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2. **Coconut Bulletin** (English) – English version of the **Pol Pawath.**
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COCONUT CULTIVATION



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R. Mahindapala
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COCONUT RESEARCH INSTITUTE OF SRI LANKA

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*Cover page: A well-managed coconut plantation.*
*Inset: Dwarf x tall (CRIC 65) hybrid coconut*

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# FOREWORD

by

## Vidya Nidhi Dr D V Liyanage

The expansion of coconut cultivation in Sri Lanka has been based on indigenous capital and enterprise. It has over the years developed from a plantation economy into a predominantly small-holder crop. The pioneers apparently selected land for coconut cultivation judiciously, but subsequently, palms have been grown throughout the country, irrespective of whether or not soil and climatic conditions are suitable for their propagation. Consequently, yield per unit area has varied considerably between localities resulting in a low national average. The national production has ranged from 1821 to 3039 million nuts per year, variations attributed largely to the amount and distribution of rainfall. The necessity to increase production to supply the requirements of a growing processing industry and domestic consumption of coconuts has been recognised for a long period. Hence the government has introduced a number of measures to improve the coconut industry,

The earliest amongst them was in relation to research. A Coconut Research Scheme was established in 1928 to conduct research on crop improvement. From very small beginnings without adequate staff and funds, it has developed into a national Institute, capable of advising the industry on all aspects of coconut cultivation. Applied research carried out by the Institute is presented in this guidebook - COCONUT CULTIVATION - for the benefit of estate and small-holder sectors.

Information on new varieties, nursery management practices, application of organic and inorganic fertilizers, pests and diseases, methods of increasing productivity from coconut holdings and management practices are described in the book in a concise and lucid manner together with over 50 illustrations. These could serve as a ready reference for field operations. The authors should be congratulated for the publication of this book.

If the recommendations given in the book, particularly those on soil moisture conservation and application of organic fertilizer combined with satisfactory management practices are adopted regularly by the coconut growers, national production could be maintained around 3000 million nuts per year from the existing stands of coconut palms. That will require a massive effort on the part of the extension services and a re-orientation of government subsidy policies on coconut development.

D V Liyanage

Colombo 5,
SRI LANKA.

12 April, 1991

# PREFACE

Coconut is ubiquitous in Sri Lanka. It is almost a 'social' crop and forms part of great traditions in the country. It is also the largest plantation crop. There are many kinds of coconut growers, ranging from small-holders to professional planters to 'portfolio' farmers, who occasionally visit their properties, mainly for recreation!

This book is offered in the hope of providing all coconut growers and part-time agriculturists with instructions on coconut cultivation. It is only a guidebook, and a conscious attempt has been made to present information in a simple and readable manner leaving out the scientific jargon. Wherever possible, drawings have been used to illustrate various practices. We have adopted the approach of indicating how things should be done without explaining why they should be done. Some readers may get a feeling of unreality, and may consider it a rebuff to the inquiring mind. To those, there are other CRI publications (see the back cover).

The Coconut Research Institute of Sri Lanka (CRISL) launched a five-year research programme in 1984 with emphasis on measures to alleviate drought effects and on reducing Cost of Production. This successful programme was followed up with a four-year research programme, currently in progress. It has been possible to incorporate in this book the recommendations arising from these research programmes.

The coconut production can be considerably increased by proper adoption of the cultivation practices given here. For obvious reasons, no attempt has been made on economic analyses of various recommendations, since cost and price factors fluctuate from time to time.

For a long time, coconut research has been funded by the state. This publication perhaps offers social accountability to these investments and to the industry's support to coconut research. It is our hope that the CRISL will continue to receive the necessary support for further improvement of the industry.

Whilst it is not the intention to blow our own trumpet, it is pertinent to note that amongst the coconut growing countries, the coconut yields per unit area is perhaps the highest in Sri Lanka - a tribute to growers, the state-sponsored development efforts and research. It is our fervent hope that this record will be maintained, in spite of various odds, and the industry will grow from strength to strength.

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May, 1991

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It is our pleasant duty to acknowledge the assistance of Dr R L de Silva, Dr U Pethiyagoda, Vidya Jyothi Mr P R Wijewardene, Mr T R Jayawardene, Mr B R T de Tissera, Mr Sumith de Silva and Vidya Nidhi Dr D V Liyanage for reading through the draft text. Their helpful comments, advice and encouragement are very much appreciated. Dr Liyanage also kindly wrote the Foreword. The encouragement and assistance of Mr Naomal S Dias and Mr J Alwis are also gratefully acknowledged.

We are grateful to Mr P M Somasirimudali for his untiring efforts with drawings. Mr M J C Perera's assistance in compiling the Index is gratefully acknowledged. Mr P S Liyanagama and Mr M R L A Perera have assisted us with information on plantation management aspects.

Figs. 2 and 56 have been obtained through the courtesy of the Surveyor General. Special thanks are due to Mr K Dayananda and his staff in the Map Publication Division.

Many others, too numerous to mention by name, have helped us in many ways. Some have sacrificed their valuable time - Mr Lakshman Fernando, Mrs Z Suhair and Miss U I Gunasekera in word-processing and Mr Neville Perera during various stages of the preparation. Had it not been for them, our task would have been difficult.

We are also grateful to Mr S M J Bandara of the Ministry of Plantation Industries and the USAID for financial assistance for publication of this book.

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Fig. 38 (b) - Mr D B Hettiarachchi
Figs. 16 (b, c, d & e), 38 (c & d) and cover page - R Mahindapala

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## CHAPTER 1

# INTRODUCTION - COCONUT IN SRI LANKA

### 1.1 The need to grow coconut

The Coconut palm is referred to as the "Tree of Life" and provides food, drink, shelter and materials for industries (Fig. 1).

The "nuts" (botanically termed drupe) provide

* milk (kernel extract) and milk powder for cooking,
* copra (dried kernel) from which edible oil is extracted, leaving coconut cake or poonac, which is a source of animal feed,
* desiccated coconut from the kernel,
* charcoal and activated carbon from the shell, and
* fibre from the husks.

The inflorescence sap provides

* toddy, a sugary drink which is a base for alcohol and vinegar production.

The stem provides

* fuelwood, and
* timber for construction and furniture.

The leaves provide

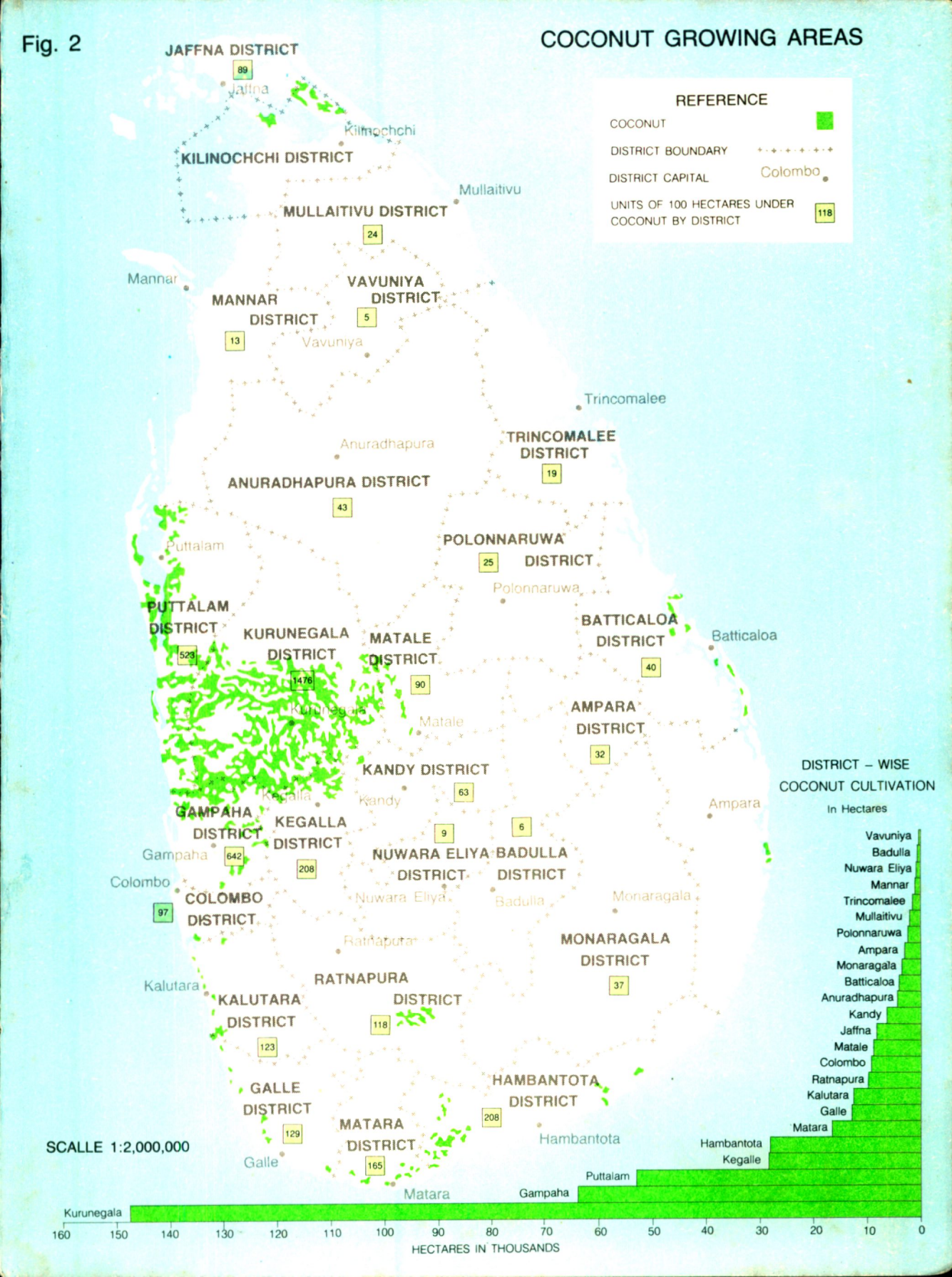
* thatching material, and
* ekels, used in brooms.

Coconut occupies about 412,550 ha (1,019,000 ac) of land and is the largest plantation crop in Sri Lanka. It is found in all administrative districts (Fig. 2).


*Fig. 1 Products from the Coconut Palm.*

Fig. 2

# COCONUT GROWING AREAS



Coconut is predominantly a small-holder crop with 75% of the area (309,400 ha) below 8 ha (20 ac). There are 700,000 small-holders. The estates sector [over 8 ha (20 ac)] is relatively small with only 103,150 ha of land. The Janatha Estates Development Board (JEDB) and the National Livestock Development Board (NLDB) are the two state-owned organisations with the largest area, owning between them 17,500 ha of coconut.

The coconut production in Sri Lanka has fluctuated widely during the last two decades. It has ranged from 1821 million nuts in 1977 to 3039 million nuts in 1986. This fluctuation is mainly due to adverse weather conditions.

Sri Lankans need coconut in their daily diet. The per capita consumption is 110 nuts/year, consisting of 90 nuts as fresh nuts and the rest as products. Based on this, about 1600 million nuts are locally consumed. Coconut is the main source of fat in the diet and provides about 22% of the daily caloric intake. Export earnings from coconut is considerable. The main items of export are desiccated coconut, coconut oil, copra and fibre. The value of exports during the period 1981 to 1990 has been about US$ 900 million.

Labour utilization in coconut cultivation is about 1 person for 4 ha, and is much lower than in tea and rubber. The processing sector is well developed. There are 54 desiccated coconut mills and 53 oil mills. About 800 fibre mills are known to exist. The processing sector employs about 42,000 persons. In all, total employment in the coconut sector - cultivation, processing, trading and other related activities - is likely to be at about 150,000 persons.

Some statistics relating to the coconut industry in Sri Lanka are given in Annexure 1.

## 1.2 Where to grow coconut

Coconut is grown in most parts of Sri Lanka excepting in the higher elevations but is concentrated in the coconut triangle in the Puttalam, Kurunegala, Gampaha, Colombo and Kalutara districts. It is cultivated in areas ranging from sea level upto an elevation of about 750 m.

Coconut is a light-loving tropical plant. It can tolerate a range of climatic conditions but performs well under the following conditions:

* **Temperature** - A mean annual temperature of 27°C is the ideal. At low temperatures (20°C) and under conditions of wide diurnal temperature variations, coconut yields are poor.

* **Rainfall** - Coconut requires an annual rainfall of at least 1500 mm (60"), spread uniformly throughout the year.

Long dry spells are harmful. Generally, the *tall* variety can tolerate a dry spell upto three months, but in the case of *dwarf* x *tall* hybrids, the dry spell should not exceed two months. Under such dry conditions, the growth of the palm is retarded and the yield reduced.

Heavy rain (350 mm or 14" / month) is of little value as most of it would be lost in run-off.

Coconut can withstand occasional water-logging for upto about seven days but in marshy areas, drainage should be provided.

* **Altitude** - Preferably less than 500 m. However, closer to the equator, coconut could be grown at higher altitudes.

* **Humidity** - Moderate relative humidity of about 80-90% is ideal. A dry atmosphere will cause water deficit in the soil.

* **Soil** - Coconut performs best in well-drained, deep sandy loam soils (about 30-40% clay, 25 to 50% silt and 25 to 50% sand), with plenty of organic matter, which enhances the water-holding capacity. Under good management, very satisfactory yields have been obtained in gravel soils, predominant in the intermediate and wet zones. The ideal soil pH is 5.5 to 7.5.

Traditionally, coconut cultivation has been undertaken as a matter of routine in many parts of the country. However, over the last two decades, the rainfall pattern in the country, particularly in the dry zone, has changed. The conditions in the dry zone are harsher than before, resulting in higher mortality of seedlings. In fact, some of these areas, eg. drier parts of the Puttalam and Hambantota districts, no longer appear to be suitable for rain-fed coconut. Extreme care, perseverance and much attention are required to establish coconut in these areas.

## CHAPTER 2

# THE COCONUT PALM AND ITS VARIETIES

### 2.1 Biology of the Coconut Palm

The coconut palm has a spreading root system, an unbranched stem, and an apical crown of leaves. It is a plant adapted to the humid tropics.

Roots are formed in the lower-most portion of the stem, called the bole, which is normally buried (Fig. 3). The number of roots in a coconut palm depends on soil conditions and vigour and range from 1500 - 8000. The greatest concentration of roots is in the top metre of the soil and within a radius of about 2 m from the base of the palm. Sometimes roots can grow much longer - in sandy soils they have been known to measure over 20 m (65') in length. The roots can tolerate salinity upto about that of sea water. Each root has a root-cap, and the thin wall just behind it forms the water absorbing region. It has no root hairs.

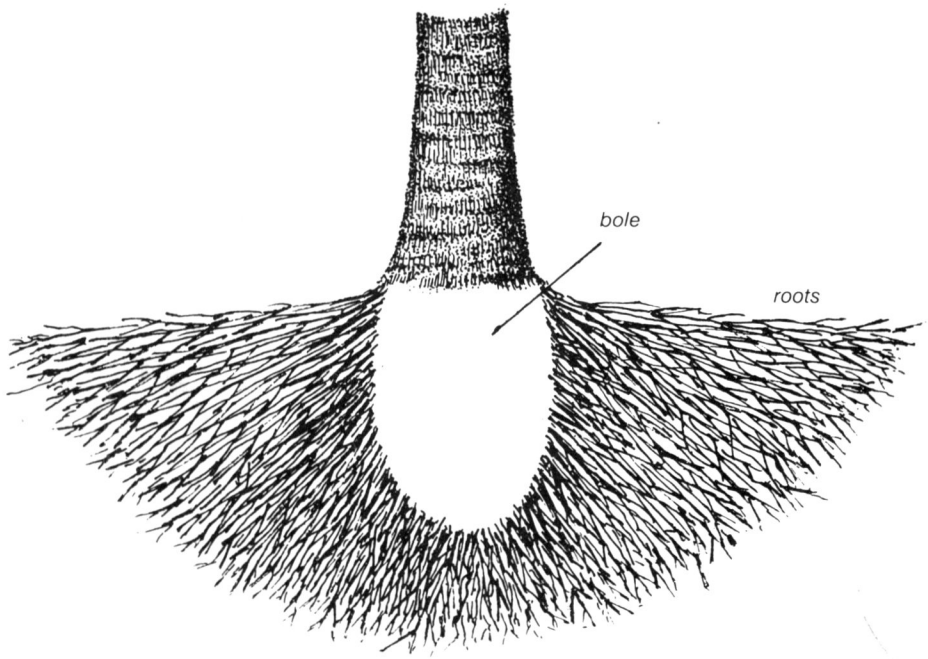



*Fig. 3 Bole and the root system of a coconut palm.*

The palm has a single terminal growing point. It contributes to stem elongation, formation of flowers and of nuts. It takes about 16 months from the initial formation of the flowers to their opening. Under favourable conditions, an adult palm produces 12 to 16 new leaves annually, with a corresponding flower cluster (inflorescence) [ Fig. 4]. In a healthy crown, there are 30 to 40 leaves. A mature leaf is 3 to 4 m in length and has 200-250 leaflets. A leaf remains on the palm for about three years. When leaves are shed, a permanent scar is left on the trunk.

A normal inflorescence may have 10 to 50 female flowers. Of them, 50 to 70% fall off and the balance develop into nuts, which will take about 12 months to mature.

The economic life of a coconut palm is about 60 to 70 years, although much older trees are known to exist and yield well. When senility is reached, the production is much reduced. Palms which regularly produce only 20 to 30 nuts per year due to senility should be replaced.

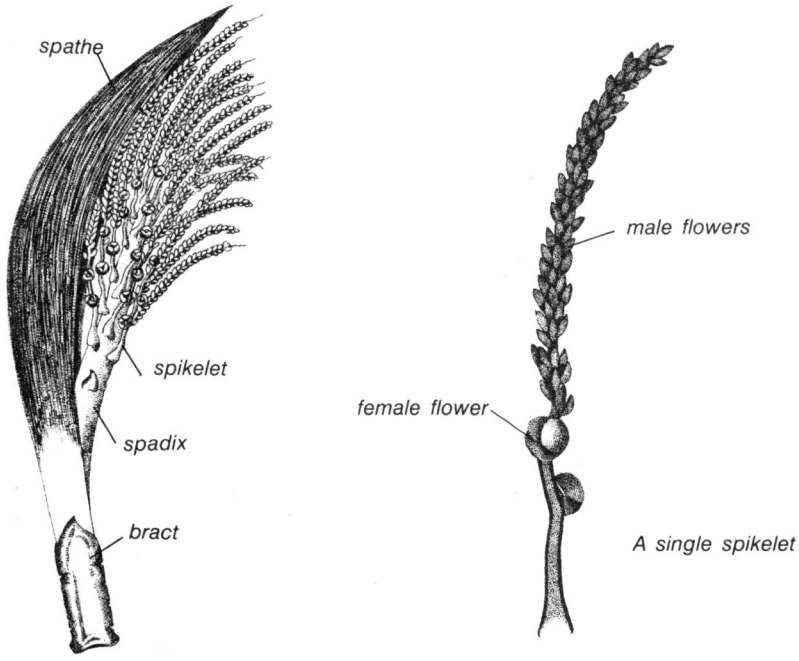



*Fig. 4 Inflorescence (flower cluster).*

The age of an adult palm can be determined from the number of leaf scars. Count the number of scars on the stem, divide it by 13 and add 7, which gives the approximate age of the palm in years.

## 2.2 Coconut Varieties

Coconut in Sri Lanka can be grouped into three varieties. They are:

(a) the commonly found tall variety (*typica*)
(b) the dwarf variety (*nana*)
(c) the king coconut variety (*aurantiaca*)

Almost all the commercially grown coconut belong to the tall variety. The dwarf variety is not grown commercially, but is used as a breeding material and occasionally grown as an ornamental plant. The king coconut variety is grown mainly for drinking.

Within each variety, there is considerable variability. Such types are called forms. Within the above three varieties, there are 13 forms of coconut. A brief description of their characters is given in Annexure 2.

## 2.3 Planting Material

In view of the long life span of the coconut palm, the growers should use the best seed available.

The Coconut Research Institute (CRI) has introduced two improved varieties of coconut.

They are:

1. CRIC 60 (*tall* x *tall* variety)
2. CRIC 65 (*dwarf* x *tall* variety)

**CRIC 60**

* A cross between selected tall forms.

* Flowers in 5 to 6 years, sometimes earlier, under good management.

* High-yielding, giving 15,000 to 20,000 nuts per ha per year (6,000 to 8,000/ac/year).

* Copra per nut about 225 g.

* A hardy plant suitable for cultivation in all areas where conditions are suitable for coconut cultivation.

**CRIC 65**

* A cross between selected dwarf and tall forms.

* Flowers early, in 3 to 4 years.

* High - yielding, as in CRIC 60.

* Copra per nut about 200 g.

* Requires a deep soil, continuous supply of water (and is therefore susceptible to drought) and needs good management.

* Ideal for home gardens or under irrigation or in wet areas.

The improved seednuts are produced in the seed gardens managed by the CRI at Rajakadaluwa (near Chilaw), Gonawila (near Pannala) and Bogaswewa (near Maduru Oya). The CRI is currently unable to provide Sri Lanka's entire requirement of seed with improved varieties, but when the seed gardens are in full production, this would be possible. The shortfall at present is met with seednuts from selected palms, called "plus palms".

**Plus palms** are above-average palms in blocks yielding over 9000 nuts/ha/yr.

They are chosen on the following criteria.

* Well-oriented leaves in the crown.

* Short-leaf and bunch stalks.

* Regular bearing, with at least 60 nuts/palm/year.

* Weight of wet kernel, 450 g or more.

* Weight of kernel per palm per year, 30 kg or more, and weight of copra at least 13.5 kg/palm/year.

The seedlings are raised in the nurseries of the Coconut Cultivation Board (CCB) located in many parts of the country (see Annexure 3 for a list of nurseries). Please contact your Coconut Development Officer or the Regional Office of the CCB for your requirement of seedlings. It is best that your requirement of seedlings is reserved well in advance.

## CHAPTER 3

# COCONUT NURSERY

Although seedlings are available in the nurseries of the Coconut Cultivation Board, estate owners may wish to raise their own seedlings. The Coconut Research Institute issues a limited quantity of seednuts of improved varieties for this purpose. However, a coconut nursery would need certain infrastructural facilities and management skills in order to raise quality seedlings.

Some important considerations in establishing a coconut nursery are given below:

### 3.1 Site Selection

* A flat land with well-drained, sandy or sandy loam soil is preferred.
* The site should be located near a reliable source of water.
* The nursery should not be heavily shaded.
* The nursery should be well protected from stray animals.
* The nursery should have access roads for heavy vehicles.

### 3.2 Seed Beds (Fig. 5)

* Seednuts should be laid in seed beds for germination.
* Seed beds should be about 150 cm (5') wide to accommodate five rows of seedlings for ease of watering and weeding. The length of the seed bed can vary, depending on convenience.
* Seed beds should be above the soil level by about 15-25 cm (6-9").
* Seed beds should be separated by shallow drains to remove excess water.
* Trenches, 25 cm (9") wide and 15 cm (6") deep should be cut on the seed bed. The gap between trenches should be 45 cm (18").

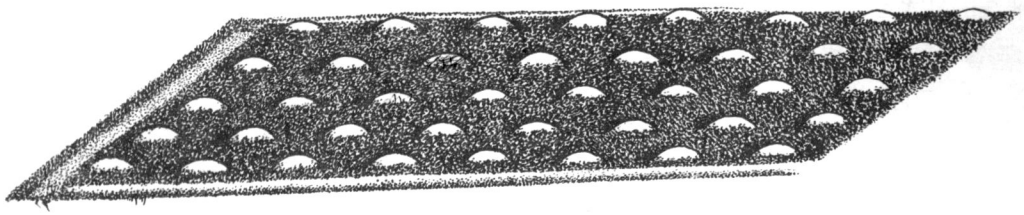


*Fig. 5 A seed bed. Note the position of seednuts.*

### 3.3 Laying of Seednuts

* Seednuts should be ripe, as indicated by the brownish colour of the nut.
* Seednuts should be laid horizontally on the broader side, in the trenches.
* Afterwards, seednuts should be covered with soil, leaving about 1 cm above the surface.
* Seednuts should be laid in rows keeping a distance of 15 cm (6") from one nut to the next.
* All seednuts should be oriented length-wise pointing in one direction. However, in the adjacent row, they should be positioned alternately.

A nursery of one hectare can raise about 50,000 seedlings (20,000/acre).

**Note:** A pre-nursery is not normally recommended. However, if poly-bagged seedlings are to be raised, a pre-nursery to select sprouted nuts is useful. In a pre-nursery, the trenches can be 15 cm (6") apart and the seednuts can be just 5 cm (2") apart to save space, as the nuts should be removed soon after sprouting. Seednuts can also be placed vertically (particularly recommended for poly-bagging) but they should be watered regularly as vertically-placed nuts can suffer from drought due to the fact that nut water is not in contact with the embryo.

### 3.4 Nursery Care

* Nursery should be shaded lightly. Nitrogen-fixing trees are ideal for this purpose.
* Regular watering is necessary during dry weather. Watering should commence if there is no rain continuously for six days and continued at three-day intervals.

* Mulching is necessary to prevent drying of the top soil and to reduce weed growth. Coconut fronds can be used for this purpose.

* The nursery bed should be free of weeds.

* Regularly examine seedlings for insect damage. The common problem is termite. Please see the section on pest control.

* Leaf blight and collar rot are common diseases in nurseries. Prevent collar rot by avoiding deep planting. Use a copper-based fungicide to control leaf blight.

* Fertilizer - The seednut contains adequate nutrients for germination and seedling development. However, for a healthier seedling, fertilizer would be useful. Also, if a nursery bed had been used continuously, application of fertilizer is recommended. The suggested mixture is:

| | | |
|---|---|---|
| Urea | - | 1.5 parts |
| Muriate of potash | - | 1.5 parts |
| Conc. Superphosphate | - | 1 part |
| Kieserite | - | 1 part |

Broadcast fertilizer at the rate of about 70 g/seedling, six months after laying seednuts. Afterwards, depending on the circumstances, monthly application of fertilizer at the same rate may be carried out.

Under satisfactory soil, climatic and management practices, over 80% of the seednuts laid should have germinated at five months from laying. At this point, non-germinations should be removed. Under very good ground conditions, 80% germination could be achieved in less than five months. Then, non-germinations should be removed once the 80% germination level is reached.

### 3.5 Poly-bagged Seedlings

Poly-bagged coconut seedlings is a recent introduction (Fig. 6).

Lay the seednuts vertically in a pre-nursery. When the sprout is about 2.5 cm (1") ("crow's beak stage"), the nuts are ready for poly-bagging.

* Use gusseted bags, made of black polythene of 500-750 gauge thickness. A convenient size is 45 cm (18") wide (laid flat with the gusset drawn out) and 40 cm (16") height. The circumference of the bag when filled, is about 90 cm (40").

* Fill the bags with a mixture containing 3 parts of coir dust, 2 parts of soil and 1 part of cattle manure.

* Place the sprouted nut upright, so that the upper surface of the nut is barely visible. Such polybags can be kept close to each other for about a month. Thereafter, they should be separated by about 75 cm (2.5') and arranged in a triangular manner to allow free growth of seedlings.

* Poly-bagged seedlings should be watered at least once in two days during dry weather. About 30 g of the fertilizer mixture, indicated earlier for the nursery, should be applied once a month to the top layer of the soil and incorporated. Water the seedlings after fertilizer application.

A limited number of poly-bagged seedlings of improved varieties is available in the nursery of the CRI. The advantages of poly-bagged seedlings are:

* They establish well, since there is no root damage at transplanting,

* field mortality is low,

* flowers early, and

* plants can be kept in poly-bags for infilling.

Poly-bagged seedlings usually cost more than the normal seedlings.

Please contact the Director, CRI or the nearest Regional Office of the CCB for your requirements of poly-bagged seedlings.

*Fig. 6 (a) Poly-bagged seedlings in a nursery.*


*Fig. 6 (b) A poly-bagged seedling ready for planting.*

## 3.6 Select a good seedling

Selection of good quality seedlings is one of the most important aspects in planting. Normally, a seedling is ready for planting at about seven months from laying of the seednut in the nursery, when there are three well-developed leaves (Fig. 7). Other characters of a good seedling are:

* Early germination,
* stout stem,
* dark green leaves,
* broad, well-spread leaves,
* short petiole,
* early splitting of leaves, and
* large number of roots.


*Fig. 7 A well-developed good seedling* ***(a)*** *and an unsuitable seedling* ***(b).***

## CHAPTER 4

# PLANTING

The land should be prepared to check soil erosion, drain away stagnant water and to conserve soil fertility.

Coconut should not be planted in slopes steeper than 1 in 10.

Planting programme must be well-timed and seedlings must be available with the onset of the rains. In areas receiving the south-west monsoon (May / June), it is preferable to plant during that period as the plants would have established well to receive the full benefits of the subsequent north-east rains (October / November).

### 4.1 Plant Density

Plant density is determined by the agro-climatic zone in which your land is situated, as given below.

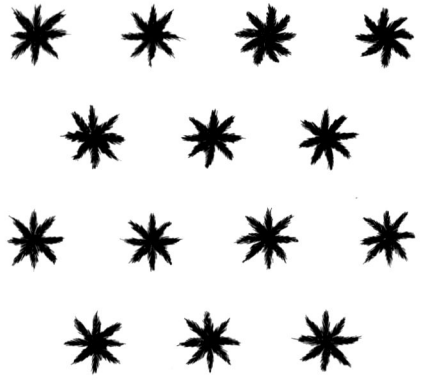
| Agroclimatic zone | Rainfall mm | No. of palms per hectare | No. of palms per acre |
|---|---|---|---|
| Wet Zone | over 1875 | 170 - 195 | 70 - 80 |
| Intermediate | | | |
| Semi-wet | 1500 - 1875 | 180 - 195 | 70 - 80 |
| Semi-dry | 1000 - 1500 | 195 - 210 | 80 - 85 |
| Dry Zone | less than 1000 | 210 - 220 | 85 - 90 |

### 4.2 Planting System

This is important as the grower must decide whether coconut will be grown as a monocrop or with other crops. If it is to be a monocrop, the maximum number of plants should be planted to utilize the entire land area.

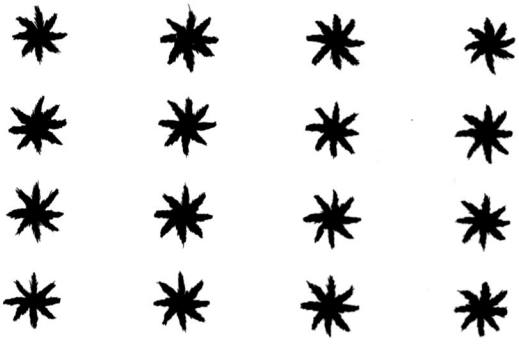
If the soil is good, and moisture is not limiting, another crop (intercrop) could be planted between coconuts to maximise land use. Generally, this is possible in the wet zone and in the wet intermediate zone.

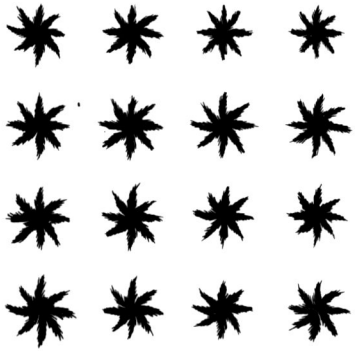
For a mono-crop, use triangular or square planting. For intercropping, use the rectangular system (Fig. 8) with wider rows oriented east-west to obtain maximum sunlight.



*(a) triangular planting*

*(b) rectangular planting*





*(c) square planting*

*Fig. 8 Planting Systems*

The required densities could be achieved as indicated in Table 1.

## 4.3 How to plant a seedling

Once the planting system has been decided upon the planting holes should be dug out after lining.

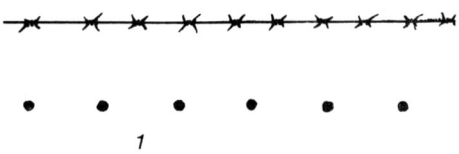
### Lining in the field

Lining is done using a marked rope. Marking out for 8 m triangular planting is illustrated below.

Requirements: Tape and a rope (about 30 m).

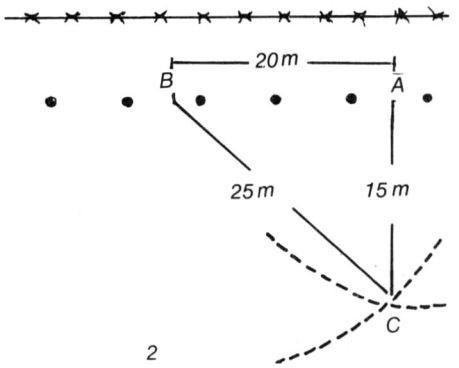
(Two persons can line about 2 ha/day).

**Step 1:** Mark the base line about 4 m from the boundary of the land. On this line, mark planting points (with pegs) at 8 m intervals.




**Step 2:** Mark a line perpendicular to the base line as follows:

Select a point (A) on the base line and mark the point 20 m (B) on the base line. Then mark the converging point (C) 25 m from B and 15 m from A. Mark the perpendicular line by joining A and C. This line would be a reference line to adjust planting points.




**Step 3:** Use a 16 m rope with a peg at the centre. Place the two free ends of the rope at two adjacent planting points on the base line and mark the planting point on the triangle on the next line.

**Step 4:** Every fith row, check and adjust the planting points using the perpendicular reference line.

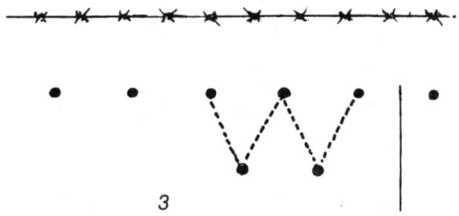


**Table 1 -** *Planting densities and Systems*

1. **Equilateral triangular planting**

| *Density / ha* | *Spacing (m)* |
|---|---|
| 170 | 8.2 x 8.2 x 8.2 |
| 175 | 8.1 x 8.1 x 8.1 |
| 180 | 8.0 x 8.0 x 8.0 |
| 200 | 7.4 x 7.4 x 7.4 |

2. **Square planting**

| *Density / ha* | *Spacing (m)* |
|---|---|
| 170 | 7.7 x 7.7 |
| 175 | 7.6 x 7.6 |
| 180 | 7.5 x 7.5 |
| 190 | 7.3 x 7.3 |
| 200 | 7.0 x 7.0 |

3. **Rectangular planting**

| *Density / ha* | *Spacing (m)* |
|---|---|
| 170 | 7.0 x 8.5 |
| | OR |
| | 6.5 x 9.0 |
| 180 | 7.0 x 7.9 |
| | OR |
| | 6.5 x 8.5 |
| 190 | 6.5 x 8.1 |
| 200 | 6.5 x 7.7 |
| | OR |
| | 5.0 x 10.0* |

* Avenue planting, with large inter-row space, provides ample opportunity for intercropping throughout.

## Size of the planting hole

| | |
|---|---|
| in gravelly soil | - 0.9 x 0.9 x 0.9 m (3 x 3 x 3 ft) |
| in loamy and sandy soils | - 0.6 x 0.6 x 0.6 m (2 x 2 x 2 ft) |

Arrnage two layers of husks or coir dust as illustrated in Fig. 9. Fill the seed hole with topsoil mixed with 1 kg of dolomite and 1 kg of the Young Palm Fertilizer Mixture (YPM).

## Young Palm Fertilizer Mixture (YPM)

| | | |
|---|---|---|
| Urea | - | 2 parts by weight |
| Saphosphosphate | - | 3 parts by weight |
| Muriate of potash | - | 2 parts by weight |

In addition, incorporation of organic manure (eg. 5 kg wood ash, and 10 kg dry cattle manure or 5 kg of goat manure) would be beneficial. In well-drained soils, plant seedlings at a depth of 20 cm (8"). In ill-drained soils, plant at ground level. Always keep the collar region exposed (Fig. 9).

Prior to planting, immerse the seednut in a recommended insecticide solution to prevent termite attacks.

