial fertilisers are as efficient as the other mixture. In a more elaborate experiment, little difference was found between inorganic nitrogenous manures such as calcium cyanamide and sulphate of ammonia, and organic nitrogenous manures such as ground nut cake. *Except when available cheap locally (e.g. cattle or goat manure) we see no justification therefore for the use of expensive organic manures.*

It is sometimes argued that organic manure improves the physical condition and moisture holding capacity of soils. But in comparison with the amount of soil involved the quantity of organic matter added 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/or by systematic burying of husks (see Leaflet No. 5).

The important factors which must be considered in selecting the type of fertilisers to be used are (*a*) price; (*b*) cost of transport and handling, and (*c*) storage qualities. In comparing the cost of manures, the unit value, or the cost per ton divided by the percentage value of the manurial ingredient should be considered. It must also be borne in mind that even if its unit value is small a low percentage manure may prove to be very costly owing to the high cost of transport and other charges involved in handling bulky manures. Storage quality is judged from the tendency of the fertilisers to absorb moisture when kept in the normal packing as received from the manure firms. Those with a high capacity for absorbing moisture are unsuitable.

The choice of fertiliser components in the mixtures recommended below have been based on the above considerations and their ready availability in the market. Substitutes may be used provided they conform to these requirements.

3. Fertiliser Mixtures

Our field experiments in different coconut growing regions of the island — Bandirippuwa, Veyangoda, Ahangama, Ratmalagara (Madampe), Nattandiya and Bingiriya — have all shown that manuring with artificial fertilisers (nitrogen, phosphoric acid and potash) brings about a significant increase in crop production.

Different soils have been found to vary in their response to manuring.

Phosphoric acid (P_2O_5) has still given no response at Bandirippuwa where the manurial experiment is now in its 25th year. This is attributed to the residual effects of heavy dressings of bone meal which these soils are reported to have received before the C.R.I. acquired the estate.

At Ratmalagara, the biennial application of 1 lb. P_2O_5 per palm has given highly significant increases in crop yields.

At Veyangoda and Ahangama phosphoric at 0.6 lb. per palm produced a significant response. The absence of phosphoric acid was a definite limiting factor to the response of added nitrogen and potash.

Potash (K_2O) has proved to be the dominant requirement at Bandirippuwa Estate. The biennial application of 0.75 lbs. K_2O per palm produced a significant response only in the 5th year after the first manuring, whereas the higher dose of 1.5 lbs. K_2O gave a significant response in the 3rd year. At Ratmalagara, where potash was applied at the rate of 1 (2 lbs. of muriate of potash) and 2 lbs. (4 lbs. muriate of potash) K_2O per palm biennally — only the higher level (2 lbs. potash) gave a response after 13 years. Here the soil was rich in available potash reserves. Nitrogen was tested at different levels only at Bandirippuwa. Biennial application at the rate of 0.5 lb. N. per palm produced an increase in crops, whereas the higher dose of 1 lb. N. per palm depressed this increase of yield.

However, in combination with potash, best crop yields were obtained for 0.75 lb. K_2O at 0.5 lb. N. and the increased yields for 1.5 lb. K_2O was highest at 1 lb. N. The results also indicate the possibility of obtaining further increase in yields by the combination 2.25 lb. K_2O and 1 lb. N. and a still further increase with 2.25 lb. K_2O and 1.5 lb. N.

In poor soil types such as the heavily leached laterite (cabook) soils of the wet zone in Ahangama and Veyangoda, the response to manuring was considerably more marked than that obtained on the comparatively richer soils of the Chilaw/Negombo districts. In the former soils, without manuring the yields were as low as 500 nuts per acre per annum. Biennial application of 0.5 lb. nitrogen (N.), 0.6 lbs. phosphoric acid (P_2O_5) and 1 lb. potash (K_2O) per palm increased the yields to about 1,500 nuts (nut size was also improved) per acre per annum — a 300% increase. At Bandirippuwa, comparative figures for no manuring were about 3,000 and the complete N.P.K. mixture 4,000—a 30% increase.

