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# Agriculture in Vanuatu

## COCONUTS



Ministry of Education  
Port Vila  
Republic of Vanuatu  
1997

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# Objectives

Having successfully completed this course, the student should be able to:

1. Name the main parts of a:
  - coconut palm
  - coconut leaf
  - coconut flower (male and female)
  - coconut seed
2. Describe the process of pollination and nut-development in a coconut.
3. Select good seed nuts, by recognising the characteristics of a good parent tree, by describing seednut collection techniques, and by knowing which nuts to discard.
4. Describe the work of the plant breeders at CIRAD, mentioning the techniques of collection, breeding and selection that are being employed, and the characteristics for which the breeders are aiming.
5. Demonstrate a knowledge of the recommended procedure to be followed when planting coconuts in a pre-nursery, and of the maintenance of the pre-nursery.
6. Demonstrate a knowledge of the recommended procedure to be followed when planting coconuts up from the pre-nursery, and of their maintenance in the nursery.
7. Demonstrate a knowledge of the recommended procedure to be followed when planting coconuts out in the plantation, both when:
  - coconuts are to be grown alone
  - coconuts are to be inter-cropped with other crops e.g. cocoa.
8. Demonstrate a knowledge of the procedures to be followed when maintaining a plantation, with particular reference to:
  - care of the young plantation
  - the relative merits of weed control by hand, by cattle, and by machine.
9. Describe the major problems affecting coconut palms growing in Vanuatu, including:
  - foliar decay

- 
- helminthosporiose
  - brontispae beetles
  - senility
10. Describe the methods used to produce
- smoke-dried copra
  - hot-air dried copra
  - sun-dried copra
- and compare the advantages and disadvantages of these three systems.
11. Describe the method by which the price paid to producers for their copra is decided, mentioning in particular the work of
- the copra graders
  - the VCMB

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# 1. The coconut palm

Common Name: Coconut

Scientific Name: *Cocos nucifera*

Origin: uncertain: either northwestern Central America or Indo-Pacific region

## Nutritional value

The flesh is a good source of Vitamins B and C. It contains fats, iron and a little amount of protein and calcium.

Coconuts are both an energy food and a protective food. The mature coconut is an energy food because it contains a lot of fat. The green nuts are protective foods because they contain large amounts of some of the vitamins and minerals that are necessary for good health.

## Introduction

The coconut palm is widely distributed throughout the tropics. It requires a warm climate without great variation in temperature. An ideal temperature would be 27 C.

Rainfall of between 1300mm to 2000mm is essential for proper growth.

The palm is a **monocot** similar to bamboo and grasses. It has no branches, no lateral growth and no tap roots. The palm provides food and a refreshing drink. Coconut oil is extracted from its white flesh.

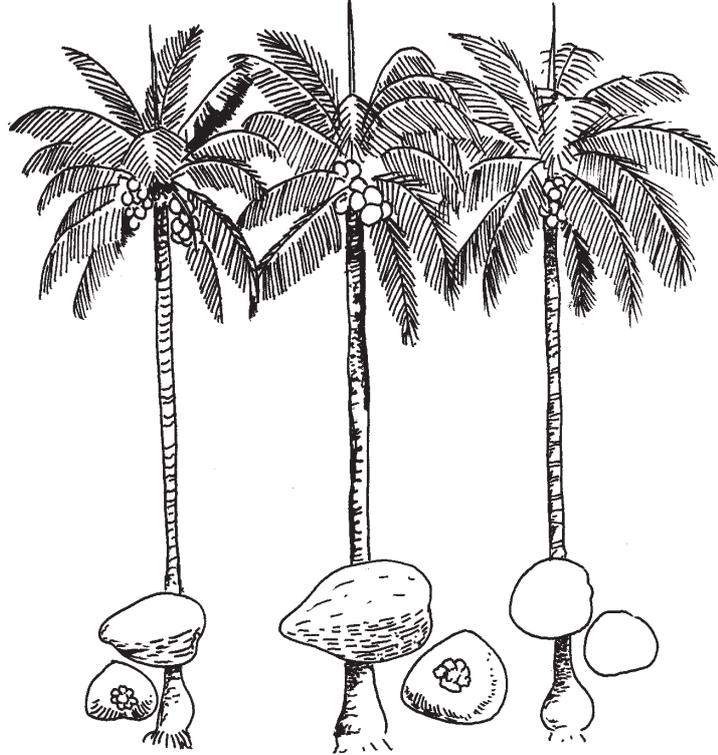
## Coconut palm

The palm is characterised by a solid unbranched trunk, crowned by fan-shape bipinnate leaves.

Occasionally branching can be seen in coconut palms. This might be caused by insects or other damage. Sometimes the base of the trunk is swollen to form the bole. In Vanuatu the trunks form medium size boles. This provides a firm grip to the soil.

There are mainly two main types of coconut palms, tall palms and dwarf palms. The tall palm might be over 25 metres when fully mature (see breeding).

Tall varieties



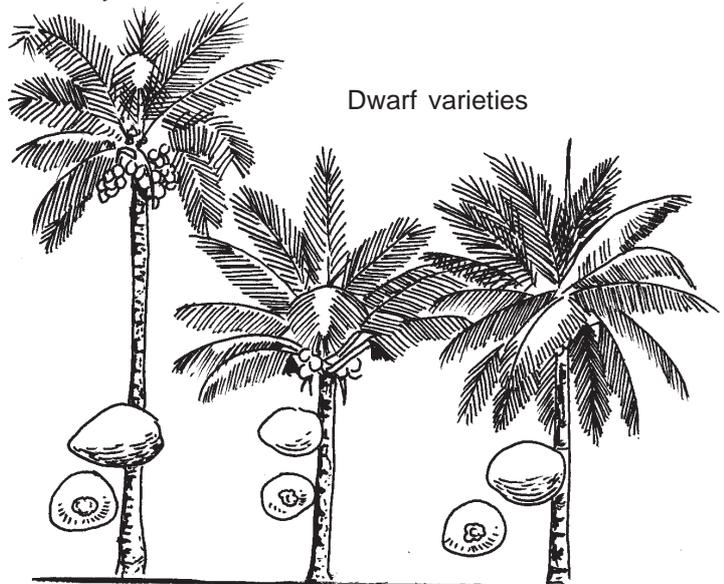
Vanuatu tall

Rennell island tall

Federated Malay States tall

A hybrid

Dwarf varieties



A hybrid

Malayan dwarf

Vanuatu Red dwarf

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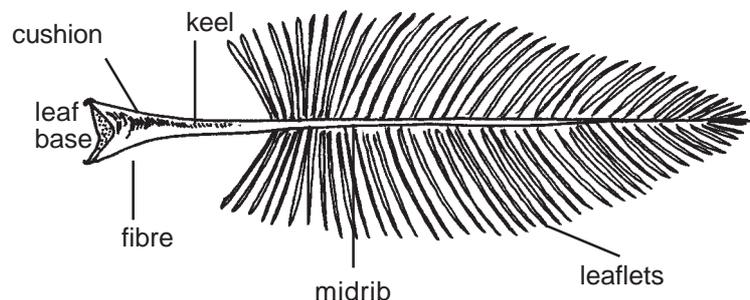
## Coconut leaf

There are about 13 or 14 leaves on a coconut palm. There may be more in some dwarf varieties (24 leaves in the Malayan dwarf). A new leaf emerges every month and it stays on the palm for three years.