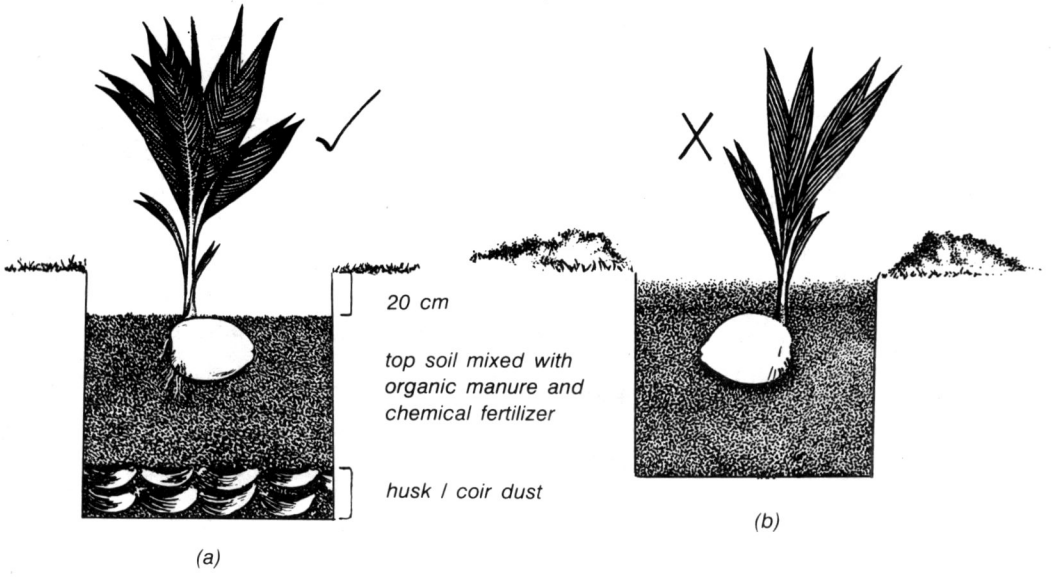



*Fig. 9 Method of planting*
*(a) Correct planting.*
*(b) Incorrect planting (note buried collar).*

## 4.4 After-care

Mulch the base of seedlings with coconut husks, leaves, salvinia etc. Irrigate during dry weather at the rate of 20 litres/seedling twice a week.

Look out for pest attacks, particularly those of termites and collar rot.

Weeds, particularly those close to the seedling should be removed.

Carry out agricultural practices to improve the fertility and water-holding capacity of the soil. Grow leguminous cover crops, gliricida etc. and bury the loppings regularly to enhance the fertility and organic matter content of the soil. Whenever possible, use organic manures such as cattle manure, goat manure and poultry litter.

## 4.5 Fertilizer application

The Young Palm Fertilizer Mixture should be applied once in every 6 months up to bearing. Rates of YPM required are as follows:

| Time after transplant | YPM (g) |
|---|---|
| 6 months | 500 |
| 1 year | 600 |
| 1 1/2 years | 600 |
| 2 years | 800 |
| 2 1/2 years | 800 |
| 3 years | 1000 |
| 3 1/2 years | 1000 |
| 4 years and upto bearing | 1200 every 6 months |

In fertile soils, the dosage may be reduced by upto 25%.

Apply dolomite annually at the rate of 500 g per palm, commencing one year after planting.

For palms upto 1 1/2 years, broadcast the mixture close to the base upto 0.3 m (1') and incorporate it into the soil. As the palm grows older, extend the area upto about 1.5 m (5') at flowering.

## 4.6 Pest Control and Plant Sanitation

In young palms, great care must be taken to avoid attacks of the Black Beetle and the Red Weevil. In the case of the Black Beetle, plants should be examined regularly. Breeding places (rotting logs, decaying vegetable matter) should be destroyed. Avoid injuries to young palm stems to prevent Red Weevil attacks.

## 4.7 Pitcher Irrigation

Seedling growth can be enhanced by providing pitcher irrigation. This practice is particularly helpful in the dry and dry intermediate zones where field mortality of seedlings due to dry weather can be rather high.

* Bury two unglazed clay pots on either side of the plant. Even a single pot is very useful.

* The capacity of the pot should be about 15 to 20 litres (about 4 gallons).

* Paint one side of the pot so that water will not seep through.

* Bury them 0.7 m (2 1/2") away from the plant, with the painted surface away from the plant (Fig. 10).

* Keep the mouth of the pot closed, and top up the pot regularly. Generally, during dry weather, it may be necessary to fill it up twice a week.

## 4.8 Moisture Conservation

Traditionally in Sri Lanka, moisture conservation practices such as buring of husk and coir dust are carried out in areas with adult palms. However, these practices are equally or more important in the young stages as well.

The advantages of moisture conservation during early stages are:

* growth is accelerated.

* early flowering takes place.

* a plantation with even growth will result.

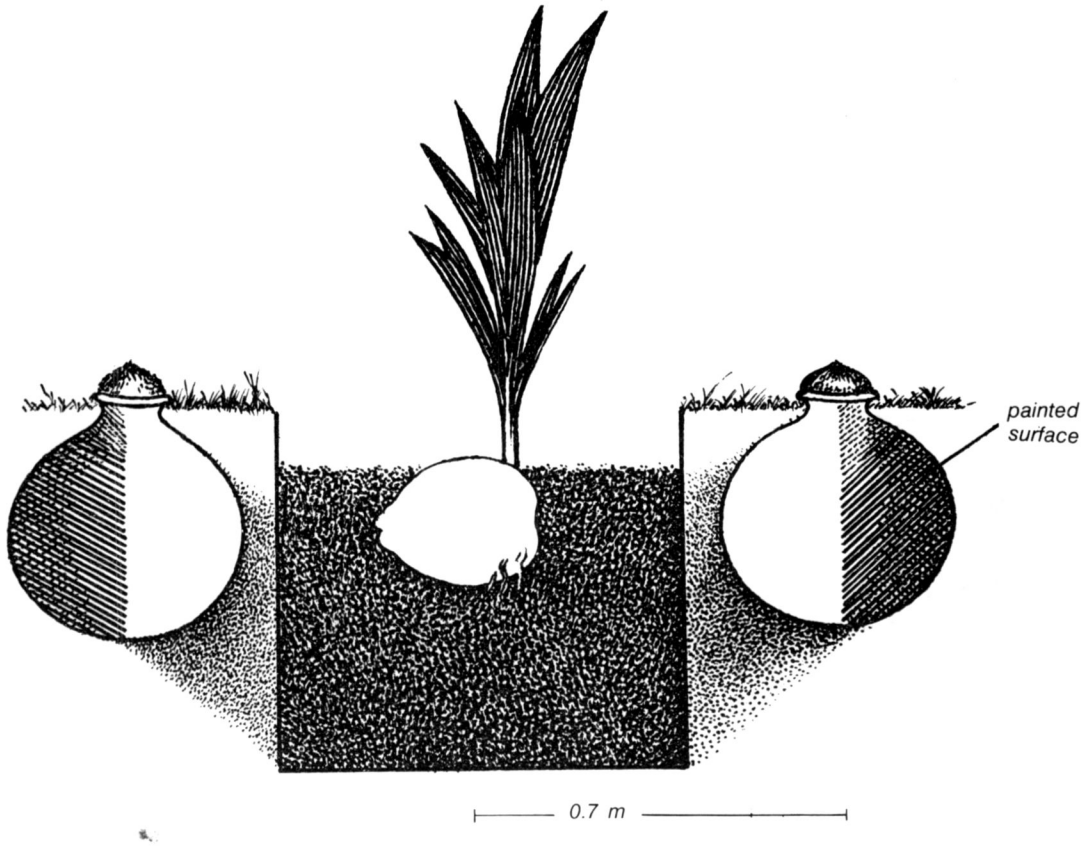



*Fig. 10 Pitcher irrigation.*

The seedlings and young palms have a limited root spread. If these roots are to benefit by moisture conservation, it is necessary to have husk/coir dust pits for individual seedlings/young palms in close proximity to the seedling. Since husk/coir dust in the planting hole can conserve moisture in the first year, individual pits may be established from the second or third year onwards.

* Provide semi-circular pits, about 1 m (3') away from the seedling (Fig. 11).

* The depth of the pit should be about 0.6 m (2") and the width also 0.6 m (2'). A pit extending about half the circle is ideal, but depending on the resources available, it may be made shorter.

* Fill with either husks or coir dust, as described elsewhere (see section 7.4.3.).

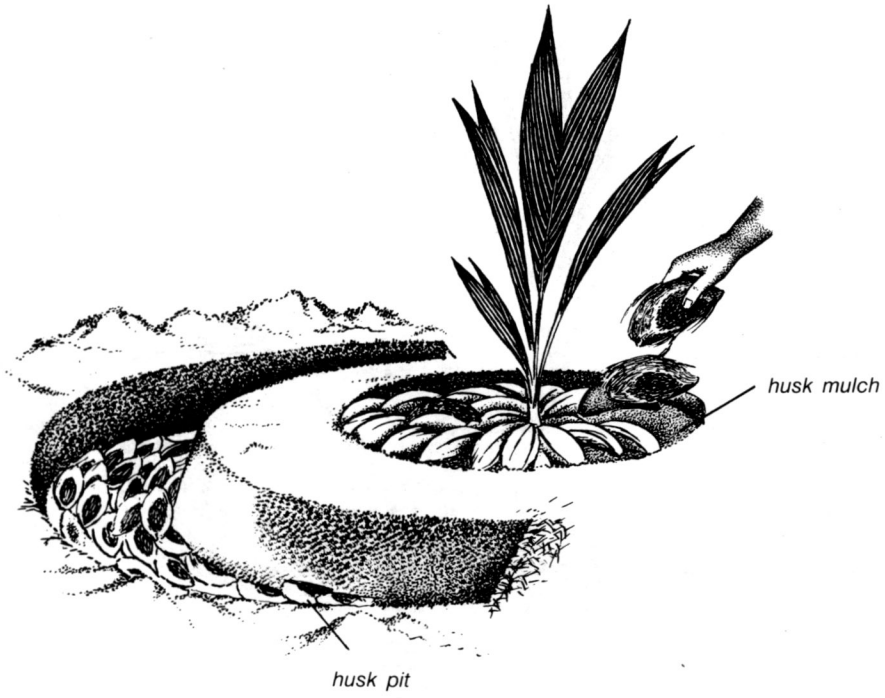



*Fig. 11* *Semi-circular pits for moisture conservation. Either husks or fibre dust can be buried in these pits. Also, note mulching with husks.*

* This practice should be a continuous programme and every year husk/coir dust burial can be undertaken in a portion of the area surrounding the seedling / young palm. Depending on the size of the pit, the entire circle around the palm will have husk or coir dust buried in two to three years. As the seedlings get older, the pit should be gradually moved out, say, 1 m during the year 2, 1.5 m during year 3 and 4, and 2 m thereafter.

## CHAPTER 5

# DEVELOPMENT OF UNPRODUCTIVE COCONUT STANDS

Coconut stands become uneconomical to manage due to a variety of reasons.

* Old age. Generally, trees after about 60 years decline due to senility.
* Long-term neglect, particularly without fertilizer.
* Continuous exposure to adverse conditions - lack of soil moisture, poor soils etc.

It is observed that the senile palm population in Sri Lanka is much higher than desired. Growers generally do not replace them in time, and this contributes to the low production levels seen. In order to maintain the profitability of a plantation, timely replacement of senile palms is essential.

### 5.1 Methods of replacing unproductive palms

Two options are available for the grower to replace unproductive coconut stands. They are:

1. Under-planting - Where seedlings are planted amongst the old stand, which is removed in stages over a period of about 5-6 years.
2. Re-planting - Seedlings are planted after the complete removal of the old stand.

Advantages and disadvantages of these two systems are given below.

| *Under-planting* | *Re-planting* |
|---|---|
| * Old stand provides some income until the new plants bear fruit. | * No regular income. |
| * Income from trunks over a period. | * Once-and-for-all income from tree trunks. |

| | |
|---|---|
| * Intercropping almost impossible. | * Intercropping can be done profitably. |
| * In practice, growers do not remove old palms in time. As a result, flowering of the young palms is delayed. | * Early flowering and early bearing. Uniform plantation. |
| | * Allows change of planting system / density. |

RE-PLANTING IS THE RECOMMENDED METHOD WHICH IS AGRONOMICALLY SUPERIOR. UNDER-PLANTING GIVES A CONTINUOUS INCOME BUT IS A RELATIVELY POOR SUBSTITUTE.

## 5.2. Re-planting

Larger holdings should undertake replanting as a matter of policy. Replanting could be staggered over a period of time, depending on the resources available, by adopting a block-by-block replanting approach. This would also allow the grower to selectively thin out poor palms at the age of about 10 years or more.

* **Remove old trees. Some growers prefer to remove the old trees with the bole. This is costlier, and is not essential.**

* Trunks can be cut at ground level. Growers often cut trunks about 0.5 m above ground level, leaving a stump. Such stumps can be a breeding ground for Black Beetle and should be avoided.

* Even after cutting at ground level, the remnants should be periodically inspected for any Black Beetle activity. If Black Beetles are suspected, the bole should either be burnt or treated with an insecticide.

* Seedlings should be planted as in a new planting (sections 4.3 to 4.8).

* Establish an intercrop which will provide an income during the first few years (see section 9.15 for a crop model for the intermediate zone).

## 5.3 Under-planting

Although the agronomic superiority of replanting is obvious, growers often prefer under-planting because of economic considerations.

If under-planting is to be attempted, follow the guidelines given below:

* Line the area for under-planting, and mark the planting holes.

* Remove poor trees, and those which are within 2 m (6') of the newly-marked planting holes. Generally about 20% of the trees would be removed at the time of planting.

* Progressively remove the old stand by annually removing the poorer trees as follows:

| | | |
|---|---|---|
| 1st year after planting | - | 15% |
| 2nd year after planting | - | 15% |
| 3rd year after planting | - | 20% |
| 4th year after planting | - | 20% |
| 5th year after planting | - | remaining trees |

If annual removal of the old stand is difficult, the following schedule may be adopted.

| | | |
|---|---|---|
| 2nd year after planting | - | 30% |
| 4th year after planting | - | 40% |
| 6th year after platning | - | remaining trees |

If the new seedlings show promise, these schedules should be advanced. On no account should they be extended.

* When felling old trees, ensure that the young palms are not damaged.

## CHAPTER 6

# FERTILIZER FOR COCONUT

### 6.1 The need for fertilizer

The coconut palm requires a regular supply of nutrients to compensate for the loss of nutrients through the removal of harvested nuts, fronds etc. from the holding. After each pick, the nuts, and sometimes husks, are taken away from the estate. In some properties, fallen fronds, flower stalks etc. too are sold or allowed to be taken out. These contribute to the loss of valuable nutrients, as shown in Table 2.

**Table 2** - *Annual removal of nutrients from a coconut plantation having 150 palms/ha.*

*(a) At a production level of 7500 nuts/ha/year (50 nuts/palm/year).*

| *Component* | | *Amount removed (kg)* | | | |
|---|---|---|---|---|---|
| | | *Nitrogen* | *Phosphorus* | *Potassium* | *Magnesium* |
| 1. | Flower parts | 2 | 1 | 1 | 1 |
| 2. | Frond | | | | |
| | a. Petiole | 11 | 7 | 7 | 11 |
| | b. Leaflets | 54 | 3 | 32 | 8 |
| 3. | Nut | | | | |
| | a. Husk | 2 | 3 | 45 | 6 |
| | b. Shell & Kernel | 42 | 6 | 11 | 4 |
| | c. Nut Water | 4 | 1 | 36 | 3 |
| | **Total** | **115** | **21** | **132** | **33** |

The above amounts correspond to 250 kg of urea, 175 kg of saphosphosphate, 265 kg of muriate of potash and 270 kg of dolomite/kieserite.

*(b) At a Production Level of 15,000 nuts/ha/year (100 nuts/palm/year)*

| *Component* | *Amount removed (kg)* | | | |
|---|---|---|---|---|
| | *Nitrogen* | *Phosphorus* | *Potassium* | *Magnesium* |
| 1. Flower parts | 2 | 1 | 1 | 1 |
| 2. Frond | | | | |
| a. Petiole | 11 | 7 | 7 | 11 |
| b. Leaflets | 54 | 3 | 32 | 8 |
| 3. Nut | | | | |
| a. Husk | 4 | 6 | 90 | 12 |
| b. Shell & Kernel | 84 | 12 | 22 | 8 |
| c. Nut Water | 8 | 2 | 72 | 6 |
| **Total** | **163** | **31** | **224** | **46** |

The above amounts correspond to 354 kg of urea, 258 kg of saphosphosphate, 450 kg of muriate of potash and 380 kg of dolomite/kieserite.

The nutrients removed in this manner could be replenished by chemical (often called 'inorganic') and organic fertilizers.

In Sri Lanka, potassium and magnesium are often found to be deficient, thereby limiting production.

## 6.2 Chemical fertilizers

The sources of chemical fertilizer are as follows:

| | | |
|---|---|---|
| Nitrogen (N) | - | Urea |
| Phosphorus (P) | - | Eppawala apatite (30% $P_2O_5$)<br>and/or<br>Imported Saphosphosphate<br>(27.5% $P_2O_5$) |

| | | |
|---|---|---|
| Potassium (K) | - | Muriate of potash (60% $K_2O$) |
| Magnesium (Mg) | - | Dolomite (20% MgO)<br>Kieserite (24% MgO) |

Eppawala apatite and dolomite are locally available but others are imported.

### 6.3 Fertilizer mixtures

The CRI recommends two fertilizer packages for adult coconut palms. Both packages will provide the same quantity of nutrients.

(a) ***Adult Palm Mixture (APM) (12-6-32)***

| | | |
|---|---|---|
| Urea | - | 4 parts by weight |
| Saphosphosphate | - | 3 parts by weight |
| Muriate of potash | - | 8 parts by weight |

(Dolomite to be applied separately)

The following table may be used as a guide in determining the appropriate dose for blocks yielding around 7500 nuts/ha/year (3000 nuts/ac/yr).

| *Agroclimatic zone* | *Soil type* | *Dose (kg/palm/year)* |
|---|---|---|
| Wet Zone | Gravel/cabook, sand | 3 |
| | Loam or clay | 2 |
| Intermediate Zone | Gravel or sand | 3 |
| | Loam or clay | 2 |
| Dry Zone | Gravel | 3 |
| | Loam or clay | 2 |
| | Sand | 2.5 |

For improved varieties (CRIC 60 and CRIC 65) and high yielding blocks use 1 1/2 times the above doses.

In addition apply dolomite annually, at the rate of 1 kg/palm. THIS IS VERY IMPORTANT.

**Application time**: When the soil is moist. In light soils after the heavy rains are over.

(b) ***Adult Coconut Mixture (ACM) (0-6 -32-5)***

ACM is a recent introduction. The advantages of using ACM are : (a) it will regularly supply magnesium, (b) can be applied when labour is available, and (c) will complement organic manures.

| | | |
|---|---|---|
| Eppawala Rock phosphate | - | 3 parts by weight |
| Saphosphosphate | - | 3 parts by weight |
| Muriate of potash | - | 16 parts by weight |
| Dolomite | - | 8 parts by weight |

**Application time**: This mixture can be applied any time of the year. Urea should be applied when the soil is moist. The following table may be used as a guide in determining the appropriate doses for blocks yielding around 7500 nuts/ha/yr (3000 nuts/ac/yr).

| *Agroclimatic Zone* | *Soil type* | *Dose (kg/palm/year)* | |
|---|---|---|---|
| | | Adult Coconut Mixture (ACM) | Urea (46% N) |
| Wet | Gravel, cabook, sand | 3 | 0.8 |
| | Loam, clay | 2 | 0.5 |
| Intermediate | Gravel, sand | 3 | 0.8 |
| | Loam, clay | 2 | 0.5 |
| Dry | Gravel | 3 | 0.8 |
| | Loam, clay | 2 | 0.5 |
| | Sand | 2.5 | 0.7 |

Instead of urea, organic manures/green manures could be used as indicated below, to obtain the nitrogen requirement of the coconut palms.

| *Urea* (kg) | Equivalent rate of organic manure (kg) | | | |
|---|---|---|---|---|
| | *Cattle manure* | *Goat manure* | *Poultry droppings* | *Fresh Gliricidia leaves* |
| 0.5 | 25 | 10 | 20 | 20 |
| 0.7 | 30 | 12 | 25 | 25 |
| 0.8 | 35 | 15 | 30 | 30 |

Please see Tables 3 and 4 for convenient measurement of organic and chemical fertilizers.

**Table 3** - *Amount of organic manure held by different containers*

| *Organic Manure (air -dried)* | *Cane Basket (42 cm dia.; 18 cm height)* | *Plastic bucket (25 cm dia.; (25 cm height)* | *Fertilizer Bag (55 cm width; 77 cm height)* |
|---|---|---|---|
| Cattle manure | 3.50 kg | 1.75 kg | 11.50 kg |
| Goat manure | 6.00 kg | 3.00 kg | 14.50 kg |
| Poultry droppings | 5.50 kg | 3.25 kg | 18.00 kg |
| Kitchen Ash | 6.50 kg | 3.50 kg | 28.00 kg |

### 6.4. Application of fertilizer (Fig. 12)

**Adult Palm Mixture**: Slash excessive weeds leaving about 6" stubble. Broadcast mixture upto a distance of 1.75 m (about 6') from the base and lightly dibble in to incorporate. Mulch well with weed trash, fronds etc. Dolomite should be applied separately.

**Adult Coconut Mixture**: Could be applied anytime of the year. Slash excessive weeds. Broadcast as above, but digging is not necessary. Mulch well.

Apply urea when the soil is moist. Broadcast urea over decayed mulch, lightly work into the soil and mulch well (Fig. 13).

MULCHING AFTER THE APPLICATION OF FERTILIZER IS VERY IMPORTANT TO AVOID LOSS OF NUTRIENTS.

**Table 4 -** *Amount of chemical fertilizer held by different containers (Quantity rounded off and given in grammes)*

| *Fertilizer* | *Coconut Shell (upto brim) Approx. 11.5 cm dia.* | *Condensed Milk Tin (upto brim) 7.5 cm dia.* | *Small Sardine Tin (upto brim 5.5 cm dia.* | *Big Sardine Tin (upto brim) 7.5 cm dia.* | *Handful* (Medium Hand)* | *Table Spoon* (Full)* |
|---|---|---|---|---|---|---|
| Young Palm Mixture YPM (13-12-17) | 375 | 300 | 175 | 425 | 225 | 45 |
| Adult Palm Mixture APM (12-6-32) | 375 | 275 | 150 | 400 | 200 | 45 |
| Adult Coconut Mixture ACM (0-6-32-5) | 500 | 375 | 200 | 525 | 275 | 65 |
| Urea (46% N) | 300 | 250 | 125 | 325 | 60 | 30 |
| Ammonium sulphate (20.6% N) | 425 | 325 | 175 | 450 | 125 | 30 |
| Saphosphosphate (27.5% $P_2O_5$) | 425 | 350 | 200 | 500 | 250 | 50 |
| Eppawala rock phosphate (30% $P_2O_5$) | 550 | 425 | 225 | 600 | 325 | 70 |
| Triple superphosphate (46% $P_2O_5$) | 425 | 300 | 175 | 425 | 100 | 25 |
| Muriate of potash (60% $K_2O$) | 425 | 325 | 175 | 475 | 125 | 45 |
| Dolomite (20% MgO) | 600 | 475 | 250 | 675 | 400 | 60 |
| Kieserite (24% MgO) | 525 | 400 | 225 | 575 | 225 | 40 |

* Given for reference purpose only.

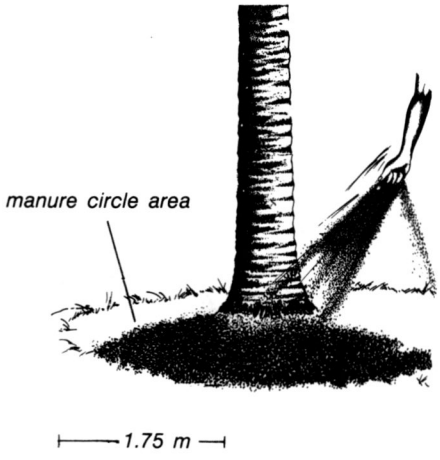



*Fig. 12* *Broadcasting fertilizer within the manure circle.*

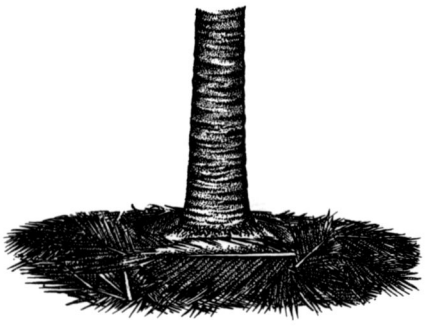


*Fig. 13* *Manure circle area mulched with coconut fronds after fertilizer application.*

## 6.5 Differential Fertilizer Recommendation

The CRI has introduced Differential Fertilizer Recommendation (DFR) for estate sector based on soil and leaf analysis. Here the nutrient levels are first determined by analysing leaves, and only the required nutrients are applied. The amount of nutrients recommended is also based on the potential productivity of palms.

The advantages are:

* Only the required nutrients are applied.
* Sometimes there could be a saving by avoiding unnecessary fertilizer.
* Would assist in regular monitoring of nutritional level in the plantation.

Please contact the CRI for this service.

## 6.6 Use of Organic Manures

Rates of application of organic manure for seedlings and young palms supplemented with chemical fertilizer are given below:

**Rate of Application for Seedlings and Young Palms**

| | *Time after transplant* | | | | |
|---|---|---|---|---|---|
| | *6 months* | *1 year* | *2 years* | *3 years* | *4 years and upto bearing* (every 12 months) |
| 1. Dried cattle manure | 6 kg | 15 kg | 20 kg | 25 kg | 30 kg |
| **Supplemented with** | | | | | |
| Saphosphosphate | 100 g | 250 g | 300 g | 400 g | 500 g |
| Muriate of potash | 50 g | 150 g | 200 g | 250 g | 300 g |
| OR | | | | | |
| 2. Goat Manure | 3 kg | 6 kg | 8 kg | 10 kg | 13 kg |
| **Supplemented with** | | | | | |
| Saphosphosphate | 150 g | 400 g | 500 g | 650 g | 800 g |
| Muriate of potash | 100 g | 200 g | 300 g | 350 g | 400 g |
| OR | | | | | |
| 3. Poultry droppings | 5 kg | 13 kg | 17 kg | 20 kg | 25 kg |
| **Supplemented with** | | | | | |
| Saphosphosphate | 50 g | 100 g | 150 g | 175 g | 200 g |
| Muriate of potash | 25 g | 75 g | 100 g | 100 g | 150 g |

Organic manures not only provide nutrients but also improve the soil physical conditions. Regular application of organic manures will enhance the organic matter content of the soil and earthworm activity, thereby improving the water-holding capacity of the soil.

Locally-available organic manures such as cattle manure, goat manure or poultry droppings are rich in nitrogen. However, the availability of phosphorus, potassium and magnesium is limited and therefore, organic manures will have to be supplemented with other nutrients. Wood or kitchen ash could be used in place of potassium.

**Rate of Application for Adult Palms**

The following tables may be used as a guide in determining the appropriate annual requirement of manure for blocks yielding around 3000 nuts per acre per year. Organic manure should be applied annually to provide the required nutrients.

**(a) Dried cattle manure**

| *Agroclimatic zone and soil type* | *Dried cattle manure* | *Saphos-phosphate* | *Muriate of potash* |
|---|---|---|---|
| **Wet/Intermediate Zone** | | | |
| Gravel or sandy soil | 35 kg | 500 g | 1200 g |
| Loam or clay soil | 25 kg | 350 g | 800 g |
| **Dry Zone** | | | |
| Gravel soil | 35 kg | 500 g | 1200 g |
| Loam or clay soil | 25 kg | 350 g | 800 g |
| Sandy soil | 30 kg | 400 g | 1000 g |

**(b) Goat manure**

| *Agroclimatic zone and soil type* | *Goat manure* | *Saphos-phosphate* | *Muriate of potash* |
|---|---|---|---|
| **Wet/Intermediate Zone** | | | |
| Gravel or sandy soil | 15 kg | 850 g | 1300 g |
| Loam or clay soil | 10 kg | 500 g | 850 g |
| **Dry Zone** | | | |
| Gravel soil | 15 kg | 850 g | 1300 g |
| Loam or clay soil | 10 kg | 500 g | 850 g |
| Sandy soil | 12 kg | 700 g | 1000 g |

### (c) Poultry droppings

| *Agroclimatic zone and soil type* | *Poultry droppings* | *Saphos-phosphate* | *Muriate of potash* |
|---|---|---|---|
| **Wet/Intermediate Zone** | | | |
| Gravel or sandy soil | 30 kg | 150 g | 1000 g |
| Loam or clay soil | 20 kg | 100 g | 650 g |
| **Dry Zone** | | | |
| Gravel soil | 30 kg | 150 g | 1000 g |
| Loam or clay soil | 20 kg | 100 g | 650 g |
| Sandy soil | 25 kg | 150 g | 850 g |

As the quantities of the organic manure to be applied are large, it is best to apply these manures in trenches about 1 m (3') wide and 15 cm (6") deep cut around the palm 1 m (3') away from the base (Fig. 14).

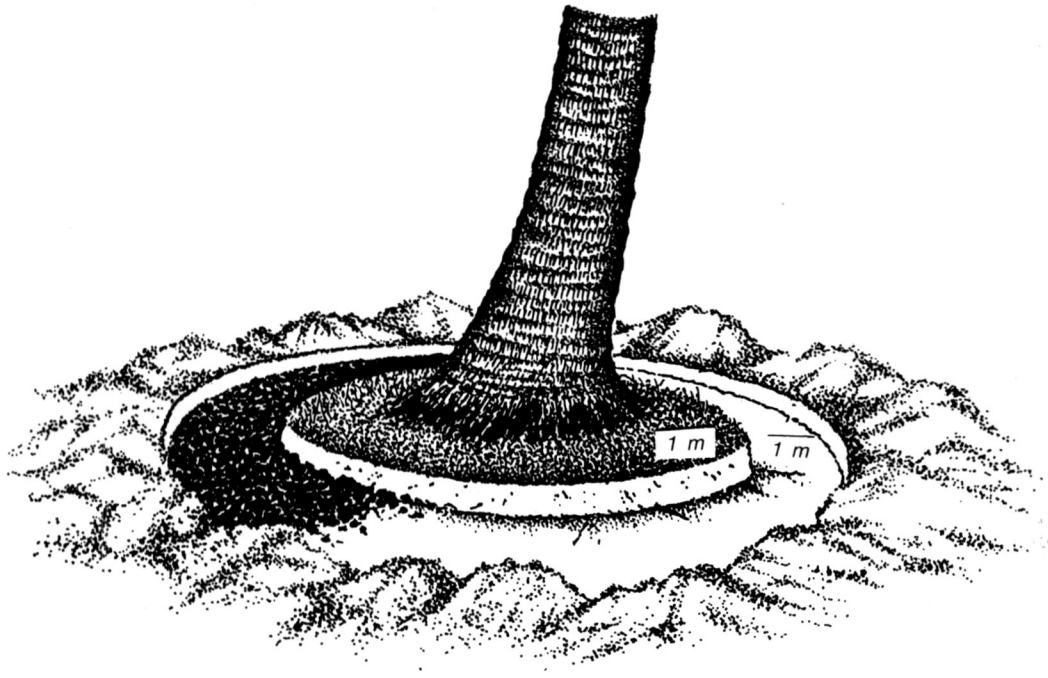



*Fig. 14 Application of organic manure in a trench.*

## 6.7 Use of Green Manure

Green manure such as gliricidia or ipil ipil loppings or cover crop loppings provide a substantial amount of nitrogen and a limited amount of other nutrients. Green manure also improves the soil texture and its water-holding capacity.

For example, 30 kg of gliricidia loppings would provide the entire nitrogen requirement and about 20% of potassium and phosphorus requirements of an adult palm. The balance requirements will have to be supplemented with chemical fertilizer. Generally, a well-bearing coconut palm would require the following:

| | |
|---|---|
| Gliricidia loppings | 30 kg |
| Saphosphosphate | 550 g |
| Muriate of potash | 1400 g |
| Dolomite | 1000 g |

Gliricidia loppings should be spread around the base of the palm, upto 1.75 m (6') and preferably incorporated into the soil by dibbling in. Other nutrients should be broadcast and the area well-mulched (Fig. 15).

Ideally, coconut estates should have a ready supply of green manure. for instance, gliricidia can be planted along the boundary fence of the estate in a double row at 60 cm (2') equilateral triangular system. Plant either seedlings or cuttings with the onset of monsoons. A well-established and properly pruned gliricidia bush will give about 5 kg of loppings annually.

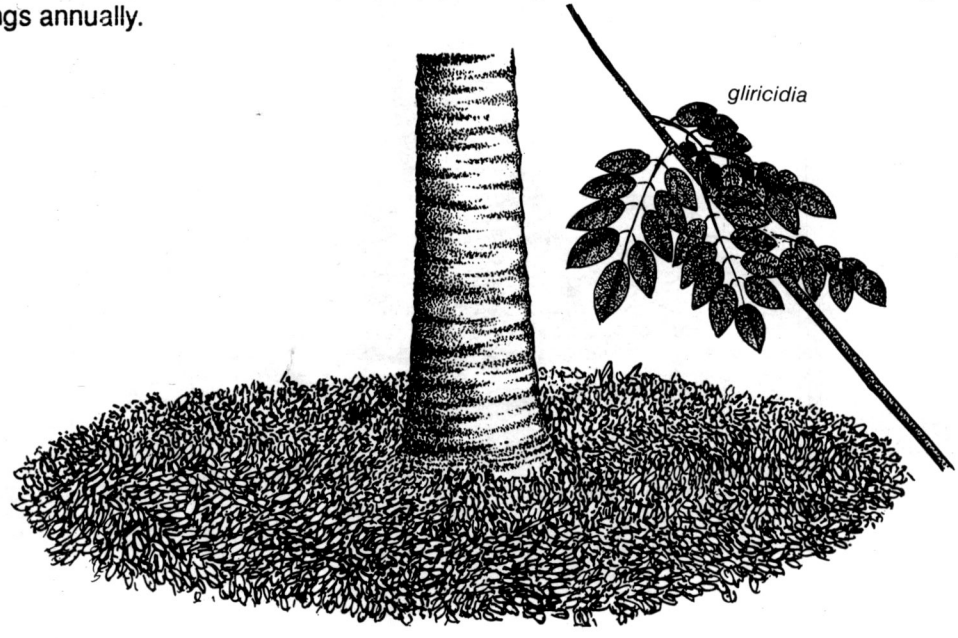
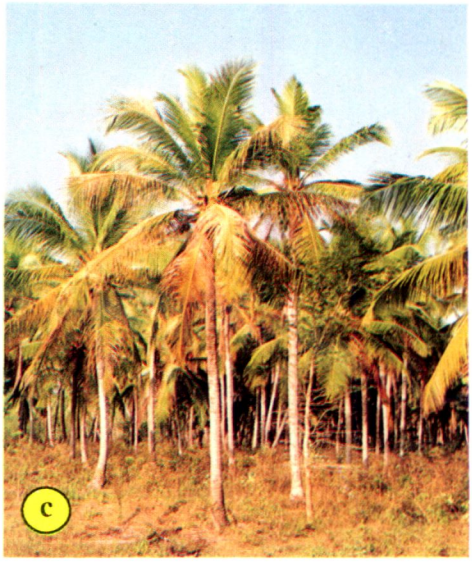



*Fig. 15 Green manuring with gliricidia loppings.*


b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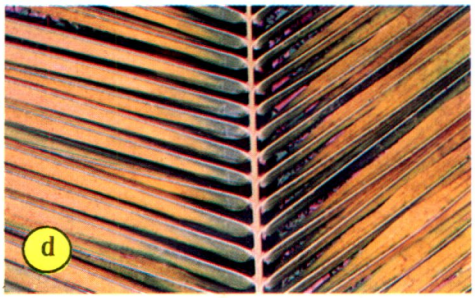
a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e

## 6.8 Mineral deficiencies

Most coconut soils are deficient in the major nutrients, nitrogen (N), potassium (K) and magnesium (Mg).

Generally, these deficiencies produce characteristic symptoms on the foliage.

### *A. Nitrogen deficiency*

* All-round yellowing of foliage.
* In advanced stages, the leaflets would show pale green to yellow coloration.
* The crown as a whole appears pale green. Older leaves are more affected.

**Note:** Water-logging, severe drought and competition from grasses may also produce similar symptoms.

### *B. Potassium deficiency* (Fig. 16)

* Rust-coloured spots appear on the leaflets in mature fronds.
* Leaflets will have yellowing with browning of tips.
* Brown patches will coalesce and distinct scorching will be seen.
* Entire crown would appear yellow to orangish-yellow. Older leaves are more affected.

