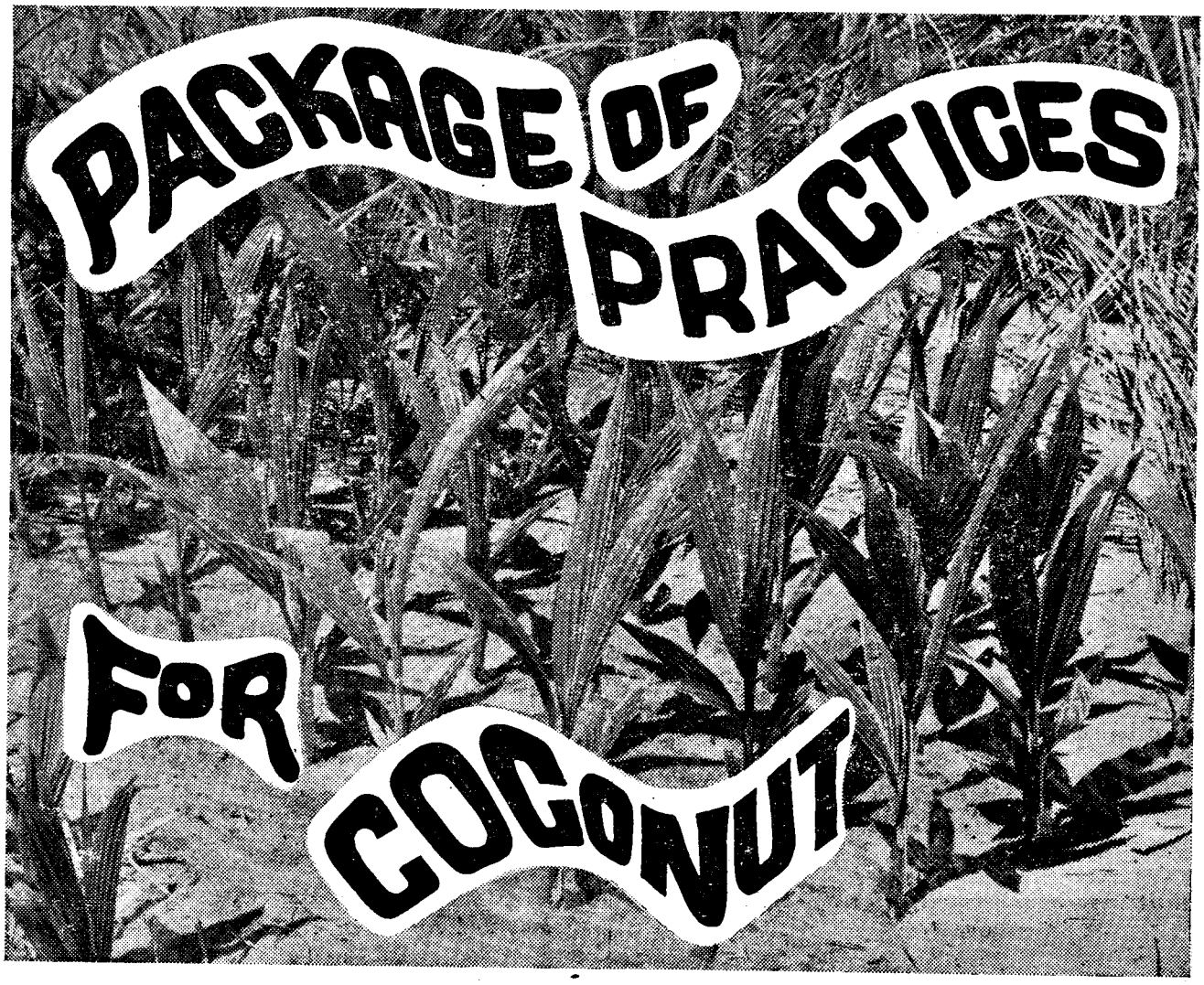


This is the second of a series of scientific articles on the Package of Practices for Coconut dealing with the various aspects of coconut cultivation from the selection of land, mother palms, seednuts etc. to the control of pests and diseases. The concluding instalment of the series will appear in a forthcoming issue.