Coconut leaves vary from 3 or 5 metres in length. The first leaves of a seedling appear as entire leaves as they are fused together. When more and more are formed they tend to split into leaflets. Each leaf consists of a large number of leaflets arranged on each side of the midrib. There may be over 200 leaflets on one leaf.

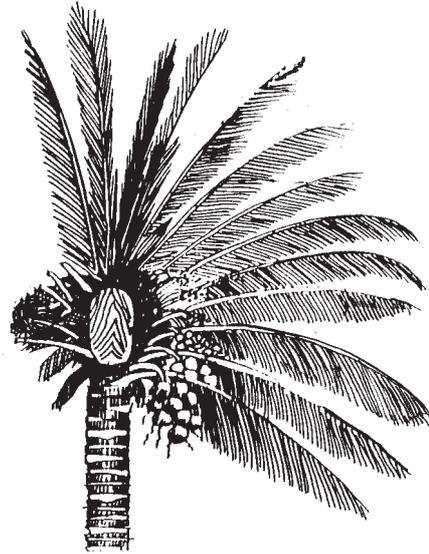
The arrangement of leaves on a palm ensures that each leaf gets the maximum amount of light. The leaves are spirally arranged in groups of five.

The number of leaves on a palm gives an indication of the number of nuts the plants can produce. Palms with many leaves will produce many nuts.



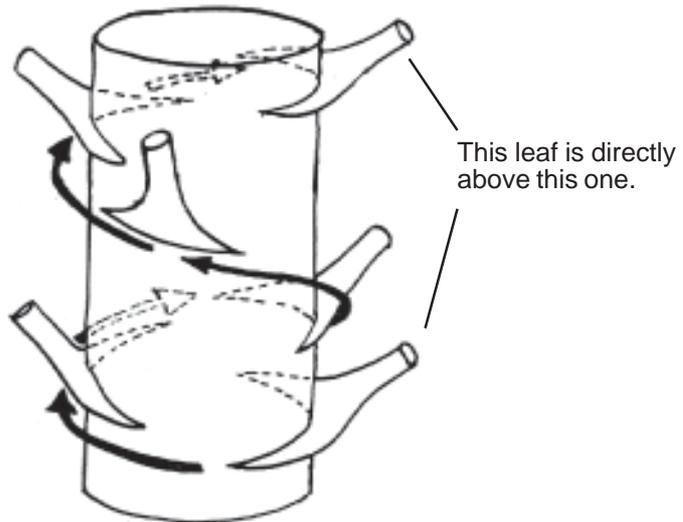
The age of a coconut palm can be calculated by counting the number of leaf scars on the trunk and divided by the number of leaves on the palm.

$$\text{Age of Palm} = \frac{\text{number of leaf scars}}{\text{number of leaves}}$$



The leaves provide food for the nuts as they grow.

**Arrangement of leaves on the trunk**

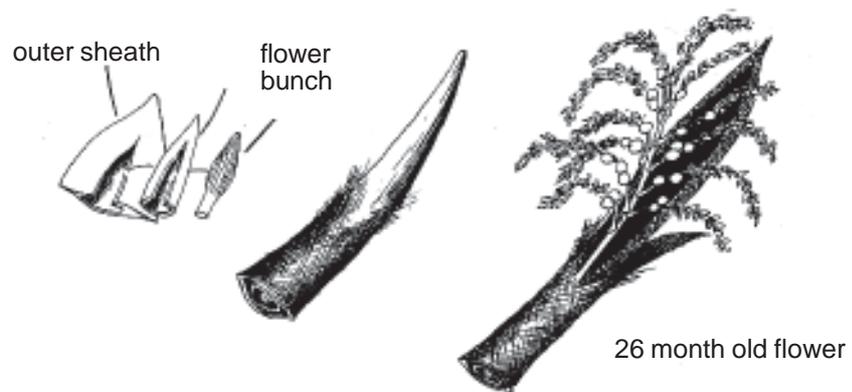


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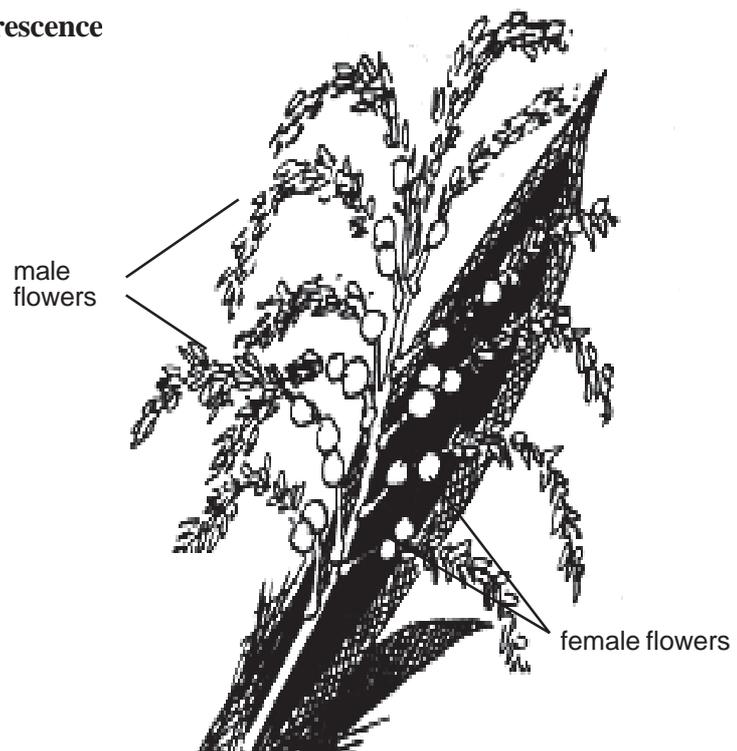
## Coconut flower

The inflorescence in coconuts is **monoecious**, that is it contains both the male and female flowers on the same palm. The inflorescence is borne singly in the axil of each leaf of a palm. It consists of a main axis with numerous side branches (sometimes as many as 40).