### *C. Magnesium deficiency* (Fig. 16)

* Yellowing of leaflets in the older fronds.
* Leaflets would be pale yellow with a green band on either side of the ekel.
* The basal areas of the leaflets remain green thereby showing a green band on either side of the rachis of the whole frond.

*Fig. 16* *Mineral deficiencies in coconut.* ***(a)*** *Potassium deficiency (note the characteristic orangish-yellow colour in the fronds);* ***(b)*** *Magnesium deficiency* ***(c)*** *Yellowing due to general neglect and lack of nutrients;* ***(d)*** *Leaflets showing symptoms of magnesium deficiency (note the green colour in the basal area of leaflets thereby showing a green band on either side of the rachis);* ***(e)*** *a healthy leaflet with that showing magnesium deficiency [above] (note characteristic yellowing in leaflets with a green band on either side of the ekel) and that showing potassium deficiency [below] (note yellowing with rust-coloured spots).*

## Remedial Measures

### *A. Nitrogen and potassium deficiencies*

* Apply fertilizer in the normal manner.

* Nitrogen deficiency in very young palms can be corrected by spraying a weak solution of urea (about 1-2%).

### *B. Magnesium deficiency*

* Apply kieserite, as indicated below, until yellowing disappears.

  Young palms 1 1/2 - 6 years: 0.5 kg per palm half yearly.
  Adults palms: 1 kg per palm half yearly.

* Very young palms will respond to spraying of a weak solution (about 1-2%) of epsom salt or kieserite.

* It is essential that as a long-term preventive measure, dolomite (which is cheap and locally-available) be applied regularly at the rate 1 kg per palm per year.

## CHAPTER 7

# SOIL AND MOISTURE CONSERVATION

### 7.1 Soil Conservation

Although coconut lands are mostly flat or have a gentle slope there can be tremendous soil losses through erosion. Both wind and rain erode soil. Storms of high intensity can remove large quantities of fertile topsoil in a relatively short time. Erosion can also be severe when the soil has been tilled, particularly by injudicious ploughing.

### 7.2 Moisture conservation

The coconut palm requires for satisfactory performance a regular supply of water, which is vital for all activities of the palm. It is essential for the proper functioning of the cells. Secondly, it is a basic raw material for food production. Thirdly, it is the medium in which all nutrients enter and are transported within the plant.

### 7.3 Drought Effects

Under prolonged drought conditions, the outer cells in the absorbing region of the roots develop thickened walls through which water will not enter. Roots so affected remain more or less in a resting condition and may cease to absorb water.

Droughts slow down or totally arrest the activity of the growing point of the stem. During a drought of two to three months, plants under two years may not produce any leaves, whilst those under five years may produce only a single leaf. In older plants, droughts cause early leaf fall. Trees without a minimum of twenty active leaves lack the vitality for satisfactory production. Fewer leaves also mean fewer flowers.

Pollinated flowers are very susceptible to moisture stress. Droughts lead to button nut fall and immature nut fall. A long dry spell will result in a reduction not only in the number of nuts but also in their size. It is reported that about 60% of potential coconut production is lost due to moisture deficit.

The importance of soil moisture conservation cannot be over-emphasised here. Estates which regularly carry out moisture conservation measures continue to obtain high yields of 10,000 to 15,000 nuts per ha (4,000 to 6,000 nuts per ac) in spite of adverse weather conditions.

## 7.4 Soil Improvement and Soil and Moisture Conservation

The water-holding capacity of the soil could be enhanced by improving the soil physical conditions. Several agricultural practices are available for soil improvement and soil and moisture conservation.

### 7.4.1. *Mulching*

Mulching is the conserving of soil by a layer of vegetable matter such as coconut husks, coconut fronds, green matter (loppings), weed trash etc. Mulching will protect soil from direct sunlight and wind, and will also reduce water loss and weed growth. It is an important agricultural practice that should be routinely done in the manure circle (1.75 m or 6') from the base of the palm (Fig. 13).

### 7.4.2. *Organic Matter*

Addition of organic matter (goat manure, cattle manure, compost) improves the soil in many ways. Sandy soils are improved and more moisture is retained. Clayey soils are made loose and porous, thereby improving aeration, drainage and water-intake. Organic matter also enhances soil microbial activity and recycling of minerals.

Organic matter also enhances earthworm activity in the soil. Earthworms re-cycle soil and bring up deep-seated fertile soil to the surface.

### 7.4.3. *Husk and coir dust pits*

Both husk and coir dust absorb and retain large quantities of water for use by the palm. Traditionally, these materials have been buried in pits and trenches, and the period of moisture retention varies between 45 to 60 days, depending on the soil type and the severity of the drought.

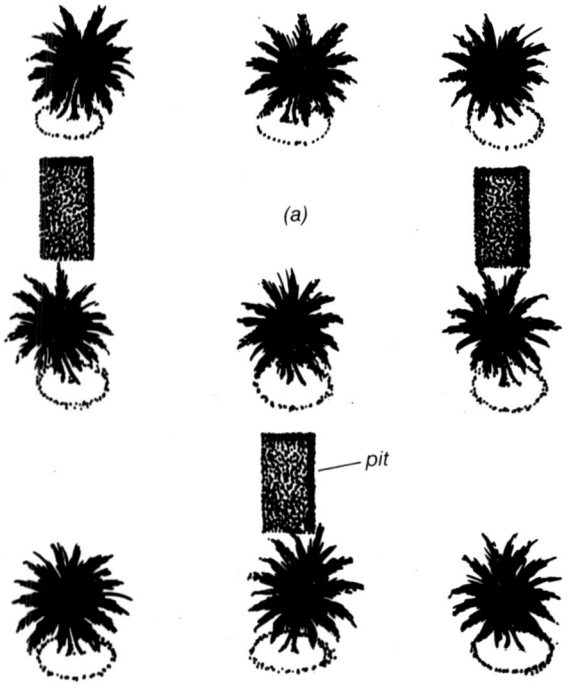
Ideally, the material should be buried about 1 m deep so that the roots can take the full benefit of the moisture conserved in them. However, in hard soils making such deep pits may cost more, and the grower should exercise his discretion on the depth of the pit.

The following systems may be used to bury husks and coir dust (Fig. 17).

**A. Pits**

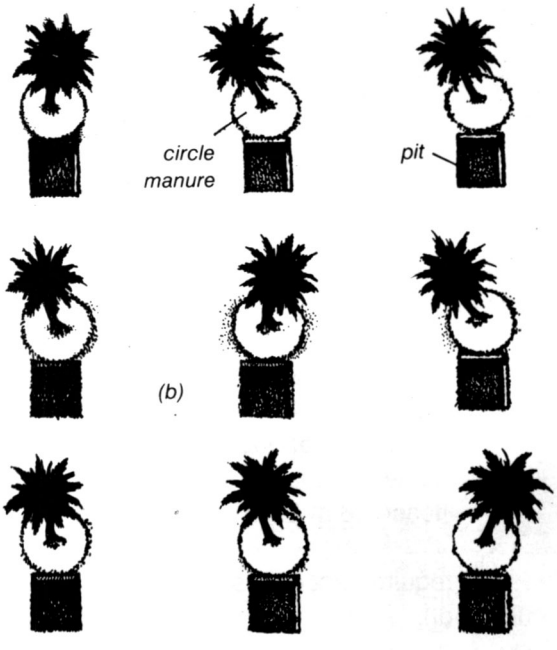
(i) Pits of the size 2.5 m long, 1.2 m wide and 0.6 m deep (8'x4'x2') can be established between two palms (Fig. 17 a).

(ii) Alternatively, pits could be provided for individual palms just outside the manure circle (about 2 m away from the bole). In such instances, the size of the pit can vary, but it is advisable to maintain a depth of about 0.6 m (2'). A convenient size is 1 m x 1 m (3' x 3') at the edge of the manure circle (Fig. 17 b).




*Systems for burying husks or coir dust in coconut lands.*

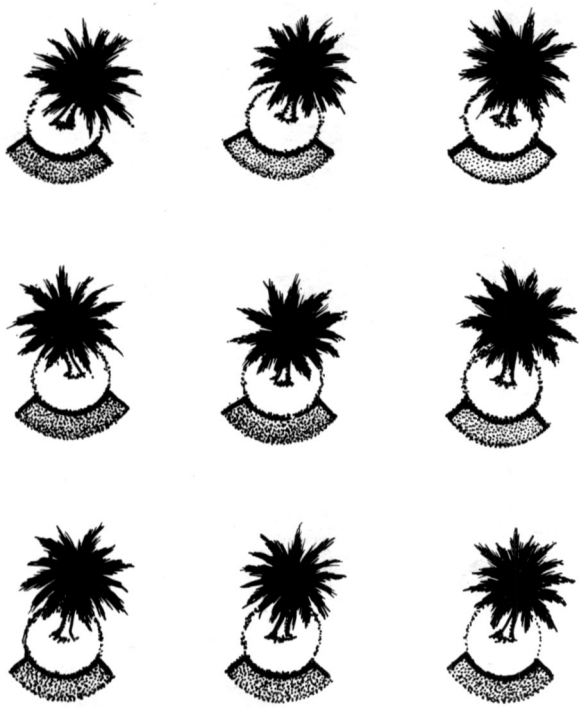
*Fig. 17 (a) Pits between palms.*




*Systems for burying husks or coir dust in coconut lands.*

*Fig. 17 (b)*
*Individual pits just outside the manure circle.*

(iii) Another method is to make a trench, 0.6 m (2') deep and 0.6 m - 1.0 m wide (2' - 3') in a quarter of the circle just outside the manure circle around the palm (Fig. 17 c).



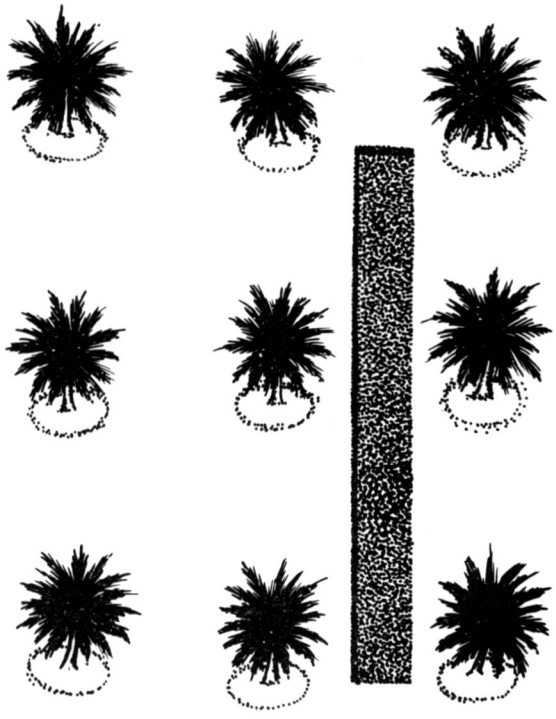
*Systems for burying husks or coir dust in coconut lands.*

*Fig. 17 (c) 1/4 - circle trenches just outside the manure circle.*

## B. Trenches

Trenches take a large quantity of husks or coir dust, and are ideal for highly productive estates with plenty of available husks. Husk trenches may be dug along the centre of each alternate avenue, the adjacent avenue being left for the passage of carts etc. The trenches should be wide, about 1.5 m or more (5') and at least 0.6 m (2') deep (Fig. 17 d).

The requirement of husks for one cubic meter is 250 - 300 (about 7 to 8 husks for one cubic foot).



*Systems for burying husks or coir dust in coconut lands.*
*Fig. 17 (d) Trenches between rows.*

**Placement of husks/coir dust in the pits/trenches**

**Husks**: Husks should be arranged in layers alternating with layers of soil, so that coconut roots grow into them and tap the moisture conserved therein.

Traditionally, each layer of husk is placed with the spongy concave side facing upwards. However, there is no particular advantage in systematically arranging husks in this manner so long as each layer is covered by earth. The pit/trench is filled so that the last layer of husks is flush with the ground level and the balance of earth is mounded on top. Generally, about three layers of husk can be accommodated in this manner. Husks should never be heaped above the ground level as they can be exposed subsequently, attracting Black Beetles to lay eggs in the decomposing husks (Fig. 18).

**Coir dust**: Coir dust should be buried in layers, each layer about 8 cm (3") thick alternating with 5 cm (2") thick layer of soil. The quantity of coir dust required to maintain this thickness of the layer varies with depth due to the weight of soil. For example, in a pit of 2.5 m x 1.2 m x 0.6 m (8' x 4' x 2'), the bottom-most layer needs about 12 baskets and the upper layers require about 8 baskets (Fig. 19).

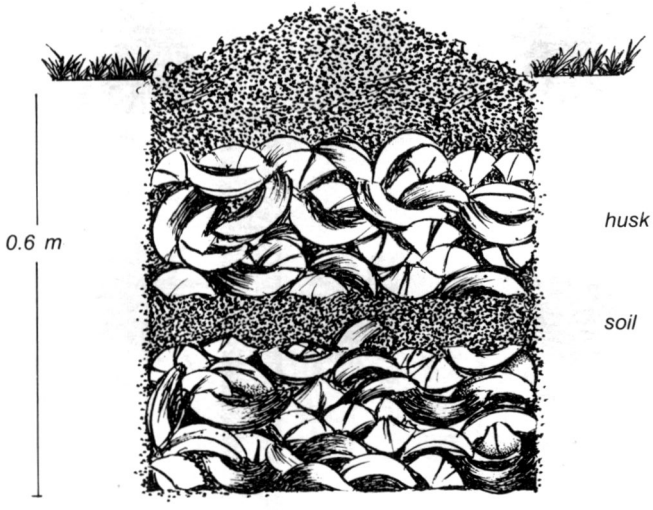



*Fig. 18* *Cross section of a husk pit. Note alternating layers of husks and soil. Husks should not be heaped above the ground level.*

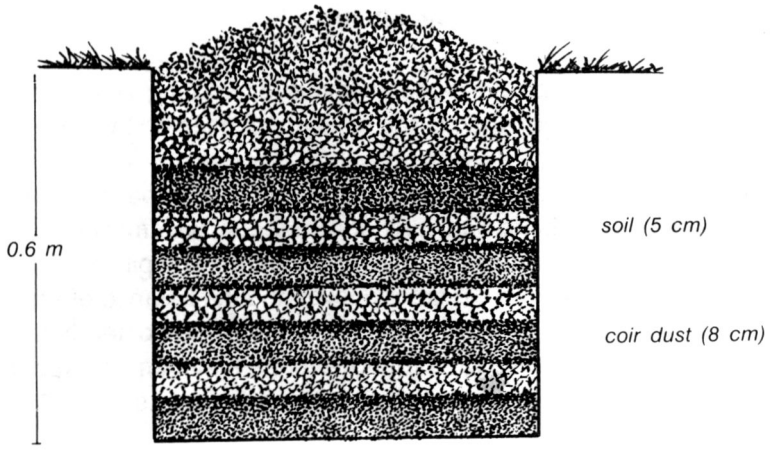



*Fig. 19* *Cross section of a coir dust pit. Note alternating layers of coir dust and soil. Coir dust should not be heaped above the ground level.*

Coir dust should not be buried alone without alternating with soil layers.

**Note:**

* Husks or coir dust should never be buried in water-logged soils.
* Cover crops can be established on pits.
* Cut pits during inter-monsoonal period when labour is available. Avoid soil excavation in dry weather.
* Husk/coir dust burying should be on a continuous cycle.

### 7.4.4. *Cover crops*

Cover crops

* prevent erosion.
* provide a large quantity of mulch and organic matter.
* improve soil.
* improve water-intake by the soil.
* reduce leaching of nutrients, soil temperature and weed growth.
* leguminous cover crops provide nitrogen to the soil.

A good cover should

* grow quickly and cover the soil in a short time.
* dry up during drought and should not compete with coconut for moisture.
* tolerate shade.

**Recommended cover crops (Fig. 20)**

A. Creeping cover crops

**For wet and wet intermediate zones**

* *Pueraria phaseoloides* ( 'Puero ')
* *Calopogonium mucunoides* (' Calopo' )
* *Centrosema pubescens* ( 'Centro' )

**For dry intermediate and dry zones**

* *Centrosema pubescens* ( 'Centro' )
* *Macroptilium atropurpureum* ( 'Siratro' )

'Calopo' and 'Puero' are also recommended for the dry intermediate zone.

*Mucuna utilis* (Wanduru-me) grows rapidly and is a good cover crop to plant in infertile soils for quick rehabilitation, particularly before replanting.

B. Bush cover crops

* *Gliricidia sepium* or *Gliricidia maculata ("weta mara")* for any soil type.
* *Leucaena leucocephala* (ipil ipil) for light soils

The following nitrogen fixing trees have also shown promise:

* *Acacia mangium*
* *Acacia auriculiformis*
* *Calliandra callothyrsus*
* *Enterolobium cyclocarpum*

**Planting**

Land should be ploughed and then disc-harrowed and surface levelled. Cover crop seeds should be dipped in hot water for three minutes, followed by soaking in cold water for 12 - 24 hours. Sow the seeds immediately thereafter, either in rows 60 cm apart or in the entire area. Depending on the type and method of sowing, about 5-10 kg of seed would be required for one hectare.

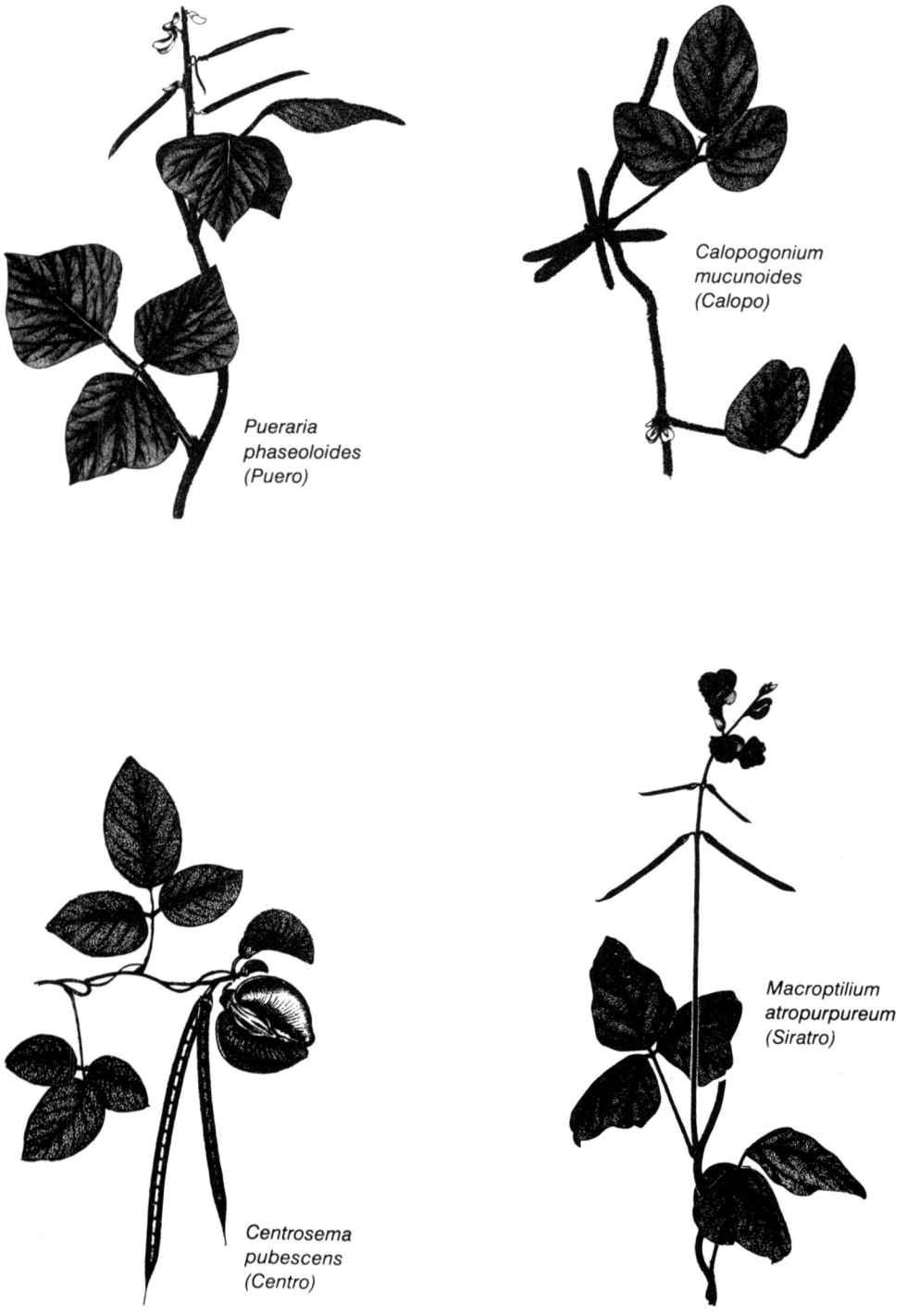



*Fig. 20 Creeping cover crops. Note the features.*

Cover crops could be conveniently established on husk/coir dust pits/trenches.

In the case of bush covers (Gliricidia, ipil ipil) it is best to have poly-bagged seedlings.

Creeping covers, once established, should be kept under control. A mulch roller could be used for this purpose (Fig. 21). Controlled grazing is also useful. Heavy grazing should be avoided.

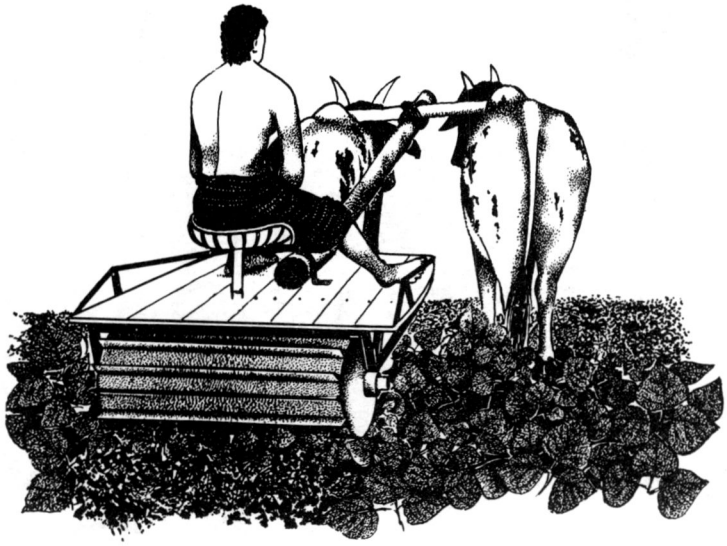


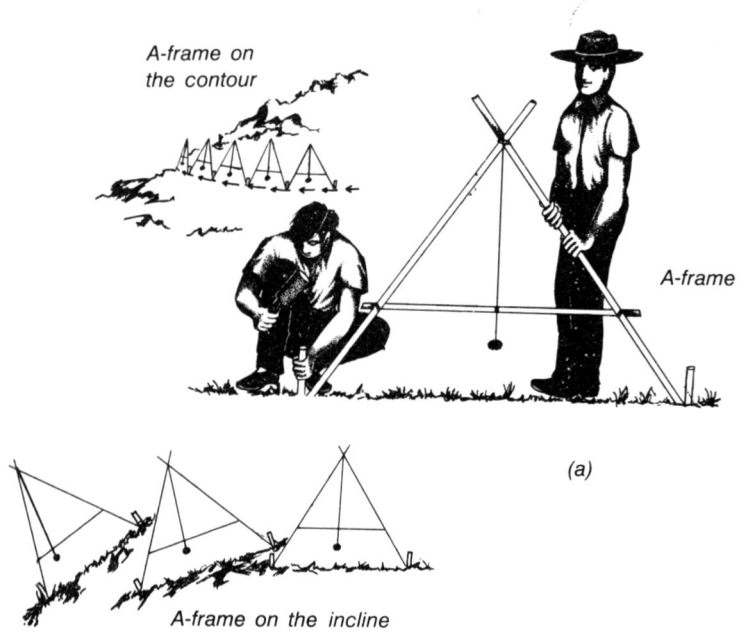
*Fig. 21* *A simple mulch roller drawn by draught animals for the control of creeping cover crops.*

### 7.4.5. *Contour drains*

Contour drains are useful in lands when the gradient is more than 1 in 10 (10%) in reducing erosion and increasing moisture conservation.

Contour drains should be laid carefully on the contour to obtain full benefits.

The contour could be traced with a simple A - frame or an ordinary level, and should start at the crown of the hill (Fig. 22 a). The drain should be 0.6 m (2') deep and 0.5 m (1.5') wide at the bottom. At the top, it should be 0.6 m (2') wide. The earth removed should be piled up on the upper side to a height of about 0.5 m (1.5') and spread over a distance about 1 m (3') (Fig. 22 b).



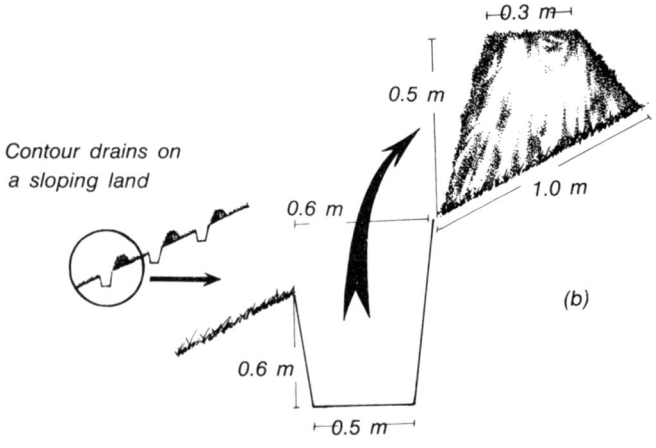




*Fig. 22* *Contour drains*

*(a) Tracing the contour with a simple A-frame.*
*(b) Section of the contour drain. Note the slanting sides and earth heaped on the upper side of the drain.*

**Spacing of contour drains**

Spacing of contour drains depends on slope, soil type, rainfall intensity etc. As a general rule, the following guidelines could be used.

| *Slope* | *Gradient* | *Spacing* |
|---|---|---|
| 5% | 1 : 20 | 40.0 m (130 ft) |
| 10% | 1 : 10 | 20.0 m ( 66 ft) |
| 15% | 1 : 7 (approx.) | 15.0 m ( 49 ft) |
| 20% | 1 : 5 | 10.0 m ( 33 ft) |

**Note**: Coconut should not be planted in slopes steeper than 1 in 10. 15% and 20% indicated above are for existing lands.

**Hedge Rows**: Planting gliricidia or ipil ipil as a hedge row on the contour will be very useful in reducing erosion. These hedge rows will also provide leaf loppings.

### 7.4.6. *Terracing*

In lands with a gradient of 1 in 7 (approx. 15%) or more where coconut is already planted, individual terracing of palms would be advantageous in the long run. A terrace with a crescent bund or husk platform would be ideal. The slopes of terraces should be stone-walled or paved and a suitable cover crop should be grown (Fig. 23).

### 7.4.7. *Drainage drains*

In areas of high rainfall [say above 5 cm (2") a day during the monsoon], it is not possible to stop and store all the rain water. However, every effort should be made to conserve as much water as possible.

Drainage drains (diversion ditches) should be provided so that the surplus water can escape. Steep downhill drains should be avoided. Drainage drains should be laid out with a very slight slope (say 1 in 200). The water flow in these drains should be controlled with earth or stone crossties, similar to lock and spill, with a view to holding back as much water as possible. The last few hundred metres of the drain could be flattened out into a true contour (Fig. 24).

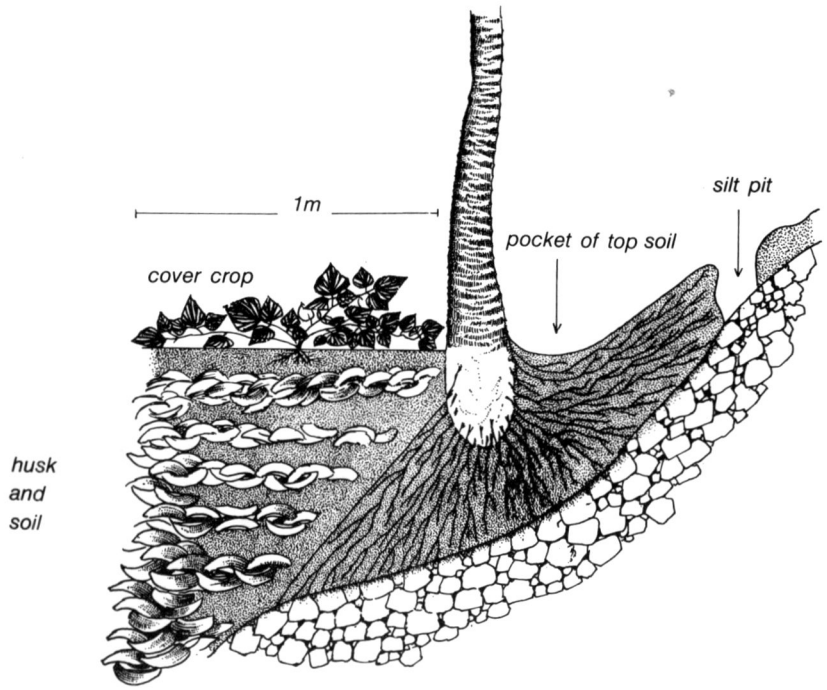



*Fig. 23 Individual terracing of palms in sloping lands.*

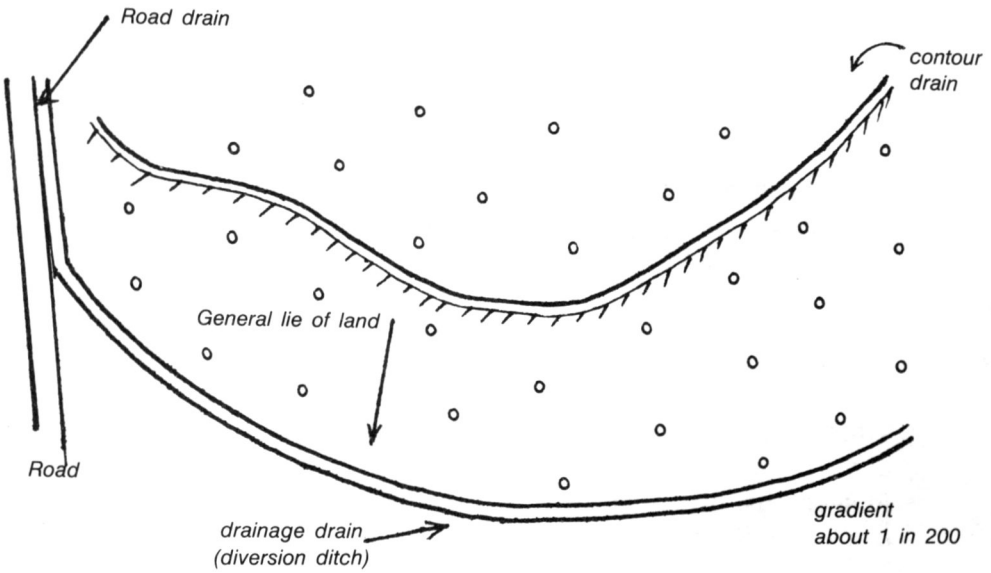



*Fig. 24 Drainage drain.*

## CHAPTER 8

# PESTS AND DISEASES OF COCONUT AND THEIR CONTROL

## A. PESTS AND THEIR CONTROL §

In Sri Lanka there are five major pests of coconut and a few minor pests. The nature of damage and their control are given below:

**Major Pests**

### 8.1 The Black Beetle or Rhinoceros beetle

Scientific name: *Oryctes rhinoceros*

This pest is found in all coconut growing areas in Sri Lanka. Although damage to adult palms is not fatal, it causes considerable retardation of growth and occasional death in young palms and seedlings.

#### 8.1.1. Nature of Damage and Identification (Figs. 25 & 26)

* The adult beetle (Fig. 25 a) is black in colour and is about 30-40 mm long. The head bears a characteristic backwardly directed horn.

* The eggs and the young stages, or grubs (larvae) and the resting stage (pupa) are found in decaying coconut logs or other vegetable matter. The grubs are whitish and about 60 mm long.

* Only the adult beetle causes damage to coconut by feeding on soft areas in the base of the bud.

* When the leaves unfold, they show characteristic geometric cuts (Fig. 26 a).

* In seedlings, beetle damage causes choking of developing leaves resulting in crooked, malformed leaves.

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§ Pesticides currently recommended for coconut pest control are given in Annexure 4.

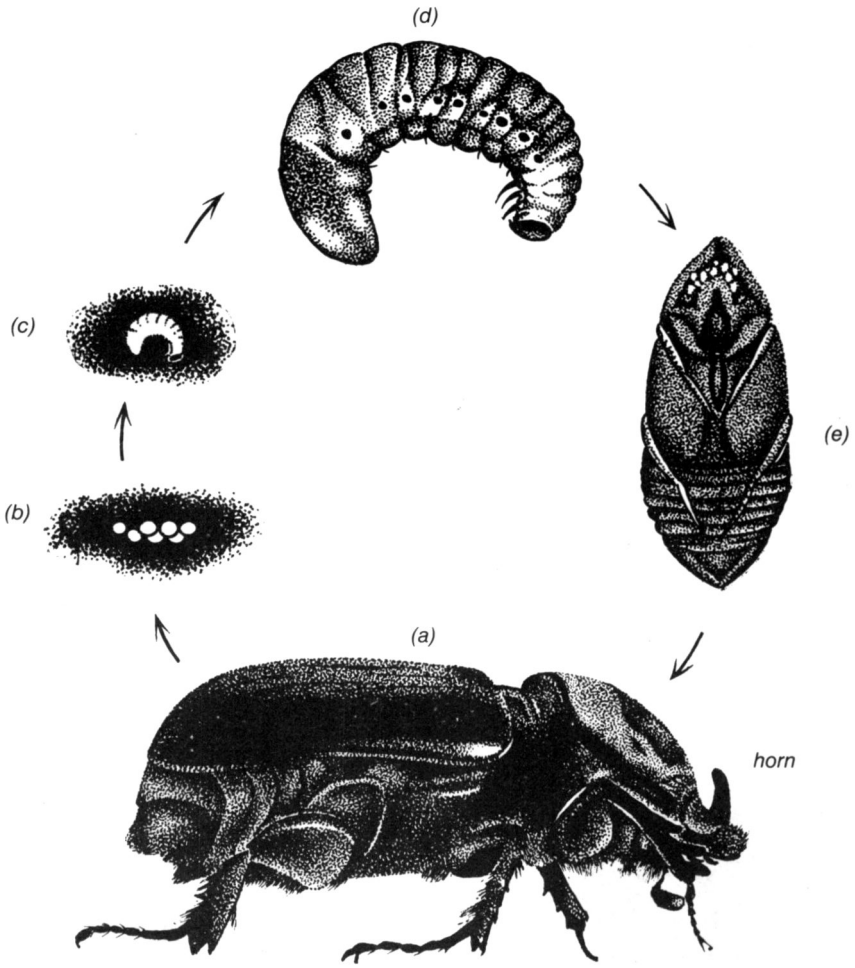



*Fig. 25* *Stages of development of the black beetle*

*(a) Adult beetle (note the characteristic horn);*
*(b) Eggs; (c) and (d) developing grubs (larvae);*
*(e) Resting stage (pupa)*

### 8.1.2. Control

* Examine young palms regularly and extract beetles from the bud region with a metal hook (Fig. 26 b).

* Maintain proper estate sanitation, split and burn decaying logs and destroy other decaying vegetable matter.

* Apply coal tar or coal tar-based preparation to the base of unopened leaves to repel the beetle.

**OR**

Place six naphthalene balls at the rate of 2 per base, in the axil

**OR**

Wet the axil area with an insecticide solution made by adding 10 ml of monocrotophos in 500 ml water.

**OR**

Sprinkle about 30 g carbofuran granules in the axils of young leaves.