Maintenance of young Palms:

The young palm stage is the period from the time of planting to the onset of flowering. This period may vary depending on the variety and agroclimatic conditions. The young palms are to be cared for very well during this period. Recent experiments have proved that nutritional deficiencies and poor management practices in the early years of its life delayed flowering and also adversely affected yielding ability when regular bearing commences. The adverse effects caused by malnutrition remained unrepaired even with adequate manuring afterwards. Unfortunately, many of the coconut growers do not attach much importance to the care of pre-bearing palms as there are no returns from the crop during this period.

Fencing:

The young plantations has to be protected against browsing by cattle. Seedlings frequently grazed by cattle seldom make satisfactory growth. If the seedlings are concentrated in one place it is cheaper to fence round the entire block but where they are isolated, protection has to be provided to the individual seedlings. This can be done by erecting fencing with bamboo, raising mud wall, laterite enclosure or providing wicker or bamboo cages. Coconut leaf petioles and rachis could be very cheaply used for such individual fences. Sprinkling of cow dung slurry on the leaves is effective, but may have to be repeated often, especially during the rainy season.

Watering:

In the absence of well distributed rains the seedlings are to be watered for early establishment and vigorous growth, in the initial three years. In the first year irrigation at the rate of 40-45 litres of water once in four days is found to be optimum especially in sandy soils. An alternative is to place three porous mud pots of the capacity of over one gallon each near the seedling and fill them with water at frequent intervals. The water in the pot will become slowly available to the seedlings. It is sufficient if the pots are refilled at weekly or even at longer intervals.

Pot-watering the Shaded seedling

Clearing of planting pits:

In the first year of planting care should be taken to see that water does not stagnate in the seedling pits. The surface water should be diverted away and the pits should be cleared of rain water. Care should also be taken to see that the collar and leaf axils of the seedlings are not covered by the soil which is washed down into the pits either through rain or irrigation water. This type of soil accumulation in the pits often occurs in sandy soils.

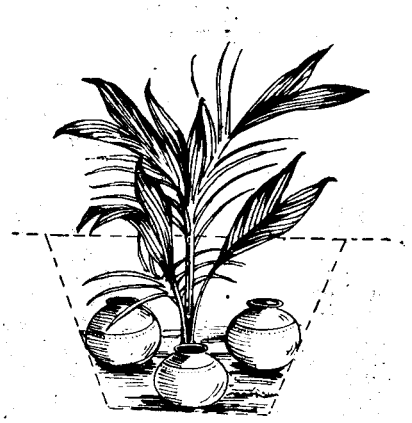
BY
V. T. MARKOSE †

Shading:

During the summer months seedlings should be adequately shaded for the first two years. Proper shade reduces casualties among the transplanted seedlings and also the frequency of watering. Coconut leaves or palmyrah leaves can be used for the purpose at a little cost. Light shading for the first two years is reported to check the grey blight of coconut seedlings.

Mulching:

Mulching the area round the base of the palm before the onset of dry weather will keep the soil moist and prevent the ground becoming hard. It also indirectly helps to keep weeds under check. Mulching can be done with easily available materials like coconut husk, leaves, coir dust and bagasse.



Placing earfhen pots filled with water

Gap filling:

At the end of the first year the gaps caused by death of seedlings should be filled up. Similarly, all the unhealthy and defective seedlings should be removed and made good by fresh planting.

Manuring:

Proper manuring from the very beginning is necessary to give a good start to the seedlings. It is already proved that coconut seedlings are capable of absorbing nutrients applied through fertilizers even at the time of planting although the efficiency of uptake of nutrients is greater in the case of later applications. Field experiments conducted at the Central Plantation Crops Research Institute, Kasaragod, showed that complete NPK fertilization is necessary for obtaining satisfactory growth in the early years. Experimental results also showed that a balanced application of NPK from the beginning could reduce the pre-bearing period of palms for about one to 1½ years. Under conditions of optimum manuring and irrigation the ordinary tall variety palms come to flowering in the

