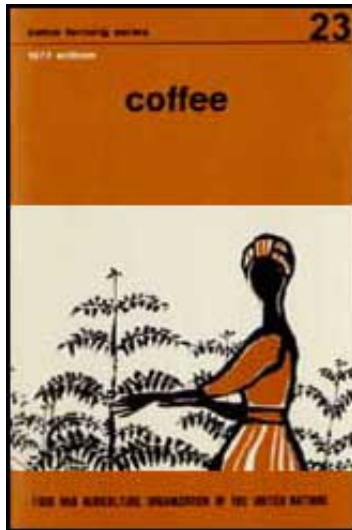






























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- ➔  Better Farming Series 23 - Coffee (FAO - INADES, 1977, 36 p.)
-  *(introduction...)*
 -  Preface
 - Where coffee is grown
 -  *(introduction...)*
 -  What varieties of coffee are grown in africa?
 -  Why coffee is grown

- Choosing the seeds or seedlings
 -  (*introduction...*)
 -  Choosing good seeds
 -  Sowing the seeds in seed beds
- Growing the seedlings
 -  (*introduction...*)
 -  Lifting the young seedlings from the seed beds
 -  Transplanting the seedlings into a nursery
- Choosing a site and preparing the plantation
 -  Choosing the site
 -  Clearing the site
 -  Tracing rows and digging holes for planting

-  Covering the bare soil
-  Sheltering the young coffee trees
-  Planting coffee trees in the plantation
-  Taking care of the plantation
 -  (*introduction...*)
 -  Replacing missing seedlings
 -  Upkeep of the soil cover and hoeing
 -  Pruning coffee trees
 -  Cutting back old trees
 -  Applying fertilizers
 -  Protecting trees from insects and diseases
-  Harvesting the berries
-  Processing the coffee beans

 Suggested question paper

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(FAO - INADES, 1977, 36 p.)

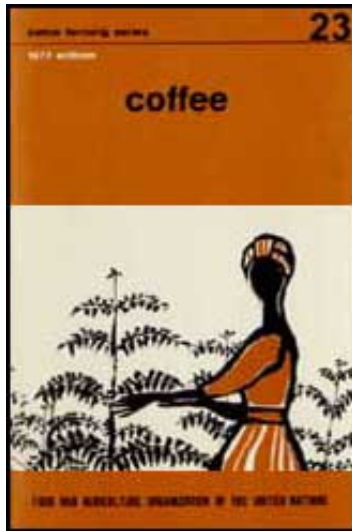
  (*introduction...*)

 Preface

 Where coffee is grown

 Why coffee is grown





- Choosing the seeds or seedlings
- Growing the seedlings
- Choosing a site and preparing the plantation
- Taking care of the plantation
- Harvesting the berries
- Processing the coffee beans
- Suggested question paper

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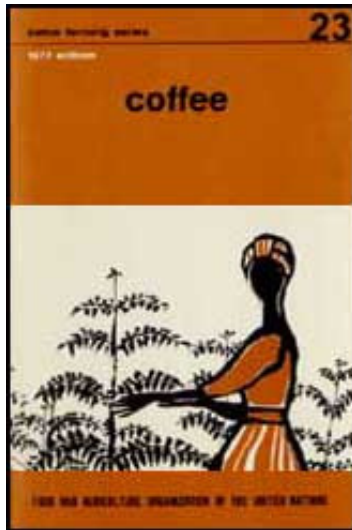
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Better Farming Series 23 - Coffee (FAO - INADES, 1977, 36 p.)



(introduction...)



Preface



Where coffee is grown



Why coffee is grown



Choosing the seeds or seedlings



Growing the seedlings



Choosing a site and preparing the
plantation



Taking care of the plantation



Harvesting the berries



Processing the coffee beans Suggested question paper

Processing the coffee beans

After you have harvested the berries, do not let them rot.

42. Drying the berries

Many African coffee beans are of poor quality, because the berries have not been well dried. To dry the berries well, spread them out in a dry place, either on very clean ground or on planks. Protect the berries against rain by building a little shelter.

43. Pulping the berries

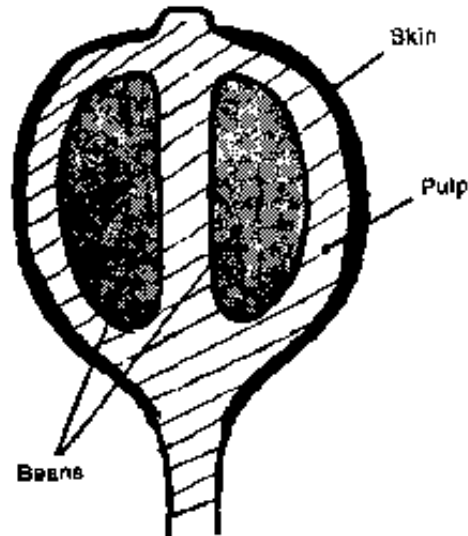
When the berries are dry, pulp them.

We have seen that the berries consist of skin, pulp and two

coffee beans.

To pulp berries means to separate the beans from the pulp and skin.

Pulping can be done by hand with a pestle, which breaks the skin and pulp, or with pulping machines.



A berry cut in two

A berry cut in two

44. Winnowing

To winnow means to separate the coffee beans from all the bits of pulp and skin.

You can winnow with a sieve.

45. Drying coffee beans

Dry the coffee beans in a very dry place, either on hard and very clean ground, or on planks.

The layer of beans should not be too thick.

Stir the beans often.

46. Sorting coffee beans

In order to have good- quality coffee which can be sold at a good price:

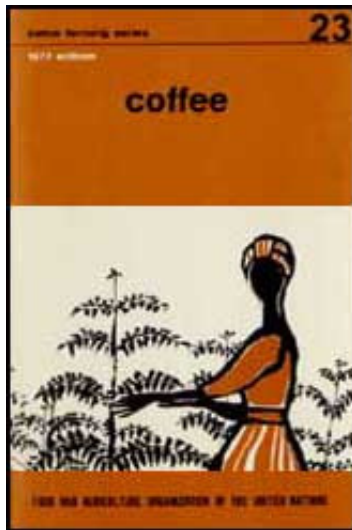
- Put to one side all the whole beans, for which you will get a good price;
- Put elsewhere the broken beans, for which you will get a lower price;
- Throw away black beans, which bring down the quality a lot.

In order to earn a lot of money, the grower must sell many coffee beans, and these coffee beans must be of good quality. In order to have many coffee beans, the grower must prune his coffee trees well and apply fertilizer. In order to have good- quality coffee beans, the grower must harvest the berries correctly and process the coffee beans wolf.



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Better Farming Series 23 - Coffee
(FAO - INADES, 1977, 36 p.)



(introduction...)



Preface



Where coffee is grown



Why coffee is grown









Choosing the seeds or seedlings



Growing the seedlings



Choosing a site and preparing the

-  plantation
-  Taking care of the plantation
-  Harvesting the berries
-  Processing the coffee beans
-   Suggested question paper

Suggested question paper

FILL IN THE MISSING WORDS

The fruits of the coffee tree are called

..... coffee beans fetch a good price.