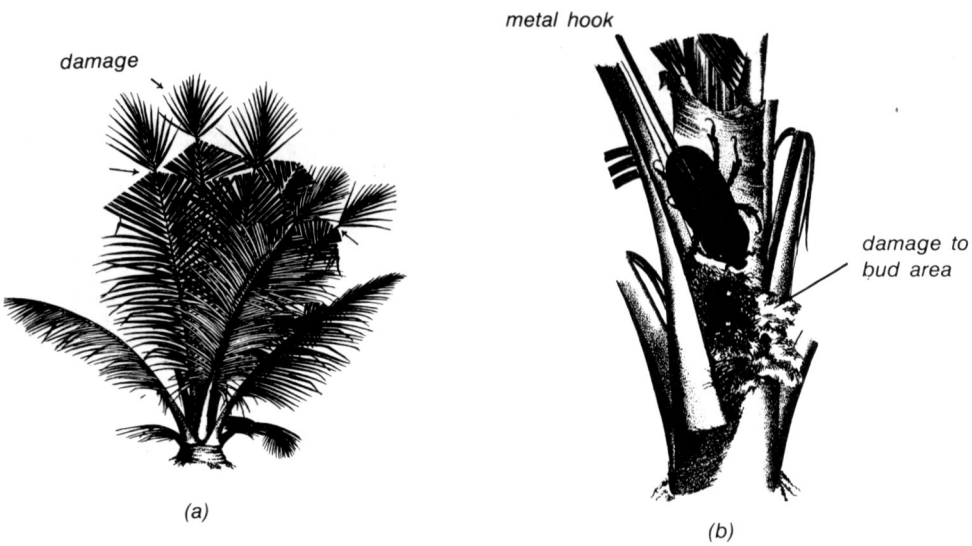



*Fig. 26* *(a) Black beetle damage to coconut fronds. Note the characteristic geometric cuts.*
*(b) Damage by adult beetles due to feeding and extraction of the beetle with a metal hook.*

## 8.2 The Red Weevil

Scientific name: *Rhynchophorus ferrugineus*

This is a serious pest of young palms. Damage is often fatal.

### 8.2.1. Nature of damage and identification (Fig. 27)

* The adult weevil is reddish brown in colour and is about 35 mm in length, and has a characteristic snout. The female lays eggs on injuries on the stem or on the petiole and the grubs burrow into and eat the soft tissue of the trunk.

* By the time symptoms appear, irreparable damage would have been done by the pest.

* An attacked palm may suddenly look sickly, with yellowish drooping leaves.

* Examine the trunk carefully for the following signs (Fig. 28).

  - Small holes on the trunk from which a gummy liquid oozes out.
  - Crunching noise inside the trunk (press the ear or place a stethescope on the trunk.

### 8.2.2. Control

* All injuries on the trunk and cut ends of petioles should be dressed with coal tar to prevent egg laying.

* In dead palms, the trunk should be split and burnt to destroy the grubs.

* If the damage is detected early, apply a systemic insecticide, as described below, to the affected palm as well as those suspected to be attacked.

(a) Requirements

1. **Insecticide** Monocrotophos at the rate of 10 ml/palm, or any other recommended insecticide.

   (A teaspoonful is about 5 ml. Do not use household teaspoons for measuring insecticide. Normally, one treatment is sufficient. If the crunching noise persists, the treatment may be repeated after one week).

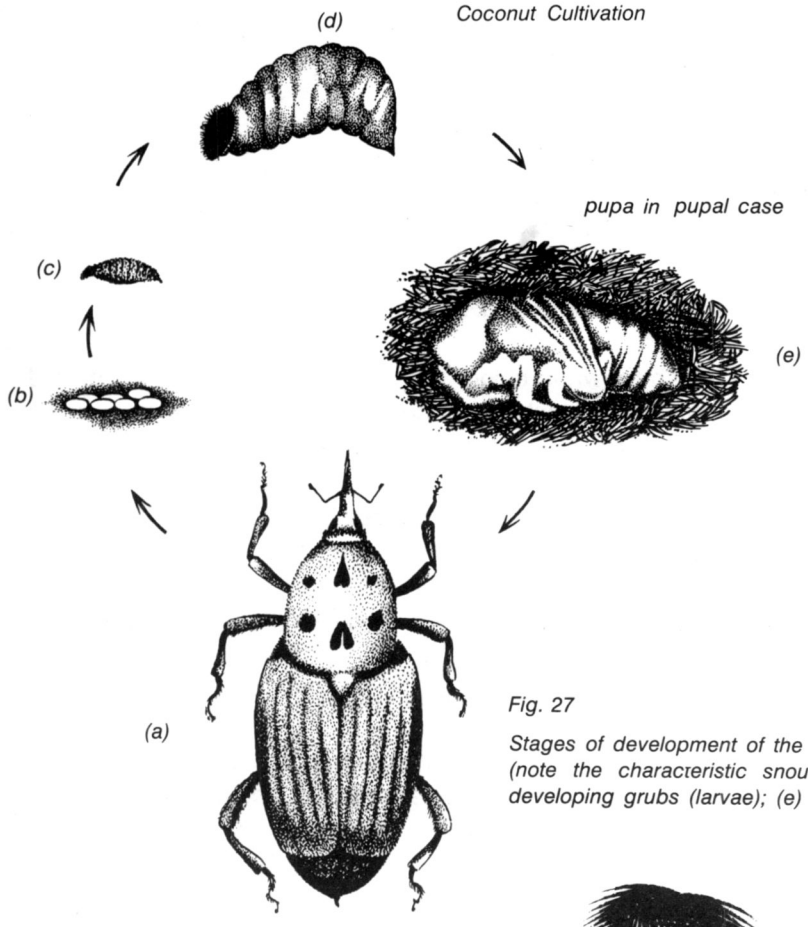



*Fig. 27*

*Stages of development of the red weevil (a) Adult weevil (note the characteristic snout); (b) eggs; (c) and (d) developing grubs (larvae); (e) resting stage (pupa).*


*Fig. 28 Young palm damaged by the red weevil pest.*

2. A small funnel (a piece of coconut leaflet can also be used.)

3. A bucket of water, soap and a towel - required to wash the body in case of accidental spilling of insecticide.

(b) Method of application (Fig. 29)

1. Drill a hole obliquely (at about 45°), about 15 cm deep, using a chisel or an auger on the trunk of the palm, a few inches below the area of infestation.

2. Insert the stem of the funnel or a piece of coconut leaf (10 cm long).

3. Wear gloves and carefully measure out the insecticide and pour into the funnel or the coconut leaf so that the insecticide will flow into the hole in the trunk.

4. Close the hole with cement/sand mortar or clay.

5. Fix a warning board or tag.

6. Wash hands with soap and water.

Normally, red weevil attacks young palms. However, if bearing palms are attacked and are treated in the above manner, nuts should not be consumed for about 45 days after treatment.

**SYSTEMIC INSECTICIDES ARE VERY TOXIC AND SHOULD BE HANDLED EXTREMELY CAREFULLY.**

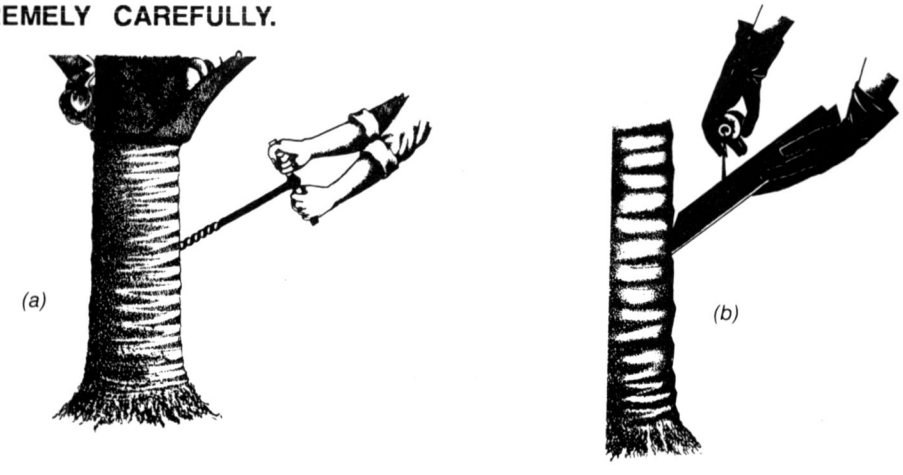



*Fig. 29* *Application of insecticide*
*(a) Drilling a hole on the trunk.*
*(b) Pouring insecticide using a piece of coconut leaflet.*
*Note the precautionary measures taken in handling insecticides.*

## 8.3 The Coconut Caterpillar (or Black-headed caterpillar)

Scientific name: *Opisina arenosella* (earlier called *Nephantis serinopa* )

This is a major pest of coconut causing considerable damage to foliage in all coconut growing areas. The pest favours dry weather and outbreaks are often seen during prolonged periods of drought. The pest usually declines with the onset of the rains.

### 8.3.1. Nature of damage and identification (Fig. 30)

* Infested palms are easily recognized by dried up patches in the leaflets.

* Cut and examine an infested leaflet. Worm-like larvae or caterpillars are found in galleries, made of small pieces of leaf tissue and excreted material, on the lower surface of the leaflet.

* Damage is done by caterpillars. With time, caterpillars transform into the resting stage, or pupae, and then, after sometime the adult moths appear. Moths fly and lay eggs on new trees thereby spreading the pest.

* When a large number of caterpillars feed on a single leaflet, it becomes completely brown.

* The moth is ashy-grey in colour and about 12 mm long. Eggs hatch out into caterpillars, which have a cream-coloured body and a dark brown head. A fully grown caterpillar is about 20 mm long. Caterpillars develop into the resting stage, or pupae which are dark brown and from them the moths emerge. The development from egg to adult takes about 2 months.

### 8.3.2. Control

* In the early stages of an infestation, cut and burn the infested leaves.

* Moderate to heavy infestations (where there are 20 or more caterpillars in 20 leaflets) should be controlled by injecting a systemic insecticide, such as monocrotophos.

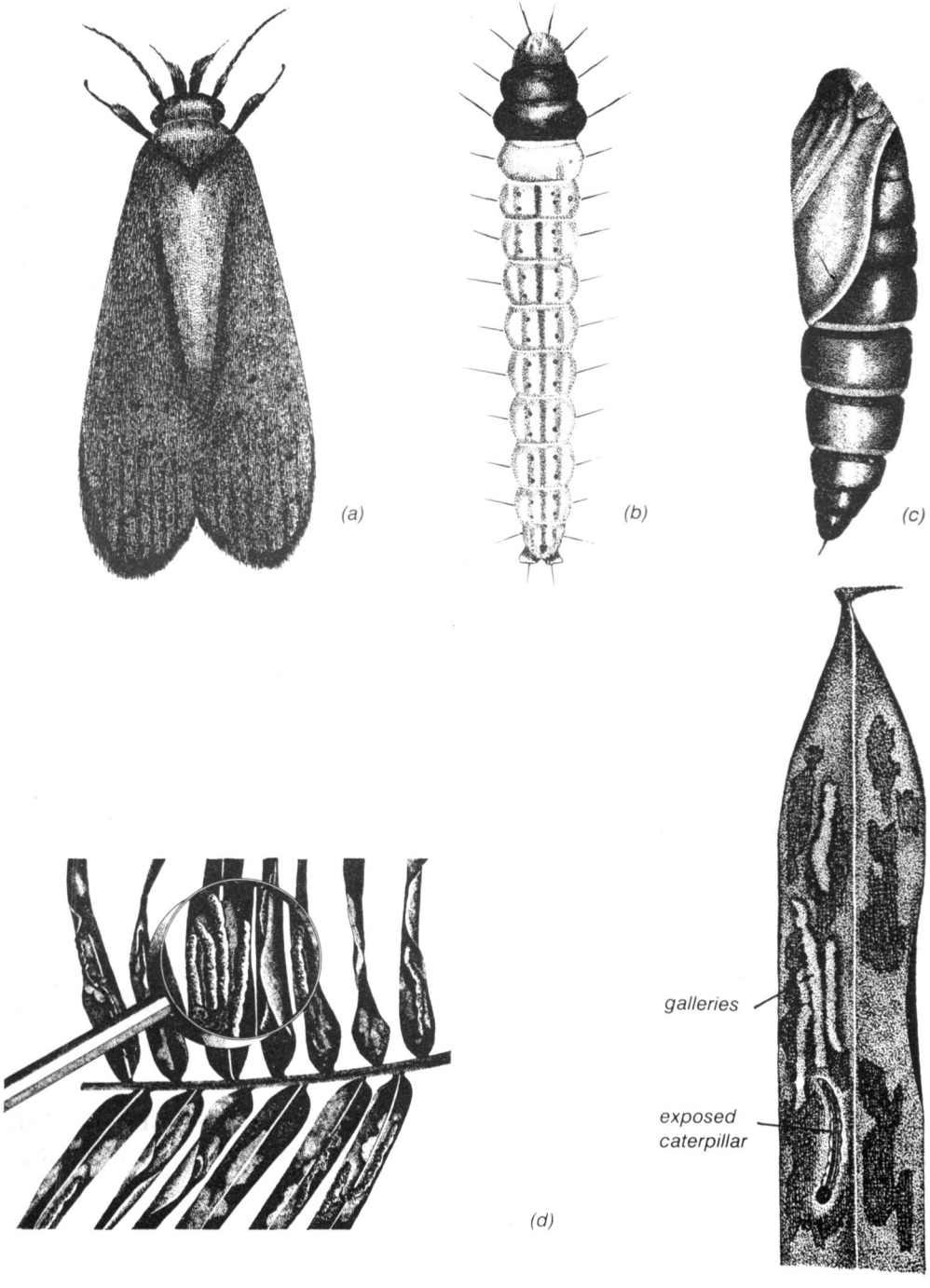



*Fig. 30* *The coconut caterpillar*
*(a) Moth (adult) stage; (b) Caterpillar stage;*
*(c) Resting stage (pupa);*
*(d) Damage to leaflets. Note the galleries on the underside of the leaflet.*

(a) Requirements

1. Monocrotophos, at the rate of 8 ml/palm.

2. A bucket of water and soap - required to wash the body in case of accidental spillage.

3. Auger or an electric drill (Electric drill is quick, and this may require a portable generator).

4. Insecticide applicator.

5. Gloves.

(b) Method (Fig. 31)

1. Using the drill or auger, bore a hole about 1 cm in diameter and at an angle of 45°. The hole should be about 8 cm deep and about 1 m from the ground level.

2. Adopting the necessary safety precautions, about 6-8 ml of insecticide should be poured into the hole.

3. After 24 hours, the hole should be closed, preferably with cement/sand mortar or good clay.

4. It is better to sample the leaves about 3-4 weeks after application to see whether there are any live caterpillars.

5. Naturally-occurring wasp-like parasitic insects also exert a considerable control, depending on the severity of the outbreak.

**PLEASE INFORM THE NEAREST COCONUT DEVELOPMENT OFFICER OR THE DIRECTOR, COCONUT RESEARCH INSTITUTE IF AN OUTBREAK IS NOTICED.**

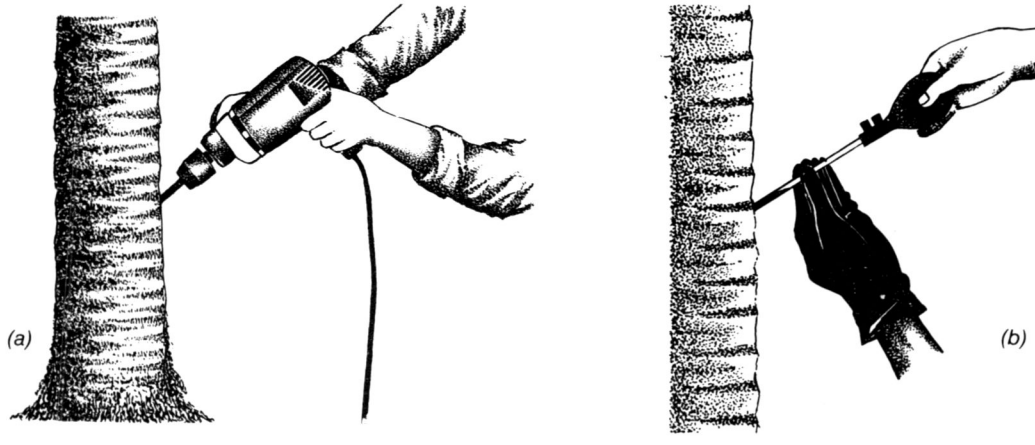



*Fig. 31 Application of insecticide*

*(a) Drilling the trunk with an electric drill.*
*(b) Administering insecticide using a safety pipette.*

## 8.4 The Coconut Scale

Scientific name: *Aspidiotus destructor*

Coconut scale is a dry weather pest found in all parts of the country.

### 8.4.1. Nature of damage and identification (Fig. 32)

* Yellow patches appear on the leaflets.

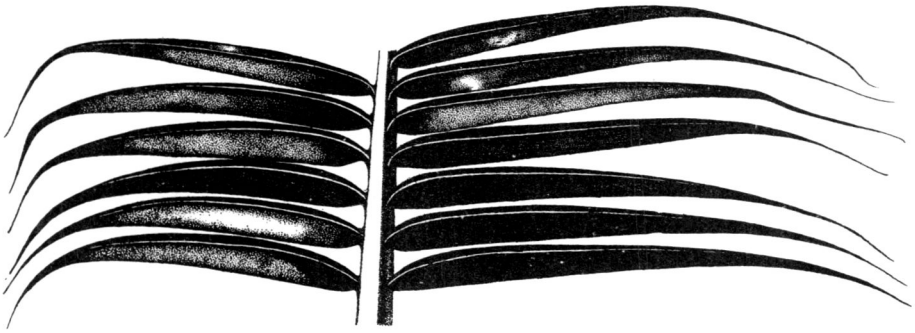
* Examine an affected leaflet. The underside will have a yellowish-white encrustation. When a finger nail is run over this, a moist mass will be collected if the scales are alive or a dry powder if they are dead.

* Examination with a hand lens will show a collection of scale insects, each appearing like a fried "bull's eye" with a yellow central area surrounded by a transparent covering (female scale).

* Underneath the transparent covering are eggs, which give rise to crawlers with legs - the mobile stage.

* Some crawlers settle on the leaf to function as female scales while others develop wings to become male scales and fly away.

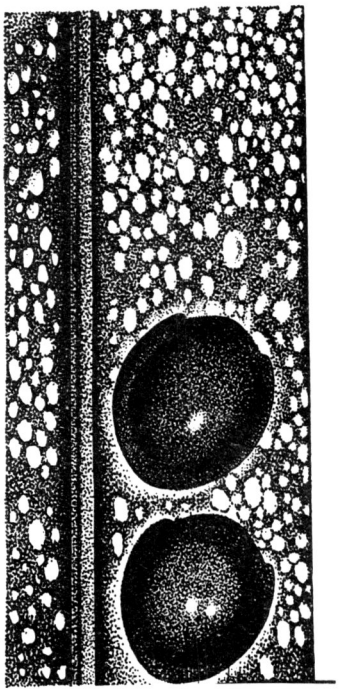
* Crawlers which are carried away by other insects, particularly ants, begin new infestations.



(a)

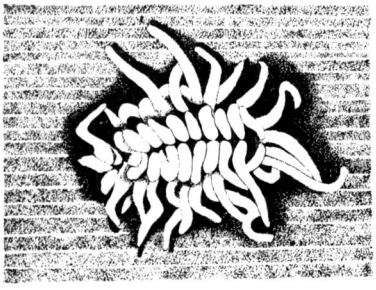
Scale insect resembling a fried "bull's eye" (highly magnified)

(b)



lady bird beetles feeding on scale insects

(d)



(c)

*Fig. 32* *The coconut scale*

*(a) Damage to leaflets;*
*(b) Magnified view of the scale insect.*
*(c) Immature stage of the lady bird beetle;*
*(d) Adult lady bird beetles feeding on scale insects.*

### 8.4.2. Control

* Early detection of the pest is important. Please notify the nearest Coconut Development Officer or the Director, Coconut Research Institute about pest outbreaks. The plantation will then be inspected and advice given.

* Naturally-occurring predatory lady bird beetles feed voraciously on scales thereby controlling them. Two kinds of lady bird beetles are common. One is a black roundish beetle about the size of a pepper seed (*Chilocorus nigritus* ), and the other is slightly small, roundish and brown (*Pullus xerampelinus* ).

* For severe outbreaks, trunk injection of systemic insecticides will be necessary. The procedure is similar to the one described for the coconut caterpillar.

## 8.5. The Coconut Leaf Miner

Scientific name: *Promecotheca cumingi*

This pest was first recorded in Sri Lanka in 1970 and caused extensive damage in Colombo, Galle and in parts of the coconut triangle.

### 8.5.1. Nature of damage and identification (Fig. 33)

* The adult stage of the insect is a beetle, similar to a fire fly ("kalamediriya"). The adult beetles feed on the leaf, leaving behind characteristic streak-like grooves on the underside of the leaflets.

* The young or immature stages, called larvae are found within the leaf tissues inside 'blister-like' formations, known as mines. The leaf tissues over the mine die and turn brown.

* A severely damaged plantation will appear brown with a burnt up appearance.

* Open a larval mine. A flattened, worm-like larva can be seen. The larval period lasts for about 30 days, and a fully grown larva, which is cream-coloured, will be about 12 mm.

* The larva develops into the resting stage, called pupa, which develops into the adult in 10-12 days. The adult emerges through the upper surface of the leaf by making a semi-circular cut.

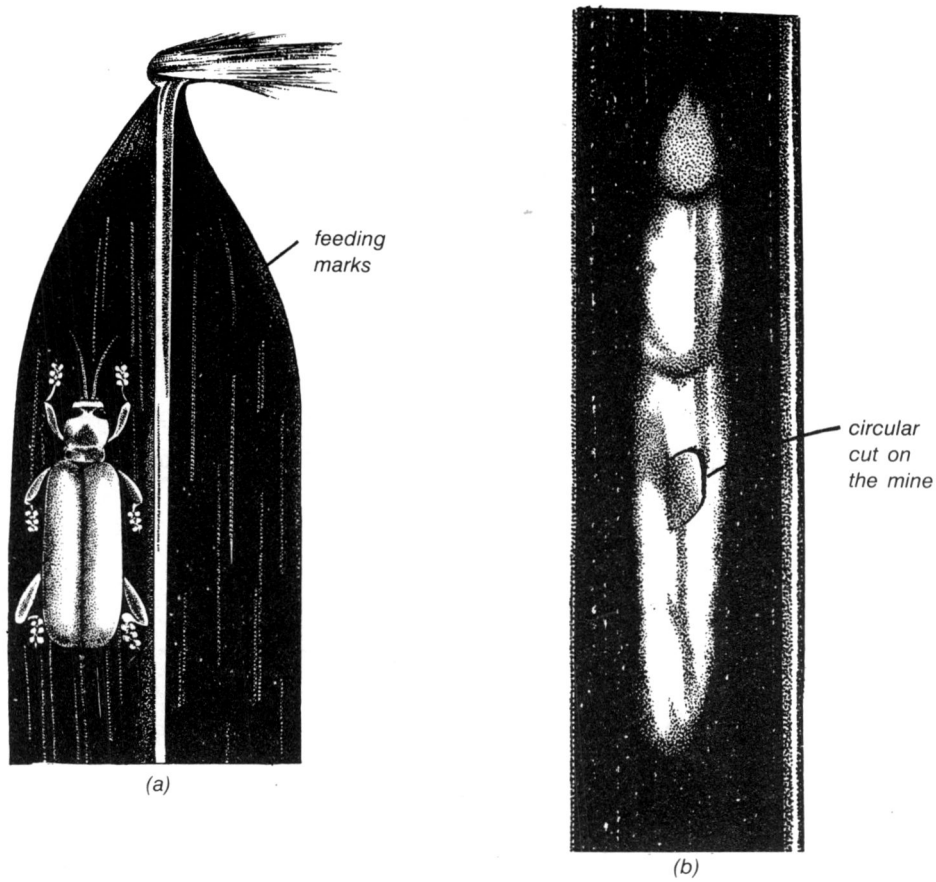



*Fig. 33* *The coconut leaf miner*

*(a) Adult beetle and streak-like feeding marks on the leaflet.*

*(b) Blister-like mine. Note the circular cut on the mine through which the adult beetle has emerged.*

### 8.5.2. Control

* Notify the nearest Coconut Development Officer or the Director, Coconut Research Institute if an outbreak of this pest is suspected.

* The pest is controlled by other parasitic insects, particularly the tiny, wasp-like *Sympiesis javanica* (earlier called *Dimmockia javanica*). In nature the pest is kept under control by a fine balance between the pest and the parasite.

* In exceptional situations, it may be necessary to resort to injection of systemic insecticides. The procedure is similar to that described elsewhere.

## Minor Pests

### 8.6 Termites *(Odontotermis)*

* Termites damage seednuts and seedlings. They may enter the seednut, and rotting occurs because of the injury.

* It is advisable to dig-out and destroy ant hills in the land, during land preparation. It is best to dip the seednut portion of the seedling in a recommended insecticide solution, prior to planting.

* If termite attacks persist after transplanting, a suitable insecticide may be applied.

### 8.7 Nettle grub *(Parasa lepida)* (Fig. 34)

* The caterpillar, which is about 1 cm in length, eats the leaf. The body has rows of sharp spines which are venomous.

* The caterpillars feed heavily on the leaf leaving only the ekel.

* A fully-grown caterpillar, about 2 cm in length, turns into the resting stage (pupa) which is in a brownish-coloured cocoon.

* The moth which emerges from the cocoon has a brownish head and light green wings.

* In nature, this pest is kept under control by wasp-like parasites. Trunk injection of systemic insecticide may be necessary in a heavy infestation.

### 8.8 Bag Worm *(Manatha albipes)* (Fig. 35)

* The larval stage is spent inside a bag-like, cone-shaped cocoon and feeding causes holes or punctures in the foliage. This insect causes considerable damage to seedlings, but adult palms may also be attacked.

* They can be hand - collected and destroyed if the numbers are few.

* Generally, the naturally-occurring wasp-like parasites keep the pest under control. When the infestation is heavy in seedlings, spraying of an insecticide will have to be considered.

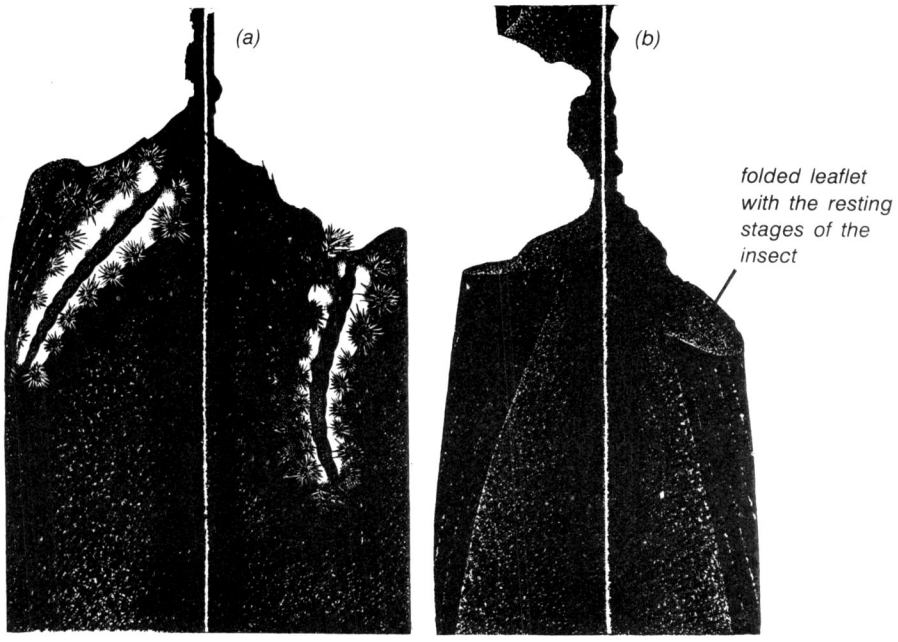



*Fig. 34* *The nettle grub*
*(a) Grubs feeding on leaflets. Note sharp spines on the body*
*(b) Partially defoliated leaflet. The resting strages (pupae) are found in the folded area.*

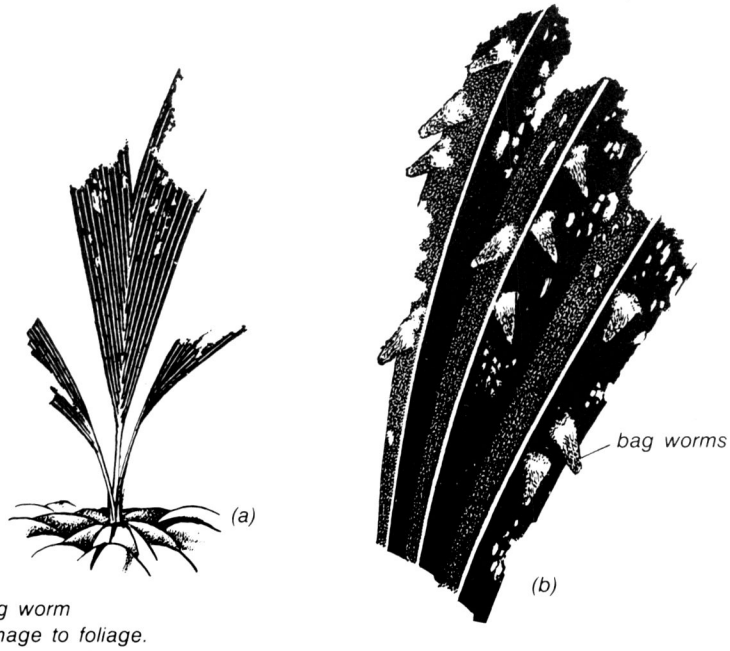



*Fig. 35* *The bag worm*
*(a) Damage to foliage.*
*(b) Bag worms feeding on the leaf.*

## 8.9 Yellow - Spotted Locust *(Aularchis miliaris)* (Fig. 36)

* The adult locust is a large insect having brownish green wings with large yellow spots.

* They feed on the leaves of many plants and sometimes invade coconut plantations, especially those in the vicinity of jungles, in large numbers. They feed heavily on coconut leaves leaving only ekels.

* As this pest takes shelter among weeds and lays eggs in the soil, estate sanitation helps in control. In case of heavy populations of this pest, it may be necessary to treat the soil where the immature stages of locust are found.

* In case of outbreaks, immediately notify the agricultural authorities in the area, nearest Coconut Development Officer or the Director, CRI.

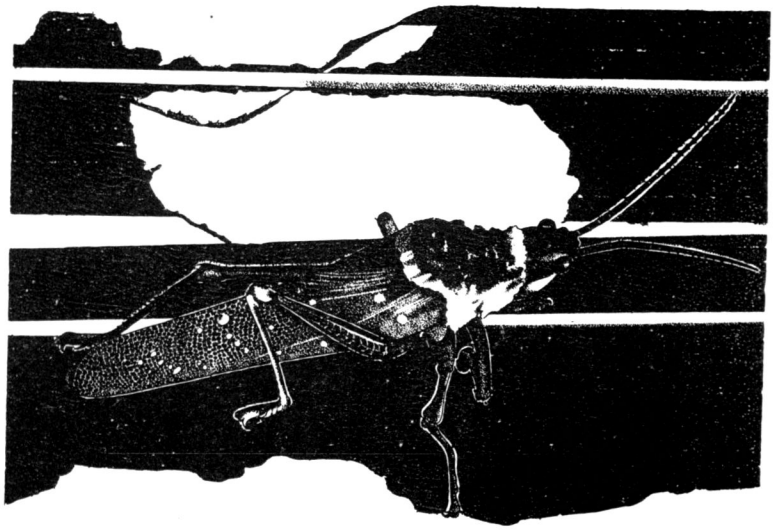


*Fig. 36 Adult locust and its damge to a coconut leaflet.*

## 8.10 Other Pests of Coconut

Rats and bandicoots damage the seedlings by eating into the kernel of the nut. Rats also damage young nuts. In jungle and rocky areas porcupines also cause damage to seedlings. Porcupine damage, at times, has been reported to have followed the Red Weevil damage. Bats and monkeys too cause damage to tender nuts.

* Rats should be controlled by using rat poison. If the population is high, practice estate sanitation and remove all rubbish from the holding.

* Rat bands, made of galvanized iron sheets, and fixed to the trunk will prevent rats from climbing trees (Fig. 37). Before rat bands are fixed, clean the crowns to remove all rats and their nests and avoid leaves, structures touching the adjacent palms, which allow rats to cross over.

* Monkeys and bats will have to be chased away.

* Porcupine damage can be prevented by fixing a 'chicken mesh' around the collar region of the seedlings, thereby preventing the animal from attacking the seedlings.

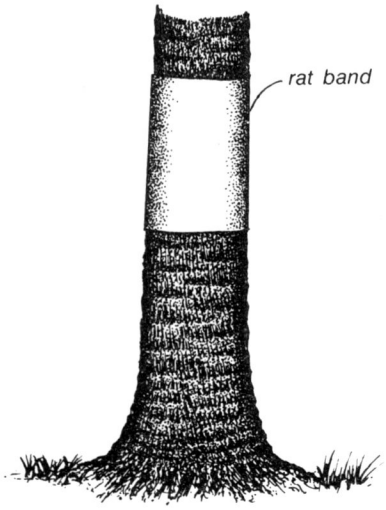



*Fig. 37 Bands on the coconut trunk to prevent rats from climbing the tree.*

## B. DISEASES OF THE COCONUT PALM AND THEIR CONTROL (see Fig. 38)

### 8.11 Bud Rot

This is a fatal disease. Although not widespread, epidemics have been seen in humid areas and in crowded under plantations, shaded by the old stand.

#### 8.11.1. Damage

* The bud collapses suddenly, which can happen in both young and adult palms.
* In the bud region, the tissue will be rotten, giving a characteristic foul smell.
* The disease is caused by a parasitic mold, *Phytophthora palmivora,* and the propagules of the mold are spread with water droplets. Thus, the spread of the mold is therefore likely to be faster during wet weather.

#### 8.11.2. Control

* If the bud collapses, the palm is beyond recovery. Affected palms should be cut and burnt to destroy the mold (inoculum).
* If detected early, the bud region should be thoroughly wetted with Bordeaux Mixture or 1% copper fungicide.
* In adult palms, it is possible to keep the bunches until the nuts are harvested. However, treat the bud region with Bordeaux mixture or copper fungicide to kill the mold.
* Healthy palms in the vicinity of affected palms should be treated as a preventive measure using Bordeaux Mixture, 1% copper fungicide or more conveniently, using fungicidal bags (see below).

If Bordeaux Mixture or copper fungicide are used, the bud regions of the healthy palms should be thoroughly wetted once in 2-3 weeks. The fungicidal bag is more convenient and is prepared as described below.

(i) Take a piece of jute hessian or gunny 15 cm square.

(ii) Place a handful of coir dust on this piece and tie up to make a small bag.

(iii) Leave these bags overnight in 1% copper fungicide solution.

(iv) Dry the bags for few hours the following morning.

(v) Place one bag in the axil of the youngest leaf.

(vi) Check the bag monthly and shift it to the base of the newly-emerged spear leaf.

If heavy rain is experienced regularly, the bags will have to be dipped in fungicide more often. In dry weather, the bags have been found to keep the fungicide properties for 4-6 months.

**Bordeaux Mixture**

Bordeaux mixture is prepared as follows: (use earthenware vessels)

| | | |
|---|---|---|
| Copper sulphate | - | 200 g |
| Quicklime | - | 200 g |
| Water | - | 25 liters |

Dissolve copper sulphate overnight in 5 liters of water (suspend in a bag to facilitate dissolving). Suspend lime separately in 20 liters of water, and strain through a fine cloth. Add the copper sulphate to the lime, stirring vigorously.

Use immediately after preparation.

*Fig. 38* *Diseases of the coconut palm. (a) Bud rot disease (note the absence of the bud); (b) Stem bleeding disease (note the brownish patches on the trunk); (c) A seedling severely affected by Leaf Blight disease (note scorched and curled leaflets); (d) Leaflets showing symptoms of leaf blight (note brownish spots).*


b


a


c


d

## 8.12 Stem Bleeding

Stem bleeding disease is common in coconut. Bleeding from the trunk is due to a variety of reasons, such as lightning, heavy manuring, fire damage, heavy rains or floods and Red Weevil attack but more often due to a fungal infection of tissues.

### 8.12.1. Nature of damage and identification

* Initial stages of the disease are characterised by the oozing of a reddish-brown or rust-coloured liquid from longitudinal cracks on the bark of the trunk.

* The liquid becomes viscous and finally solidifies as streaks of resinous material.

* When a slice of the infected patch is cut with a sharp knife, it will be seen that the fibrous tissue underneath is rotten and blackish.

* A mold, *Ceratocystis paradoxa* is often associated with this condition. Rarely, stem bleeding can be brought about due to the infection of *Ganoderma*. In these instances, the bracket-like fungal structures can be seen in the bole region.