Female flowers are situated at the base of each branch of the inflorescence. There are usually less than five female flowers on each branch. The male flowers are much more numerous. They are small and are distributed above the female flowers.

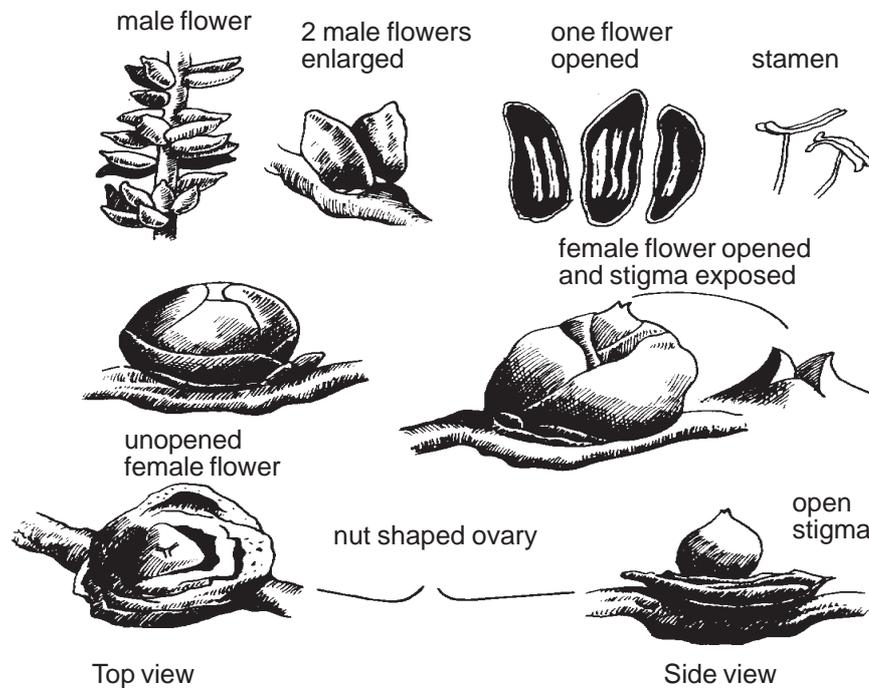


### An inflorescence



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## 2. Pollination and nut development



### Pollination

Pollination is the transference of pollen grains from the anther to the stigma. Tall varieties are **halogamous**, that is they are cross-pollinated. This is because the male flowers are receptive. The tall varieties self pollination does not normally take place. Pollination is performed by insects.

Dwarf varieties are **autogamous**, that is they are self pollinated. This is because in dwarf varieties the male and female flowers usually mature at the same time. Pollination is normally carried out by insects, though wind pollination is also possible.

Bees, wasps and beetles are examples of pollination agents.

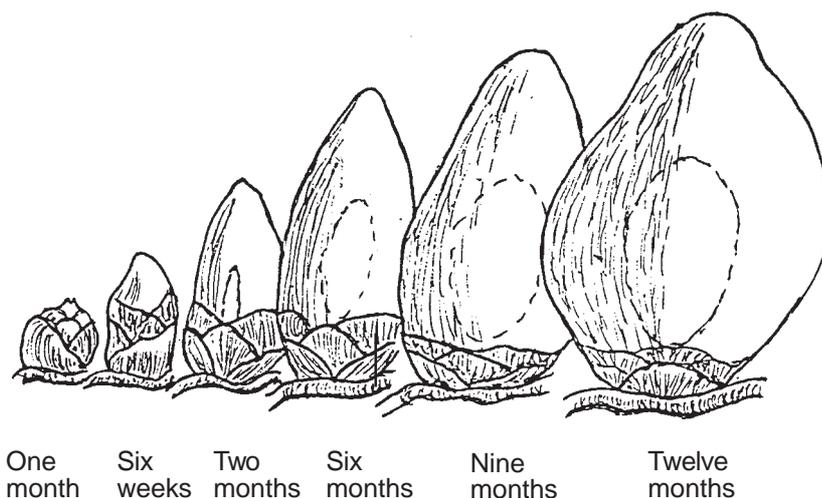
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## Fertilisation

When the pollen is transferred to the stigma, the pollen produces a tube which grows down into the ovary. The nucleus of the pollen moves down through the pollen tube to meet the nucleus of the ovary. There both nuclei fuse together to form the zygote. This process is known as fertilisation.

## Nut development

After fertilisation the ovary of the female flower grows into a nut. The young nut first grows in length and later grows wider. It takes about one year for a nut to grow. The time from fertilisation to maturity is shown here.