The place where seeds are sown to make them germinate is called

The root system of the coffee tree is a

The young coffee tree does not like too much and dry are bad for it.

To make a coffee tree young again you

In order to get good- quality coffee beans, the grower must

the berries correctly and the coffee beans well.

ANSWER THE FOLLOWING QUESTIONS

What varieties of coffee do people grow where you live?

Are there centres in your region which sell coffee seedlings for planting in a plantation?

Why should you protect the bare soil?

Why should you leave some trees in your coffee plantation?

Why should you burn diseased coffee trees?

How are the berries dried?

Describe how your people prune coffee trees.

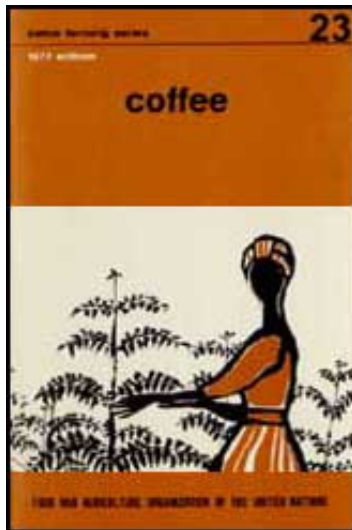
Make a drawing or two to explain.


Why should you harvest your berries properly and dry them well?

Describe how your people process the coffee beans.



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 Better Farming Series 23 - Coffee
(FAO - INADES, 1977, 36 p.)

 *(introduction...)*





  Preface

Where coffee is grown

 Why coffee is grown

Choosing the seeds or seedlings

Growing the seedlings

- Choosing a site and preparing the plantation
-  Taking care of the plantation
-  Harvesting the berries
-  Processing the coffee beans
-  Suggested question paper

Preface

The first twenty- six volumes in FAO's Better Farming Series were based on the Cours d'apprentissage agricole prepared in the Ivory Coast by the Institut atricein de developpement conomique et social for use by extension workers. Later volumes, beginning with No. 27, have been prepared by FAO for use in agricultural development at the farm and family level. The approach has deliberately been a general one, the intention being to constitute basic prototype outlines to be modified or expanded in each area according to local

conditions of agriculture.

Many of the booklets deal with specific crops and techniques, while others are intended to give the farmer more general information which can help him to understand why he does what he does, so that he will be able to do it better.

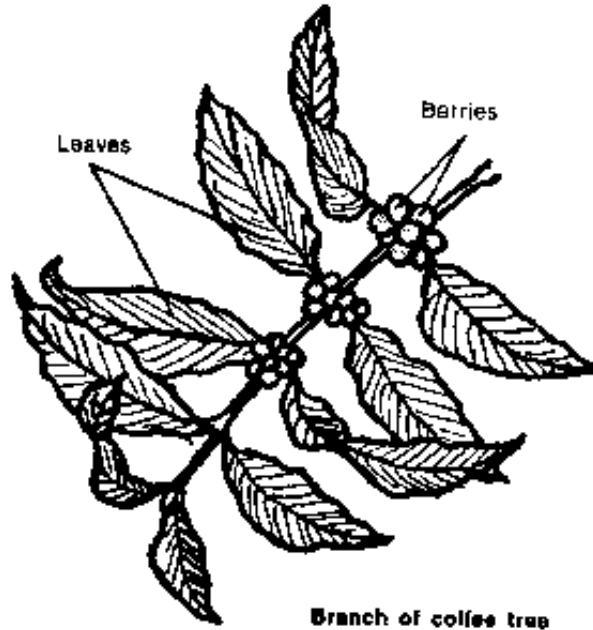
Adaptations of the series, or of individual volumes in it, have been published in Amharic, Arabic, Bengali, Creole, Hindi, Igala, Indonesian, Kiswahili, Malagasy, SiSwati and Turkish, an indication of the success and usefulness of this series.

Requests for permission to issue this manual in other languages and to adapt it according to local climatic and ecological conditions are welcomed. They should be addressed to the Director, Publications Division, Food and Agriculture Organization of the United Nations, Via delle Terme di Caracalla, 00100 Rome, Italy.

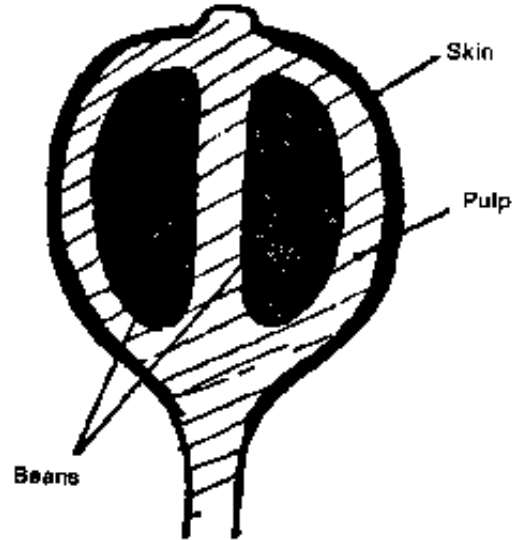
Coffee tree



Coffea tree



The coffee tree bears fruit which are called berries.



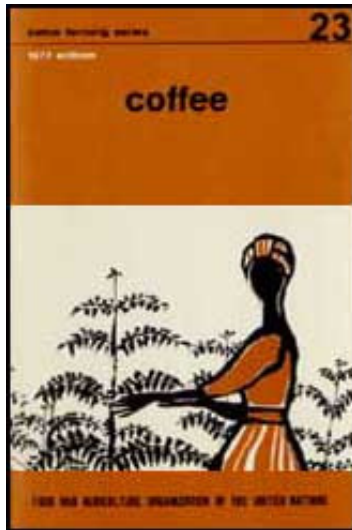
A coffee berry cut in two


The berries contain two seeds called coffee beans.



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 Better Farming Series 23 - Coffee (FAO - INADES, 1977, 36 p.)

➔ Where coffee is grown

 (*introduction...*)

 What varieties of coffee are grown in africa?

Better Farming Series 23 - Coffee (FAO - INADES, 1977, 36 p.)

Where coffee is grown

1. Coffee needs plenty of water, permanently moist air, a high temperature. Therefore, coffee is found in the moist, hot regions of Africa, South America and Asia. In Africa coffee is grown mainly in forest regions.

What varieties of coffee are grown in africa?

2. Liberica and Gros Indni

These are very large trees, 10 to 15 metres high. They are grown in the coastal regions of the Ivory Coast. They yield coffee of fairly good quality.

Excelsa

These are big coffee trees. They are grown in the Central African Empire and in the Ivory Coast. They yield coffee of

fairly good quality.

Arabica

These are small coffee trees. In Africa they are grown only in mountain areas, for example, at Man, in Ivory Coast, at Dshang, Foumbot, in Cameroon. They yield coffee of fairly good quality.