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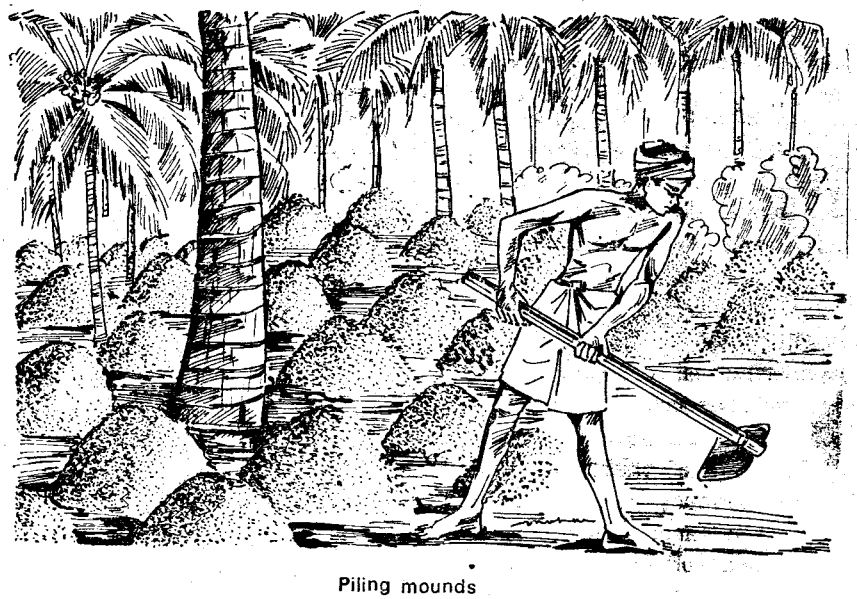


Piling mounds

fourth or fifth year. Under rainfed conditions flowering is usually delayed till the sixth or seventh year.

Although coconut is cultivated mainly under rainfed conditions in our country, the unusual response of palms to irrigation, during the rainless period prompt many growers to provide irrigation facilities. Under irrigated conditions the plants make better utilization of added nutrients and also respond to increased doses of fertilizers. This aspect is often overlooked by many growers. Therefore, a manurial schedule for young palms of the ordinary tall variety under rainfed and irrigated conditions is given below:

Manurial schedule for young palms of the oridinary tall variety

Age of palms	Irrigated	Rainfed
1st year (3 months after planting)	1/3 full dose	1/4 full dose
2nd year	2/3 ,,	1/3 ,,
3rd year	Full dose	1/2 ,,
4th year	...	3/4 ,,
5th year	...	Full dose

Under irrigated conditions the full dose of NPK comprises 0·5 kg. N, 0·32 kg. of P_2O_5 and 1·2 kg. K_2O per tree per year. In terms of fertilizers the above doses of nutrients can be supplied through 2·5 kg. of ammonium sulphate or 1 kg. urea for N, 2 kg. of superphosphate or 1 kg. of ultraphos for P, and 2 kg. of muriate of potash for K.

Under rainfed conditions in Kerala the full dose of NPK comprises 0·34 kg. N, 0·34 kg. of P_2O_5 and 0·68 kg. of K_2O per tree per year. In terms of fertilisers the above dose of NPK can be supplied through 1·75 kg. ammonium sulphate or 750 g. urea for N, 2 kg. superphosphate or 1 kg. ultraphos for P and 1·2 kg. muriate of potash for K. If 8:8:16 coconut mixture is used, 4·5 kg. mixture per tree per year is enough to supply the required dose of NPK.

Organic manures:

It will be always advantageous to supplement this dose of fertilisers with organic manures like green manure, compost or cattle manure @ 10 kg. in the first year, 20 kg. in the second year and 30 kg. in the third year and 50 kg. afterwards in full bearing. Organic manure may be applied in the pits in July-August under West Coast conditions and partially covered. Burial of coconut husks, leaves, spathes and coconut pith is also beneficial in sandy soils and laterites besides, the scheduled dose of fertilisers and organic manures.

Method of application of fertilisers:

The fertilizers are applied and forked in, in the pits during the first, second and third year. The pits should be widened 30 cm. around every year and are thus filled up gradually and at the end of the third year the pits are completely covered.

It should be remembered that placement of fertilizers in close proximity to the rooting zone will maximise fertiliser uptake by any field crop. Therefore, in the young palm stage fertilisers and manures should be applied only in planting pits.

Care of adult palms

The adult stage in the life of coconut commences with flowering and during this stage it will continue to produce regular crops at monthly intervals for a period of 80 years or more. There is definite evidence to prove that judicious manuring, irrigation and regular cultivation to coconut is very essential to step up and maintain yields at a high level. Generally the effect of manuring on yield becomes visible only after two to 2½

years, which is also the period required for the nuts to reach full maturity from the primordial stage of the flower. Due to this phenomenon the response to manuring coconut palms in terms of increased yield may not be manifested in the following year. It is, therefore, quite essential that the palms are manured regularly and systematically every year.