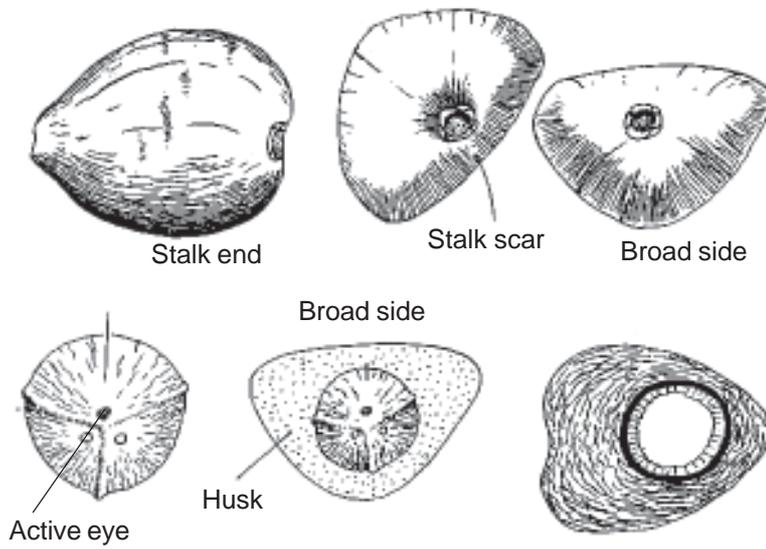


## Coconut seed

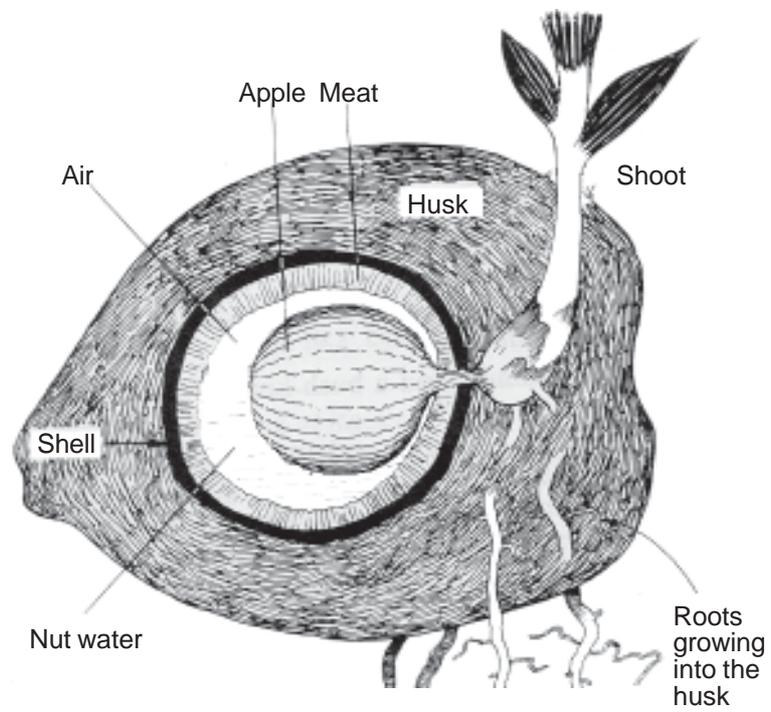
The nut is 20 to 30cm long and is 1 to 2kg in weight. It is attached to the plant at the stalk end. Some nuts are round but most of them have 3 sides. One is flatter and broader than the others. The stalk end is closer to the broader side.

Inside the fibrous coat (husk) the shell is divided into 3 parts by small ridges. One part is broader than the others. Each section has one eye. The eye found at the broader side is bigger and is known as the active or germinating eye. It is at this point that germination starts.

The white fleshy part of the nut, also known as the meat, is found immediately beneath the shell. Coconut oil is extracted from the meat. The white fleshy part is hollow and contains water rich in sugars and vitamins.



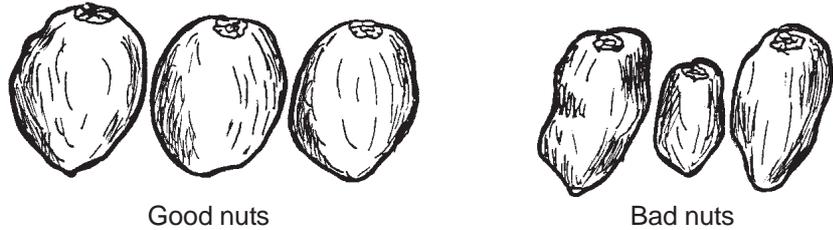
**Germinating nut**



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## Selection of seed nuts

It is highly advisable to get your seeds for planting at CIRAD on Santo. Good seednuts will produce about 2 tons of copra per hectare per year.



When selecting nuts for planting it is very important to look for the following characteristics:

- Big nuts
- Even shape
- Nuts containing enough (or a large amount) of water
- Nuts that come from high-yielding palms

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## 3. Plant breeding at CIRAD

C.I.R.A.D. (Centre de Coopération Internationale en Recherches Agronomiques pour le Développement) is a research institute based on Santo. Its main work is to undertake research and experimental work on coconuts.

The aim of the plant breeders is to get a good selection of nuts which will

- increase the yield of copra per hectare
- increase the resistance to diseases and pests.

There is a large collection of coconut palms available at CIRAD

- 10 different tall varieties
- 13 different dwarf varieties

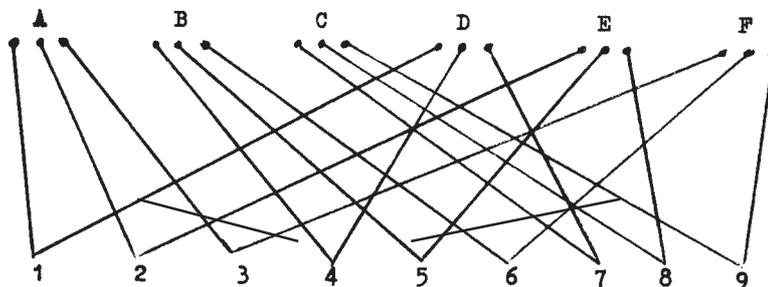
The breeders have a large collection of germplasm which is used for producing high yielding and pest and disease resistant plants.

Pollen grains are imported from the Philippines and the IRHO in the Ivory Coast. The Ivory Coast IRHO is the biggest coconut research centre in the world). Pollen can be freeze-dried and vacuum stored. The viability of the pollen is 2 to 3 months.

### Nut selection at CIRAD

Selection provides breeders with the best materials. The aim is to improve plant materials by selecting those with desirable characteristics.

### One method of breeding

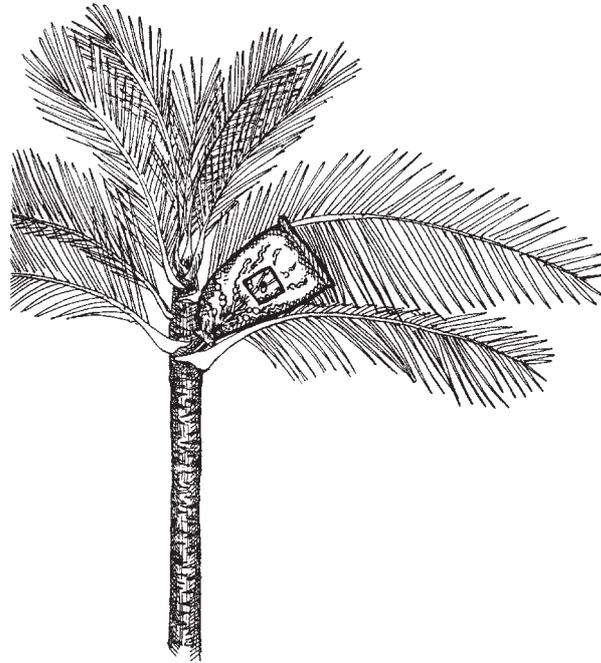


A to F are different varieties of coconuts. They are intercrossed and the best quality obtained from 1 to 9 is selected. This method provides the breeder with the best selection of nuts for planting.