Kouilou and Petit Indni

These are small coffee trees. They are grown in the inland regions of the Ivory Coast.








Robusta

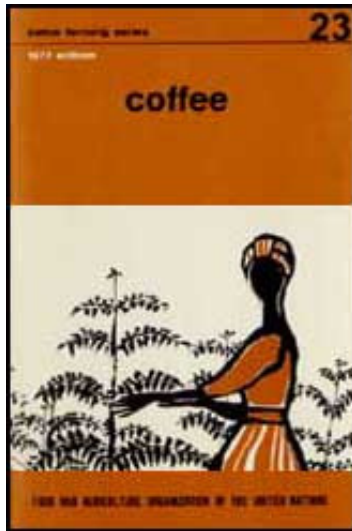
These are also small coffee trees.

They are grown in many regions of Africa, for they grow well. They yield coffee of fairly good quality.



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-  Better Farming Series 23 - Coffee (FAO - INADES, 1977, 36 p.)
-  *(introduction...)*
-  Preface
-  Where coffee is grown
-   Why coffee is grown
-  Choosing the seeds or seedlings



- ☐ Growing the seedlings
- ☐ Choosing a site and preparing the plantation
- ☐ Taking care of the plantation
- 📄 Harvesting the berries
- 📄 Processing the coffee beans
- 📄 Suggested question paper

Why coffee is grown

3. People grow coffee trees in order to sell coffee to foreign countries.

In certain countries of Europe people drink a lot of coffee, but the coffee tree does not grow in their own countries.

They buy coffee from Africa.

The countries of Africa earn a lot of money by selling their coffee.

With this money, they can build schools and dispensaries, they can make roads and modernize the country.

For several African countries (Ivory Coast, Uganda Cameroon), coffee is an Important export crop.

But there are many countries in the world which produce coffee.

Often there is too much coffee on the market and poor-quality coffee is difficult to sell.

Foreign countries buy

- good- quality coffee at a good price;
- they do not pay much for coffee of poor quality.

The grower must produce good coffee beans.

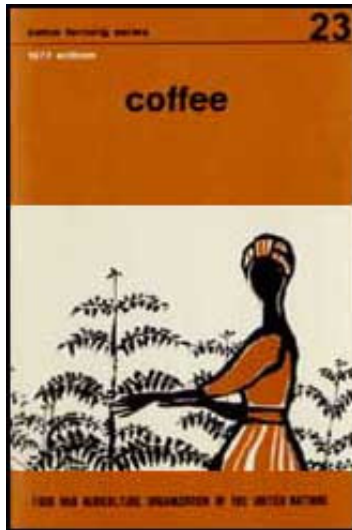
To produce coffee beans of good quality the grower must:


- choose his seeds and grow his seedlings carefully
- choose a good site for his plantation and prepare It well
- tend his plantation well and prune his coffee trees
- harvest the berries and prepare the beans properly.






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 Better Farming Series 23 - Coffee (FAO - INADES, 1977, 36 p.)

- ➔ Choosing the seeds or seedlings
 -  *(introduction...)*
 -  Choosing good seeds
 -  Sowing the seeds in seed beds

Better Farming Series 23 - Coffee (FAO - INADES, 1977, 36 p.)

Choosing the seeds or seedlings

Because the International Coffee Agreement does not allow producing countries to add to their coffee plantations, the grower cannot make new plantations.

But he can replant his old plantations which do not produce much.

4. The grower can ask the local advisory service for help in buying:

- either selected seeds of good quality which he first sows in a seed bed, then transplants into a nursery bed, and finally plants in the plantation;
- or seedlings of good quality, which have been grown in a seed bed and a nursery bed, and which the grower plants directly in his plantation.

5. Some growers have no advisory service nearby. They can nevertheless make good coffee plantations by

- choosing their own seeds,
- sowing their seeds in seed beds,
- transplanting the young seedlings into nursery beds, and later planting out the seedlings in the plantation.

B. Seed bed is the name for the place where the seeds are sown to make them germinate.

Seedling is the name for the young plants that have grown in the seed bed.

Nursery bed is the name for the place to which seedlings are transplanted.

Choosing good seeds

If the grower wants to have fine coffee trees which produce a lot of big berries, he must choose carefully the seeds he is going to sow

When choosing seeds you should:

7. Take the berries from the finest trees which bear the biggest fruit.

The good quality of the tree and of the seed enters into the new plant, which will also yield many fine berries.

B. Choose berries that are quite ripe.

If the berry is not quite ripe, the seed is not ready.

It cannot germinate well, and it may rot.

Take the pulp out of the berry and dry the beans in the shade.

If the beans are put in the sun, they dry too quickly and the germ may die.

Never keep the seeds more than two weeks. If they are kept longer, the germ dies and the plant will not grow.

Sowing the seeds in seed beds

9. Preparing the seed plot

Choose a small plot, quite flat, with light and rich soil. It is best to prepare a plot which is near a small stream, because watering will be easier.

Till the soil fairly deeply, to more than 30 centimetres. Break all the lumps of earth so that you get a fine filth.

Put in some old, well- decomposed manure, to make the soil contain more humus.

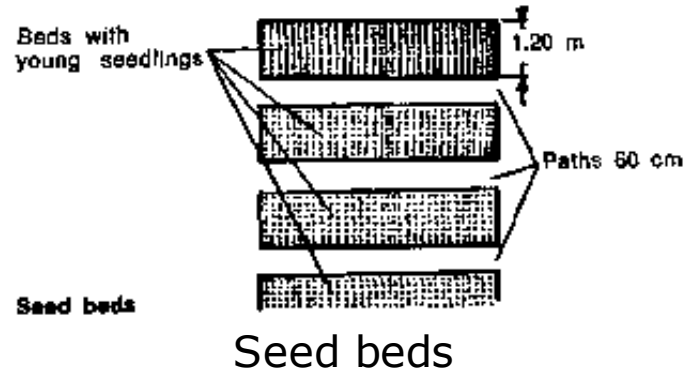
10. Sowing

Make beds of soil 1.2 metres wide.

Leave a little path of 60 centimetres between one bed and the next, so that you can walk between the beds.

Take a piece of string and mark out little furrows in each bed.

Leave 8 centimetres between one furrow and the next. Sow your seeds in each furrow, leaving 4 centimetres between one seed and the next.

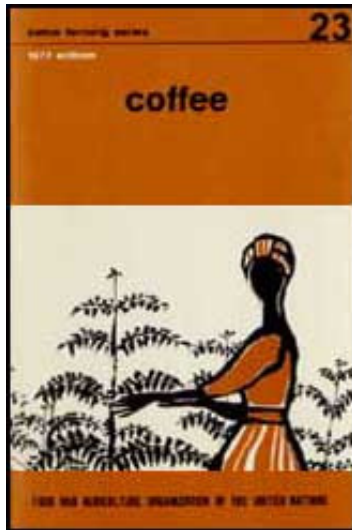



Do not push the seed in too deeply, otherwise it will not have enough air. Put the beans in flat, with the groove downward.