Manuring:

While we discuss the manuring programme to a perennial crop like coconut the growers should have a general understanding about the nature of growth of the crop, its requirements of nutrients at various stages of growth, the chemistry of added nutrients applied as fertilisers, and the agroclimatic factors.

(1) Coconut as we all know is perennial in vegetative growth and cropping. Since the very early stage i. e., the nursery stage, its vegetative growth is continuous and unrestricted if all other environmental factors remain favourable. Leaves are produced one after the other in succession before and after flowering. When it commences flowering, inflorescences emerge at the rate of one inflorescence in every month on an average. Nuts remain on the bunches in various stages of development till each bunch becomes fully ripe. This peculiar nature of growth and cropping point to its continued requirement of nutrients throughout the year and the whole productive life i. e., say, beyond sixty or seventy years whereas in the life of seasonal crops like cereals, legume etc. where there are certain very definite stages like tillering, flowering etc. in which more of nutrients are required for successful crop production. But in the case of coconut there are no particular stages in which it requires more or lesser quantities of nutrients. In other words, its requirement of nutrients is uniform throughout.

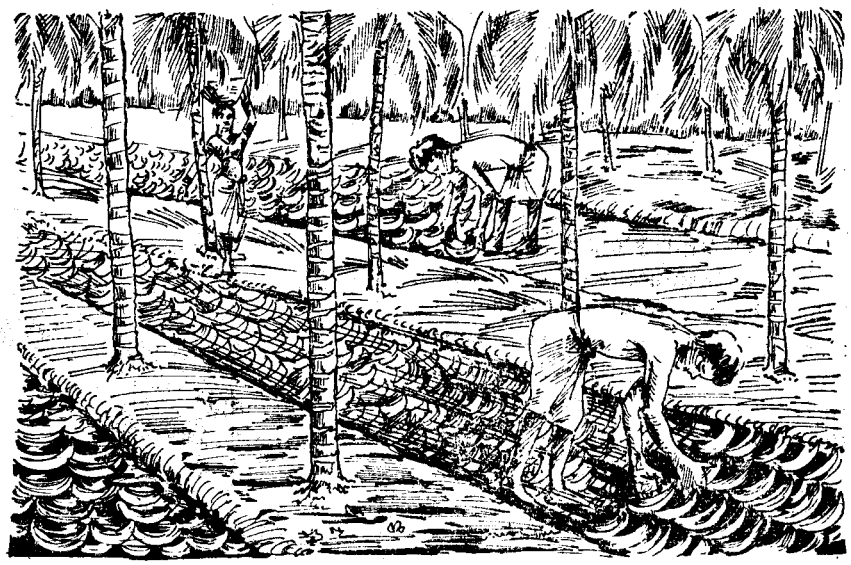
(2) The quantity of organic matter added to soil by way of crop residues in a coconut plantation is practically negligible as almost all parts of the palms are removed by human beings. This is a very special case unlike in many other field crops whether annual or perennial in nature. For example, take the case of paddy. The plant residues added back to the soil by way of stubbles and dead roots amount to a large quantity per unit area. In a plantation crop like rubber the organic matter added to the soil by dead and fallen leaves, twigs etc. account for a large quantity of organic matter. But in the case of coconut under monoculture, the plant residues added back is practically nil and therefore continued cropping with coconut, without sufficient application of organic manures, is sure to deplete the soil of the very vital organic matter fraction.

(3) The coconut is assumed to have a well spread out, deep, penetrating root system. But in a recent root study it was revealed that 75 per cent of the functioning roots, are confined to a distance of two metres around the bole of the palms and about 90 per cent of the roots are distributed in a soil column of 1·5 m in depth from the soil surface.

(4) Due to the perennial nature of the crop, immediately available plant nutrients, in other words, water soluble nutrients are not at all very much essential for coconut unlike in the case of seasonal crops where the availability and subsequent uptake of nutrients is limited and time bound during the critical stages of their growth.

In the light of the above broad general principles let us now critically analyse the fertilization programme for coconut.