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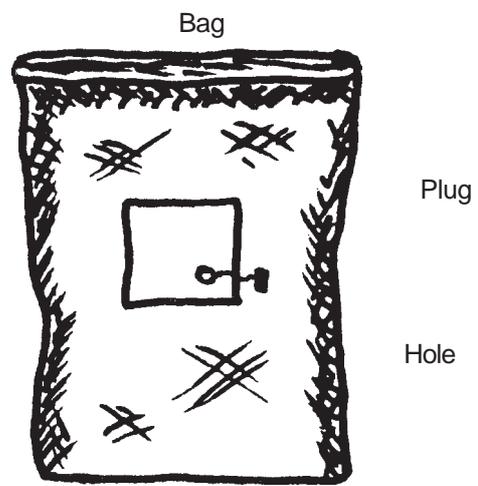
### Bagging on coconut palm



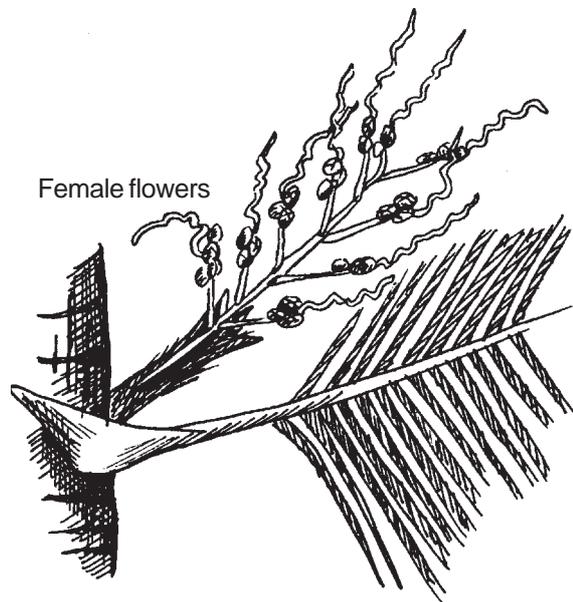
#### 1st Method

Breeding is done in the following steps:

1. The flowers are emasculated, that is all the male flowers are removed from the bunch.
2. The bunch with the female flowers is placed into a tarpaulin bag. The opening of the bag is securely attached at the base of the flower stalk.
3. Some insecticide powder is placed at the base of the flower stalk in order to keep insects away from the female flowers.
4. The pollen is mixed with some talcum powder and put in a plastic bottle. The talcum powder facilitates dispersal of pollen inside the bag.
5. When ready to pollinate, the pollen from the plastic bottle is pumped onto the female flowers through a small hole in the bag.
6. The bag is left on the palm until fertilisation occurs.
7. Fertilisation is confirmed when small drops of water appear on the flower. This is visible through the transparent part of the bag.



Bag with transparent window



Emasculated flower bunch

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## **2nd Method**

Sometimes a seed garden with assisted pollination is set up. The flowers of the mother plant are emasculated. Pollination is done everyday with the plastic bottle containing pollen grains.

This is a very expensive method which needs a lot of people and lots of care.

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## 4. The pre-nursery

Seed nuts are first raised in a pre-nursery in order to identify the fast germinating ones.

It is extremely important to identify the early germinating seeds as they will produce:

- early flowering palms
- early producing palms
- high yielding palms

This is true of any variety of coconut.

### Methods, procedures and care

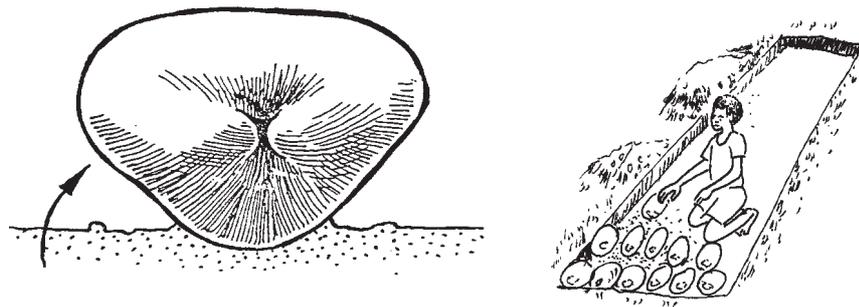
A rectangular shallow pit (1 metre wide and 15cm deep) is dug. The pit can be of any suitable length.

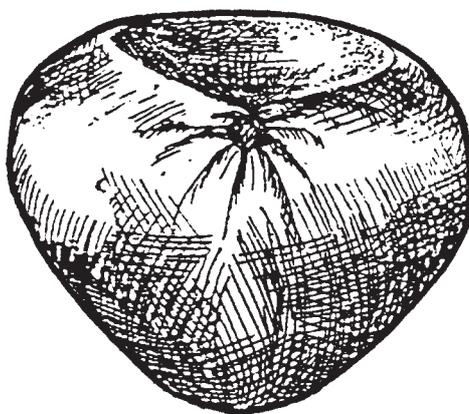
The nut is shaken to check its water content. A small part of the husk is sliced to facilitate water absorption.

The nuts are placed side by side with the sliced surfaces facing upwards. They are about two thirds covered with soil.

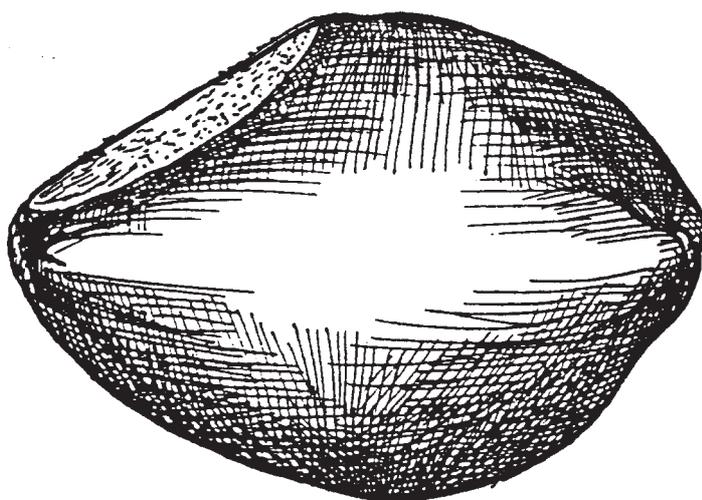
The bed is thoroughly watered and mulched.

It is extremely important to keep the bed weed-free, so weeding is done regularly by hand.





Front View  
Position of slicing a nut before  
placing in a pre-nursery



Side view

### **Selection of early germinating nuts**

The selections of early germinating nuts are done every week. The seedlings are transferred directly to the nursery.

Seedlings are transferred to the nursery when their leaves are 15 to 20cm in length.

70% of the seedlings are usually transferred to the nursery. Sometimes only 50% of the seedlings are selected.

The selection should be done within a period of 3 months. Seeds that do not germinate within the 3 months should be rejected.

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## 5. The nursery

A nursery is important as it facilitates a proper selection of the strongest seedlings.