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 Better Farming Series 23 - Coffee
(FAO - INADES, 1977, 36 p.)

- ➔  Growing the seedlings
 -  (*introduction...*)
 -  Lifting the young seedlings from the seed beds
 -  Transplanting the seedlings into a nursery

Better Farming Series 23 - Coffee (FAO - INADES, 1977, 36 p.)

Growing the seedlings

11. Tendins' the seed plot

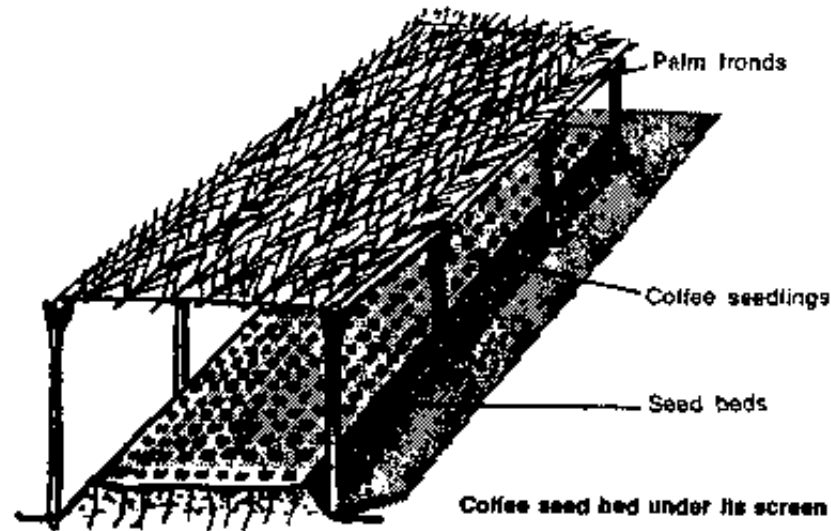
The little coffee seedlings are very delicate. You must protect them from the sun. You must put them in the shade.

In order to protect the seed plot from the sun, put up a screen above each bed, 1.5 to 1.8 metres high. You can make the screen of palm fronds.

The seeds need a lot of water.
Water them often.

Hoe between the rows, so that weeds cannot grow and take nourishment away from the young seedlings. Look for Insects and kill them, so that they cannot ruin your young seedlings.

Pull out diseased seedlings and bum them.



Coffee seed had under its screen

Lifting the young seedlings from the seed beds

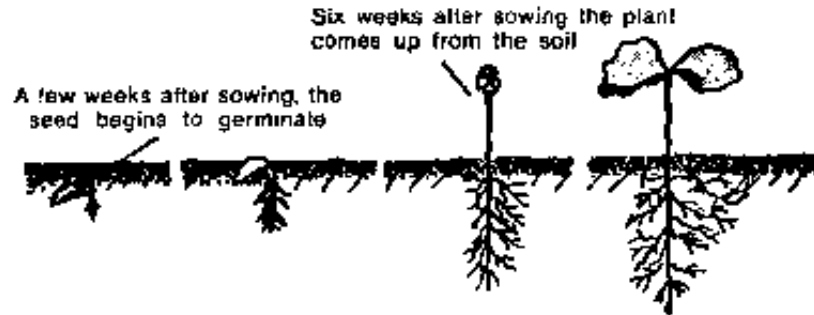
12. Six weeks after sowing, the little plant comes up from the soil.

When the seedlings are three months old, the first two leaves

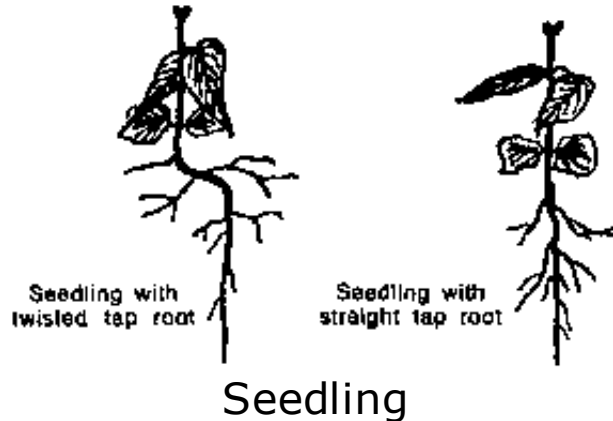
are well developed.

This is the moment to take the seedlings out of the seed beds and to transplant them into a nursery.

In removing the seedlings from the seed beds, be very careful not to break the roots.



Six weeks after sowing, the little plant comes up from the soil



Sort out the young seedlings

- Throw away diseased seedlings and seedlings with a twisted tap root;
- Use only the finest seedlings, those with a tap root that is quite straight.

Transplanting the seedlings into a nursery

13. Preparing the nursery plot

Choose a bigger, flat and fertile plot next to the seed plot. Till the soil deeply, to 40 centimetres. Break all the lumps of earth. Put in a lot of manure.

14. Transplanting the seedlings

Make beds of soil 1.2 metres wide, with 60- centimetre paths in between.

Mark out furrows, leaving 30 centimetres between one furrow and the next.

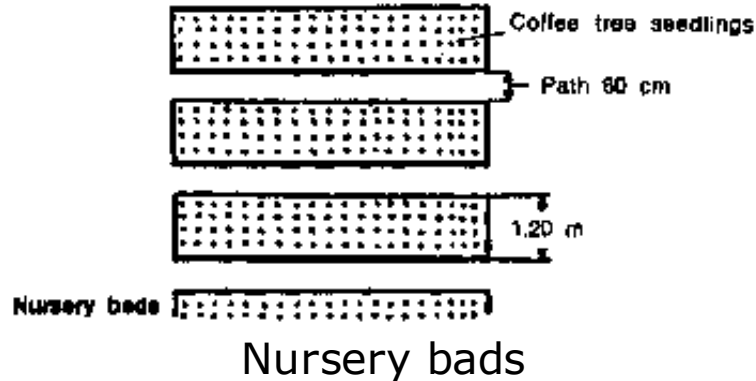
Dig holes, leaving 30 centimetres between one hole and the next.

The holes should be 15 centimetres deep.

Plant the seedlings in the holes, pack the soil down well around the root. Be very careful not to twist the tap root, and

do not bury the crown.

15. Looking after the nursery



In order to protect the nursery from the sun, put up a screen of palm fronds above each bed.

But when the little plants grow bigger, give them less shade, so that the coffee trees get used to the sun. Young coffee trees need a lot of water.

Water them often.

If any seedlings die, replace them.

Protect the coffee seedlings from diseases and insects.

Pull out diseased seedlings.

Apply treatment for diseases. Kill insects with DDT.

16. Seedlings can stay In the nursery

4 to 5 months if you want to plant them during the next rainy season,

12 months or more if you want to plant them only next year.

When you remove the coffee tree seedlings from the nursery bed in order to plant them in the plantation, be very careful not to break the roots.

Sort out the seedlings: throw away diseased seedlings and seedlings with a twisted tap root.