### 8.12.2. Control

* Early detection makes treatment easier. The infected patches should be cut away using a sharp knife, chisel, or more conveniently using a hand adze.

* The rotten tissue should be completely removed until the pink, healthy tissue is exposed.

* The pieces that are removed should be burnt.

* Once the affected area is cleaned, 1% copper fungicide or Bordeaux Mixture should be applied. After 7-10 days, if there is no further bleeding, the wounds should be dressed with coal tar.

* If a fungicide is not available, the cleaned wounds should be dressed with coal tar.

* Growers should investigate the real cause of stem bleeding to ascertain whether or not stem bleeding is a secondary symptom of a more fundamental problem (eg. lightning, Red Weevil attack, flooding, fire damage etc).

* In the case of lightning, the excessive fluids in the trunk should be drained out by making oblique holes.

## 8.13 Leaf Blight (or Grey Blight)

Leaf Blight Disease is common in neglected lands.

### 8.13.1. Nature of damage and identification

* Yellowish-brown spots appear on leaflets. These spots gradually enlarge and turn grey. As the condition advances, the patches coalesce to form large brown areas. Blight is predominant on the lower fronds.

* Seedlings and young palms are very susceptible to this disease.

* Neglected and weak palms are very susceptible. Drought aggravates the condition.

* Two weak parasitic molds, *Pestalotiopsis palmarum* and *Bipolaris incurvata* are associated with the condition.

### 8.13.2. Control

* Proper management and due care are adequate to correct the condition.

* If palms are weak, apply an additional dose of muriate of potash (250 g for seedlings/young palms and 500 g for adult palms). Kitchen ash could be used instead of muriate of potash (5 kg of kitchen ash instead of 250 g of muriate of potash).

* If there is severe blight spraying of 1% copper fungicide or Bordeaux mixture may be considered.

## 8.14 Leaf die-back in Seedlings

Occasionally, seedlings in nurseries or soon after transplanting may show extensive die-back of leaves.

Generally, die-back starts from the tip of the leaf but it is not uncommon to see circular brown patches in the mid-portion of the leaf.

This condition is due to an infection by a mold, *Curvularia* and is common during periods of dry weather. In nurseries, the disease spreads rapidly when plants are regularly watered, which increases humidity of the environment.

### Control

The disease can easily be controlled by spraying 1% copper fungicide.

## 8.15 Tapering and Premature Decline

Tapering and premature decline (also called Leaf Scorch Decline) are common in many coconut growing areas.

### 8.15.1. Tapering

The gradual tapering of the trunk is generally the result of prolonged neglect and malnutrition. Tapering is also seen under adverse conditions such as water-logging, prolonged moisture stress, hard pan etc., and also with the advent of senility.

As soon as the condition is detected, the adoption of cultural practices and good management to improve the soil conditions will rehabilitate the palms.

### 8.15.2. Premature Decline or Leaf Scorch Decline

There is rapid tapering. The condition has been observed generally in palms over 20 years of age. The condition has been seen in well-managed plantations also. However, a relatively higher rate of tapering has been observed in holdings which have not been fertilized regularly and where the soil is shallow and compacted.

### Symptoms

* Scorching and downward curling of leaf tips in older fronds.
* Tapering of the stem and reduction of the size of the crown.
* Reduced nut production, elongated and malformed nuts.
* Extensive dieback of roots.
* Condition is associated with heavy soils, and soils with a shallow hard pan and also with magnesium deficiency.

**Method of rehabilitation**

* The condition, if treated early, can be corrected by inducing the palm to produce new roots.

* Bench terracing around the base of the palm to a height of about 0.5 m (1 1/2') with coconut husks about 1 to 1.5 m (3 to 5') away from the base and filling the space with soil rich in organic matter (Fig. 39).

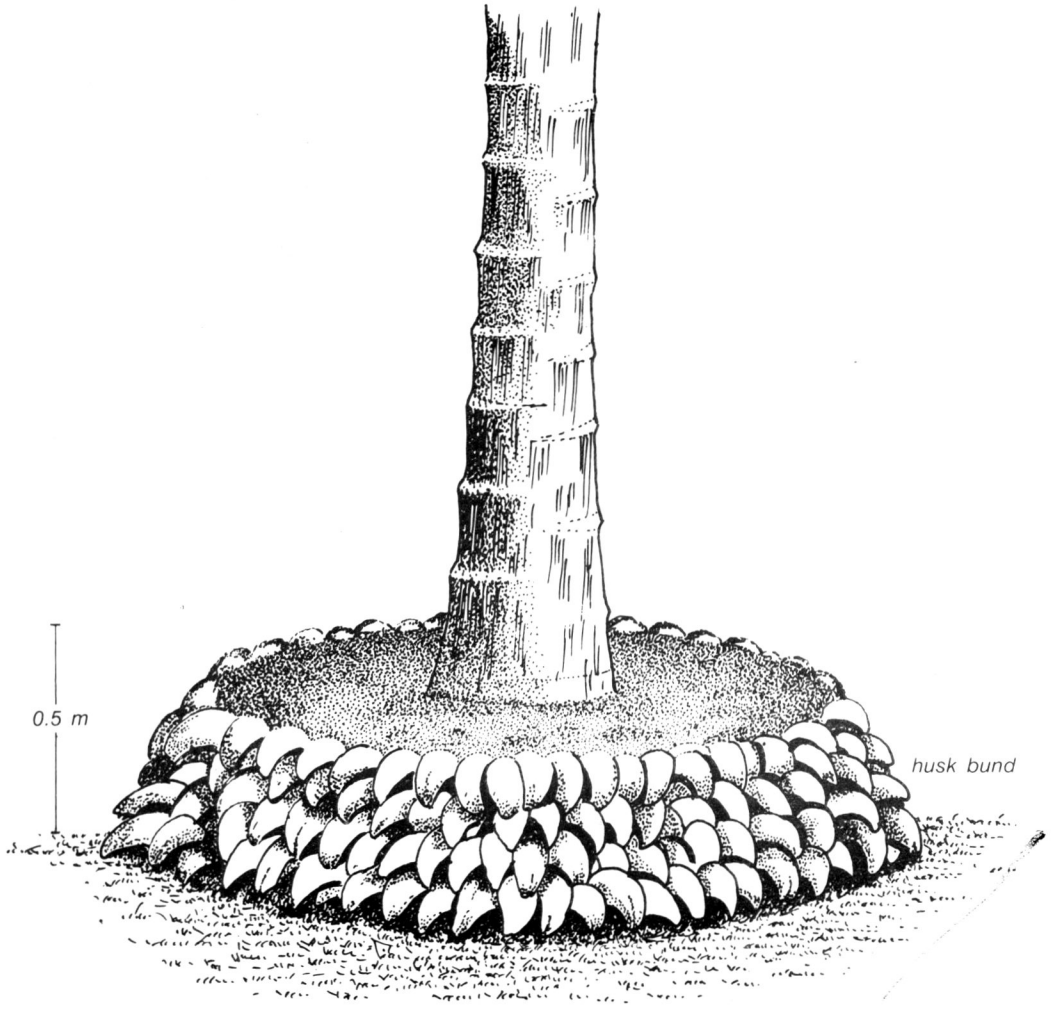



*Fig. 39 Bench terracing around the base of the palm with husks.*

## CHAPTER 9

# MAXIMISE LAND USE

Coconut roots use only about 25% of the soil. Their distribution in a coconut square is shown in Fig. 40. It is obvious that, as a monocrop, coconut is a poor user of land. Other plants can be accommodated in the unutilized area, which will enable better use of natural resources. Of the 400,000 ha of coconut in Sri Lanka, about 100,000 ha have the potential to grow other crops and raise livestock, thereby maximising land use

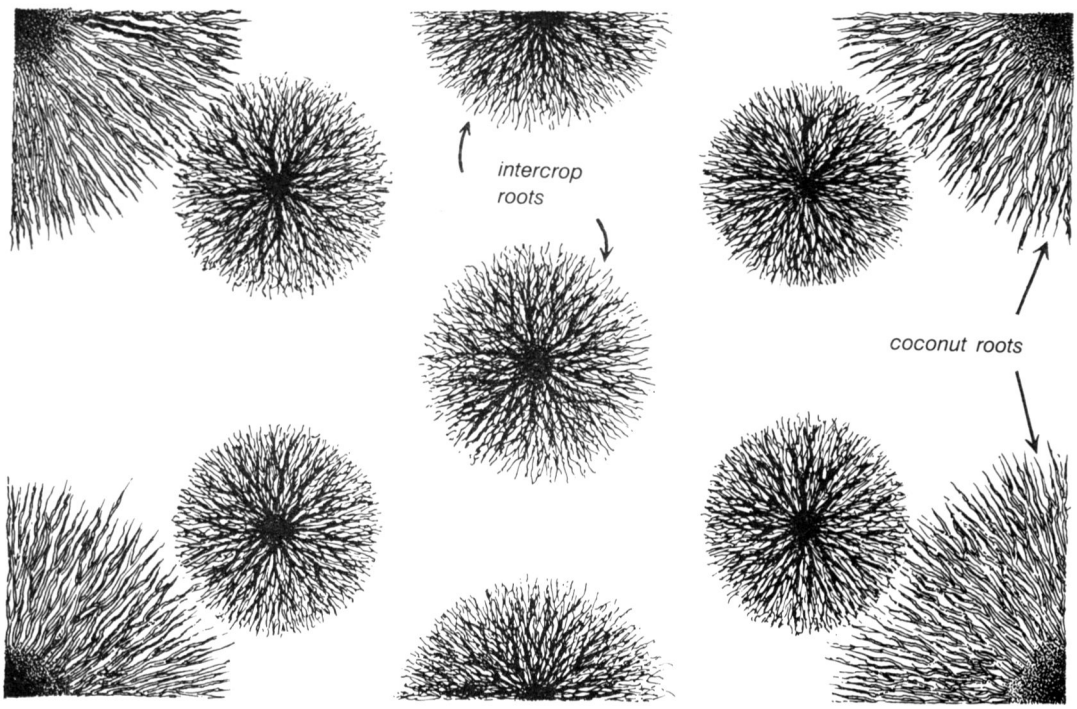



*Fig. 40* *Schematic diagram of the lateral distribution of roots of coconut and other crops in a coconut square.*

Growing other crops under coconut (intercropping or multicropping) and raising livestock (cattle and sheep) not only intensifies land use but also bring in additional income, which can cushion the fluctuating income from coconut. It is estimated that about 75% to 80% of the potential area suitable for intercropping are still unutilized.

Wide spacing of coconut, in particular in rectangular or avenue planting, permits the cultivation of another crop in between rows of coconut. However, there are several agronomic, ecological and socio-economic considerations associated with intercropping.

The coconut palm requires a continuous supply of water. Intercropping should therefore be attempted in areas where there is no moisture limitation. Under rainfed conditions, intercropping should be restricted to areas with adequate rainfall to provide moisture to both crops. Otherwise, coconut production will decline. It is best that intercropping is limited to wet and wet intermediate zones.

## 9.1 General Guidelines

* Ensure that there is adequate sunlight (or shade, depending on the crop) available for intercropping. Generally, intercrops can be grown during the first five years of a plantation, and then from 25 years. During the period 5-25 years, sunlight is inadequate for most crops (Fig. 41).

* The avenue system of planting with wider rows oriented east-west will permit some intercropping even during the first 20 to 25 years of the plantation. When a new plantation is to be established, this aspect should be considered (see section 4.2).

* Ensure that there will be no competition between coconut and other crops for moisture.

* Soil should not have been degraded. Different crops require different soil types.

* Ensure that all crops receive adequate fertilizer. Failure to apply fertilizer to the intercrop will affect the intercrop as well as coconut because the intercrop will draw on the nutrients applied to coconut.

* Ensure that the correct crop is chosen. In most cases failure of intercropping is due to the wrong choice of the intercrop.

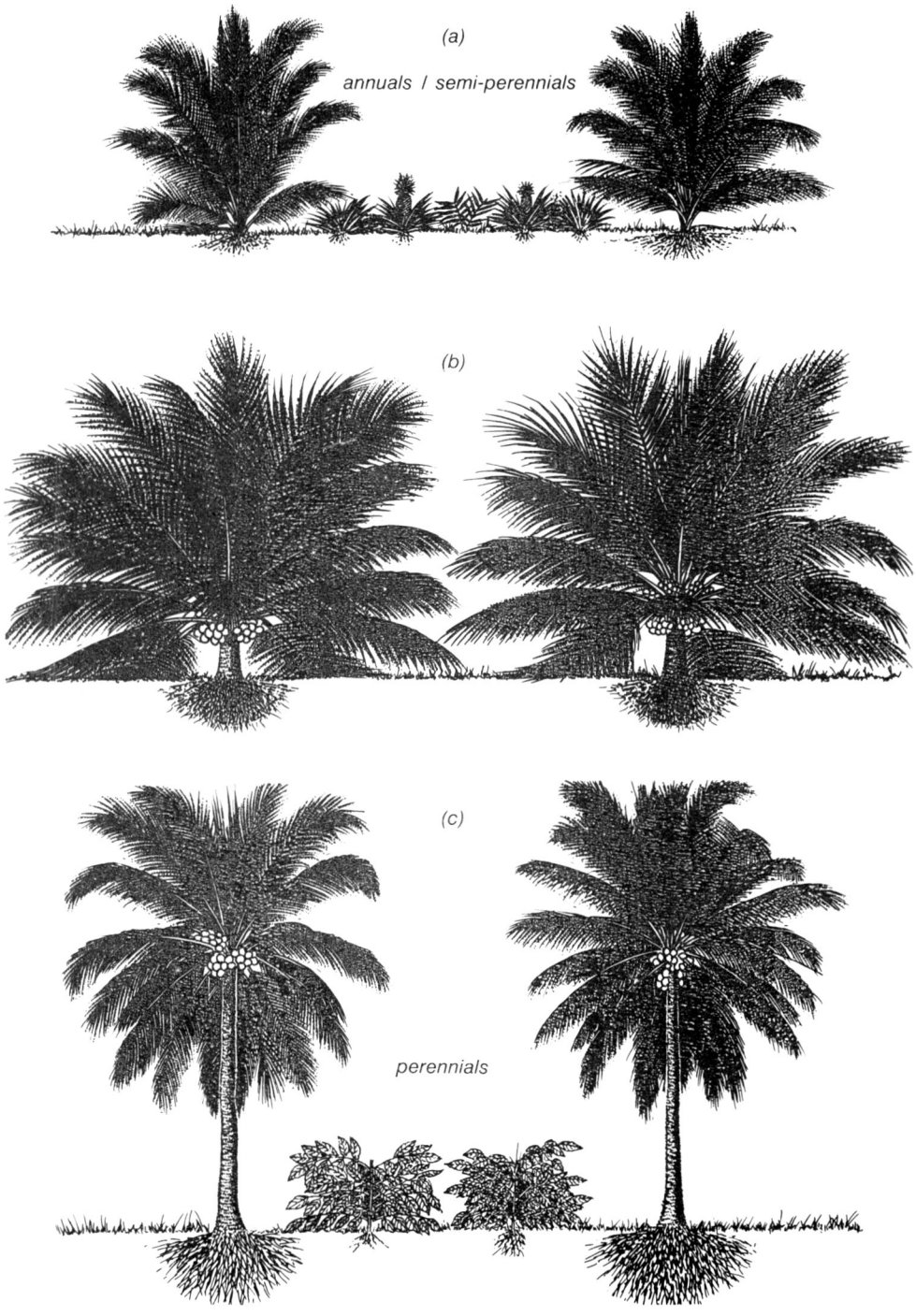



*Fig. 41* *Opportunities for intecropping during different stages of growth of coconut*

## 9.2 Agronomic and socio-economic advantages of intercropping

Intercrops

* improve soil fertility by building up organic matter.
* reduce soil temperature.
* check soil erosion.
* check weed growth.
* provide additional income.
* Increase employment opportunities.
* increase income and guard against market risks and price fluctuations of coconut.

## 9.3 What can be grown in coconut plantations

A large number of crops can be grown under coconut depending on the soil type, soil depth, rainfall etc. (see Table 5).

Intercrops can also be selected depending on the depth of soil. Deep-rooted crops such as cacao, coffee, cinnamon, clove, nutmeg and citrus can be planted in deep soils whereas shallow-rooted crops such as cardamom, pepper, pasture grasses, betel, annual crops and semi-perennials can be grown in shallow soils.

Crops can also be selected on the basis of the age of the coconut plantation (see Table 6).

## Table 5 - *Selection of crops for coconut intercropping*

| *Agro-Eco. Zone* | *Annual Rainfall (mm)* | *District* | *Soil Group** | *Intercrops*** | |
|---|---|---|---|---|---|
| | | | | *Young plantations 0-5 Yrs.* | *Mature Plantations 25-60 Yrs.* |
| Low Country Wet Zone | 1875-2500 | Colombo Gampaha | (a) Red Yellow Podzolic | Ginger, turmeric, tubers, yams Passion fruit, banana, pineapple, pasture. | Ginger, turmeric, yams, tubers, pineapple, passion fruit, banana, cinnamon, betel, pasture, cacao, coffee, pepper. |
| | | Colombo Gampaha | (a) Regosols | Chillies, yams, tubers, banana, pasture. | Chillies, yams, tubers, banana, pasture, cinnamon. |
| | | Kurunegala Kegalle | (a) Red Yellow Podzolic<br>(b) Reddish brown latosols | Ginger, turmeric, yams, tubers, pineapple, passion fruit, banana, pasture. | Ginger, turmeric, yams, tubers, pineapple, passion fruit, banana, pasture, sugarcane, cacao, coffee, clove, nutmeg, pepper, pasture, betel, cardamom. |
| | | Kalutara Galle Matara | (a) Red Yellow Podzolic | Ginger, turmeric, yams, tubers, pineapple, passion fruit, banana, pasture. | Ginger, turmeric, yams, tubers, pineapple, passion fruit, banana, pasture, sugarcane, cacao, clove, nutmeg, coffee, pepper, cinnamon, betel. |
| | | Kalutara | (a) Regosols | Chillies, yams, tubers, banana, pasture. | Chillies, yams, tubers, banana, pasture, cinnamon. |
| Low Country Intermediate Zone (Semi-Wet) | 1875-1500 | Kurunegala Puttalam | (a) Red Yellow Podzolic | Ginger, turmeric, yams, tubers, pulses, chillies, vegetables, banana, pineapple, passion fruit, papaya, pasture. | Ginger, turmeric, yams, tubers, pulses, chillies, vegetables, banana, pineapple, passion fruit, papaya, pasture, cacao, coffee, pepper, citrus, cinnamon, betel. |
| | | Puttalam | (a) Regosols | Yams, tubers, cereals, pulses, chillies, banana, pasture. | Yams, tubers, cereals, pulses, chillies, banana, pasture, cinnamon. |
| Low Country Intermediate Zone (Semi-Dry) | 1500-1250 | Kurunegala Puttalam | (a) Reddish-brown Earths | Chillies, yams, tubers, cereals, pulses, vegetables, tobacco, banana, papaya, citrus, pomegranate, pasture. | Chillies, yams, tubers, cereals, pulses, vegetables, tobacco, banana, papaya, citrus, pomegranate, pasture, cinnamon. |
| | | Puttalam | (a) Red Yellow Latosols<br>(b) Regosols | Chillies, yams, tubers, pulses, cereals, banana, pasture. | Chillies, yams, tubers, pulses, cereals, banana, pasture, cinnamon. |





*Please see page 82 for common names for soil groups.

**Avenue planting can accommodate intercropping throughout.

**Table 6** - *Selection of crops based on the age of palms*

| *Age of Coconut* | *Intercrop type* | | |
|---|---|---|---|
| | *Annual* | *Semi-perennial* | *Perennial* |
| 0-5 Years | Ginger<br>Turmeric<br>Cereals & Pulses<br>Yams & Tubers<br>(Sweet potato,<br>Colocasia, innala)<br>Chillies<br>Vegetables | Pineapple<br>Passion fruit<br>Banana<br>Papaya | |
| 25-45 Years | Yams & Tubers<br>Ginger<br>Turmeric | | Cacao<br>Coffee<br>Pepper<br>Clove<br>Nutmeg<br>Cardamom<br>Pasture and<br>Fodder |
| 45-60 Years | Yams & Tubers<br>(Cassava, Colocasia,<br>dioscorea. innala,<br>sweet potato)<br>Cereals & Pulses<br>Chillies<br>Vegetables | Pineapple<br>Banana<br>Passion fruit<br>Papaya | Cinnamon<br>Citrus<br>Pasture and<br>Fodder<br>Betel |

*Common names for soil groups.*

***Low Country Wet Zone***

Colombo, Gampaha, Kalutara, Galle, Matara.

***Red Yellow Podzolic*** – *Soils with laterite or lateritic gravel in profile.*
***Regosols*** – *Coastal sands with shallow water table.*

*Kurunegala*

***Red Yellow Podzolic*** – *Soils with mottled sub-soil.*

***Low Country Intermediate Zone***

*(Semi-wet)* – ***Regosols*** – *as above.*
***Red Yellow Podzolic*** – *Soils with mottled sub-soil.*
*(Semi-dry)* – ***Regosols*** – *As above.*

## 9.4 How to plant intercrops

Once a crop is selected, the appropriate planting system should be adopted. Some general guidelines are given below.

* Orient intercrop rows in the east-west direction.
* Select the correct spacing (see below) and leave at least 2 m from coconut.
* A planting hole is required for perennials and semi-perennials.
* Plant with the onset of south-west monsoon.
* Shade and mulch the seedling.
* Apply fertilizer as required.

In view of the large number of crops involved, it is not possible to give planting details for all crops. However, some information on a few popular crops is given below. Details on other crops can be obtained from the Coconut Research Institute, Dept. of Export Agriculture, the Regional Research Centres of the Dept. of Agriculture, their extension staff or from the extension staff of the Coconut Cultivation Board.

## 9.5 Coffee

* Coffee rows 2.5 m (about 8') apart and coffee plants 2.0 m (about 6 1/2') apart.

  Approx. 1300 plants/ha (Fig. 42).

* **Planting hole**

  0.5 m x 0.5 m x 0.5 m (1 1/2' x 1 1/2' x 1 1/2') in hard soils.

  0.3 m x 0.3 m x 0.3 m (1' x 1' x 1') in sandy-loam soils.

* **Fertilizer mixture**

| | | |
|---|---|---|
| Urea | - | 4 parts by weight |
| Saphosphosphate | - | 5 parts by weight |
| Muriate of potash | - | 3 parts by weight |
| Kieserite | - | 1 part by weight |

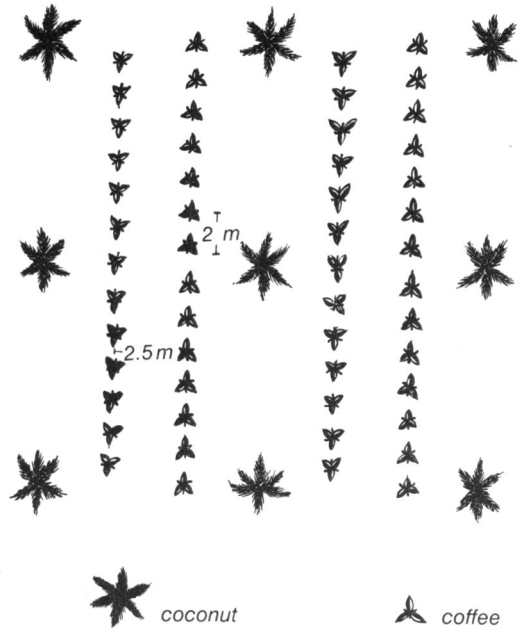



*Fig. 42 Double row of coffee between coconut.*

*** Rate of application**

| Season | 1st year | 2nd year | 3rd year onwards |
|---|---|---|---|
| Yala | Applic. 1 - 40 g<br>Applic. 2 - 40 g | 125 g | 200 g |
| Maha | Applic. 1 - 40 g<br>Applic. 2 - 40 g | 125 g | 200 g |

* Fertilizer requirement for 100 coffee plants for one season (3rd year onwards)

| | | |
|---|---|---|
| Urea | - | 5.5 kg |
| Saphosphosphate | - | 6.5 kg |
| Muriate of potash | - | 4.0 kg |
| Kieserite | - | 1.4 kg |

* Apply fertilizer when soil is wet. During the first year, fertilizer should be applied in a band at a distance of 15 cm (6") from the base. From the second year onwards, it should be applied 30 cm (12") away from the plant in a circular area upto half canopy radius (Fig. 43).

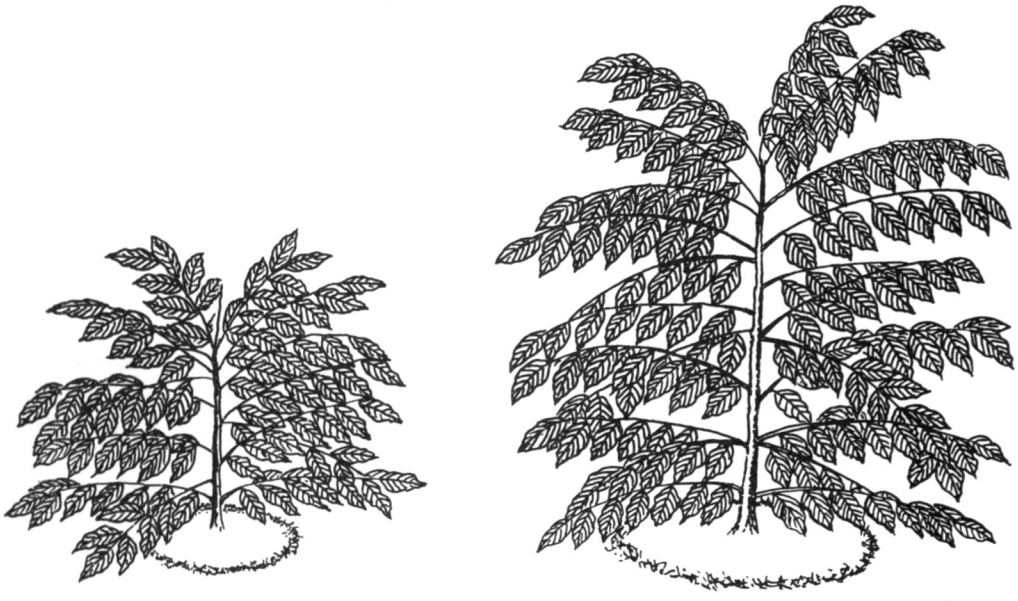


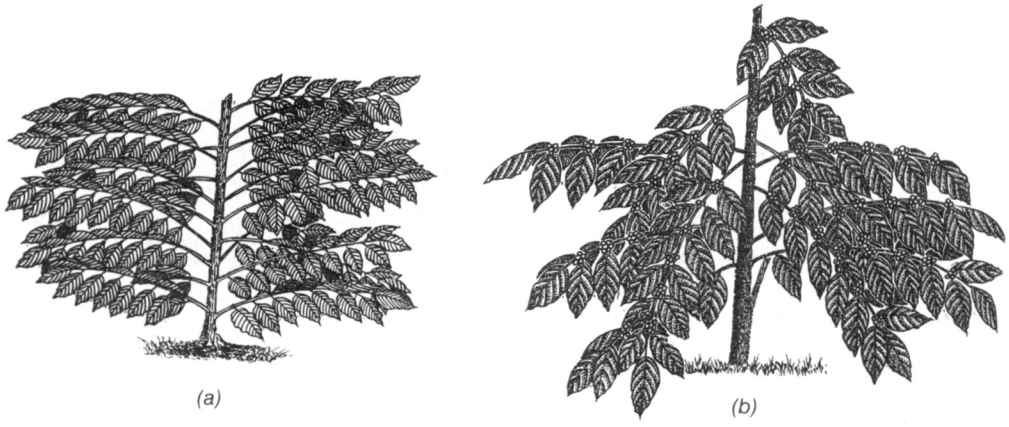
*Fig. 43 Fertilizer application in coffee.*

* **Pruning**

  Remove all water suckers. Allow the main stem to grow upto 1 m. Remove terminal bud. Fruiting branches will then grow.

  After several harvests, allow the main stem to grow further 0.5 m. Coffee plants should not be allowed to grow any taller (Fig. 44).

* **Expected yield** - About 0.7 to 1 kg per year per plant.



(a) (b)

*Fig. 44 Pruning in coffee*
*(a) Pruned at 1 m (b) Pruned after further growth.*

## 9.6 Cacao

* Cacao rows 2.5 m (8') apart and cacao plants 3 m (10') apart. About 800 plants/ha (Fig. 45). Growers could also adopt the single row system.

* **Planting hole**

  0.6 m x 0.6 m x 0.6 m (2' x 2' x 2') in hard soils.
  0.4 m x 0.4 m x 0.4 m (approx. 1 1/2' x 1 1/2' x 1 1/2') in light soils.

* **Fertilizer mixture** (same as for coffee)

* **Rate of application**

| Season | 1st year | 2nd year | 3rd year onwards |
|---|---|---|---|
| Yala | Applic. 1 - 75 g<br>Applic. 2 - 75 g | 250 g | 350 g |
| Maha | Applic. 1 - 75 g<br>Applic. 2 - 75 g | 250 g | 350 g |

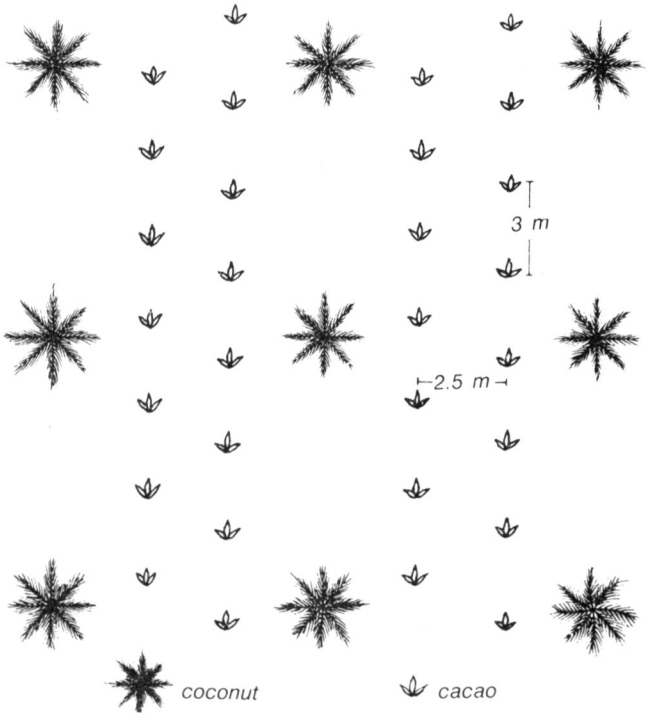



*Fig. 45 Double row of cacao between coconut.*

* Fertilizer requirement for 100 plants for one season (3rd year onwards)

| | | |
|---|---|---|
| Urea | - | 11 kg |
| Saphosphosphate | - | 13 kg |
| Muriate of potash | - | 8 kg |
| Kieserite | - | 2.7 kg |

* Method of fertilizer application - Similar to that in coffee (Fig. 46).

* **Pruning**

  Remove water shoots and preserve side branches. Encourage side branches at about 1.5 m to 2.0 m. Side branches should not grow closer than 2.0 m from coconut (Fig. 47).

* **Expected yield -** About 1 kg beans per year per plant.


*Fig. 46 Fertilizer application in cacao.*

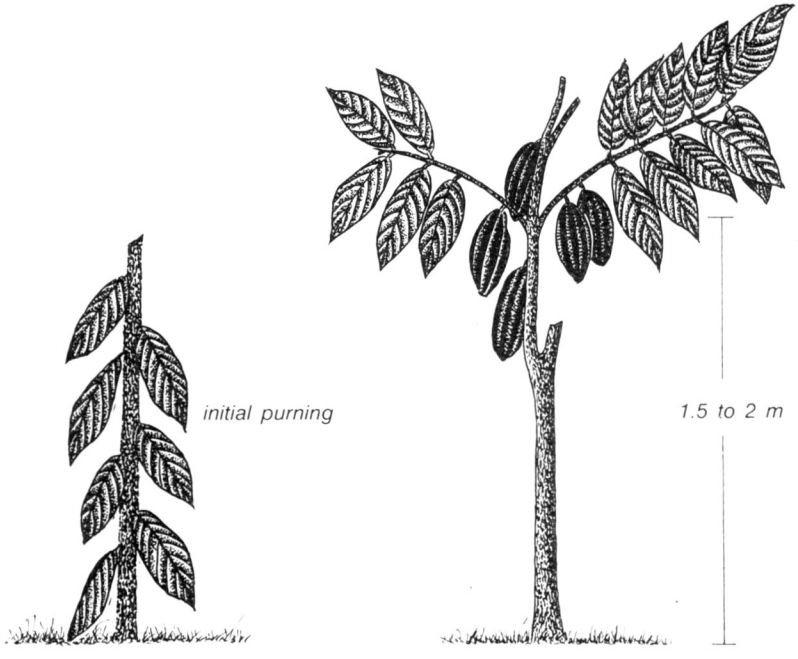



*Fig. 47 Pruning in cacao*

## 9.7 Pepper

* **Planting supports**

  Pepper vines require a support. The most popular is the live support, gliricidia. Mature gliricidia stakes should be planted 30 cm (1') away from the proposed planting point for pepper, during the monsoon preceding pepper planting. Only 1-2 branches should be allowed in gliricidia. When branches spread out, they should be pruned during the rainy season, and the loppings could be used as green manure.

* Pepper rows 2.0 m (6') apart and pepper plants 2.0 m (6') apart (Fig. 48).

* **Planting hole**

  0.6 m x 0.6 m x 0.6 m (2' x 2' x 2') in hard soils.
  0.4 m x 0.4 m x 0.4 m (approx. 1 1/2' x 1 1/2' x 1 1/2') in light soils.

* **Fertilizer mixture** (same as for coffee and cacao).

* **Rate of application**

| Season | 1st year | 2nd year | 3rd year onwards |
|---|---|---|---|
| Yala | Applic. 1 - 125 g<br>Applic. 2 - 125 g | 500 g | 700 g |
| Maha | Applic. 1 - 125 g<br>Applic. 2 - 125 g | 500 g | 700 g |

* Fertilizer requirement for 100 plants for one season (3rd year onwards)

| | | |
|---|---|---|
| Urea | - | 21.5 kg |
| Saphosphosphate | - | 27 kg |
| Muriate of potash | - | 16 kg |
| Kieserite | - | 5.4 kg |

* Apply fertilizer in a circle 15 cm (6") away from the base of the vine upto a distance of 45 cm (1 1/2'). Fork in and mulch.

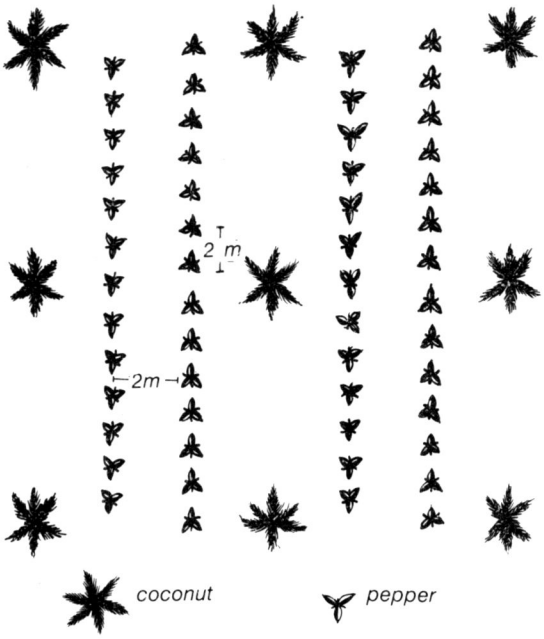



*Fig. 48*
*Double row of pepper between coconut.*

* **Training vines and pruning**

Once about 10 leaves are formed, remove all leaves except the lower most three leaves. After one week, prune the defoliated section. Then 2-3 branches will emerge. Once 8-10 nodes are formed in new branches, defoliate and prune as earlier. Then from each pruned branch, 2-3 vegetative branches will develop. Eventually, a single vine will have 7-10 branches (Fig. 49).

* **Expected yield** - About 2-3 kg black pepper/vine/year.