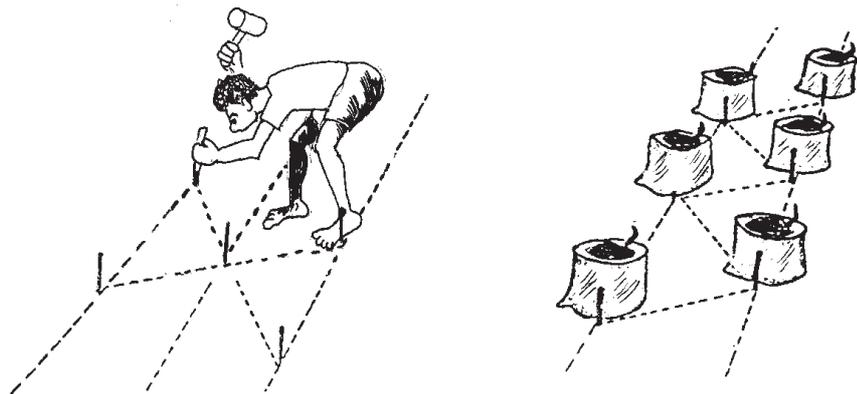
Seedlings from the pre-nursery are transferred to the nursery. They are placed in polybags in order to avoid transplanting shock later.

### Planting in polybags

A polybag is filled with top soil and the seedling is placed in it.

Some more soil is then added, followed by some water.

Sometimes a small amount of fertiliser is added around the seedling. (Muriate of Potash and Ammonium Sulphate)

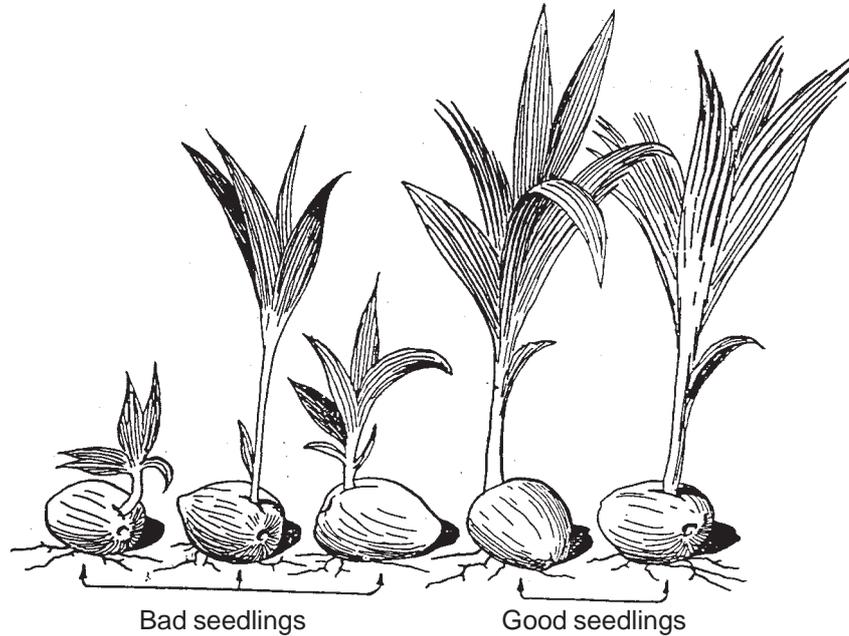


### Application of fertiliser to the seedling in the polybag

Prior to the transference of seedlings from the pre-nursery to the polybag nursery, a basal dressing is essential. 25 grams of the fertilisers are applied.

After 3 months another 25 grams are applied as a side dressing.

Lastly 2 months before transplanting to the field, 50 grams of the same fertilisers are applied



#### **Advantages of using polybags**

- There is a better seedling development.
- The bag containing the seedling can be handled safely.
- There is no root damage.
- Transplanting shock is very small (less than 1%).

#### **Disadvantages of using polybags**

The heavy weight of the seedling causes a problem for transport.

### **Nursery techniques**

#### **Spacing**

The seedlings are arranged in a 60cm triangle in a nursery. Sometimes the distances is increased to 70cm or 80cm. Bigger spacing is done when the seedlings are to be kept for a longer time in the nursery. This method of spacing gives a lot of sunlight to the plant and facilitates watering.

#### **Duration**

A seedling is best kept in a nursery for a period of 6 months.

The dwarf varieties are kept for 10 months and the local tall for 5 to 8 months. Hybrids are normally kept for 8 months.

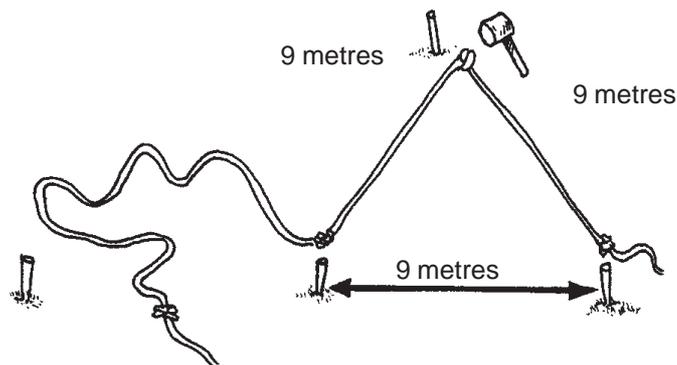
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## 6. Planting out coconuts

### Marking Out

A long rope is taken and knots 9 metres apart are tied. The rope is then stretched in a north-south direction along one side of the planting area. Some small pegs are fixed into the ground at the positions of the knots.

To mark the second row the first and third knots are tied on the first two pegs. The second knot is then pulled sideways and a peg is fixed at the point it reaches. This process is continued until the whole plot is marked.

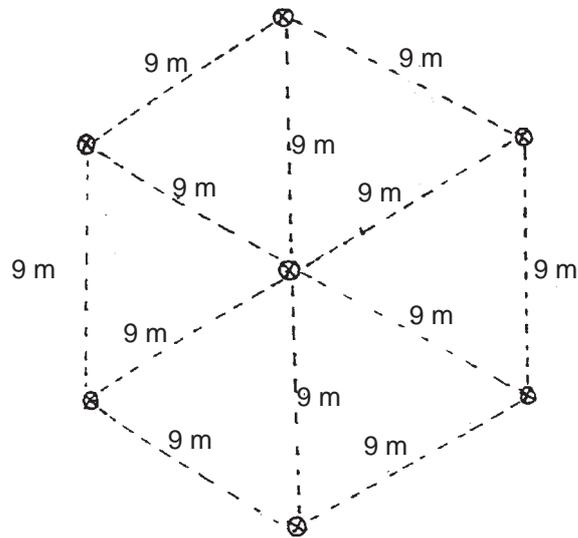


It is best to plant coconuts in 9 metre triangles in a north-south direction. This system avoids overshade and provides maximum sunlight to the plant.

If a compass is not available at the time of marking, the north-south direction can be found by using the direction of the sun as a guide.

(The sun always moves from east to west, so the north-south position can be found).

The 9 x 9 metres triangle system will give 143 Coconut palms per hectare.