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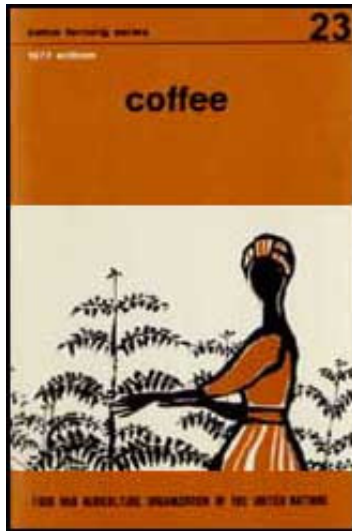
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(FAO - INADES, 1977, 36 p.)








☐ Choosing a site and preparing the
plantation



Choosing the site



-  Clearing the site
-  Tracing rows and digging holes for planting
-  Covering the bare soil
-  Sheltering the young coffee trees
-  Planting coffee trees in the plantation

Better Farming Series 23 - Coffee (FAO - INADES, 1977, 36 p.)

Choosing a site and preparing the plantation

Choosing the site

17. If a coffee tree is to grow well, it needs more than anything else a soil of good structure, permeable and deep.

The coffee tree has tap roots.

The tap root goes straight down into the soil.

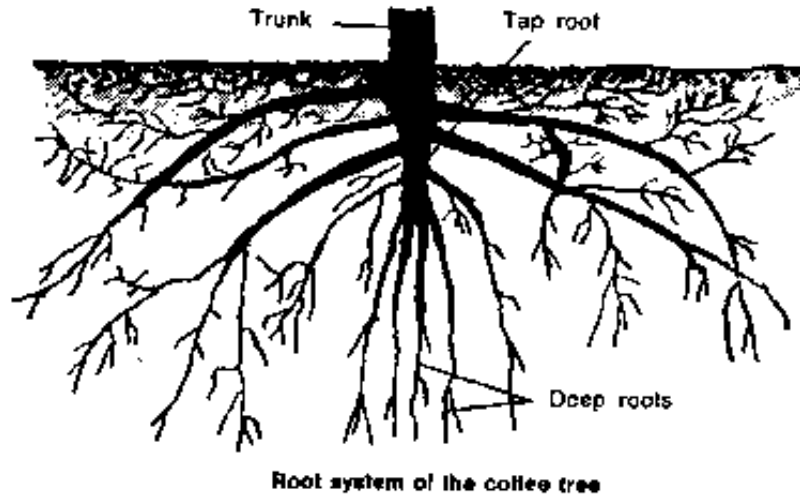
The branch roots go down very deep.

The soil must have a good structure so that the roots can penetrate well.

You can improve the soil structure by spreading manure around the base of the coffee trees.

The soil must be deep, so that the roots can go down deep.

Never plant coffee trees in soil which has a hard layer or, if you do, break up the hard layer.



Root system of the coffee tree .

Clearing the site

18. With the traditional method coffee is often grown in the forest region. Before making a plantation, growers cut down and pull out the trees, and burn everything.

This Is a bad method.

In this way the soil is left bare, without protection against sun and rain.

The humus is destroyed and the soil becomes less fertile. The coffee trees do not grow well and do not yield many berries.

19. It is better not to remove all the trees.

Cut first the tall weeds and the smaller trees. Then at once cover the soil either with the vegetation you have cut, or by sowing a cover crop.

Trace rows, put in pegs as markers and dig holes. Remove the large, useless trees, but leave trees which cast shade and can therefore protect the young coffee trees against the sun.

Tracing rows and digging holes for planting

20. With traditional methods, the trees are most often planted

In a haphazard way

The coffee trees are not planted in rows.
There is not the same distance between them.

When they are too far apart, they do not use all the soil.
When they are too close, they grow badly.

You should plant In rows.

First trace the rows for the coffee trees, leaving 3 metres between rows.

Along each row, mark out with pegs the spot where the coffee trees are to go.

Leave 3 metres between trees.

In this way you can plant about 1000 coffee trees per hectare.

21. Diggings the holes

Before planting the coffee seedlings you must dig holes in order to stir the soil and loosen it.

Dig the holes two months before planting the coffee trees.

The holes should be about 50 centimetres long, 50 centimetres wide and 50 centimetres deep.

When you are digging a hole, do not put together the soil from above and the soil from below: make two separate heaps.

Covering the bare soil

You have now cut down the weeds and the smaller trees, and you have traced the rows where you will plant the coffee trees.

22. But the soil is bare If you leave the soil bare, the rain will spoil the soil and destroy its good structure.

Water washes away the mineral salts, and the sun very quickly decomposes humus.

The soil becomes poorer and does not feed the coffee trees well enough.

So the coffee trees will not yield many berries.

23. You must cover the soil to protect It against erosion

You can cover the soil

- either by mulching

You can leave on the ground the vegetation you have cut, or you can put down palm fronds.

In this way the soil is protected against sun and rain.

The rotting leaves give the soil organic matter.

- or by a cover crop

Between the rows of coffee trees, you can sow legumes.

They also protect the soil.

Legumes give nitrogen to the soil.

Sheltering the young coffee trees

You have not removed all the other trees; you have left some large ones to protect the soil against sun and rain.

When you have covered the soil either by a mulch or a cover crop, you can cut down the remaining large trees.

24. But the coffee tree Is a delicate plant

Young coffee trees do not like too much sun.

Young coffee trees need to grow in the shade.

Often, a few large trees are left on the plantation.

Trees with long branches and many leaves provide shade for the young coffee trees.

Sometimes all the trees are cut down and other trees are planted, which grow quickly and give enough shade.

In some regions there are many clouds, so that it is not always necessary to provide shade.

Then all the other trees can be cut down.

Dry winds are very bad for young coffee trees.

In regions where a dry desert wind blows, the plantation must

be sheltered by a line of trees.

Planting coffee trees in the plantation

25. After you have grown your coffee seedlings in seed beds and a nursery, you can plant the seedlings from the nursery in the plantation.

The day before you plant the seedlings In the plantation

- Remove a few leaves from each coffee seedling.
- The seedling will then lose less moisture.

A few hours before taking the seedlings out of the nursery

- Water the soil.
- Then lift the seedlings from the nursery beds with a spade or a hoe.
- Be very careful not to break the roots.

Next sort out the coffee seedlings.

Throw away diseased plants and plants that have a twisted tap root.

You can dip the roots of the seedlings into liquid mud, so that the coffee trees will take root again easily.

26. When to plant coffee trees

Plant your young coffee trees during the rainy season. Choose a day after it has rained a lot, and when the sky is cloudy.

Plant your young coffee trees when they are about six or seven months old, or when they are 15 to 18 months old.