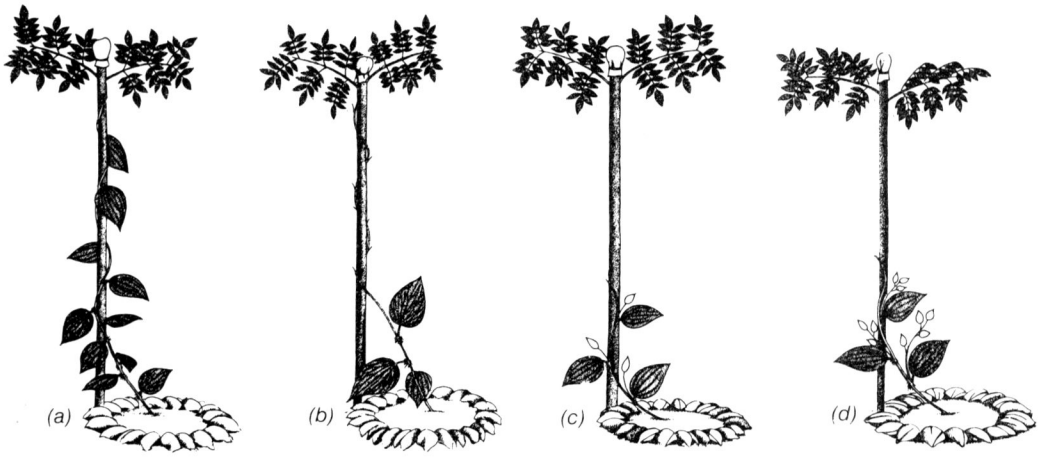



*Fig. 49* *Training of pepper vines:*
*(a) Pepper vine with about 10 leaves;*
*(b) All leaves except the three lower leaves removed;*
*(c) Defoliated section pruned;*
*(d) Development of branches.*

## 9.8 Mixed cropping

Coffee, pepper and cacao can be mixed in coconut holdings, and several models are given in Fig. 50.

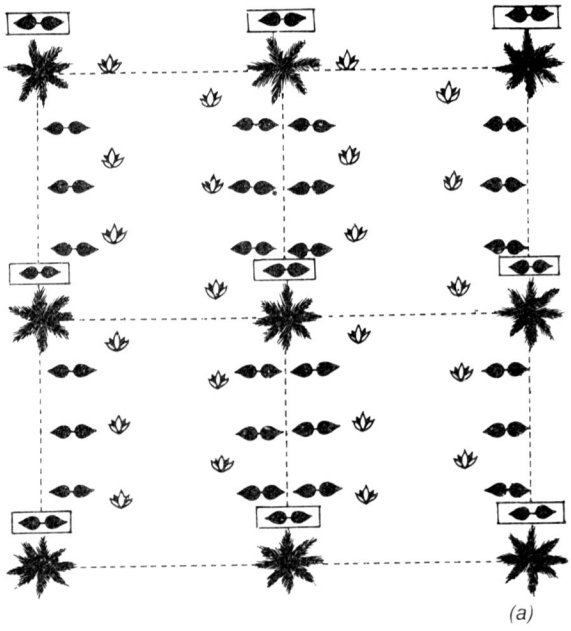



*Fig. 50* *Models for mixed cropping with cacoa and pepper.*

*(a) cacao (double row), pepper on gliricidia as well as on coconut.*

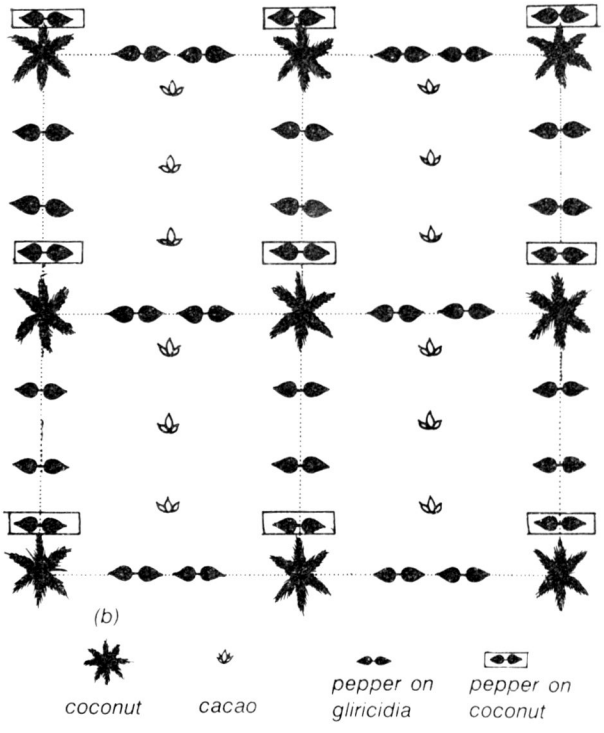



*Fig. 50* *Models for mixed cropping with cacao and pepper*

*(b) cacao (single row), pepper on gliricidia as well as on coconut*

## 9.9 Cloves

* One plant in the centre of the coconut square.

* Planting hole 1 m x 1 m x 1 m (3' x 3' x 3').

* **Fertilizer mixture**

| | | |
|---|---|---|
| Urea | - | 2 parts by weight |
| Saphosphosphate | - | 3 parts by weight |
| Muriate of potash | - | 3 parts by weight |
| Kieserite | - | 1/3 parts by weight |

* **Rate of application**

| | | |
|---|---|---|
| 1st year | - | 250 g |
| 2nd year | - | 500 g |
| 3rd year | - | 750 g |
| 4th year | - | 1000 g |
| 5th year onwards | - | 1250 g |

* **Fertilizer application**

Broadcast in a circle 30 cm (1') away from the plant upto half the canopy radius.

* Clove plants cannot tolerate a drought of more than 1 to 1 1/2 months. Adopt pitcher irrigation, if necessary.

## 9.10 Cinnamon

* Cinnamon rows 1.3 m (4') apart, cinnamon plants 0.6 m (2') apart.

* Plant 7-8 cinnamon seeds in a polybag and remove weak seedlings leaving 3 seedlings only.

* Plant a cluster of 3 plants in each planting hole (22,000 plants/ha).

* **Fertilizer mixture**

| | | |
|---|---|---|
| Urea | - | 4 parts by weight |
| Saphosphosphate | - | 3 parts by weight |
| Muriate of potash | - | 3 parts by weight |
| Kieserite | - | 1 part by weight |

* **Rates of application**

| | | |
|---|---|---|
| For 1-3 year cinnamon | - | 250 kg/ha/yr |
| For 3 years onwards | - | 500 kg/ha/yr |

* **Fertilizer application**

The above dosage should be split and applied once every six months, when the soil is wet.

## 9.11 Pineapple

* Pineapple rows 2 m (6') apart, pineapple plants about 0.5 m (1 1/2') apart (spacing will influence the size of fruit).

* Plant disease-free suckers. Apply a suitable insecticide to remove all mealy bugs.

* Mulching with coir dust is necessary for the control of weeds and for moisture conservation, particularly in the intermediate zone. About 100 tractor loads of coir dust are required for a hectare of land.

* **Fertilizer application**

Requirements for 10,000 plants.

(a) Basal dressing (at the time of planting)

| | | |
|---|---|---|
| Superphosphate | - | 220 kg |
| Muriate of potash | - | 110 kg |

(b) Top dressing

| | | |
|---|---|---|
| 4-6 weeks after planting | - | Urea 220 kg |
| 5-6 months after planting | - | Urea 220 kg |
| 9 months after planting | - | Muriate of potash 175 kg |

(C) Second year application (15 months after planting)

| | | |
|---|---|---|
| Urea | - | 175 kg |
| Saphosphosphate | - | 10 kg |
| Muriate of potash | - | 35 kg |

Same dose should be repeated once every 6 months.

Basal dressing should be mixed with top soil.

Top dressing should be applied on either side of rows and forked in to 5 cm depth (2").

Fertilizer application should be stopped one month before flowering.

* Flowering hormones are applied when the plant is 11 to 12 months old. Generally, hormones are used about a month before the anticipated flowering.

## 9.12 Banana

* Banana rows 3-4 m (10'-13') apart and banana plants 2.5 m (8') apart.

* **Planting hole**

0.6 m x 0.6 m x 0.6 m (2' x 2' x 2')

In areas with strong winds use 1 m x 1 m x 1 m (3' x 3'x 3')

* **Fertilizer mixture**

| | | |
|---|---|---|
| Urea | - | 1 part by weight |
| Saphosphosphate | - | 1 part by weight |
| Muriate of potash | - | 4 parts by weight |

* **Rates of application**

Apply 900 g at 2 months and 6 months. In the subsequent years apply the same dose during the two monsoons.

* **Fertilizer application**

Sprinkle around the plant and incorporate to a depth of 10 cm (4").

## 9.13 Ginger

* There are two varieties of ginger. The local variety, which is more pungent, has smaller rhizomes and therefore yields less than the Chinese variety, which requires better management. The Chinese variety is grown for export.

* Prepare land well. Plough and till the land in between coconut leaving about 2 m (6') undisturbed around the coconut palm.

* A single ginger bush requires 0.09 sq. m (1 sq. foot) of land (about 55,000 plants/ha).

* About 1,200 kg of ginger are required for one hectare of coconut land.

* Plant in mid-March to April. Harvest in December/January.

* **Fertilizer mixture**

  The coconut fertilizer mixture could be used.

* **Rates of application**

  A handful of cattle manure can be used as the basal dressing.

  First top dressing (1 1/2 months after planting) 10 g/plant.

  Second top dressing (3 months after planting) 20 g/plant.

  Third top dressing (5-6 months after planting) 25 g/plant.

* Mulching with coir dust or straw is required.

* **Expected yield** - About 6 MT/ha of coconut.

## 9.14 Turmeric

* Turmeric can tolerate drought better than ginger.
* A number of local varieties is available. Varieties which produce large rhizomes ("tubers") are preferred.
* Land preparation similar to that for ginger.
* Planting system similar to that for ginger.
* About 950 kg of seed rhizomes are required for one hectare of coconut land.
* Planting time and harvesting time similar to those of ginger.
* Other operations similar to that for ginger.
* **Expected yield** - About 6 MT/ha of coconut.

## 9.15. Crop Models for Replanted Lands

Coconut growers resort to underplanting rather than replanting because of their reluctance to remove old palms and lose income. However, in underplantings, the old plants are kept longer than desired, which hinder the growth of the young plants. This is highly unsatisfactory.

Replanting is an agronomically superior practice. Replanted areas, particularly in the wet and intermediate zones, can be intercropped during the first five years with a range of crops, both annual and semi-perennial. These intercrops would bring in a considerable income, which would offset the loss caused by the complete removal of the old coconut stand. In fact, it is possible to reap profits during the first five years from replanted areas planted to intercrops.

A range of annual and semi-perennial crops are available for intercropping in the intermediate and wet zones. The annuals include pulses, vegetables, chillies, yams and tubers and ginger and turmeric. The popular semi-perennials are banana, papaya and pineapple. The choice for the rain-fed dry zone is limited to pulses and grains planted with the onset of rains.

The grower should choose an appropriate combination of annuals and semi-perennials, depending on the resources available. It is not possible to give details of all possible crop combinations for a given situation. However, Fig. 51 gives a well-tested 4 ha crop model in the gravel soils of the intermediate zone.

In this crop model, the following crops are grown between coconut seedlings:

a. pineapple
b. banana
c. ginger
d. papaya
e. lime

The actual income and expenditure in respect of this holding for the first three years after establishment of coconut and other crops are given below:

| Year | Expenditure (Rs) | Income (Rs) | Profit / Loss (–) (Rs) |
|---|---|---|---|
| 1987 | 164,053 | – | – 164,053 |
| 1988 | 143,369 | 142,725 | – 644 |
| 1989 | 46,803 | 335,215 | 288,412 |
| | Profit at the end of the third year | | **Rs. 123,715** |

It would be seen that although there are no profits in the first two years, there is a considerable profit from the third year. Planting annuals in the first year would also give an income. The grower should therefore exercise his discretion about the crop combination for replanted lands.

In situations like this, coconuts will flower earlier than in an underplanted field.

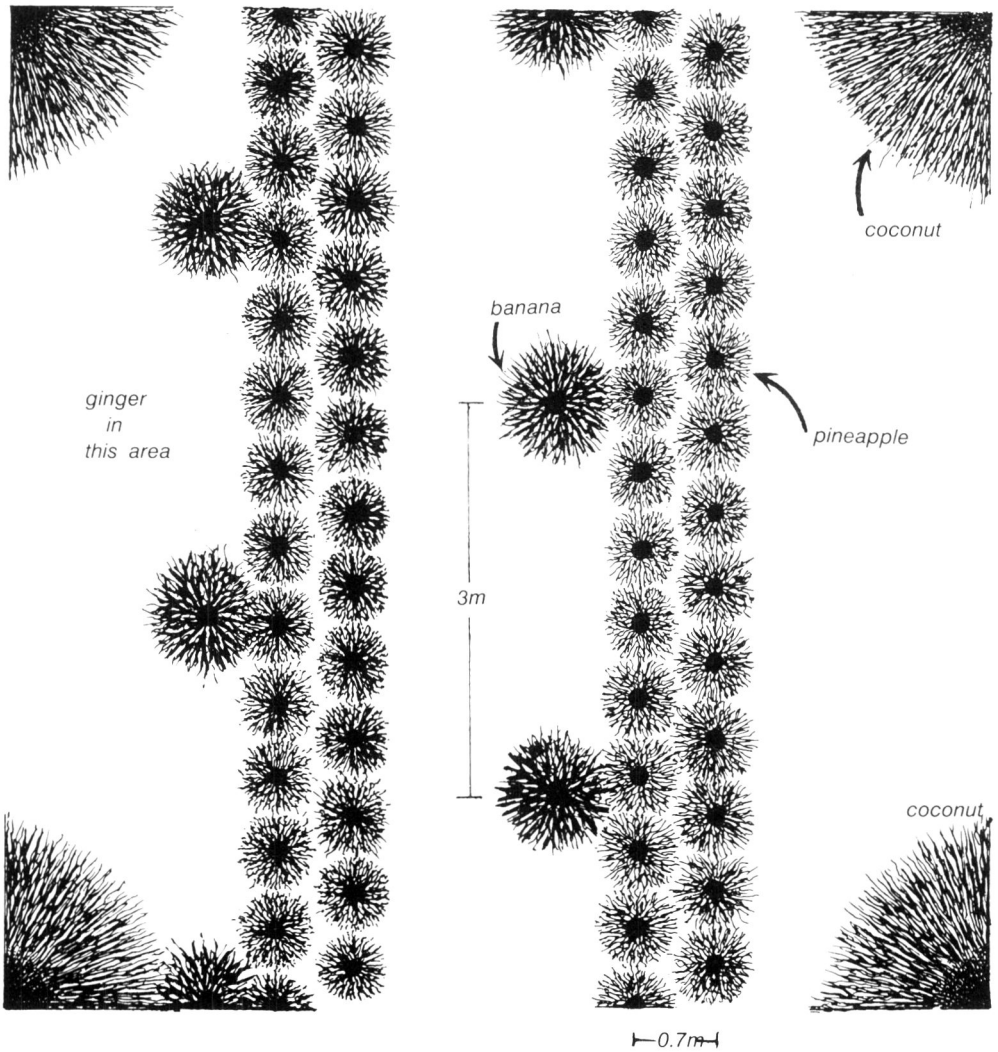



*Fig. 51 Crop model for replanted lands.*

## CHAPTER 10

# ANIMAL HUSBANDRY IN COCONUT LANDS

Animal husbandry could be undertaken in coconut lands in the Wet and Intermediate Zones where grass can be grown easily.

As grass will require moisture and nutrients, it is necessary to ensure that there is no competition for them between grasses and coconut. This would necessarily mean that the grasses should be adequately fertilized and that there will be no moisture deficiency in the soil.

Naturally-occurring grasses in coconut lands do not give a satisfactory yield. About 2 ha of such land will be required to maintain a single head of cattle. Therefore, improved high-yielding grasses should be used.

### 10.1 Properties of Good Grasses:

* Competition with coconut for plant nutrients and soil moisture should be minimal.
* They should be able to withstand the shade.
* They should have short spread and should be able to withstand close grazing.
* They should have a good response to ferilizer.
* They should be able to grow with leguminous fodder plants.
* They should be relished by cattle.

### 10.2 Suitable Grass Varieties

**(a) Pasture Grasses:**

* *Brachiaria miliiformis* (the most suitable variety)
* *Brachiaria ruziziensis*
* *Brachiaria dictyoneura*

* *Brachiaria brizantha*

* *Brachiaria decumbens*

**(b) Fodder Grasses:**

* *Panicum maximum*

* Hamil grass *(Panicum maximum cv.* Hamil*)*

## 10.3 Suitable Legumes

Legumes increase the protein level in the feed.

**(a) Ground Covers**

* *Pueraria phaseoloides* (Puero)

* *Calopogonium mucunoides* (Calopo)

* *Centrosema pubescens* (Centro)

* *Macroptilium atropurpureum* (Siratro)

**(b) Bush Covers:**

* *Leucaena leucocephala* (Ipil Ipil)

* *Gliricidia sepium*

## 10.4 Mixed Swards of Grass and Legume

* A mixed sward of grass and legume is more advantageous than establishing a single species.

* In the event of an adverse situation at least one crop will remain.

* Mixed swards improve the quality of the feed and control weeds more effectively.

* They are more suitable for different soils and are attractive to animals.

* Any mixed swards of plant varieties should mature at the same time. Also the animals should not prefer one component of the mixed sward to others.

* Generally, legume seeds and grass cuttings should be planted in alternate rows, 60 cm (2') apart.

Once the grass is planted, the recommended fertilizer should be applied. In the early stages weed control is necessary. About 20,000 cuttings of pasture grasses and 15,000 cuttings of fodder grasses are required for one hectare of coconut.

About 5-8 kg of legume seeds are required to plant one hectare. Before sowing, seeds should be immersed in warm water (70°C) for 3 - 5 minutes and then soaked in cold water for 12-24 hours.

### 10.5 Silage and Straw

During certain periods of the year adequate grass may not be available. However, during wet season there will be a surplus of grass. Such surplus grass could be converted to silage. It is also possible to use urea-treated straw for cattle during the dry season.

### 10.6 Integrated Farming

It is possible to have an integrated system involving pasture/fodder, tree fodder and cattle, which is particularly suitable for small-holdings.

For example, a system containing *Brachiaria miliiformis, Pueraria phaseoloides,* ipil ipil and gliricidia, grown under coconut and in the perimeter of the plantation, has been able to sustain cattle, which in turn provides a considerable amount of manure to the palms.

In integrated systems, the cattle will be allowed to graze and will also be fed with fresh loppings of ipil ipil and gliricidia. During dry periods, urea-treated rice straw could be fed mixed with tree fodder loppings.

Dung and urine produced by the animals provide substantial quantities of nitrogen, phosphorus and potassium. In fact, the fertilizer cost could be reduced by about 70% annually. The indirect benefits of organic manure are also evident in increased coconut production in such holdings.

## CHAPTER 11

# IRRIGATION

Recurrent droughts in the coconut growing areas in Sri Lanka have generated considerable interest on supplementary irrigation in coconut cultivation.

Research conducted by the CRI has clearly demonstrated the benefits of supplementary irrigation. In mature palms, irrigation during dry months has increased the nut yield by 30% and copra yield by 54%. Similar results have been obtained from experiments conducted elsewhere in the world.

The coconut palm requires uniform distribution of rainfall. In the intermediate zone where coconut is concentrated, there are two peaks of rainfall (called bimodal distribution), coinciding with the two monsoons. Similarly, there are two periods of stress due to dry weather in January/February and July/August. Although these two stress periods are normally short; extended stress periods of even three months have been observed in the recent past. In the dry zone with a single monsoon, there are longer dry periods. Sometimes, the adverse effects are overcome naturally in areas with high water table (eg. areas bordering the lagoons in Puttalam, Jaffna and Kalkudah areas).

The most effective way of overcoming drought stress is by irrigation.

### 11.1 Water Requirement of Coconut

The water requirement of the coconut tree depends on many factors. They are: rainfall in the area, soil type and soil moisture availability, evaporation (loss of water from the soil surface due to heat), transpiration (loss of water from leaves), plant age, humidity in the environment etc. It is therefore difficult to generalize the water requirement in coconut in different areas. However, considering all available data, the following average water requirements have been determined.

* Adult palms - Average 50 litres per day. (This ranges from 10 to 150 litres per day.)

* Seedlings and young palms - 5 to 10 litres per day.

## 11.2 Irrigation

The grower should give careful consideration to the availability of adequate water for irrigation during the dry period, which can be reasonably expected to be about 90 days per year. Several water resources can be considered:

(a) Open wells - these would be useful where ground water is not very deep.

(b) Tube wells - to exploit deep underground water, and

(c) Reservoirs and ponds - to store rain water and surface run-off. Construction of new reservoirs is costly. Reservoirs and ponds have the added advantage of elevating the water table in the land.

The land owner should carefully consider the above options together with the water requirement (see Section 11.1 ) and the availability of funds.

The Water Resources Board and the Coconut Cultivation Board have the machinery to construct tube wells.

## 11.3 Methods of Irrigation

### A. Traditional Methods

#### 11.3.1. *Small Water-Holes:*

Coconut plantations, particularly in the east coast where the water table is high, have small water-holes conveniently located for manual irrigation of plants. Workers walk into the water-hole and carry away water in buckets etc. This is only possible in certain areas.

#### 11.3.2. *Pitcher Irrigation:*

Experiments have shown that this traditional method using clay pots is very effective. Also, water is used efficiently. This method is described in section 4.7, and is particularly beneficial for seedlings and young palms.

### 11.3.3 . *Basin and furrow method:*

A basin of shallow depth (say 10 cm) is prepared around the base of the palm, and the basins of adjacent palms are inter-connected with furrows. Water is allowed to flow freely in the furrows to the basins and irrigate the trees (Fig. 52).

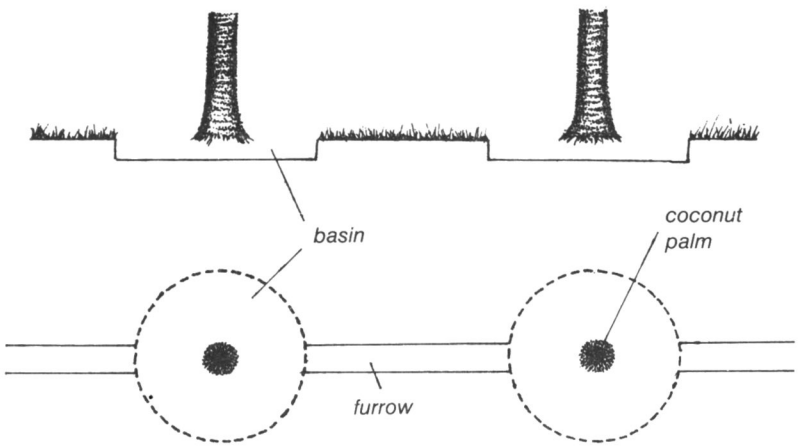



*Fig. 52 Furrow irrigation.*

This method is not suitable for undulating lands. Even in relatively flat lands, considerable land preparation is required initially, to establish levels for free flow of water.

Also, this system would be unsuitable for sandy soils due to heavy water loss by percolation. The water requirement for this method will be high, too.

## B. Improved Methods

### 11.3.4. *Sprinkler Irrigation System:*

Sprinkler irrigation requires high capital investment and an abundant supply of water. Individual trees cannot be irrigated, and much water is wasted.

This system, however, is suitable for commercial nurseries where seedlings are closely spaced and where annuals and pasture are grown as intercrops.

### 11.3.5 . *Drip Irrigation System:*

Drip irrigation systems are feasible in coconut lands, and are often seen in coconut holdings in Kerala in India. Several estates in Sri Lanka too have established drip irrigation systems of different designs.

Advantages of this system are:

* requires relatively less water as the system can be designed for efficient water use.

* water use can be regulated.

* fertilizer could be added to the irrigation water, thereby saving the cost of fertilizer application.

* intercrops could be irrigated with simple modifications to the system.

* can be operated with minimal labour.

Disadvantage of this system is:

* high capital investment.

The CRI has designed a gravity-flow drip irrigation system for coconut lands using as much local material as possible.

This system consists of an overhead water reservoir and an underground looped pipe network to deliver water to individual coconut trees. The pipe system consists of four main pipe lines (20 mm) and feeder lines (12 mm). At the base of each tree, a riser pipe has been installed, from which water is delivered to three points around the base of the tree by 6 mm plastic 'dripper' hoses. Water is allowed to drip freely into the ground or into a 15 cm-long piece of bamboo cylinder buried vertically. A schematic diagram of this system for a 2 ha holding is given in Fig. 53.

The looped pipe network stabilizes the water pressure in the system and would facilitate uniform discharge of water at any given point. All feeder lines are valved which should be adjusted initially for the desired level of delivery. Thereafter, these valves need not be manipulated except to shut off feeder lines for repairs etc.

The plastic 'drippers' have a relatively bigger diameter (6 mm) than the conventional drippers. These 'drippers' therefore do not get clogged easily.

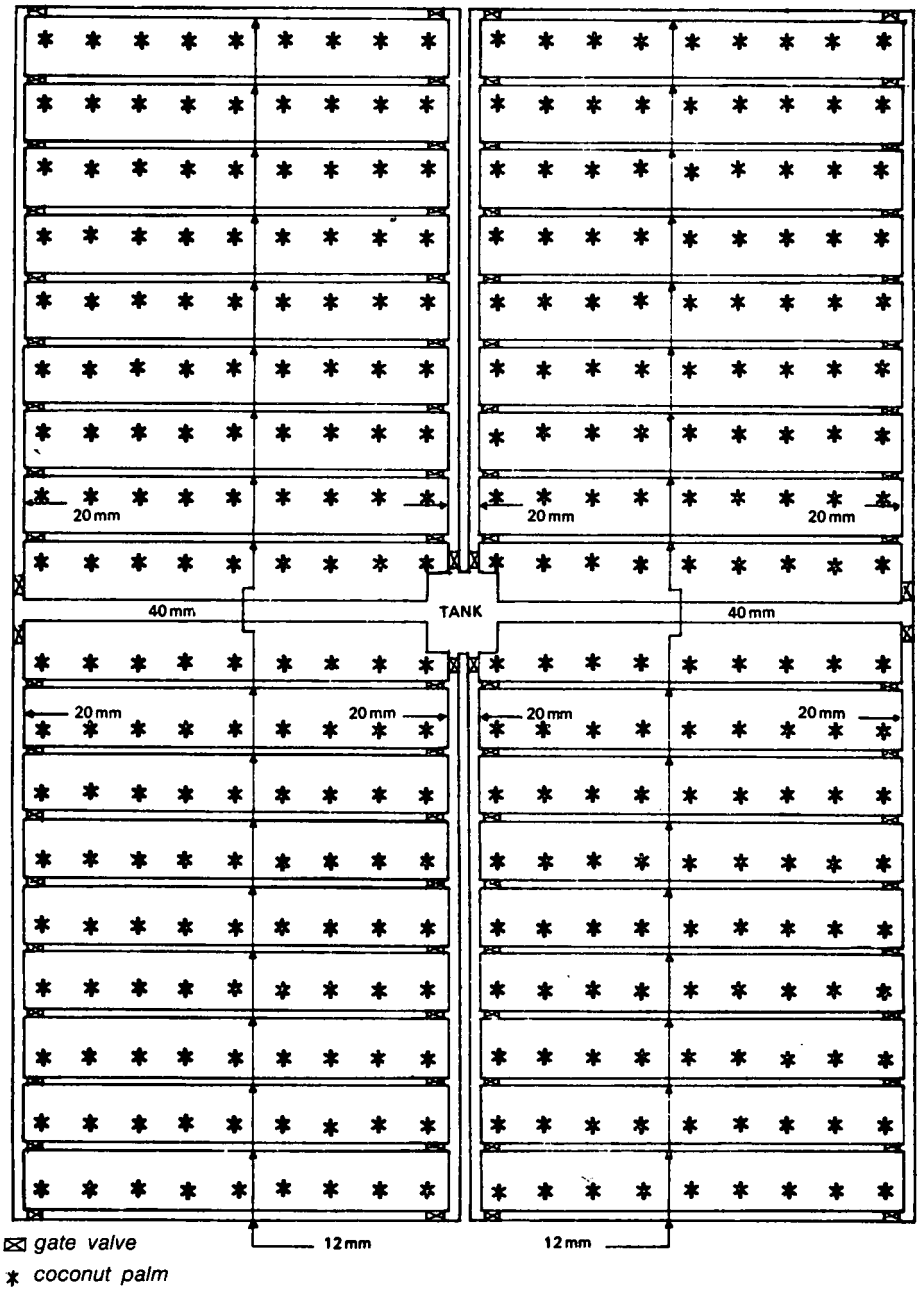



*Fig. 53* *Schematic diagram of a sub-terranean pipe-borne drip irrigation system for 2 ha coconut plot. (Reproduced from Coconut Bulletin 5; 14).*

The 2 ha plot is divided into four blocks of equal size and it is anticipated that each block could be irrigated within two hours. Thus during a normal working day of 8 hours, the entire 2 ha could be irrigated. The system could be suitably adjusted for larger or smaller areas of land by merely adjusting the head of water and the delivery pressure. Assuming a density of 150 palms/ha, the water requirement of the 2 ha plot would be 15,000 litres per day at the rate of 50 litres per tree.

In a flat land, the minimum head required for the overhead reservoir is about 4 m. However, this aspect should be carefully examined in relation to each location taking into consideration the topography of the land, location of the water source etc. A contour map of the land would be useful in determining the head.

It is desirable to install a simple filter in the system to prevent impurities from clogging the 'dripper'.

The approximate cost of the pipe network and the ancilliary fixtures for the 2 ha plot and the cost of infrastructure are given in Table 7.

The annual maintenance and operational costs of the system are estimated at about Rs 3,750 to 4,000 per ha.

Increase in yield due to irrigation depends on several factors such as age of the palms, their nutrition, soil factors, climate etc. A very nominal increase of 25 nuts per tree per year due to irrigation alone would increase income by Rs. 9,375/- per ha per year, assuming an average price of Rs. 2.50 per nut. Other benefits of irrigation would be the possibility of incorporating fertilizer into the irrigation water thereby reducing application costs and opportunities for intercropping under irrigation.

**Note:** A drip irrigation system similar to the one described in section 11.3.5 has been installed at the CRI sub-station, Ratmalagara Estate, Madampe, and is available for inspection.

**Table 7** - *Cost of Drip Irrigation System for a 2 ha Coconut Plantation*

| | | |
|---|---|---|
| **A - Cost of pipes and related fixtures** | | |
| 1. Overhead tank to ground 75mm-5m | 1000.00 | |
| 2. Pipes: | | |
| 140 m of 40 mm (@ Rs 60/-) | 8400.00 | |
| 140 m of 20 mm x 4 (@ Rs 17/-) | 9520.00 | |
| 140 m of 12 mm x 18 (@ Rs. 13/-) | 32760.00 | |
| 3. Risers | 4000.00 | |
| 4. Drippers | 13200.00 | |
| 5. Gate valves: | | |
| 2 Nos 40 mm (@ Rs. 180/-) | 360.00 | |
| 4 Nos 20 mm (@ Rs. 80/-) | 320.00 | |
| 2 Nos 12 mm (@ Rs. 50/-) | 100.00 | |
| Other valves | 5500.00 | |
| 6. Reducing T-joints (Overhead to outlets): | | |
| 4 Nos 75 mm/20 mm (@ Rs. 150/-) | 600.00 | |
| 2 Nos 75 mm/40 mm (@ Rs. 175/-) | 350.00 | |
| 7. Reducing T-joints (20mm/12mm) 72 Nos (@ Rs. 12/-) | 864.00 | |
| 8. Riser T-joints | 1750.00 | |
| 9. Other pipe fittings | 2000.00 | |
| 10. Manholes | 8000.00 | |
| 11. Labour charges (10%) | 8800.00 | **97,524.00** |
| **B - Cost of Infrastructure** | | |
| 1. Cost of overhead tank (5x4x1.5m) 5 meters above ground | 30000.00 | |
| 2. Water pump | 10000.00 | |
| 3. Well 1.75 m Diameter, 10 m deep, concrete rings | 30000.00 | |
| 4. Simple filter system | 5000.00 | |
| 5. Pipe from well to over-head tank 40mm PVC pipe (20 m) x (@ Rs. 60/-) | 1200.00 | **76,200.00** |
| Total (A + B) | | **173,724.00** |
| Contingencies (10%) | | **17,375.00** |
| **GRAND TOTAL** | | **191,099.00** |

## CHAPTER 12

# SOME ASPECTS OF PLANTATION MANAGEMENT

Increasing production from coconut lands not only requires the adoption of proper cultural practices but also requires managerial capability of a high order. Generally, income from coconut lands is relatively low compared to some other plantation crops. This is particularly so because of the low prices realized for coconut during the last decade. The profits can be considerably enhanced by increasing the yield, adopting cost control measures and by good management.

### 12.1 Staff

Well-trained staff is a primary requirement. The cadre of the supervisory staff will depend on the size of the property, its production, activities and profitability. Generally a property of 20 ha will need an officer of the status of a Field Officer to be in charge. A Junior Field Officer too will be required.

A large property of over 100 ha would require a Superintendent, a Field Officer and two Field Assistants. A Clerical/Accounts Assistant will also be required.

The requirement of Watchers will vary from property to property. However, one Watcher for 30 to 40 ha is the generally accepted number.

### 12.2 Know your land

The staff should know the property well.

**A contour map and a soil map** of the estate would be most useful. An experienced manager will always dig pits at various points in the land to determine the soil type, soil depth etc. which would be very useful in deciding on the agricultural practices on a priority basis, identifying poor areas requiring special attention etc.

**Fields and Census of Palms:** The estate fields should be clearly marked on a survey plan, and the fields demarcated showing the area in each of the fields. An area statement for the entire land should be prepared as follows:

*Area Statement*

a - Coconut
- Bearing area
- - Immature area
b - Roads & Buildings
c - Paddy land
d - Waste land
e Jungle

A census of the palms should be taken annually. It would be desirable to give each palm an identification number which will be very useful in keeping records of specific activities, monitoring yield, demarcating field operations, monitoring weak palms etc. The palms could be categorized into the following groups:

a. Bearing palms
b. Immature palms
   1. Seedlings
   2. Young Palms in stem
   3. Partially-bearing palms
c. Dud palms
d. Vacancies

**Water:** Drainage drains and contour drains should be maintained in good order for proper soil moisture management. If there are open wells in the property, it would be useful to keep a daily record of the fluctuation of the water table. This could be measured easily using a calibrated stick. These records will give useful information on the availability of ground water and the depth of the water table in the property, particularly during periods of drought.

**Rainfall:** A simple rain gauge is an essential item to keep records of rainfall. Both rainfall and the number of wet days should be recorded daily (any day receiving more than 2 mm rain is considered a wet day).

**Roads & Paths:** Roads should be kept in good order. Motorable roads should be maintained well with the proper camber so that rain water will flow into the drains. Drains too should be kept clean. If there are no drains, rain water will collect on the road thereby damaging the surface (also see Section 7.4.7).

## 12.3 Weed Management

Weeds compete with coconut for moisture and nutrients and should be kept under control.

A large number of weeds are found in coconut plantations. Some of these, such as foxtail grass, are more troublesome than others. The grower should therefore acquaint himself with the common weeds in the area, their behaviour, their flowering and dispersal aspects.

* Plan out a regular weed control programme, depending on weed growth in the estate.

* Slashing is a common and effective method of controlling most weeds, when the weed population is moderate. Repeated slashing will also eventually kill those weeds with underground reserves.

* Mammoty weeding is useful and effective in removing deep rooted weeds when the weed population is low.

* Heavy growth of bushy type, deep-rooted weeds such as `Babila' (*Cida*), `Apala' (*Urena lobata*), `Thora' (*Cassia occidentalis*), `Pila' (*Tephrosia purpurea*) and `Maduruthala' (*Ocimum sanctum*) should be controlled by harrowing.

* In the long-term, establishment of a cover crop will keep the land free of weeds (see Section 7.4.4).

* Some pernicious weeds such as "Mana" (*Pennisetum polystachyon*) and "illuk" (*Imperata cylindrica*) should not be allowed to establish themselves in the estate. Look out for these weeds, and remove them completely as soon as they are seen. These weeds establish and spread very quickly, and can quickly ruin a plantation.

  Heavy growth of these two weed species should be controlled using the herbicide, glyphosate. Afterwards, a cover crop should be established.

* In large estates, mechanical weed control is cost effective. There are tractor - operated (PTO - driven) rotary slashers which could slash about 2 ha in an 8 hour shift. These are particularly useful for lands short of labour, which makes it impossible to perform timely weed control operations.