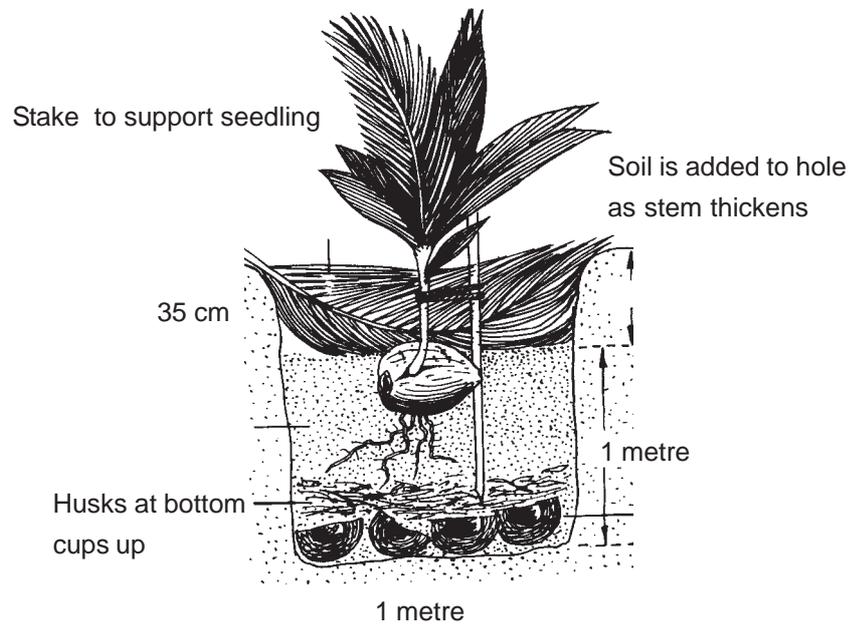
## Planting holes

Planting holes are dug at the places previously marked with the pegs. The holes are dug about one metre deep and 60cm diameter.

One or two layers of husk, cups up, are placed at the bottom of the holes. The husks contain potassium and putting the cups up holds the potash well. Some good soil and mixed fertiliser are then put on the husks. A stake is driven in the hole to hold the seedling straight.

## Transplanting

The seedling is transplanted in such a way that the top part of the nut is about 35cm below the surface of the soil. Soil is placed around the nut, with care being taken not to cover the collar of the stem. Soil is added later as the stem grows in thickness



### Planting from polybags

When the planting hole is ready for transplanting the bottom of the polybag is cut off. The bag together with the seedling is carefully lowered down into the hole. The polybag is then pulled up over the leaves. The seedling is then watered.



Cutting the bottom off the polybag



Lifting the bag up over the seedling



Placing the bag in the hole

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## **Intercropping**

A shade resistant crop like cocoa may be grown between the rows of coconut palms. The practice of intercropping will bring in extra income for the farmer.

Other crops that can be intercropped with young coconut palms are cassava, sweet potatoes, banana, pineapples and maize. These crops should not be planted too close to the palms (at least 2 metres away) as, if they are, they will take too many plant nutrients from the soil. This will damage the young palms.

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## 7. Care of the young plantation

### Weeding

Weed control is very important in coconut plantation. Ring weeding is done using 3 metre diameter around the palm. This should be carried out regularly. Weeding can be done by using a bush knife.

The soil should also be loosened. After the rainy season, disc-harrowing can be done in the plantation. This controls the weeds. Cover crops will provide a useful mulch.

Weed control can also be done by cattle, slashing and herbicides.

Cattle can graze in the plantation provided the coconuts are adult.

### Fertilising

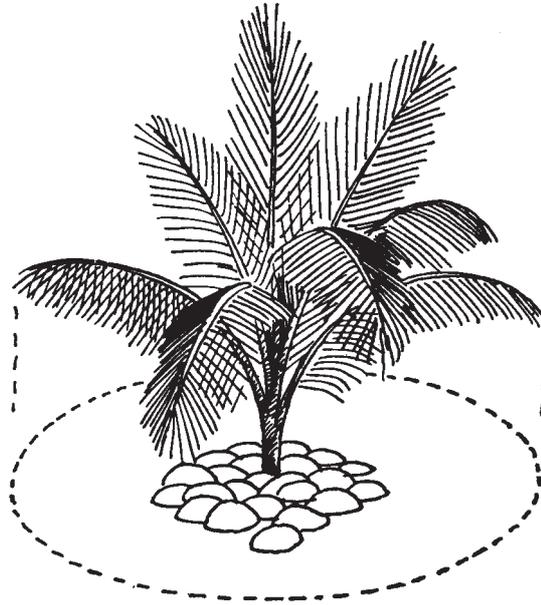
Fertilising is necessary for vigorous growth and for obtaining constant high yields.

The best time to apply fertiliser is at the beginning of the rainy season. During this time the soil is moist and nutrients by the roots is rapid.

Fertilisers are applied in drills made around individual palms. Drills should not be too close to the palm. The distance depends on the size of the palm.

Fertilisers applied should contain adequate amounts of nitrogen, phosphorus and potassium.

Potassium Chlorate (Muriate of potash) and Ammonium Sulphate are normally used.



## 8. Coconut pests

### Foliar Decay

Foliar decay is a very serious disease affecting coconuts. The cause of the disease is unknown. Researchers say that probably Viroids cause the disease. However, it has been found that the disease is spread by an insect called *Myndus leffini*. The insect is endemic in Vanuatu. It feeds on coconut, injecting a pathogen in the coconut sap.

The local tall and Vanuatu dwarf are resistant. They have acquired resistance by adaptation. Introduced materials (coming from overseas) are easily affected. The hybrid 'NRVGT' is 100% resistant.

The disease causes yellowing of the middle leaves.

### Helminthosporiose

Helminthosporiose is a fungal disease caused by *Helminthosporium incurvatum* (*Drechslera incurvata*). It affects mostly young palms in the nurseries. A minor disease which can cause severe infection where young palms are overcrowded, heavily intercropped, under fertilised or given excessive shade.

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### Symptoms

A leaf spot of young palms. The spots are at first small, oval and brown. The spots enlarge and become pale buff in the centre with a broad dark brown margin. In severe attack the edges of leaves become extensively necrotic.

### Control

Fungicides can be used for controlling the disease. Fungicides can be used for controlling the disease.

Organil 66 (Procida) - 25 grams in 10 litres of water

Dithan M 45 - 25 grams in 10 litres of water

Maneb 80% - 25 grams in 10 litres of water

Daconil - 25 grams in 10 litres of water

In case of underfertilised palms an application of P and K on a 2 to 3 year old palm reduces the disease by about 40%.

### Brontispa



Scientific name of insect: Brontispa Longissima

Common name of insect: Coconut Leaf Hispa or Coconut Hispine beetle

Brontispa attacks palms of all ages although it is more damaging to young palms in nurseries. Neglected palms are more heavily attacked than those that are carefully looked after.

Both adult insects and larvae damage the leaflets of unopened fronds.