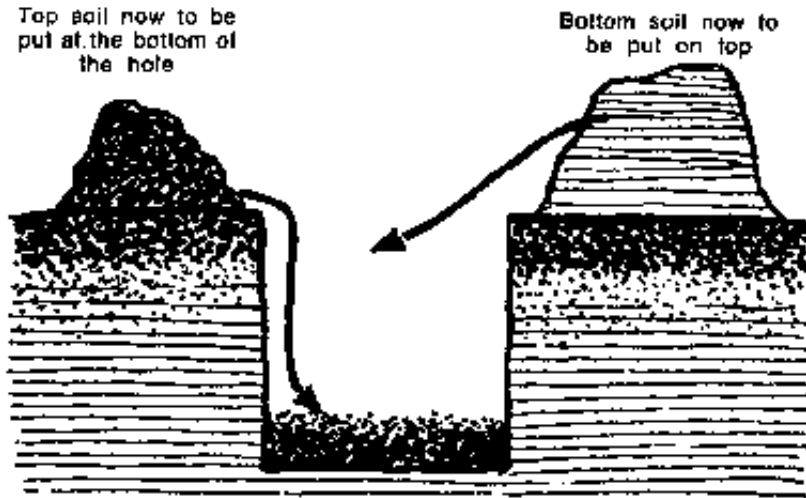
27. How to plant coffee trees

A few days before planting, fill in the holes you have dug.

At the bottom of the hole, put the soil you have dug out from the top, and on top put the soil you have dug out from below. You may mix the soil with manure.

When you are ready to plant, make a small hole with your hand or a machete. In this small hole place your young coffee tree. Be very careful not to twist the tap root.

Leave the crown above the ground surface. Pack the soil down well around the tap root. For the first few days, protect the young coffee tree from the sun with a palm frond.

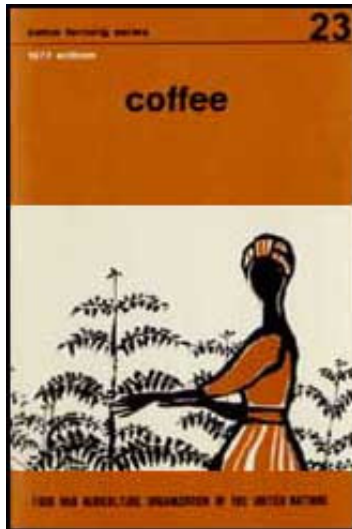


Leave the crown above the ground surface



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➔ Taking care of the plantation

 *(introduction...)*


 Replacing missing seedlings

 Upkeep of the soil cover and hoeing

 Pruning coffee trees

 Cutting back old trees

 Applying fertilizers

 Protecting trees from insects and diseases

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Taking care of the plantation

28. When the coffee trees are planted the work is not finished.

The grower still has a lot of work to do to look after his coffee trees.

A grower who does not look after his plantation properly cannot get a good harvest of berries and will not earn much money.

To look after your plantation properly, you must:

- replace seedlings that have not grown,
- keep the soil covered and remove weeds,
- prune the coffee trees correctly,

- apply fertilizers,
- protect the coffee trees from insects and diseases.

Replacing missing seedlings

29. Sometimes certain coffee seedlings do not grow well. They remain small or die.

During the months after planting, you must look often to see whether your coffee trees are growing well.

If you see diseased or dead coffee trees, pull them out and burn them.

In their place, plant other coffee seedlings from among those you have kept in the nursery.

Upkeep of the soil cover and hoeing

30. Between the rows of coffee trees the soil must always be covered either by palm fronds or cut weeds. or by a cover crop.

Palm fronds and cut weeds keep the soil moist and protect it against erosion.

If you have a cover crop, make sure it covers the whole of the soil.

But sometimes cover plants climb on the coffee trees. In that case, cut down those plants that wind around the trunk and branches of the coffee tree.

31. Weeds often grow among the coffee tree rows.

Do not let the weeds take the nourishment away.

Hoe often but, when hoeing, be very careful not to damage

the trunk and roots of the coffee trees.

Pruning coffee trees

Why coffee trees need pruning

32. The coffee tree grows too fast.

During the first few years, the tree makes many branches: it uses all its nourishment to make wood. At the first harvest, the tree yields a lot of berries.

But the coffee tree ages very quickly.

The coffee tree uses all the mineral salts of the soil in order to feed the wood of the branches.

It can no longer yield a lot of berries.

Therefore the coffee tree must be pruned so that It do not make too many branches.

The coffee tree does not develop well.

The branches of the coffee tree grow all over the place.
The coffee tree is not well- shaped and not strong.

Therefore the coffee tree must be pruned to give it a good shape.

The coffee tree grows too tall.

The coffee tree may grow to 10 or 15 metres.

It is then not easy for the grower to pick the berries.

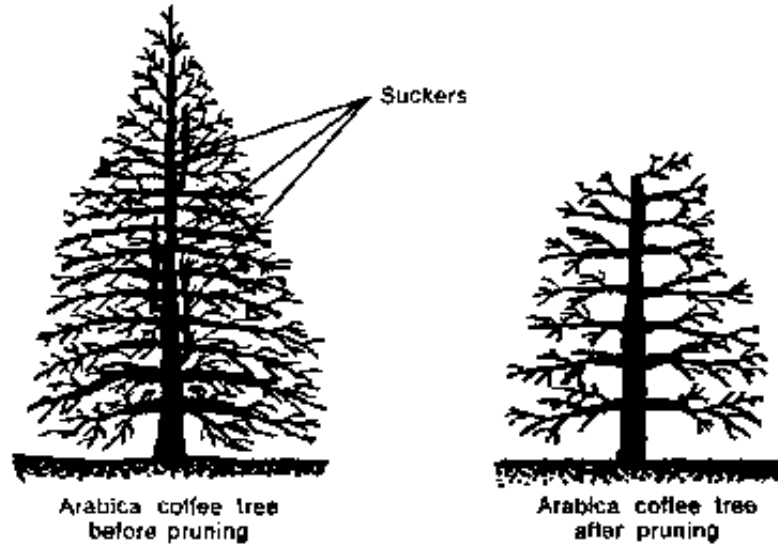
Therefore the coffee tree mud be pruned so that It is not too tall.

Every variety of coffee. tree needs different pruning.

33. Trees of Arabica, Liberica, Gros Indni and Excelsa coffee have only one main stem: one trunk only. The berries grow for several years on all parts of the branches.

Pruning these coffee trees Is simple:

- Cut off the top of the tree so that the coffee tree is not taller than 1.5 to 2 metres.
- Remove the branches at the bottom of the trunk.
- Leave only the thickest and best branches on the trunk.
- Cut away all the small branches that grow on the trunk.
- Cut away all the dead and dry branches, and all diseased branches.
- Cut away suckers; they are not needed.