As in the case of all important field crops N, P and K are the major nutrients supplied through fertilizers to coconut. The common fertilizer sources for nitrogen are ammonium sulphate and urea. These two fertilizers are readily soluble in water, and hence, are liable for leaching percolation and run-off losses to a great extent if they are applied under excessive



Burying husks

Open basins round the palms to apply manures

soil moisture conditions, either in heavy rains or abundant supply of irrigation water. Apart from such losses, nitrogen in the soil is easily and quickly converted to nitrate nitrogen in tropical soils under optimum moisture conditions. Any form of nitrogen, i. e. protein, amides or ammonia, is sure to undergo this nitrification process, (i.e., conversion to nitrate) thereby forming nitrates before it is actually utilised by any crop. The major form of nitrogen utilised by the plants is the nitrate. Once nitrate nitrogen is formed, the soil colloids are not able to retain them any longer and therefore, if the plant roots are not receiving them in a reasonable period of time, get lost from the soil. Through research at the Central Plantation Crops Research Institute and elsewhere it has been proved that the soil nitrogen status of coconut soils which received nitrogen through nitrogenous fertilizers reverted back to the pre-application level within a maximum period of three months. This leads to a very logical conclusion that the loss of applied N as ammonium sulphate and/or urea either through crop removal or through other sources of loss occurred within a very short period i. e., say three months. If this is a scientifiic evidence, application of chemical fertilizers to supply N once during a year to a crop like coconut which requires continued availability of this very vital major element, may lead to N starvation during the remaining period of 9 months, in a year ?

Phosphorus fraction of the fertilizers is not lost from the soil as it gets fixed in the soil colloidal complex. But the available phosphorus i. e., the form which is readily utilized by plants does not remain for so long after application to the soil, especially in soils where large quantities of hydrated oxides of iron and aluminium are present. The unavailable phosphorus or fixed phosphorus might gradually become available due to various biochemical activities in the soil. So it is quite logical to conclude that the application of water soluble of P may not be so necessary for a perennial crop like coconut especially under acid soil conditions of Kerala State. In laterite and lateritic soils hydrated oxides of iron and aluminium also occur in large quantities. Under such conditions a cheaper source of phosphorus like rock phosphate or basic slag would be economical than the superphosphate which is costlier. Bonemeal, if available, will be another good source of phosphorus for acid soil conditions. Basic slag can be another useful fertiliser material both as a source of phosphorus and calcium for perennial crops.

Soil potash is also fixed and hence appreciable loss of K does not occur even though the immediately available quantities do not remain in exchangeable or water soluble forms for so long after application of potassic fertilizers.

The characteristics of the crop given above coupled with the properties of the commonly used fertilizers ultimately lead to some important conclusions with regard to manuring the coconut palm.

(1) The manuring programme is to be so adjusted as to supply

Sunnhemp is a good green manure for coconut

the nutrients throughout the year.

(2) Sufficient care is to be taken to maintain the organic matter content of coconut soils at a reasonably good level.

(3) Fertilizers are to be applied at the active rooting zone i. e., at a radius of about two m. around the palms.

(4) On a critical view a perennial crop like coconut need not be fertilized with fertilizers which contain water soluble or immediately available nutrients especially P and K and other secondary and micro nutrients.

5) In order to get maximum recovery of applied nitrogen, slowly available nitrogenous fertilizers are the best suited. Since such nitrogenous fertilizers are not readily available in the market at present, nitrogen recovery, i, e· maximum utility of applied nitrogen, can be increased by increasing the number of split aplicat-ions.

Considering the vegetative characters of the crop, agroclimatic conditions and the characteristics of the commonly used fertilizers, the time of application of fertilisers to coconut under rainfed conditions can be in two split doses, first dose in early May with the pre-monsoon showers and the remaining in September when the heavy monsoon season is over.

For irrigated crop, as the soil moisture is not a limiting factor, the total quantity of fertilizers may be split in four equal doses and can be applied at an interval of three months avoiding application during the heavy monsoon period.

Manurial schedule for adult palms:

Fertilizer schedules for varieties and hybrids under rainfed conditions in Kerala and other regions are given below:

TABLE-I

For hybrids and high yielding varieties (all regions) Fertilizers in gm.