* Road edges, foot paths etc. should be kept free of weeds using a herbicide.

* TIMELY WEED CONTROL IS ESSENTIAL.

### 12..4 Maintenance of the Manure Circle

The condition of the manure circle area (2 m from the base of the coconut palm) will influence the productivity of the palms, and therefore, this area should be maintained in good order. Soil in this area should be improved to enhance its water-holding capacity.

* Apply herbicide in the manure circle area to kill the weeds. The weed trash should be kept as a mulch. Avoid herbicides getting into contact with the seedlings.

* Use all fronds, flower parts, bunch stalks etc. to mulch the manure circle area. These will not only keep the weeds away but will also help in moisture conservation. There will also be the addition of nutrients to the soil (recycling of nutrients) as the fronds etc. decay. Please see section 6.1 and Table 2 for the estimated nutrient content in fronds, flower parts etc.

* A thick mulch of organic matter in the manure circle area will reduce the soil temperature and enhance earthworm and microbial activity. Earthworms bring deep-seated nutrients to the soil surface.

* A husk mulch in the manure circle will also improve the moisture status in the manure circle area.

* MANAGEMENT OF THE MANURE CIRCLE AREA IS ONE OF THE MOST IMPORTANT AGRICULTURAL ACTIVITIES AND UNRESERVED ATTENTION SHOULD BE GIVEN TO THIS ASPECT.

## 12.5 Harvesting

Generally, coconuts are harvested using long bamboo picks. This is a skilled job and good pickers are difficult to find. Well trained pickers are quite efficient. In a 40 to 50-year-old plantation having uniform trees, a good picker can harvest about 300 trees in a day. The efficiency of the picker is much reduced if there are trees of varying heights, because he has to change the picking bamboo quite often

### How many picks for an year?

Traditionally, coconuts are picked once in two months, and two bunches are harvested from a tree at each pick.

Coconut production within an year is not uniform. There is generally a high crop in May/July period. The production pattern in the six picks is as follows:

| | | |
|---|---|---|
| First pick (January/February) | - | 10% of the annual crop |
| Second pick (March/April) | - | 17% of the annual crop |
| Third pick (May/June) | - | 23% of the annual crop |
| Fourth pick (July/August) | - | 22% of the annual crop |
| Fifth pick (September/October) | - | 17% of the annual crop |
| Sixth pick (November/December) | - | 11% of the annual crop |
| Total | - | 100% |

(This pattern may vary in some areas.)

Coconuts mature quickly during the dry months. Therefore, there will be more fallen nuts in February/March and July/August periods. The crop loss due to lost fallen nuts can be quite considerable in large properties. The labour requirement for the collection of fallen nuts is also high. Some estates resort to the practice of paying an incentive to the watchers for collection of fallen nuts.

The loss of crop due to fallen nuts and theft can be minimised by more frequent picking. However, the grower should weigh the economic benefits of more frequent picking, considering the extra expenditure involved.

Harvesting at 42 to 45 day intervals (nine picks per year) has been found to be advantageous in many estates. In these instances, the loss of crop due to fallen nuts and theft has been minimised. The picking schedule should be flexible. The principle is that more frequent picking can be done during dry months and the period between picks can be extended during wet months. On this schedule, there will sometimes be only one bunch for picking during the lean period.

## 12.6 Pest Control

Every estate should train a few workers in pest control work. They should attend to the following items of work:

* Treat seedlings at the time of transplanting to prevent termite damage.

* Regularly inspect seedlings and young palms for black beetle and red weevil damage. They should be able to extract adult black beetles with a hook, and should carry a coal tar preparation during their field rounds to dress wounds and damaged petioles. One worker can inspect about 300 seedlings/young palms in a day.

* Look for yellowing of palms or other abnormal conditions and report such instances to the Superintendent.

* They should be competent to administer insecticides, as indicated in sections 8.1 and 8.2.

  (The workers should be given a basic training on the safe use of pesticides).

* THE STAFF SHOULD BE VIGILANT. PREVENTION IS BETTER THAN CURE.

## 12.7 Estimates and Cost Control

Every estate should prepare an annual estimate at the beginning of the year. The Superintendent should have detailed discussions with his staff and the owners on the proposed programme for the year and should then prepare an estimate of costs and a work programme (see Section 12.8).

The estimate should be a realistic one and should be able to accommodate unforeseen expenditure items. It is also desirable to review the estimates quarterly and make

the necessary adjustments. The major recurrent expenditure components are categorized as follows:

A. General Charges
B. Upkeep
C. Cultivation
D. Harvesting
E. Curing

Some explanatory notes on these components are given below:

### A. *General Charges*

These include the following:

1. Salaries, Wages and Allowances: Includes salaries, wages and allowances, travelling expenses and holiday pay of supervisory staff.

2. Other charges: Includes Employer's contributions to the Employees Provident Fund (EPF) and Employees Trust Fund (ETF) and other applicable funds.

3. Equipment & Buildings: Includes upkeep of tools, plant and machinery, equipment and farm implements; upkeep of buildings.

4. Transport: Includes upkeep of vehicles, carts (including bulls) and their operations; depreciation of vehicles. (Normally only 'supervisory' vehicles are considered here. Expenditure on agricultural vehicles is charged to upkeep).

5. Services and Charges: Includes land rent and taxes, medical and maternity expenditure, insurance, stationery, postal and telephone charges.

### B. *Upkeep*

This item includes clearing boundaries, weed control, census, removal of old palms, soil and moisture conservation, drains, pest and disease control, upkeep of roads and fences, cover crop establishment, intercropping and irrigation.

### C. *Cultivation*

This item includes all items relating to purchase, transport of fertilizer and its application.

### D. *Harvesting*

This item includes costs of picking, collecting and counting nuts.

### E. *Curing*

This items includes costs of curing and transport and brokerage.

A typical estimate for a well-managed 20 ha property is given in Table 8.

**Cost Control:** It is essential that expenditure is closely monitored. The annual estimate may be divided into monthly estimates, depending on the activities.

Cost controls can be monitored very effectively by computerization. A programme such as Lotus 1, 2, 3 could be used profitably to monitor the expenditure items, cost of production etc. and will be invaluable in the long run.

## 12.8 Work Programme

Estate management is made easy by scheduling all cultivation programmes monthly. This would enable monitoring field work effectively and distribute work amongst workers. The work programme could be drawn up in the form of a bar-chart and histograms and should be displayed in the office so that the supervisory staff will have occasion to study it regularly and implement the activities. An example of a work programme is given in Fig. 54.

*Fig. 54*

***Explanatory notes:***

*This programme has been drawn up for a 20 ha* ***mature*** *coconut plantation, divided into two fields, each of 10 ha in extent, receiving rainfall in the two monsoons (May/June and October/November). An attempt has been made to distribute labour throughout the year.*

*Picking:* *Scheduled at two-monthly intervals, and is normally done on contract.*

*Manuring:* *Scheduled for the use of Adult Coconut Mixture (ACM) which can be applied anytime of the year. For convenience, only 5 ha of a field is scheduled for ACM application during any given application. Thus ACM application is staggered over a period of four (4) months. Urea application (indicated by u) will be done when the soil is moist.*

*Mulching:* *Three rounds of mulching for an year are scheduled. The first one is in January in anticipation of a dry period. Others coincide with urea application. Extra mulching is encouraged, and may coincide with weeding.*

*Husk Burying:* *Husk burying is scheduled for only 10 ha of the plantation and should be done when the soil is not too dry.*

*Weeding:* *Three rounds are scheduled. An additional round of cheddy weeding may be considered in July/August, depending on the ground conditions.*

*Roads/Drains:* *Maintenance of roads/drains is scheduled for August, in anticipation of the monsoonal rains in October/November.*

*Depending on the climate of the area and other ground conditions, the programme may be appropriately adjusted.*

Fig. 54 Programme of Work for Monitoring Field Work

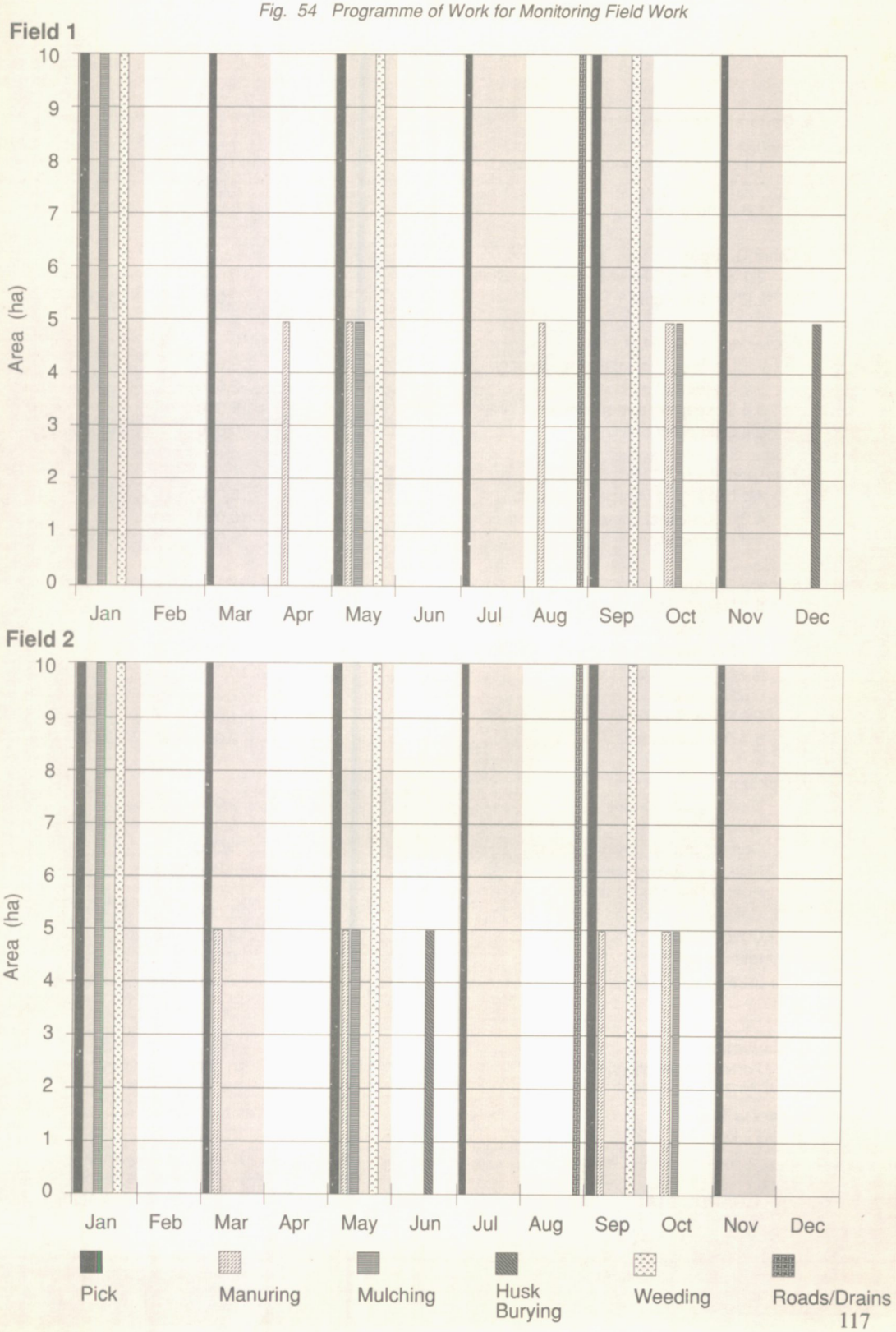


**Table 8 - *Annual estimate for a 20 ha property***

| | | |
|---|---|---|
| **A. General Charges** | | |
| 1.*Salaries and Wages* | | |
| 1.1 Salaries, Wages & Allowances | 100,000 | |
| 1.2 Travelling expenses | 3,000 | |
| 1.3 Holiday pay | 5,000 | 108,000 |
| 2.Other Charges | | |
| 2.1 EPF and ETF of Supervisory Staff | 15,000 | |
| 2.2 Visiting Agent | 6,000 | 21,000 |
| 3.*Equipment & Buildings* | | |
| 3.1 Upkeep of plant and machinery | 6,000 | |
| 3.2 Upkeep of tools | 2,000 | |
| 3.3 Upkeep of farm machinery | 6,000 | |
| 3.4 Upkeep of buildings | 10,000 | 24,000 |
| 4.*Transport* | | |
| 4.1 Upkeep of vehicles, carts etc. | 5,000 | |
| 4.2 Operational costs | 10,000 | |
| 4.3 Depreciation | 5,000 | 20,000 |
| 5.*Service Charges* | | |
| 5.1 Rent & Taxes | 2,000 | |
| 5.2 Medical benefits | 2,000 | |
| 5.3 Insurance | 1,000 | |
| 5.4 EPF for labour force | 10,000 | |
| 5.5 Stationery | 2,000 | |
| 5.6 Postal Charges | 1,000 | |
| 5.7 Contingencies | 2,000 | 20,000 |
| **B. Upkeep** | | |
| Clearing boundaries | 2,000 | |
| Weed Control | 5,000 | |
| Census and removal of palms | 1,000 | |
| Moisture Conservation | 16,000 | |
| Pest & Disease Control | 1,000 | |
| Upkeep & Road and Fences | 1,000 | |
| Cover Cropping | 2,000 | |
| Intercropping | 8,000 | |
| Irrigation | 2,000 | 38,000 |
| **C. Cultivation** | | |
| Fertilizer & Application | 80,000 | 80,000 |
| **D. Harvesting** | | |
| Picking | 5,000 | |
| Collecting & Counting | 10,000 | 15,000 |
| **GRAND TOTAL** | | **326,000** |

## 12.9 Cost of Production (COP)

The estate management staff should regularly review the COP. Every effort should be made to keep the COP low so that the profits will be increased.

COP data will also give an indication of heavy expenditure items where economy is required.

The COP for the estate indicated in Table 8 (Section 12.7) is calculated as follows:

A. Expenditure for the year **Rs. 324,000**

B. Income
@ 10,000 nuts/ha, 200,000 nuts Rs. 400,000
(Net Sale Average for the year Rs. 2,000/1000 nuts)
Income derived from intercrops Rs. 40,000

**Total Income** **Rs. 440,000**

C. Profit Rs. 440,000 - Rs. 324,000 = **Rs. 116,000**

D Cost of Production $\frac{324,000}{200,000} \times 1000$

**Rs. 1,620 per 1000 nuts**

## 12.10 Crop Budgets

Growers who wish to undertake replanting on a large scale should carefully consider the expenditure involved and the availability of funds.

It is therefore useful to prepare crop budgets in respect of the activities envisaged.

The crop budget for replanting 20 ha is given in Table 9. The details of maintenance costs are given in Table 10. It would be observed that the major components in maintenance costs are the general charges and fertilizer. The general charges largely depends on the staffing level of the estate and on the level of infra-structural developments. The costs indicated in Tables 9 and 10 correspond to a property comparable in staffing and other facilities to that given in Table 8. The general charges could be considerably reduced by reducing the staffing level, depending on the circumstances.

The crop budget would also indicate that excepting in Year 1, losses are incurred from Year 2 upto Year 9. This aspect is well known to growers and this understandably discourages growers from undertaking large scale replanting.

**Table 9 - Crop Budget (20 ha replanted monoculture coconut)**

| **Year** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
|---|---|---|---|---|---|---|---|---|---|---|
| Area to be planted | 20 ha | | | | | | | | | |
| ***Expenditure*** | | | | | | | | | | |
| Cost of establishement | 152000 | | | | | | | | | |
| Maintenance cost | 256000 | 282000 | 296000 | 310000 | 258000 | 280000 | 340000 | 342000 | 296000 | 296000 |
| ***Income*** | | | | | | | | | | |
| Sale of trees @ Rs. 300/= 150 trees/ha | 900000 | | | | | | | | | |
| Coconuts @ Rs.2.50 | | | | | | 25000 | 40500 | 125000 | 250000 | 312500 |
| **Profit/loss(-)** | **491200** | **-282000** | **-296000** | **-310000** | **-258000** | **-255000** | **-299500** | **-217000** | **-46000** | **-16500** |

**Table 10 - Maintenance cost (Rs./ha) for 20 ha replantation**

| Year / *Item* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. General charges | 7500 | 7500 | 7500 | 7500 | 7500 | 7500 | 8500 | 8000 | 8000 | 8000 |
| 2. Upkeep | | | | | | | | | | |
| Weed Control | 750 | 750 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 |
| Pest & Disease Control | 3000 | 3000 | 1500 | 1500 | 1000 | 500 | 500 | 500 | | |
| Soil Moisture Conservation | | | 2000 | 2000 | | | 2000 | 2000 | | |
| Mulching | 250 | 300 | 300 | 300 | 500 | 500 | 500 | 500 | 600 | 600 |
| Vacancies | | 150 | | | | | | | | |
| 3. Cultivation/ Fertilizer Application | 1300 | 2400 | 3000 | 3700 | 4400 | 4400 | 5400 | 5400 | 5400 | 5400 |
| 4. Harvesting | | | | | | 100 | 100 | 200 | 300 | 300 |
| **Total (Rs.)** | **12800** | **14100** | **14800** | **15500** | **12900** | **14000** | **17000** | **17000** | **14800** | **14800** |

Plant density - 200/ha; Labour day - Rs. 60.00 ; Cost & Transport of Fertilizer - Rs. 8.00/kg; Fertilizer application Rs. 2.50 in the first year to Rs. 3.00 in the 10th year; Mulching Rs. 1.25 in the first year to Rs. 2.00 in the 10th year; Semi-circular husk pit Rs. 10.00 per pit.

However, if replanting is to be attempted in the intermediate and wet zones, growers should seriously consider intercropping in the first few years, using a model similar to that described in section 9.15. Let us consider establishing intercrops, as shown in the model in section 9.15, in 4 ha out of the 20 ha replanted area. The income and expenditure from the intercrops can now be included in the crop budget given in Table 9, and a totally different picture emerges. In fact, the entire replanting exercise in 20 ha becomes a profitable venture by intercropping just 4 ha (Table 11). Large scale intercropping with annuals and semi-perennials would require labour, adequate supply of planting material, irrigation during dry months etc. The growers should consider these aspects before embarking on large scale intercropping in replanted areas.

The examples given in Tables 9, 10 and 11 could be appropriately adjusted depending on the scale of activities, growers' preferences etc. to obtain a clear understanding of the financial commitments and profitability of replanting. Of course, it is important to remember that plants would start yielding from about the sixth year onwards, and considerable yield levels are achieved by the tenth year, which would be almost impossible with underplanting. The cumulative economic benefits of early flowering too should receive consideration.

**Table 11 - Crop Budget**

**(20 ha of replanted coconut with 4 ha Intercropping)**

| Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Area to be planted 20 ha | | | | | |
| ***Expenditure*** | | | | | |
| Cost of Establishment | 152000 | | | | |
| Maintenance Cost | 256000 | 282000 | 296000 | 310000 | 258000 |
| Intercropping | 250000 | 150000 | 190000 | 200000 | 160000 |
| ***Total Expenditure*** | 658000 | 432000 | 486000 | 510000 | 418000 |
| ***Income*** | | | | | |
| Sale of trees @ Rs. 300/= 150 trees/ha | 900000 | | | | |
| Intercrops from 4 ha | 120000 | 510000 | 830000 | 900000 | 620000 |
| Coconuts @ Rs. 2.50/= | – | - | - | - | |
| ***Total Income*** | 1020000 | 510000 | 830000 | 900000 | 620000 |
| **Profit / Loss (-)** | **362000** | **78000** | **344000** | **390000** | **202000** |

## CHAPTER 13

# ASSISTANCE TO COCONUT GROWERS

The coconut sector comes within the purview of the Ministry of Coconut Industries and Crop Diversification (MCI & CD). The government provides considerable assistance to the growers for the upliftment of the industry. This assistance is channelled through the following organizations:

1. The Ministry of Coconut Industries & Crop Diversification
   320, T B Jayah Mawatha, Colombo 10.
   (Postal Address: P O Box 978, Colombo).
   Telephone: 01-698289, 01-698290

2. The Coconut Development Authority
   11, Duke Street, Colombo 1.
   (Postal Address: P O Box 386, Colombo)
   Telephone: 01-421025/28
   Telex: 21217 COCOBOD CE
   Fax: 01-447602

3. The Coconut Cultivation Board
   320, T B Jayah Mawatha, Colombo 10.
   (Postal Address: P O Box 1388, Colombo)
   Telephone: 01-694872; 01-694873; 01-694876

4. The Coconut Research Institute
   Bandirippuwa Estate,
   Lunuwila.
   Telephone: 030-3795; 031-5300
   Fax: 031-7195

The assistance provided by the statutory bodies is described below:

### 13.1 The Coconut Development Authority

* Formulation of policy in the coconut sector and determination of its development priorities.

* Co-ordination of activities of different organizations involved in the coconut sector.

* Development and promotion of new techniques in the processing of coconut and also monitoring quality control aspects.

* Promotion and direction of the modernization and provide assistance in increasing the efficiency of establishments manufacturing coconut products.

* Prescription and maintenance of standards of quality of coconut products manufactured in and exported from Sri Lanka.

* Development of marketing of coconut products; conducting regular copra auctions; dissemination of market information; the maintenance, promotion and creation of demand for coconut products outside Sri Lanka by organizing and participating in international exhibitions and trade fairs.

* Promotion of co-operative systems of management of manufacturing and trading in coconut products.

* Providing assistance, including financial assistance through loans to co-operative societies and state-owned business establishments.

* Operation of the Price Stabilization and Price Support schemes for coconut products in order to guarantee remunerative farm-gate prices to the growers.

* Enforcement of government policies on internal and external marketing.

## 13.2 The Coconut Cultivation Board

* Provides assistance for the development of coconut lands.

* Provides an extension service to the small-holder sector. This service is executed through the Coconut Development Officers located in the field. They would assist the growers in matters relating to coconut cultivation and in the implementation of subsidy schemes.

* Administers the government subsidy programmes for coconut cultivation.

Subsidy schemes change from time to time, and details of assistance can be obtained from the Coconut Development Officers. Currently, the government provides financial assistance for the following activities:

- Rehabilitation of coconut lands. Specific activities are:

    1. Establishment of contour and drainage drains.
    2. Removal of excess palms.
    3. Filling vacancies.
    4. Replacement of unproductive palms.
    5. Soil moisture conservation practices (husk/coir dust pits).

- Replanting and underplanting.
- New plantings.
- Planting coconut in plots less than 0.4 ha (1 ac).
- Intercropping (pasture, cacao, coffee and pepper).
- Construction of tube wells.

* Maintains nurseries to provide quality coconut seedlings for the national replanting programme.

* Maintains fertilizer stores for the supply of fertilizer.

* Maintains demonstration sites to educate farmers on scientific methods of coconut cultivation.

* Conducts field days, seminars, exhibitions etc. on various aspects of coconut cultivation.

* Conducts training programmes on coconut cultivation for field officers and growers.

* Provides a crop protection service.

The above functions are implemented through a network of Regional Offices, Coconut Development Officers, nurseries and fertilizer stores.

**Annexure 3** gives the locations and addresses of the Regional Offices, Coconut Development Officers, nurseries and fertilizer stores.

### 13.3 The Coconut Research Institute (CRI)

The CRI is the executing agency of the Coconut Research Board. The primary function of the CRI is research and development in the growth and cultivation of coconut palms and coconut-based cropping systems. Other services offered by the CRI are:

* Provides advisory assistance to the estates sector (over 20 ha).

* Provides Differential Fertilizer Recommendations (DFR) based on soil and leaf analysis.

* Provides seednuts of the improved varieties to the CCB. A limited quantity of these varieties is issued by the CRI to the estates sector.

* Conducts training programmes for the transfer of new technologies.

* Conducts field days, seminars, exhibitions etc. on various aspects of coconut cultivation.

* Provides expert guidance on all matters relating to coconut cultivation.

* Provides a crop protection service. Pest infestations are inspected and assistance provided on control measures, including the supply of biological control agents.

* Provides Advisory Circulars embodying the research findings. These are available in sinhalese, english and tamil.

* Acts as a centre for the collation and dissemination of information on coconut to research workers and others engaged in the coconut industry throughout the world (through the Coconut Information Centre).

* Publishes several technical and non-technical publications for research workers as well as for growers.

***Technical Publications***

1. *Annual Report of the CRI* - Gives details of experiments and research findings of the CRI.

2. *COCOS* - Contains technical articles and research notes on all aspects of coconut.

3. *Occasional Publications Series* - Contains technical reviews.

### *Non-Technical Publications*

1. *Pol Pawath* (sinhalese) - Contains advice to growers, based on research findings. Written in a simple form, this is a valuable source of information for the grower.

2. *Coconut Bulletin* (english) - English version of the Pol Pawath.

3. *Advisory Circulars* - Contains information on coconut cultivation.

The head office, laboratories and the library of the CRI are situated at Bandirippuwa Estate, Lunuwila. The experiments and demonstrations are carried out at six sub-stations and three seed gardens. The locations of these stations are given in **Annexure 3.**

**ANNEXURE 1**

## COCONUT STATISTICS

**Table 12 - Area under Coconut in the World**

| ***Countries in the Asian & Pacific Coconut Community*** | ***Area (ha)*** | |
|---|---|---|
| Federated States of Micronesia | 17,000 | |
| Fiji | 23,000 | |
| India | 1,473,000 | |
| Indonesia | 3,317,000 | |
| Malaysia | 286,000 | |
| Palau | 14,000 | |
| Papua New Guinea | 260,000 | |
| Philippines | 3,110,000 | |
| Solomon Islands | 59,000 | |
| Sri Lanka | 419,000 | |
| Thailand | 407,000 | |
| Vanuatu | 96,000 | |
| Vietnam | 333,000 | |
| Western Samoa | 47,000 | **9,861,000** |
| | | |
| ***Others*** | | |
| Bangladesh | 32,000 | |
| Burma | 28,000 | |
| Ivory Coast | 34,000 | |
| Jamaica | 50,000 | |
| Kiribati | 36,000 | |
| Mexico | 105,000 | |
| South America | 27,000 | |
| Tanzania | 280,000 | |
| Other parts of Asia & Pacific | 33,000 | |
| Other Parts of Africa | 478,000 | |
| Other Parts of North & Central America | 13,000 | **1,116,000** |
| **Total** | | **10,977,000** |

Adapted from the Yearbook of the Asian & Pacific Coconut Community (1989).

**Table 13 - Distribution of Coconut Small-holdings and Estates by Districts**

**(Sri Lanka)**

| District | Small-holdings | | Estates | | Total | |
|---|---|---|---|---|---|---|
| | Total area (ha) | Bearing area (ha) | Total area (ha) | Bearing area (ha) | Total area (ha) | Bearing area (ha) |
| Ampara | 3148 | 2156 | 739 | 532 | 3887 | 2688 |
| Anuradhapura | 5569 | 4555 | 160 | 114 | 5729 | 4669 |
| Badulla | 846 | 682 | 38 | 29 | 884 | 711 |
| Batticaloa | 2508 | 1266 | 1583 | 254 | 4091 | 1520 |
| Colombo | 8156 | 7338 | 1069 | 932 | 9225 | 8270 |
| Galle | 11673 | 10220 | 1575 | 1353 | 13248 | 11573 |
| Gampaha | 45205 | 43502 | 11867 | 10665 | 57072 | 54167 |
| Hambantota | 18280 | 15835 | 2158 | 1748 | 20438 | 17583 |
| Jaffna | 6072 | 5748 | 3957 | 3431 | 10029 | 9179 |
| Kalutara | 11443 | 9317 | 919 | 778 | 12362 | 10095 |
| Kandy | 6730 | 5506 | 1578 | 1410 | 8308 | 6916 |
| Kegalle | 18663 | 17116 | 1764 | 1532 | 20427 | 18648 |
| Kurunegala | 103281 | 92800 | 45885 | 42629 | 149166 | 135429 |
| Manner | 976 | 924 | 205 | 196 | 1181 | 1120 |
| Matale | 6882 | 5787 | 2417 | 1813 | 9299 | 7600 |
| Matara | 11944 | 9791 | 2431 | 2021 | 14375 | 11812 |
| Monaragala | 4140 | 2493 | 31 | 9 | 4171 | 2502 |
| Mullaitivu | 1297 | 1021 | 907 | 763 | 2204 | 1784 |
| Nuwara Eliya | 827 | 678 | 5 | 4 | 832 | 682 |
| Polonnaruwa | 2929 | 1974 | 74 | 59 | 3003 | 2033 |
| Puttalam | 29198 | 23383 | 22605 | 20108 | 51803 | 43491 |
| Ratnapura | 11461 | 7869 | 973 | 572 | 12434 | 8441 |
| Trincomalee | 1603 | 1341 | 204 | 116 | 1807 | 1457 |
| Vavuniya | 407 | 384 | 17 | 6 | 424 | 390 |
| **Total** | **313238** | **271686** | **103161** | **91074** | **416399** | **362760** |

Source: Adapted from data published by the Coconut Development Authority.

**Table 14 - Distribution of Coconut Small-holdings and Estates by Size Classes**

| Size Class of holdings | Number of holdings | Area* (ha) | Bearing* Area (ha) |
|---|---|---|---|
| **(a) Small-holdings** | | | |
| < 2 Acres | 405289 | 93689 | 82577 |
| 2 < 3 " | 100563 | 43142 | 36076 |
| 3 < 4 " | 63587 | 31667 | 26307 |
| 4 < 5 " | 38266 | 23404 | 19676 |
| 5 < 7 " | 45685 | 35527 | 29821 |
| 7 < 10 " | 22860 | 25579 | 22567 |
| 10 < 20 " | 17290 | 39586 | 35722 |
| > 20 " | 4628 | 20807 | 18947 |
| **Total** | **698168** | **313401** | **271693** |
| **(b) Estate Sector** | | | |
| 20 to 29 Acres | 2225 | 17363 | 14928 |
| 30 to 49 Acres | 1787 | 21107 | 18674 |
| 50 to 99 Acres | 1432 | 25790 | 23475 |
| 100 Acres and above | 836 | 38908 | 34013 |
| **Total** | **6280** | **103168** | **91090** |
| **TOTAL (SRI LANKA)** | **704448** | **416569** | **362783** |

**Note:** The extents have been computed from data available elsewhere, and the total under coconut may vary slightly from that given in the text.
* Based on the number of coconut palms on the land.

Source: Adapted from data published by the Coconut Development Authority. (1 ha = 2.47 acres)

**Table 15 - Coconut Production, Export of Kernel Products and Domestic Consumption**

| YEAR | Coconut Production (million) | Export of Kernel Products (million) | Domestic Consumption (million) | Population (million) |
|---|---|---|---|---|
| 1970 | 2,445 | 880 | 1,564 | 12.5 |
| 1971 | 2,668 | 1,110 | 1,558 | 12.8 |
| 1972 | 2,818 | 1,259 | 1,559 | 13.0 |
| 1973 | 1,948 | 423 | 1,525 | 13.2 |
| 1974 | 2,030 | 468 | 1,562 | 13.4 |
| 1975 | 2,585 | 914 | 1,671 | 13.6 |
| 1976 | 2,330 | 794 | 1,536 | 13.7 |
| 1977 | 1,821 | 233 | 1,588 | 13.9 |
| 1978 | 2,207 | 507 | 1,700 | 14.2 |
| 1979 | 2,393 | 561 | 1,832 | 14.5 |
| 1980 | 2,026 | 242 | 1,784 | 14.7 |
| 1981 | 2,258 | 439 | 1,819 | 14.9 |
| 1982 | 2,521 | 628 | 1,893 | 15.2 |
| 1983 | 2,312 | 572 | 1,740 | 15.4 |
| 1984 | 1,942 | 282 | 1,660 | 15.6 |
| 1985 | 2,958 | 931 | 2,027 | 15.8 |
| 1986 | 3,039 | 1,162 | 1,877 | 16.1 |
| 1987 | 2,292 | 561 | 1,731 | 16.4 |
| 1988 | 1,937 | 236 | 1,701 | 16.6 |
| 1989 | 2,484 | 588 | 1,896 | 16.8 |
| 1990 | 2,523 | 514 | 2,009 | *17.0 |

**Source:** Coconut Development Authority

*Provisional

**Table 16 - Export of Coconut Products from Sri Lanka, 1989**

| | Quantity (MT) | | Value (Rs. millions) | Value (US $ '000) |
|---|---|---|---|---|
| **(a) Kernel Products** | | | | |
| 1. Coconut Oil | 29,668 | | 749.5 | 20,791 |
| 2. Desiccated coconut | 43,205 | | 1,023.1 | 28,383 |
| 3. Copra | 8,250 | | 147.8 | 4,101 |
| 4. Poonac | 11,880 | | 46.5 | 1,290 |
| 5. Coconut Cream | 352 | | 13.7 | 379 |
| 6. Coconut Milk Powder | 189 | | 20.9 | 580 |
| 7. De-fatted Coconut | 157 | | 2.7 | 75 |
| Sub total - Kernel Products | 93,701 | | 2,004.2 | 55,599 |
| **(b) Husk Products** | | | | |
| 1. Mattress fibre | 35,562 | | 199.6 | 5,538 |
| 2. Bristle fibre | 7,971 | | 178.9 | 4,962 |
| 3. Twisted fibre | 28,362 | | 270.8 | 7,512 |
| 4. Coir yarn | 1,436 | | 20.4 | 566 |
| 5. Coir twine | 3,495 | | 116.0 | 3,218 |
| 6. Fibre dust and husk chips | 58 | | 0.6 | 17 |
| 7. Brooms and brushes (finished products) | 52,874,745 | pcs | 295.1 | 8,188 |
| 8. Other finished products (carpets etc.) | 106, 827 | $m^2$ | 32.3 | 896 |
| Sub total - Husk products | | | 1,113.7 | 30,897 |
| **(c) Shell Products** | | | | |
| 1. Shell charcoal | 20,673 | | 158.4 | 4,395 |
| 2. Shells & shell flour | 1,042 | | 9.3 | 258 |
| 3. Activated carbon | 11,262 | | 475.5 | 13,190 |
| Sub total - shell products | 32,977 | | 643.2 | 17,843 |
| **(d) Fresh nuts and seednuts** | 16,262,630 | nuts | 90.1 | 2,500 |
| **TOTAL VALUE OF ALL PRODUCTS** | | | **3,851.2** | **106,839** |

Source: Adapted from data published by the Coconut Development Authority.

**Table 17 - Coconut Conversion Table**

**(a) Kernel Products**

| | | | | | |
|---|---|---|---|---|---|
| 1 | MT | Copra | equivalent to | 4,900 | nuts |
| 1 | MT | Desiccated coconut | equivalent to | 6,800 | nuts |
| 1 | MT | Coconut oil | equivalent to | 8,000 | nuts |
| 1 | MT | Poonac | equivalent to | 16,000 | nuts |

**(b) Coconut Shell Products**

| | | | | | |
|---|---|---|---|---|---|
| 1 | MT | Shell | equivalent to | 5,900 | whole shells |
| 1 | MT | Shell flour | equivalent to | 7,900 | whole shells |
| 1 | MT | Charcoal | equivalent to | 19,700 | whole shells |
| 1 | MT | Activated carbon | equivalent to | 3.3 | MT charcoal or |
| | | | | 65,000 | whole shells |

**(c) Coir Fibre**

| | | | | | |
|---|---|---|---|---|---|
| 1 | MT | Coir fibre | equivalent to | 7,900 | husks |
| 1 | MT | Mattress fibre | equivalent to | 11,800 | husks |
| 1 | MT | Bristle fibre | equivalent to | 23,600 | husks |
| 1 | MT | coir fibre has 65% mattress fibre and 35% bristle fibre. | | | |

**Source:** Adapted from data published by the Coconut Development Authrity.

**ANNEXURE - 2**

## COCONUT VARIETIES IN SRI LANKA

There is considerable variability in the coconut population in Sri Lanka. According to a classification by Dr D V Liyanage[§], there are three main varieties. Within each variety, different types (called forms) are found. Altogether, 13 forms have been described (Fig. 55).

**Varieties:**

- the tall variety - ***typica***
- the dwarf variety - ***nana***
- the king coconut variety - ***aurantiaca***

**Description of varieties:**

**(a) *Typica***

- Tall in habit, with average height of 18 m (60').
- Stout trunk, with the base expanded into a bole.
- Long fronds, approx. 5 m.
- Late flowering, approx. 5 - 8 years from planting. Continuous flower production. Male and female flowers do not become functional at the same time, and therefore cross-pollinating.
- Medium to large nuts with about 40 nuts/palm/year. Copra per nut - 220 g (about 4500 nuts for 1 MT of copra).
- Tolerates a variety of soil types, climatic conditions, including drought, and a low management level.
- Productive life about 60 years.
- Grown commercially.