The adult beetle chew leaves between or inside the tightly folded leaflets. They graze away the surface in streaks which are typically parallel to the midrib.

The narrow feeding scars enlarge to form irregular brown blotches as the frond opens. Destruction of young leaves restricts growth for a long time and heavy attack may cause death.

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## **Control**

The damage produced by *Brontispa* is considered serious enough for control measures to be recommended for young palms.

Triohiorfon and Lindane are chemicals which are recommended for *Brontispa*. The pesticide is applied to the central spike of the palm.

Old palms are controlled by introducing parasites (*Tetrastichodes brontispae*) which destroy the *Brontispa*.

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## 9. Copra

Copra is the main product of the coconut in Vanuatu. The meat is dried in a hot air drier or a smoke drier or by the sun.

### Hot air drier

The meat is placed in enclosed chambers and heated with hot air. Coconut husks and shells can be used as fuel.

The hot air drier provides a complete homogenous drying with about 6% humidity.

### Sun drying

The meat of the coconut is placed on mats, drying floors or small platforms and left in the sun. The copra should be covered at night or when there is rain. It takes about one week for sundrying copra.

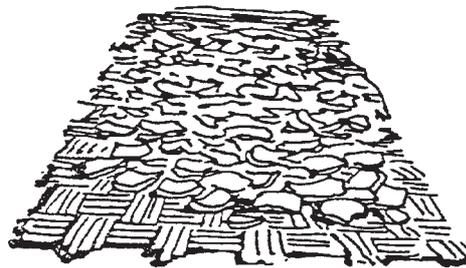
### Smoke drier

Copra is sometimes dried on open fires. There should be as little smoke as possible. It is very difficult to get an homogenous drying with this method.

### Quality of copra

Good quality copra should have the following characteristics:

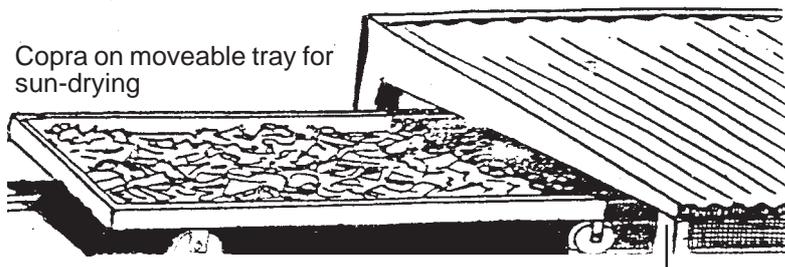
- should contain less than 7% moisture
- should be brittle and break easily
- small slice should burn with a clear flame (above 0% moisture the copra will not burn).
- should be prepared from mature ungerminated nuts.
- the surface should be clean, smooth and hard
- the testa should be brown and inner surface white or greyish white
- should be free from dust, soil or any foreign matter.



Copra being sun-dried on bamboo mats



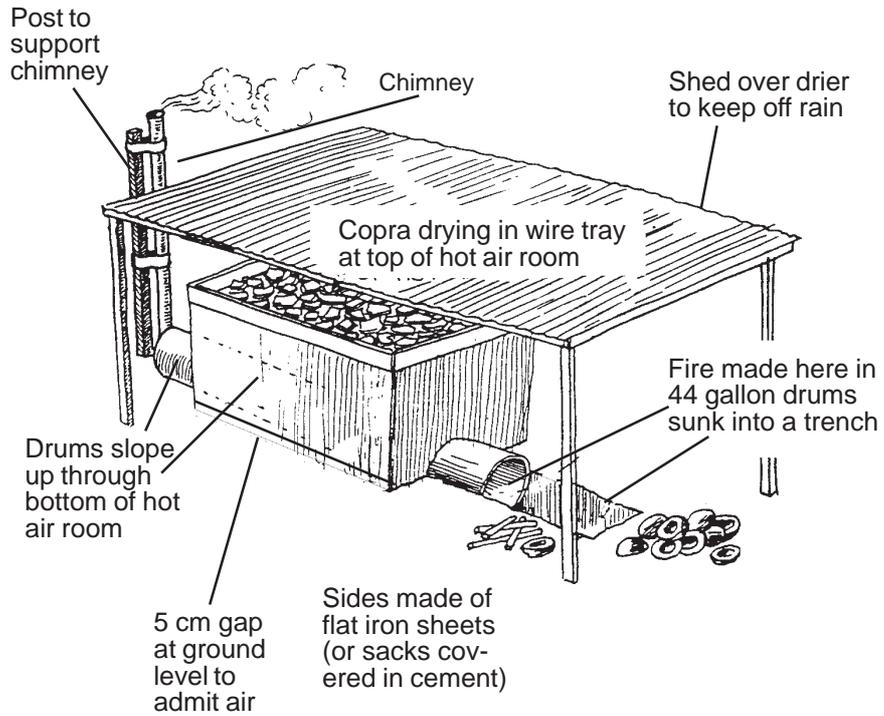
Smoke drier



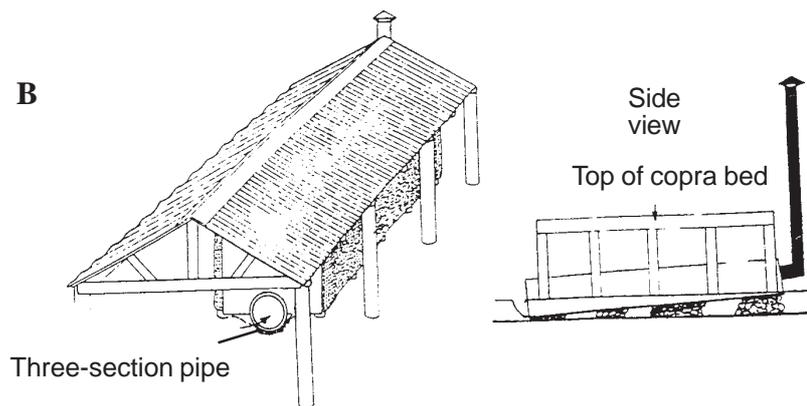
Copra on moveable tray for sun-drying

## Two kinds of hot air copra drier

**A**



**B**



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## 10. V.C.M.B

The Vanuatu Commodities Marketing Board was set up under the UNDP/Vanuatu Government joint project in 1980.

The board started operation on the 5th April 1982. Its operation and price stabilisation scheme has been initially funded by the EEC, Stabex Fund through the Ministry of Finance Vanuatu.

The VCMB's main aims are:

- to receive copra offered for export at Vila and Santo.
- Sell copra overseas.
- Control the domestic price payable for copra in Santo and Vila.
- Operate a stabilisation scheme to maintain price at a steady level.
- Maximise returns to the producers.

The board also deals with cocoa and kava.