We have yet had no experiments at high levels of manuring. But from the experimental results discussed above, it seems reasonable to expect that higher fertiliser dosage would bring further increases in crop yields particularly with soils which have poor reserves of available plant nutrients such as the laterite soils of the wet zone, or the cinnamon sands. Provided that soil physical conditions and moisture availability are not limiting

RECOMMENDED FERTILISER MIXTURES (parts by weight).

		C.R.I. Mixture 'A' (Soil fertility good)	*C.R.I. Mixture 'B' (Soil fertility fair)*	*C.R.I. Mixture 'C' (Soil fertility poor)*
Sulphate of ammonia (20.6%N.)	(%N.)	1 (6.9)	5 (7.4)	5 (6.4)
Saphos phosphate (28.5%P_2O_5)	(%P_2O_5)	1 (9.5)	4 (8.1)	5 (8.9)
Muriate of potash (50% K_2O)	(%K_2O)	1 (16.7)	5 (17.9)	6 (18.8)

(The percentage composition is given within brackets).

The fertilisers may be obtained mixed, or the individual components may be mixed at the time of application.

RATES OF FERTILISER APPLICATION FOR ADULT PALMS ON DIFFERENT SOIL TYPES (lbs. fertiliser mixture per annum).

Soil Type:	*C.R.I. Mixture*	*lbs. Mixture*
1. Laterite and lateritic gravels of Southern and Western Province ..	C	8
2. Lateritic loams of Southern and Western Province	B	8
3. Lateritic gravels and lateritic loams of North Western Province ..	B	7
4. Cinnamon sands of Negombo and Madampe districts and coastal marine sands of Puttalam and Eastern Province	C	8
5. Deep non-lateritic alluvial reddish brown loams and sandy loams of Chilaw/Puttalam districts ..	A	6
6. Limestone derived chocolate loam soils of Kurunegala/Matale districts and Northern Province	A	6
7. Estuarine clay soils	A	4

factors, it should be possible to obtain similar crop yields from palms grown in poor and rich soil types through adequate fertiliser application.

It is necessary to mention here that we have taken the liberty of utilising the available experimental data for the purpose of making recommendations regarding higher levels of fertiliser application and different soil types other than those on which we have experimented. These recommendations should therefore not be considered conclusive, and, as further experimental data became available will be subject to modification.

Coconut lands which have been neglected and not manured for sometime should be given double the fertiliser dosage recommended during the first year.

The above rates of manuring are higher than those previously recommended by us and are aimed at maximum yields as previously discussed. Should proprietors of estates find it difficult to apply manures at the rates now recommended, manuring even at lower rates should be maintained.

4. Fertiliser Placement

It appears that the main reason for continuing the widely used system of circular trench manuring is that it has been traditional practice. Alternate methods much less expensive, are broadcasting and harrowing in of the fertilisers or spreading round the base of the palm and forking it in. At present labour rates, the cost of opening and closing manure circles involves an extra expenditure of at least 25 to 30 cents per palm. Our experiment on a light sandy loam soil at Marandawila has clearly shown that broadcasting is as efficient as circular trench manuring.

The root system of the coconut palm has a natural tendency to spread far and wide. Broadcasting of fertilisers should therefore promote better and more extensive root development.

An extensive root system would enable the palm to obtain nutrients and water from a wider volume of soil. This should prove particularly beneficial in areas susceptible to long periods of drought.

An estate which has been regularly manured on the circular trench system *may* have a temporary set back on changing over to broadcasting due to two factors — (*a*) concentration of the roots near the manure circles and (*b*) fixing of the fertilisers by the soil in the centres of the squares which have been starved of nutrients for a long period. Such an effect could be minimised by broadcasting double the recommended fertiliser dosage for the first year after changing over.

In the absence of data from a large number of experiments, the following tentative recommendations are made:—

Recommendations

1. BROADCASTING and harrowing in of fertilisers is recommended on flat or gently undulating lands where the soils are open textured e.g. sand, sandy loams, loams and light gravelly loams. When changing over from the circular trench system, double the recommended fertiliser dosage should be applied in the first year.