Arabica coffee tree

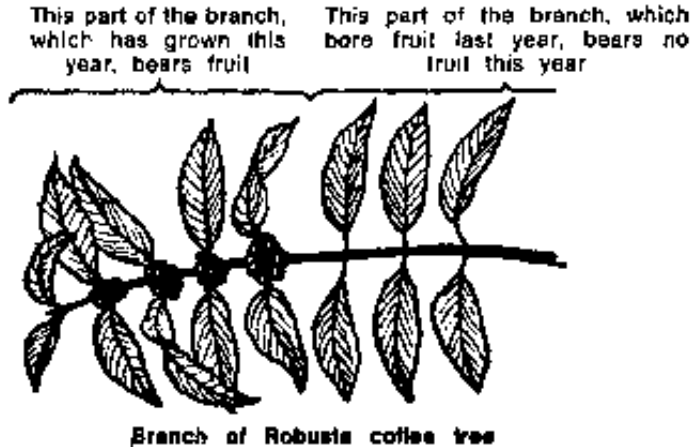




Kouliou coffee tree

Kouliou coffee tree

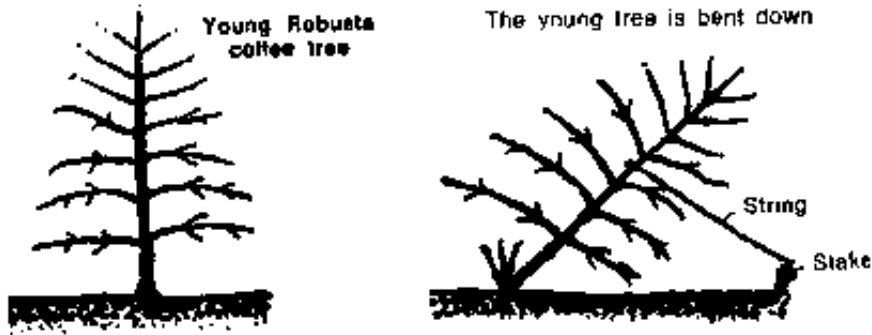
34. Trees of the Robusta, Kouilou and Petit Indni varieties have several main stems: several trunks.



Branch of Robusts coffee tree

The wood of a branch has berries only for one year. The next year, that part of the branch bears no fruit. The berries grow on the new wood which has grown during the year. A branch yields fruit for several years, but it is always a different part of the branch that bears fruit.

Pruning these coffee trees Is difficult:



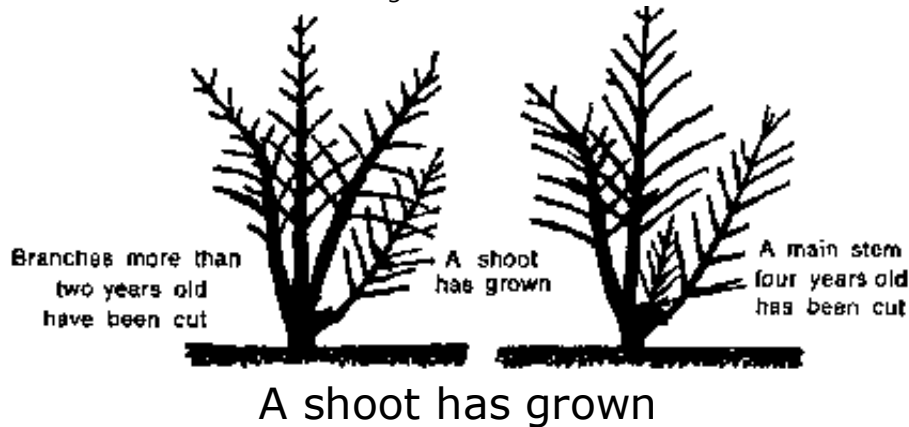
Young coffee tree



A new shoot grows out of it

- Bend down the first stem and tie it to a stake.

- Let three to five main stems develop: they will bear fruit.
- Cut off the bent stem: a new stem will grow in its place.
- On the main stems, branches will grow and bear fruit. After two years of harvests, fruit will grow only on the tips of the branches: cut down these branches.
- When a main stem has borne fruit for three to five years, cut it off. In the place of the stem you cut off, a new stem or shoot will grow and bear fruit.
- Every year cut off one of the main stems.

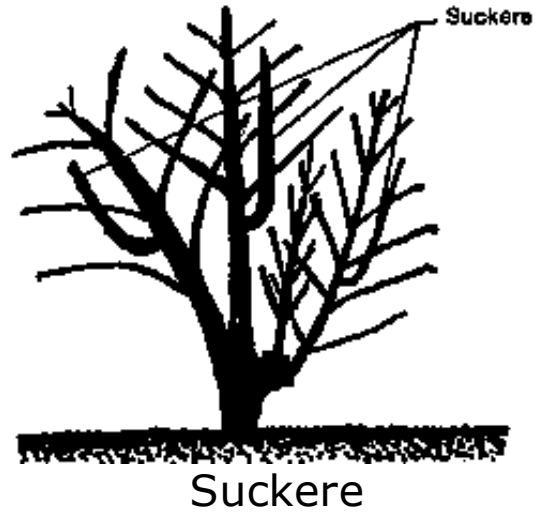


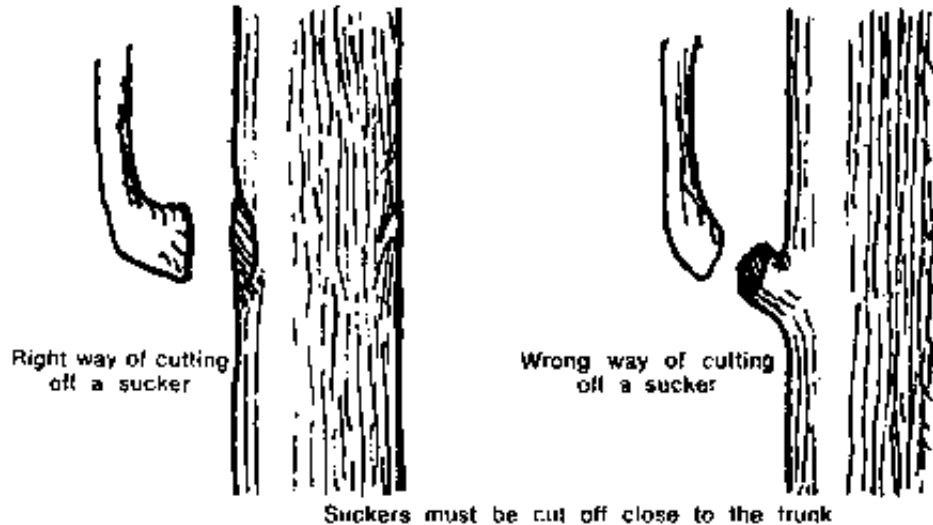
Cut away suckers.

A sucker is a twig that grows upward out of a main stem.

A sucker never bears fruit.

Cut away also all dry or dead branches.





Suckers must be cut off close to the trunk

Cutting back old trees

35. When coffee trees in a plantation get too old they no longer yield many berries and do not bring in much money.

To make your coffee trees young again, cut them back:

- Leave on the trunk only one main stem; cut off all the others.