Time and application of fertilizers	Season					
	April - May			August - September		
	Urea / Am. Sulph.	Ultraphos / Super-phosphate	Muriate of potash	Urea / Am. sulph.	Ultraphos / Superphos.	Muriate of potash
3 months after planting				240 600	190/375	380
First year	240/600	190/375	380	480/1000	380/750	760
Second year	480/1200	380/750	760	965/2000	740/1450	1480
Third year and afterwards	720/2000	555/1110	1110	1450/3000	1110/2150	2220

TABLE - II

For ordinary variety (Kerala)

3 months after planting				85/185	120/240	125
First year	85/185	120/240	125	165/370	240/475	250
Second year	165/370	240/480	250	335/740	480/950	500
Third year and afterwards	250/550	375/720	400	500/1100	750/1425	700

TABLE - III

For ordinary variety in regions other than Kerala

3 months after planting				120/250	120/240	220
First year	120/250	120/240	220	240	235	440
Second year	240/600	235/470	445	480/1200	475/950	890
Third year and afterwards	360/800	355	465	720/1700	710/1420	1330

In addition to the fertilizers, dolomite at two kg. or magnesium sulphate 0·5 kg. plus lime at one kg. per palm per year may be applied in root (wilt) affected areas. Dolomite or lime may be broadcast in April-May and incorporated with the soil by ploughing. Magnesium sulphate can be applied along with other fertilizers in basins in September.

Organic matter deficient soils like sandy, sandy loam, laterite and/lateritic soils need judicious application of organic matter for high yields. Therefore, care must be taken to see that organic manures like green manure, farmyard manure or compost etc. may be added to bearing palms @ 50 kg. per year. In reclaimed soils of Kuttanad addition of silt is a common practice which is very useful, for sustaining high yields.

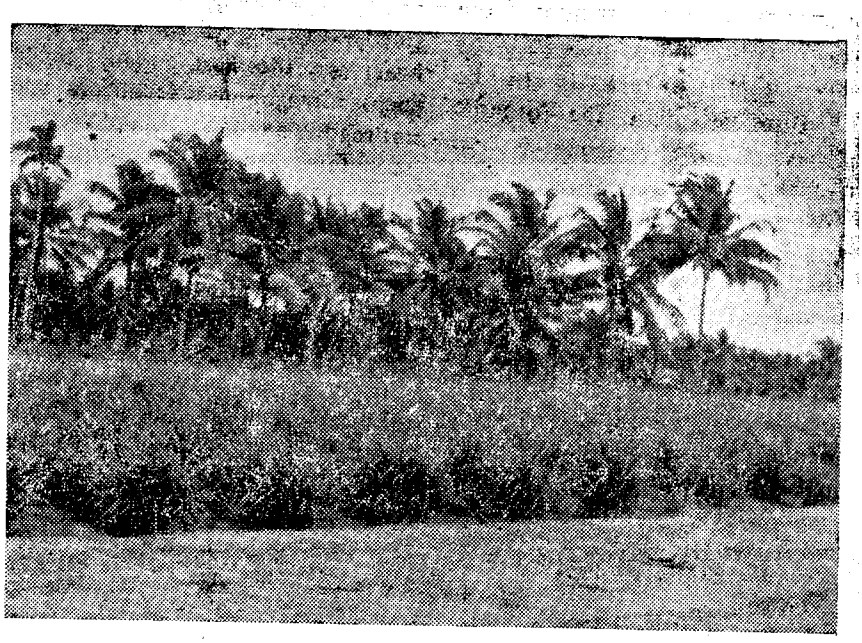
Intercultural operations:

There is a controversy among the experts over the usefulness of intercultivation in coconut gardens. Some are of the opinion that the response to intercultural operations like ploughing, tillage, etc. on coconut is due to their effect on controlling weeds in the garden which compete for nutrients and moisture. But others disagree with this opinion. All agree that the cultural operations should be adapted to the soil type and also the coconut gardens should be subjected to the 'minimum tillage' possible.

Ploughing, harrowing, hoeing, digging and piling of mounds and levelling are the common tillage operations in vogue. The soil should be cultivated when it contains proper amount of moisture.

Ploughing :

Ploughing is generally practised in light soils. Two ploughing in a year is optimum. The first ploughing is carried out in November



Growing Hybrid Napier as a mixed crop

or December after the heavy showers of monsoon. The second ploughing is done during April-May after the receipt of summer showers. Along with the second ploughing green manure seeds are also sown if the green manure crop is raised *in situ*. The plough depth may be from 15 to 20 cm. One or two hoeings is recommended in case of luxuriant weed growth. Ploughing with bullock is suited in gardens of average size and fewer intercrops. Tractor ploughing is suited in plantations.