2. SPREADING ROUND the base of the palm and forking in of fertilisers is recommended on flat or gently undulating lands where the soil type is of a heavy gravel overlying heavy loam or clay. This method may also be used on soil types where broadcasting has been recommended.

The fertiliser should be spread 3 feet away from the base of the palm in a 3 feet wide circular strip and forked into the soil with mammoty forks.

3. CIRCULAR TRENCH manuring may be adopted in general, but is particularly recommended under conditions where development of an extensive root system is restricted due to physical impediments such as the existence of hard pans of rock, cabook or clay. This system should also be adopted on sloping lands which are subject to considerable surface run off, so that the risk of loss of fertiliser is minimised. The usual method is to apply the fertilisers in circular trenches 3 feet wide and 6 inches deep cut at a distance of 3 feet from the palm.

(See also Leaflet No. 5 on husk mulching with manuring).

5. Time of Application

Fertilisers should be applied early during the South-West and North-East Monsoon. In districts where the South-West Monsoon is uncertain such as Puttalam and Batticaloa, it is advisable to manure mostly during the North-East Monsoon.

6. Frequency of Manuring

Traditionally, coconut plantations have been manured once in two years. Today many plantations are adopting the practice of annual manuring. Although we have no experimental evidence to support either of these practices, on scientific grounds the latter should prove to be more efficient, particularly with artificial fertilisers. The availability of soil nutrients to plants depends on the concentration of nutrient in the soil water. Immediately after the application of fertilisers this concentration is high, but would gradually reduce with time due to leaching and absorption of nutrients by the soil.

By reducing the time interval between successive fertiliser applications, it would be possible to maintain the nutrient concentrations in the soil at

a higher level, particularly when soluble fertilisers are used such as sulphate of ammonia and muriate of potash. More frequent manuring should therefore ensure greater efficiency in fertiliser utilisation.

Recommendations

Generally, manuring should be carried out annually — broadcasting in the entire area, or spreading round in full circles. Where the circular trench system is used, annual manuring in half circles may be adopted to reduce costs.

In areas where both monsoons prevail and particularly on sandy soils biannual manuring during each monsoon might be preferably adopted. This should involve little or no extra cost where the fertiliser is broadcast and harrowed, or the manure spread round the base of the palm. For biannual manuring, use half the annual fertiliser dosage recommended.

7. Selective Manuring

Just as poor soils show a larger response to manuring compared to good soils, palms in low bearing respond to manures better than heavy bearers. Where circumstances do not permit the manuring of an entire estate or field, selective manuring of backward palms is to be recommended. Even under normal circumstances selective manuring would be judicious. The present practice of giving a uniform dose of manure to all palms seems unscientific, as well as uneconomic while no doubt, the application of several mixtures would involve practical difficulties.

8. Importance of Adequate Cultivation

Particular attention should be paid to this section.

We should not ignore the importance of adequate cultivation involving tillage operations that bring about a physical improvement of the soil, particularly in relation to soil moisture, if the best results of manuring are to be obtained. There seems to be an opinion that cultivation causes root damage, and as such is disadvantageous. On the other hand, the coconut root-system is such that in the process of cultivation, numerous feeding rootlets are developed from the damaged root ends, and this would certainly stimulate the uptake of plant nutrients.

Cultivation operations aimed at the conservation of soil moisture are of the utmost importance. The first line of defence in conserving soil moisture is an adequate system of catch water drains. The second line of defence is burying husks, particulars about which will be found in Leaflet No. 5.

Regular harrowing is necessary to control excessive weed growth, and ploughing should be done once in two years.

9. Limitations of Soil Analyses

Many requests are made for analysis of soil samples of estates for purposes of recommending manure mixtures. There seem to be a considerable amount of popular misunderstanding on the use of soil analysis. No reliable recommendations can be based on soil analysis until data correlating such analytical figures with accurately designed field experiments are available for coconut soils.