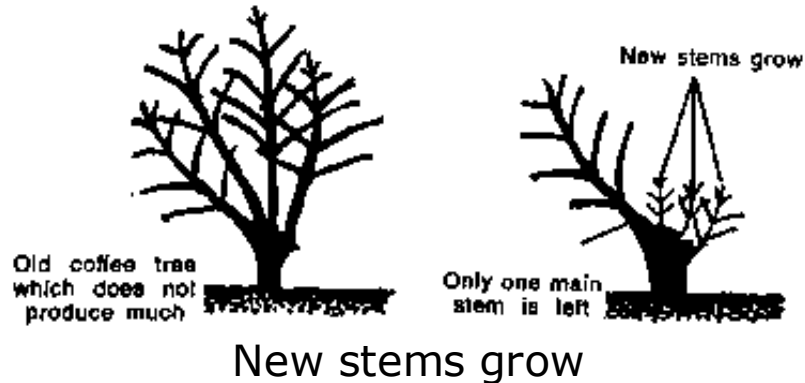
New stems will grow in the place of the stems you cut off.

- When the new stems have grown, cut off the old stem you have left on the trunk.

The tree becomes young again and bears a lot of berries.

Cutting back should be done at the beginning of the rainy season.

After cutting back, apply fertilizer.



Applying fertilizers

Fertilizers cost a lot of money.

Use fertilizers only when this will earn a lot of money.

36. It is useless to apply fertilizer in a plantation that is not well looked after.

If you do not prune your coffee trees, and you do not hoe, then you should not apply any fertilizer.

The fertilizer would do nothing except feed the wood of the branches and the weeds.

When you have pruned your coffee trees well, when you have hoed up the weeds, then apply fertilizer.

Coffee trees need a lot of potash, a lot of nitrogen, and a little phosphoric acid.

Spread the fertilizer in a ring around each coffee tree, but be very careful not to put any on its trunk, branches or leaves.

If you do, the fertilizer will burn the coffee tree.

Spread the fertilizer at a distance of about 1 metre from the trunk.

Apply fertilizer several times a year (except for dicalcium phosphate, only once a year).



Spread the fertilizer around the tree
at a distance of about 1 metre

Spread the fertilizer at a distance of about 1 metre

37. Different soils have different fertilizer needs. For example, in the Ivory Coast:

- On the more sandy soils, along the coast, apply to each coffee tree:

in March: 50 g ammonium sulfate

50 g dicalcium phosphate

40 g potassium sulfate

in July: 30 g ammonium sulfate

40 g potassium sulfate

in October: 30 g ammonium sulfate

40 g potassium sulfate

- On the more granitic soils of the interior, apply to each coffee tree:

in March: 30 g ammonium sulfate

50 g dicalcium phosphate

30 g potassium sulfate

in July: 20 g ammonium sulfate

40 g potassium sulfate

in October: 20 g ammonium sulfate

30 g potassium sulfate

Protecting trees from insects and diseases

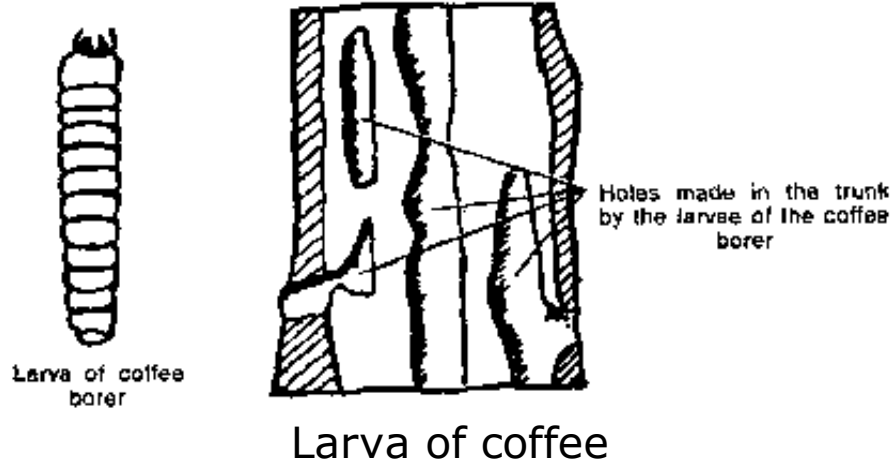
The most dangerous enemies of the coffee tree are:

38. Coffee stem borers

The larvae of these insects bore holes in the stems and so ruin the coffee trees. So you must:

Pull up and burn affected trees. Try to catch these insects and kill them.

You can control borers with Dieldrin.



39. Coffee berry borer

These insects lay their eggs in the coffee beans. The berries turn black. Remove the black berries and burn them. Pick up all the berries that have dropped to the ground and burn them.

You can control the coffee berry borer with endrin.

Hole made in a berry by a coffee berry borer



Coffee berry borer



Eggs laid by coffee berry borer

Hole made in a berry by a coffee berry borer

40. Tracheomycosis

This is the most dangerous disease of the coffee tree.

It has caused great damage to the coffee plantations of the Ivory Coast.

It comes from a fungus which attacks the stems and branches. The trees dry out and die.

To control this disease, pull up the diseased trees and burn them.

There are many other diseases, for instance:

Coffee leaf disease The leaves, branches and fruit become dry. Cut off the diseased parts and burn them.

Berry rot The berries become brown, then dry. Pick them and burn them.

There are also many other Insects:

Green scale on the branches

Thrips

Leaf caterpillars

Always burn diseased trees, diseased branches, diseased berries.

Look for Insects and kill them.



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(introduction...)

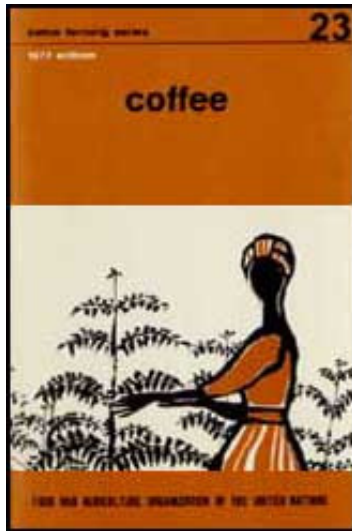


Preface



Where coffee is grown





- Why coffee is grown
- Choosing the seeds or seedlings
- Growing the seedlings
- Choosing a site and preparing the plantation
- Taking care of the plantation
- ➔ Harvesting the berries
- Processing the coffee beans
- Suggested question paper

Harvesting the berries

41. Good coffee beans can be sold at a good price.
Bad coffee beans cannot be sold at a good price.

If you want to earn a lot of money, you must sell good coffee beans.

To get good coffee beans, you must harvest the berries properly.

- Do not pick all the berries at the same time.
- Pick only berries that are quite ripe: those which are red.
- Leave on the tree any berries that are not ripe, that are still a little green.
- Pick the remaining berries when they are ripe.
- You should harvest three or four times a year.

When harvesting, sort out the good berries and the bad berries.

Burn dry berries, black berries, berries that have dropped to the ground, for they contain parasites which cause diseases.

In Africa yields are low: 100 to 500 kilogrammes of berries per

hectare.

In South America yields are sometimes more than 1000 kilogrammes per hectare.