**(b) *Nana***

- Short in habit with average height of 10 m (35').
- Slender trunk without bole.
- Short fronds, approx. 4 m.
- Early flowering, approx. 3 - 4 years from planting. Seasonal flower production. Male and female flowers usually become functional at the same time, and therefore often self-pollinating.
- Small nuts with about 100 nuts/palm/year. Copra per nut about 100 g (about 10,000 nuts for 1 MT of copra). Copra leathery and of poor quality.
- Requires deep soils and well-distributed rainfall. Susceptible to drought.
- Productive life about 40 years.
- Grown occasionally for drinking and as an ornamental plant, but used mainly for breeding purposes.

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§ Liyanage D V (1958) Varieties and forms of coconut palms grown in Ceylon. *Ceylon Coconut Quarterly* 9 (3/4); 1-10.

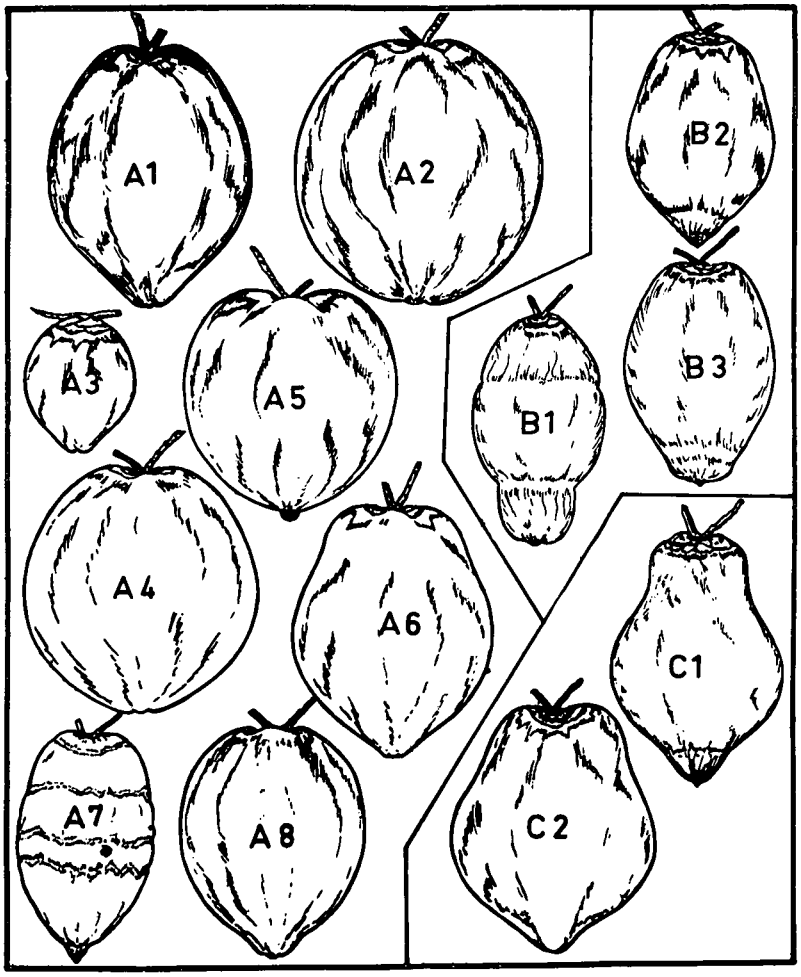


*Fig. 55* *Shape and size (approximate) of forms of coconut found in Sri Lanka.*
*Forms of variety typica (A): A1-typica, A2-kamandala. A3-bodiri, A4-nawasi, A5-ran-thembili, A6-gon thembili, A7-pora-pol, A8-dikiri pol.*
*Forms of variety nana (B): B1-pumilla, B2-eburnea, B3-regia.*
*Forms of variety aurantiaca (C): C1-thembili (king coconut), C2-navasi thembili.*
*(Reproduced from Ceylon Coconut Quarterly 9(3/4), 1-10.)*

**(c) *Aurantiaca***

- Intermediate in habit with average height of about 12 m (40').
- Trunk of medium girth.
- Short fronds, approx. 4.5 m.
- Late flowering, approx. 6-8 years from planting. Seasonal flower production. Male and female flowers may become functional at the same time, and therefore often self-pollinating.
- Small nuts with about 100 nuts/palm/year. About 8,000 nuts for 1 MT copra. Not useful for copra production.
- Requires good soil, high water table and/or well-distributed rainfall.
- Productive life about 40 years.
- Grown for nut water (for drinking).

**Forms of the Variety *typica***

| | | |
|---|---|---|
| (i) ***typica*** | - | Fruit colour may range from green through orange green (bronze) to brownish red (russet). Used for commercial planting, and is found commonly throughout Sri Lanka |
| (ii) ***nawasi*** | - | Green fruits. Fibrous portion of the immature nut sweet and nut water insipid. No commercial value. |
| (iii) ***gon thembili*** | - | Outer covering of the nut and branches ivory yellow. Nuts fairly large. Oil content high. |
| (iv) ***ran thembili*** | - | Usually outer covering is green, and the fibrous portion near the point of attachment is pink. |
| (v) ***porapol*** | - | Trees have somewhat slender trunk and a sparse crown. The husked nuts are small and elongated with very hard and thick shell. Oil content high. Nuts used for the traditional sport, "pora pol". |
| (vi) ***bodiri*** | - | Heavy bearing, with 50 - 100 nuts/bunch. Very small nuts requiring about 20,000 nuts for 1 MT of copra. Oil content very high. |
| (vii) ***kamandala*** | - | Nuts very large, about 1 1/2 times the size of commercial *typica*. Few nuts per bunch. Distribution restricted to the Southern Province of Sri Lanka. |
| (viii) ***dikiri pol*** | | Nut filled with a light but firm jelly-like substance, instead of the kernel and nut water. The jelly-like meat is a delicacy. Two to three nuts in a bunch are of this type, but they will not germinate. Rest of the nuts are of usual type but may give rise to trees of dikiri type. |

**Forms of the Variety *nana***

| | | |
|---|---|---|
| (i) ***pumilla*** (green) | - | Outer covering of fruit and the branches green. Constriction at the distal end of the nut. |
| (ii) ***eburnea*** (yellow) | - | Outer covering of fruit and the branches ivory yellow. |

(iii) ***regia*** (red)

Outer covering of the fruit and the branches orange red. Somewhat similar to king coconut nuts, but nut water not as sweet as in king coconut.

**Forms of the Variety *aurantiaca***

(i) ***thembili*** (rath thembili or king coconut

Inflorescence orange, outer covering of fruits and the branches orange-red. Nut water sweet due to high sugar content.

(ii) ***nawasi thembili***

Similar to *nawasi* but the fruit, branches and inflorescence orange in colour.

**Improved Varieties**

(A) ***Tall***

(i) ***CRIC 60 or Ambakelle tall***

Tall in habit. Flowers in 5 - 8 years. Produces about 100 nuts palm/year. Copra content about 220 g per nut. Hardy palms, tolerant to pests and diseases and drought. Produced in the Seed Gardens.

(ii) ***Ambakelle Special***

Similar to CRIC 60, but has greater stability of production with less fluctuation under favourable and unfavourable periods. Limited production.

(iii) ***Moorock tall***

Tall in habit. Produces about 70 nuts/palm/year. Copra content about 250 g per nut.

(iv) ***San Ramon***

Majestic trees, very tall and straight, nuts green, brownish red or orange green. Higher copra content of 350 - 400 g per nut. Produces 35 - 60 kg copra/palm/year.

(B) ***Hybrids***

(i) ***CRIC 65 or dwarf green x tall***

Generally tall in habit. Flowers in 3 to 4 years. Produces about 120 nuts/ palm/year.

Sensitive to moisture stress. Requires well-drained soils of good texture and well-distributed rainfall. Produced at the Isolated Seed Garden, Ambakelle.

(ii) ***Dwarf yellow x tall***

Similar to dwarf green x tall but not so vigorous. Produced at the Isolated Seed Garden, Ambakelle.

**ANNEXURE 3**

## SOME USEFUL INFORMATION FOR THE GROWER

This annexure gives the locations of

(a) Sub-stations and seed gardens of the Coconut Research Institute (CRI), and

(b) Regional Offices, Coconut Development Officers, nurseries and fertilizer stores of the Coconut Cultivation Board (CCB).

These locations are marked in Fig. 56.

### A. The Coconut Research Institute

***Head office, laboratories and the library***

Bandirippuwa Estate, Lunuwila.
Telephone: 030-3795; 031-5300
FAX: 031-7195

***Sub-stations***

(a) Rathmalagara Estate, Madampe.
(b) Pothukulama Research Station, Pallama.
(c) Walpita Estate, Kotadeniyawa.
(d) Research & Demonstration Farm, Minneriya.
(f) Research & Demonstration Farm, Passekudah, Kalkudah.
(g) Adaptive Research Farm, Thabbowa, Nattandiya.

***Seed Gardens***

(a) Isolated Seed Garden, Ambakelle, Rajakadaluwa.
(b) Makandura Seed Garden, Gonawila (NWP).
(c) Maduru-oya Seed Garden, Bogaswewa (Mahaweli System `B').

## B. The Coconut Cultivation Board

### *Head Office*

320, T. B. Jayah Mawatha
Colombo 10.
Telephone: 01-694872; 01-694873; 01-694876

### *Regional Offices*

Locations of the Regional Offices (in alphabetical order) are as follows:

| *Regional office* | *District* | *Address & Telephone No.* |
|---|---|---|
| Ampara | Ampara | New Central Building,<br>D S Senanayake Mawatha, Ampara.<br>Telephone: 063-2477 |
| Anuradhapura | Anuradhapura<br>Trincomalee. | Dahaiyagama Junction, Anuradhapura.<br>Telephone: 025-2543 |
| Batticaloa | Batticaloa. | 3/19, Corner Road, Batticaloa.<br>Telephone: 065-2477 |
| Galle | Galle | Labuduwa, Akmeemana.<br>Telephone 09-23301 |
| Gampaha | Gampaha | Bendiyamulla, Gampaha.<br>Telephone: 033-2037 |
| Hambantota | Hambantota | Tangalle Road, Hambantota.<br>Telephone: 047-2324 |
| Kalutara | Kalutara<br>Colombo | Nagoda, Kalutara.<br>Telephone: 034-22732 |
| Kegalle | Kegalle | Karandupana, Kegalle.<br>Telephone: 035-2120 |
| Kilinochchi | Kilinochchi,<br>Jaffna, Mullaitivu,<br>Mannar, Vavuniya | Kilinochchi. |
| Kuliyapitiya | Kurunegala | 20, Pannala Road, Kuliyapitiya.<br>Telephone 037-41169 |

Fig. 56


LOCATION OF CRI, Its Sub-Stations, Seed Gardens and Location of Regional Offices, Nurseries and Fertilizer Stores of the CCB
LEGEND
COCONUT RESEARCH INSTITUTE
SUB-STATION
SEED GARDEN
REGIONAL OFFICES OF COCONUT CULTIVATION BOARD
COCONUT NURSERIES MAINTAINED BY COCONUT CULTIVATION BOARD
FERTILIZER STORES MAINTAINED BY COCONUT CULTIVATION BOARD
JAFFNA
MULLAITTIVU
MANNAR
VAVUNIYA
TRINCOMALEE
MEDAWACHCHIYA
ANURADHAPURA
PUTTALAM
POLONNARUWA
CHENKALADI
BATTICALOA
CHILAW
KURUNEGALA
MATALE
LUNUWILA
DANKOTUWA
POLGAHAWELA
KANDY
KEGALLA
AMPARA
NEGOMBO
BIBILE
GAMPAHA
BADULLA
COLOMBO
MONERAGALA
RATNAPURA
KALUTARA
HAMBANTOTA
GALLE
MATARA

| | | |
|---|---|---|
| Kurunegala | Kurunegala | Wehara, Kurunegala.<br>Telephone: 037-22534 |
| Marawila | Puttalam | Mudukatuwa, Marawila.<br>Telephone: 031-8237 |
| Matale | Kandy, Matale,<br>Nuwara Eliya | 86, Vihara Road, Matale.<br>Telephone: 066-2047 |
| Matara | Matara | 38, Sirimangala Road, Walpola, Matara.<br>Telephone: 041-2060 |
| Monaragala | Monaragala | Hulandawa, Monaragala.<br>Telephone: 055-6058 |
| Polonnaruwa | Polonnaruwa | New Town, Polonnaruwa.<br>Telephone: 027-2377 |
| Ratnapura | Ratnapura | New Town, Ratnapura.<br>Telephone: 045-2061 |

***Coconut Development Officers***

Each Regional Office has several Coconut Development Officers (CDO) working in the field. Generally, the offices of these officers are located in the Agrarian Services Centre (ASC) of the area. The addresses of these officers are given below:

**1. Ampara Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Ampara | Ampara | Regional Office of the CCB,<br>New Central Building,<br>D S Senanayake Mawatha, Ampara. |
| Mahaoya | Ampara | ASC, Padiyatalawa. |
| Nindavur | Nindavur | ASC, Oluvil, Palamune. |
| Pothuvil | Pothuvil | ASC, Pothuvil. |
| Samanthurai | Samanthurai | Assistant Government Agent's Office,<br>Samanthurai. |
| Thirukkovil | Pothuvil | Assistant Government Agent's Office,<br>Thirukkovil. |

**2. Anuradhapura Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Anuradhapura | Anuradhapura | Regional Office, Dahaiyagama Junction, Anuradhapura. |
| Kahatagasdigiliya | Horowupothana | ASC, Kahatagasdigiliya. |
| Kalawewa | Kalawewa | ASC, Ipalogama. |
| Kantale | Muttur<br>Trincomalee<br>Serunuwara | ASC, Thambalagamuwa. |
| Muttur | Muttur | ASC, Muttur. |
| Thambuththegama | Kalawewa<br>Anuradhapura (West) | Coconut Development Officer's Office, Pahalagama. |
| Trincomalee | Trincomalee | ASC, Uppuveli, Trincomalee. |

**3. Batticaloa Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Batticaloa | Batticaloa | Regional Office of CCB, 3/19, Corner Road, Batticaloa. |
| Chenkaladi | Batticaloa<br>Kalkudah. | Regional Office of CCB, 3/19, Corner Road, Batticaloa. |
| Kalawanchikudi | Padirippu | Assistant Government Agent's Office, Kalawanchikudi. |
| Vakare | Kalkudah | ASC, Valachchenai. |

**4. Galle Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Ambalangoda | Ambalangoda | Old Road, Patabendimulla, Ambalangoda. |
| Baddegama | Baddegama | ACS, Baddegama. |

| | | |
|---|---|---|
| Elpitiya | Bentara-Elpitiya | ASC, Elpitiya. |
| Galle | Galle | Regional Office of CCB, Labuduwa, Akmeemana. |
| Habaraduwa | Habaraduwa | ASC, Koggala, Habaraduwa. |
| Hiniduma | Hiniduma | ASC, Thavalama, Hiniduma. |
| Karandeniya | Karandeniya | ASC, Karandeniya. |
| Ratgama | Ratgama | 'Jayamedura', Pinkanda, Dodanduwa. |

**5. Gampaha Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Badalgama | Divulapitiya | ASC, Badalgama, |
| Dompe | Dompe | ASC, Dekatana. |
| Gampaha | Gampaha | Regional Office of CCB, Bendiyamulla, Gampaha. |
| Ja-ela | Ja-ela | ASC, Sekkuwatta, Ja-ela. |
| Katana | Katana | ASC, Thimbirigaskatuwa. |
| Kelaniya | Kelaniya | ASC, Biyagama, Delgoda. |
| Mabodala | Minuwangoda | ASC, Dewalapola. |
| Marandagahamula | Divulapitiya | Peoples Bank Building, Marandagahamula. |
| Mirigama | Mirigama | ASC, Wewaldeniya Road, Mirigama. |
| Minuwangoda | Minuwangoda | ASC, Minuwangoda. |
| Negombo | Negombo | ASC, Andiambalama. |
| Nittambuwa | Attanagalla | ASC, Nittambuwa. |
| Pallewela | Mirigama | ASC, Pallewela. |
| Udugampola | Minuwangoda | ASC, Udugampola. |

| | | |
|---|---|---|
| Udupila | Mahara | ACS, Udupila, Delgoda. |
| Urapola | Attanagalla | ASC, Urapola. |
| Walpita | Divulapitiya | ASC, Walpita. |
| Weke | Dompe | ASC, Weke. |

**6. Hambantota Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Ambalantota | Tissamaharama | Daksina', Thavaluwila, Ambalantota. |
| Angunakolapelessa | Tangalle | ASC, Angunakolapelessa. |
| Beliatta | Beliatta | ASC, Beliatta. |
| Meegasara | Mulkirigala | ASC, Meegasara. |
| Netolpitiya | Tangalle | ASC, Netolpitiya. |
| Tissamaharama | Tissamaharama | ASC, Tissamaharama. |
| Walasmulla | Mulkirigala | ASC, Katuwana. |
| Weeraketiya | Mulkirigala | ASC, Weeraketiya. |

**7. Kalutara Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Agalawatta | Agalawatte | ASC, Agalawatte. |
| Bandaragama | Bandaragama | Uggalyaya Watte, Bandaragama. |
| Beruwela | Beruwela | Assistant Government Agent's Office, Beruwela. |
| Homagama | Homagama | ASC, Homagama. |
| Horana | Horana | 216, Panadura Road, Horana. |
| Ingiriya | Horana | ASC, Ingiriya. |
| Kalutara | Kalutara | Regional Office of CCB, Nagoda, Kalutara. |

| | | |
|---|---|---|
| Kosgama | Avissawella | ASC, Kosgama. |
| Malabe | Kaduwela, Kolonnawa | ASC, Malabe. |
| Matugama | Matugama | ASC, Matugama. |
| Panadura | Panadura | ASC, Dakunu Pattiya, Galle Road, Panadura. |
| Piliyandala | Kesbewa, Kotte, Dehiwala, Mt Lavinia, Maharagama, Ratmalana | ASC, Bokundara, Piliyandala. |

**8. Kegalle Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Ambepussa | Dedigama | ASC, Ambepussa. |
| Batuwatta | Galigamuwa | ASC, Batuwatta, Helamada. |
| Dehiowita | Deraniyagala | Eheliyagoda Road, Algoda, Dehiowita. |
| Kegalle | Kegalle | Regional Office of the CCB, Karandupana, Kegalle. |
| Mawanella | Mawanella | ASC, Baminiwatta. |
| Rambukkana | Rambukkana | ASC, Pinnawala. |
| Ruwanwella | Ruwanwella | 339, Kahatagastenna , Ruwanwella. |
| Yatiyantota | Yatiyantota | ASC, Yatiyantota. |

**9. Kilinochchi Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Alampil | Mullaitivu | CCB Demonstration Centre, Alampil. |
| Jaffna | Jaffna | ASC, Nallur. |
| Kilinochchi | Kilinochchi | ASC, Kilinochchi. |

| | | |
|---|---|---|
| Mannar | Mannar | CDO's Office, Kachcheri, Mannar. |
| Pallai | Kilinochchi | CCB Demonstration Centre, Wannankerni Estate, Pallai. |
| Vavuniya | Vavuniya | ASC, Kovilkulam, Vavuniya. |

**10. Kuliyapitiya Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Bingiriya | Bingiriya | ASC, Bingiriya. |
| Dummalasuriya | Bingiriya | ASC, Dummalasuriya. |
| Hamangalla | Katugampola | ASC, Hamangalla, Narangoda. |
| Hettipola | Panduwasnuwara | ASC, Hettipola. |
| Horombawa | Kuliyapitiya | ASC, Horambawa. |
| Katupotha | Panduwasnuwara | ASC, Katupotha. |
| Kithalawa | Kuliyapitiya | ASC, Kithalawa. |
| Kobeigane | Nikaweratiya | ASC, Kobeigane. |
| Kuliyapitiya | Kuliyapitiya | ASC, Kuliyapitiya. |
| Munamaldeniya | Panduwasnuwara | ASC, Munamaldeniya. |
| Pannala | Katugampola | The Secretariat, Pannala. |
| Tharana | Bingiriya | ASC, Tharana. |
| Udubaddawa | Bingiriya | ASG, Udubaddawa. |
| Welpalla | Katugampola | ASG, Welpalla. |
| Yakwila | Katugampola | ASC, Yakwila. |

**11. Kurunegala Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Alawwa | Dambadeniya | ASC, Alawwa. |
| Dambadeniya | Dambadeniya | ASC, Dambadeniya. |
| Dodangaslanda | Dodangaslanda | ASG, Dodangaslanda. |
| Ganewatte | Hiriyala | ASG, Kumbukgate. |
| Ibbagamuwa | Hiriyala | ASG, Ibbagamuwa |
| Karandagolla | Dodangaslanda | ASG, Karandagolla, Ambakote. |
| Kudagalgamuwa | Kurunegala | ASG, Kudagalgamuwa. |
| Kurunegala | Kurunegala | Regional Office of CCB, Kurunegala. |
| Maharachchimulla | Dambadeniya | ASC, Maharachchimulla. |
| Maho | Yapahuwa | ASC, Daladagama, Maho. |
| Mawathagama | Mawathagama | ASC, Mawathagama. |
| Narammala | Dambadeniya | ASC, Narammala. |
| Nathagane | Wariyapola | ASC, Nathagane, Panadaragama. |
| Nikaweratiya | Nikaweratiya | ASC, Nikaweratiya. |
| Polgahawela | Polgahawela | ASC, Polgahawela. |
| Pothuhera | Polgahawela | ASC, Pothuhera. |
| Rambe | Yapahuwa | ASC, Rambe, Thambuwa, Maeliya. |
| Rambodagalla | Dodangaslanda | ASC, Rambodagalla, Ridigama. |
| Wariyapola | Wariyapola | Coconut Nursery, CCB, Wariyapola. |
| Wellawa | Kurunegala | ASC, Wellawa. |
| Weerambugedera | Polgahawela | ASC, Weerambugedera, Kalugamuwa. |
| Werawella | Kurunegala | ASC, Werawella, Doratiyawa. |

**12. Marawila Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Anamaduwa | Anamaduwa | Mahauswewa Road, Anamaduwa. |
| Arachchikattuwa | Chilaw | ASC, Arachchikattuwa. |
| Battuluoya | Chilaw, Anamaduwa | Coconut Development Officers' Quarters, Battuluoya. |
| Chilaw | Chilaw | ASC, Mugunuwatawana, Chilaw. |
| Dankotuwa | Wennappuwa | ASC, Haldanduwana, Dankotuwa. |
| Kalpitiya | Puttalam | ASC, Palakudah, Thalawila Church. |
| Madampe | Chilaw | ASC, Madampe. |
| Mahawewa | Nattandiya | ASC, Kudawewa, Mahawewa. |
| Mundel | Puttalam | Demonstration Centre, Mundel. |
| Nattandiya | Nattandiya | ASC, Thabbowa, Nattandiya. |
| Puttalam | Puttalam | Coconut Development Offficer's Quarters, Anuradhapura Road, Puttalam. |
| Serukelle | Anamaduwa | ASC, Serukelle. |

**13. Matale Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Dambulla | Dambulla | ASC, Dambulla. |
| Galagedara | Galagedara | ASC, Galagedera. |
| Gampola | Gampola | ASC, Gampola. |
| Hanguranketha | Hanguranketha | ADC, Hanguranketha. |
| Kandy | Kandy | ASC, Udaperadeniya, Peradeniya. |
| Kundasale | Kundasale | ASC, Digana, Rajawella. |

| | | |
|---|---|---|
| Matale | Matale | ASC, Palapathwala. |
| Rattota | Rattota | ASC, Weragama. |
| Walapane | Walapane | ASC, Nildandahinna. |

**14. Matara Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Akuressa | Akuressa | ASC, Akuressa. |
| Dickwella | Devinuwara | ASC, Polgahamulla, Dickwella. |
| Hakmana | Hakmana | ASC, Hakmana. |
| Kamburupitiya | Kamburupitiya | Coconut Fertilizer Stores, Yatiyana. |
| Matara | Matara | Regional Office of the CCB, 38, Sirimangala Road, Walpola, Matara. |
| Weligama | Weligama | ASC, Thalarambe, Kamburugamuwa. |

**15. Monaragala Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Badulla | Badulla | ASC, Rambukpotha, Badulla. |
| Bibile | Bibile | ASC, Bibile. |
| Mahiyanganaya | Mahiyaganaya | ASC, Ridimaliyadda. |
| Medagama | Bibile | Coconut Nursery, Welipitiya Estate, Nannapurawa, Bibile. |
| Monaragala | Monaragala | Regional Office of CCB, Hulandawa, Monaragala. |
| UVA Paranagama | Uva Paranagama | ASC, Uva Paranagama. |
| Wellawaya | Wellawaya | ASC, Wellawaya. |

**16. Polonnaruwa Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Bakamuna | Minneriya | ASC, Bakamuna. |
| Maduru Oya | Polonnaruwa | ASC, Manampitiya. |
| Medirigiriya | Medirigiriya | ASC, Medirigiriya. |
| Minneriya | Minneriya | ASC, Hingurakgoda. |
| Pimburaththewe | Polonnaruwa | ASC, Manampitiya. |
| Polonnaruwa | Polonnaruwa | Regional Office of CCB, New Town, Polonnaruwa. |

**17. Ratnapura Regional Office**

| *Range* | *Electorate(s) served* | *Address* |
|---|---|---|
| Balangoda | Balangoda | ASC, Rassagama, Bulathgama, Balangoda. |
| Embilipitiya | Kolonna | Mahaweli Authority Office, Embilipitiya. |
| Godakawela | Rakwana | Coconut Development Officer's Office, Godakawela. |
| Nivitigala | Nivitigala | ASC, Nivitigala. |
| Pallebedda | Rakwana | ASC, Pallebedda. |
| Ratnapura | Ratnapura | Regional Office of CCB, New Town, Ratnapura. |

***Coconut Seedling Nurseries***

There are 33 coconut seedling nurseries for the supply of quality seedlings. These nurseries are administered by the Regional Offices of the CCB. The locations of the nurseries are indicated below. Most nurseries have seedlings for issue during both monsoons but those in the dry zone may have seedlings only for October/November season.

Growers should reserve their requirements of seedlings with the Regional Office well in advance. Choose the closest nursery for convenience of transport. Some of the nurseries may have poly-bagged seedlings.

| | Issue Season |
|---|---|
| **1. Ampara Regional Office** | |
| • 1 Palam Camp, Uhana. | Oct./Nov. |
| • 2 Kaliodai Estate, Oluvil, Palamune. | Oct./Nov. |
| **2. Anuradhapura Regional Office** | |
| • 1 Kalawewa, Vijithapura. | Oct./Nov. |
| • 2 Kumburupiddi, Trincomalee. | Oct./Nov. |
| **3. Batticaloa Regional Office** | |
| • 1 Mylambavely, Chenkaladi. | Oct./Nov. |
| **4. Colombo** | |
| • 1 114, Wijerama Mawatha, Colombo 7. | May/June; Oct./Nov. |
| **5. Galle Regional Office** | |
| No nursery at present. | |
| **6. Gampaha Regional Office** | |
| • 1 Kirindiwela | May/June; Oct./Nov. |
| • 2 Walpita, Kotadeniyawa. | May/June; Oct./Nov. |
| **7. Hambantota Regional Office** | |
| • 1 Medamulana, Weeraketiya. | May/June; Oct./Nov. |
| **8. Kalutara Regional Office** | |
| • 1 Korosduwa, Wadduwa. | May/June; Oct./Nov. |
| **9. Kegalle Regional Office** | |
| • 1 Eraminigolla, Hiriwadunna. | May/June; Oct./Nov. |
| • 2 Kanantota, Mattamagoda. | May/June; Oct./Nov. |
| **10. Kilinochchi Regional Office** | |
| • 1 Demonstration Centre, Alampil | Oct./Nov. |
| • 2 Kilinochchi | Oct./Nov. |
| **11. Kuliyapitiya Regional Office** | |
| • 1 Prasannagama, Bingiriya. | May/June; Oct./Nov. |
| • 2 Diyadorawatta, Wewagama. | May/June; Oct./Nov. |
| • 3 Hettipola | May/June; Oct./Nov. |
| • 4 Kandetiya, Makandura, Gonawila. | May/June; Oct./Nov. |

**12. Kurunegala Regional Office**

| | |
|---|---|
| • 1 Dodangaslanda. | May/June; Oct./Nov. |
| • 2 Thorayaya, Ibbagumuwa. | May/June; Oct./Nov. |
| • 3 Wariyapola. | May/June; Oct./Nov. |
| • 4 Nikaweratiya. | May/June; Oct./Nov. |
| • 5 Mutugalawatta, Wennoruwa. | May/June; Oct./Nov. |
| • 6 Cerepes Estate, Panaliya, Polgahawela. | May/June; Oct./Nov. |

**13. Marawila Regional Office**

| | |
|---|---|
| • 1 Kirimetiyana, Lunuwila. | May/June; Oct./Nov. |
| • 2 Wilpotha, Battuluoya. | May/June; Oct./Nov. |
| • 3 Attavillu, Puttalam. | May/June; Oct./Nov. |

**14. Matale Regional Office**

| | |
|---|---|
| • 1 Pallekelle, Kundasale. | May/June; Oct./Nov. |

**15. Matara Regional Office**

| | |
|---|---|
| • 1 Pathegama, Weligama. | May/June; Oct./Nov. |

**16. Monaragala Regional Office**

| | |
|---|---|
| • 1 Welipitiya Estate, Nanna-purawa, Bibile. | Oct./Nov. |
| • 2 Handapangala, Etiliyawewa, (near Wellawaya) | Oct./Nov. |

**17. Polonnaruwa Regional Office**

| | |
|---|---|
| • 1 Richard Aluvihare Park, Parakrama Samudra. | Oct./Nov. |

**18. Ratnapura Regional Office**

| | |
|---|---|
| • 1 Tunkama, Embilipitiya. | May/June; Oct./Nov. |

***Fertilizer Stores***

1. **Ampara Regional Office**
   - 1 Palam Camp, Uhana.

2. **Anuradhapura Regional Office**
   - 1 Regional Office of CCB, Dahaiyagama Junction, Anuradhapura.

3. **Batticaloa Regional Office**
   - 1 Mylambavely, Chenkaladi.

4. **Colombo**
   - 1 Coconut Nursery,
     114, Wijerama Mawatha, Colombo 7.

5. **Galle Regional Office**
   - 1 Regional Office of CCB, Labuduwa, Akmeemana.
   - 2 Old Road, Patabendimulla, Ambalangoda.

6. **Gampaha Regional Office**
   - 1 19, Udayar Thoppu Road, Negombo.
   - 2 Kirindiwela.
   - 3 Nittambuwa Road, Veyangoda.
   - 4 Suriyapaluwa, Kadawata.
   - 5 Regional Office of CCB, Bendiyamulla, Gampaha.
   - 6 Coconut Nursery, Walpita, Kotadeniyawa.

7. **Hambantota Regional Office**
   - 1 Regional Office of CCB, Tangalle Road, Hambantota.
   - 2 Coconut Nursery, Medamulana, Weeraketiya.

8. **Kalutara Regional Office**
   - 1 Regional Office of CCB, Nagoda, Kalutara.
   - 2 Meegoda.

9. **Kegalle Regional Office**
   - 1 Regional Office of CCB, Karandupana, Kegalle.
   - 2 Rambukkana.

10 **Kilinochchi Regional Office**
   - 1 Demonstration Centre, Alampil.
   - 2 Vannankerni Estate, Pallai.

11. **Kuliyapitiya Regional Office**
   - 1 Regional Office of CCB, 20, Pannala Road, Kuliyapitiya.
   - 2 Mahayaya Estate, Gonawila (NWP).
   - 3 Coconut Nursery, Prasannagama, Bingiriya.

**12. Kurunegala Regional Office**

- 1 Ibbagamuwa, Thorayaya.
- 2 Cerepes Estate, Panaliya, Polgahawela.
- 3 Coconut Nursery, Wariyapola.

**13. Marawila Regional Office**

- 1 Regional Office of CCB, Mudukatuwa, Marawila.
- 2 Kuliyapitiya Road, Nattandiya.
- 3 Negombo Road, Dankotuwa.
- 4 Demonstration Centre, Mundel.
- 5 Puttalam Road, Chilaw.

**14. Matale Regional Office**

- 1 Coconut Nursery, Pallekele, Kundasale.

**15. Matara Regional Office**

- 1 Regional Office of CCB, 38, Sirimangala Road, Walpola, Matara.
- 2 Medawiyangoda, Yatiyana.

**16. Monaragala Regional Office**

- 1 Welipitiya Estate, Nannapurawa, Bibile.

**17. Polonnaruwa Regional Office**

- 1 Regional Office of CCB, New Town, Polonnaruwa.

**18. Ratnapura Regional Office**

- 1 Godakawela.
- 2 CCB Regional Office, New Town, Ratnapura.

**ANNEXURE 4**

## INSECTICIDES CURRENTLY RECOMMENDED FOR COCONUT PEST CONTROL

This Annexure gives details of the insecticides currently recommended for coconut pest control. The recommendations may change from time to time with the development of new products and with the removal of certain pesticides from the market.

This Annexure should be read with Chapter 8, where the circumstances requiring the use of insecticides are described.

ALL PESTICIDES ARE VERY TOXIC AND SHOULD BE HANDLED WITH EXTREME CARE.

* Use gloves and other protective clothing when handling insecticides (note that insecticides can be absorbed into the body through the skin).

* Use the recommended rates.

* After application, wash hands thoroughly with soap and water.

* Avoid eating during insecticide application.

* In case of a pesticide-related accident, seek medical assistance at once. It will be useful to take the empty insecticide container to the doctor so that he can check the label and determine the antidote.

**Currently recommended insecticides** §

1. **The foliar pests**

   Coconut Caterpillar, Coconut scale, Coconut leaf miner, Nettle grub, Bag worm.

   These foliar pests are normally controlled by biological methods (using parasitic and predatory insects). Heavy infestations may require insecticides, usually administered by trunk injections.

   Please consult the Coconut Development Officer of the area or the Director, Coconut Research Institute if an outbreak of a foliar pest is seen.

   Use •1 Monocrotophos
   (If this is not available in the market, the CRI can recommend an alternative).

2. The Black Beetle
   Use • 1 Naphthalene balls OR
   • 2 Aldrin OR
   • 3 Carbofuran OR
   • 4 Monocrotophos

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§ Insecticide formulations are identified by a *generic name*, based on the active ingredient. Any given insecticide can be formulated/marketed by traders using their own brand names. These brand names are given later in this Annexure.

3. The Red Weevil

Use • 1 Monocrotophos OR
• 2 Methamidophos

4. Termites

Use • 1 Aldrin OR
• 2 Chlorpyrifos

The brand names of these insecticides and their distributors are given below:

| *Generic name* | *Brand name* | *Distributors* |
|---|---|---|
| 1. Aldrin | Aldrin 20 | Lankem Ceylon Ltd. |
| 2. Carbofuran | Carbofuran 3 G | Ceylon Petroleum Corporation |
| | Curaterr 3% G | Haychem Ltd. |
| | Furadan 3% | Chemical Industries (Colombo) Ltd. |
| 3. Chlorpyrifos | Pyrimack 40% EC | Mackwoods Ltd. |
| | Chlorpyrifos | Chemical Industries (Colombo) Ltd. |
| 4. Monocrotophos | Monocrotophos 60% | Anglo-Asian Fertilizers Ltd. |
| | | A Baur & Co. Ltd.. |
| | | Ceylon Petroleum Corporation. |
| | | Chemical Industries (Colombo) Ltd. |
| | | Hoechst (Ceylon) Ltd. |
| | | Lankem Ceylon Ltd. |
| | Monocron | Mackwoods Ltd. |
| | Nuvacron | Harrison & Crossfield (Colombo) Ltd. |
| | Moriphos | JL Morison Son & Jones 'Ceylon' Ltd. |
| 5. Methamidophos | Methamidophos | Anglo-Asian Fertilizers Ltd. |
| | | Ceylon Petroleum Corporation |
| | | Lankem Ceylon Ltd. |
| | | Mackwoods Ltd. |
| | Monitor | Harrison & Crossfield (Colombo) Ltd. |
| | Tamaron | Haychem Ltd. |
| | Morithion | JL Morison Son & Jones 'Ceylon' Ltd. |

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