Digging :

In heavy type of soil, digging is ideal. Digging is also practised in very small holdings and in mixed gardens. Cutting of surface roots, though do not harm the palm much, digging deep in such soil types should be avoided. November-December is the ideal months for digging. If digging the entire area is not possible, forking in the basins around a radius of 2·5 to 3·0 metres is recommended. If this is practised control of weeds is necessary by some other methods viz., chemical weed control etc.

Piling mounds and levelling :

This is an ideal operation in sandy and sandy loam soils. Piling mounds with spade to a height of about 30 cm. during September-October months is carried out. These mounds are levelled during December-January either by spades or mammatty or by ploughing.

In low-lying areas like Kuttanad tillage operation is not found to be much beneficial. A suitable cover crop is advantageous in these areas.

Burial of husk:

For coconut raised in unirrigated conditions and subject to drought, husk burial is highly beneficial, as the husk absorbs large quantity of moisture which it releases during summer months in addition to the supply of nutrients to a certain extent. Husk burying is usually done at the beginning of monsoon in linear trenches of 1·5 to 2 m. wide and about 0·3 to 0·5 m deep between the rows of palms. The trenches are taken against the slope of the land. The husks are arranged in layers with the spongy

inner side facing upwards. Each layer is covered with soil and the trench is finally closed and the soil worked over. Usually 500-1000 husk per tree will be sufficient for the purpose. The effect of this operation lasts for five to six years. The process may be repeated after that.

Cover cropping :

In order to prevent soil erosion in coconut gardens, cover cropping is recommended. This will add organic matter to the soil. Leguminous crops such as *Mimosa invisa, Stylosanthes gracilis and Calopogonium mucunoides* are recommended. Sunnhemp, Kolinji etc. can also be raised as green manure crops and ploughed under in August-September. Sowing of all the above crops can be done in April-May when pre-monsoon showers are received. This practice can be recommended in large plantation where the area is not intercropped.

Irrigation :

Coconut palm responds to irrigation which increases its yield considerably. Depending upon the soil type irrigation is carried out at proper intervals. In a loamy soil copious irrigation once a week is sufficient. For pure sandy soil types two irrigations in a week become necessary. Sea water can also be used for irrigation for all soil types except heavy soils. Sea water may be avoided for irrigating seedlings upto 2-3 years. According to the water source and machinery used for irrigation different methods are used. Flood irrigation is commonly followed in gardens where there are no permanent irrigation arrangements. Channel irrigation connected to the basins of the palms is suitable where permanent irrigation arrangements are available. A five H.P. motor is enough for irrigating 3-5 hectare area. Pot watering is resorted to in small holdings. An adult palm requires about 30 to 40 litres of water in a week. Hence irrigation may be adjusted accordingly. In sandy areas tube wells and filter points are recommended for irrigation. Sprinkler irrigation is also found to be beneficial.

Inter and mixed cropping :

Since the ordinary variety coconut requires about 8-10 years to attain normal bearing in order to obtain income from the farm, in order to increase net income per unit area intercropping in coconut gardens can be adopted. In young plantations pineapple, banana, elephantfoot yam, groundnut, chillies, sweet potatoes, tapioca etc. can be successfully growm. When intercrops are raised care must be taken to fertilise the intercrop and the main crop, separately and adequately. In older plantations mixed cropping may be attempted by growing cacao, pepper, cinnamon, nutmeg cloves etc. In places where the rainfall is not well distributed irrigation during the dry months has to be provided. However, these crops are to be adequately manured in addition to the manures applied to the coconuts.

Mixed farming :

Mixed farming by raising fodder grass such as hybrid napier or guinea grass along with leguminous fodder crops such as *Stylosanthes gracilis* has been found to be profitable. Raising the above crops in one hectare of coconut garden can support four to five milch cows. The animals also supply large quantities of cattle manure which when added back to the area improves the soil fertility considerably. Trials conducted at the Central Plantation Crops Research Institute, Regional Station, Kayamkulam have shown that by maintaining five milch cows in an area of one ha. of coconut garden an additional net income of Rs. 2,384/- per year could be obtained apart from the income from coconut. In addition it was also found that the vigour of the palms has markedly improved. Mixed farming, however, will be successful only where irrigation facilities exist.