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1977 edition

roots and tubers



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Roots and tubers

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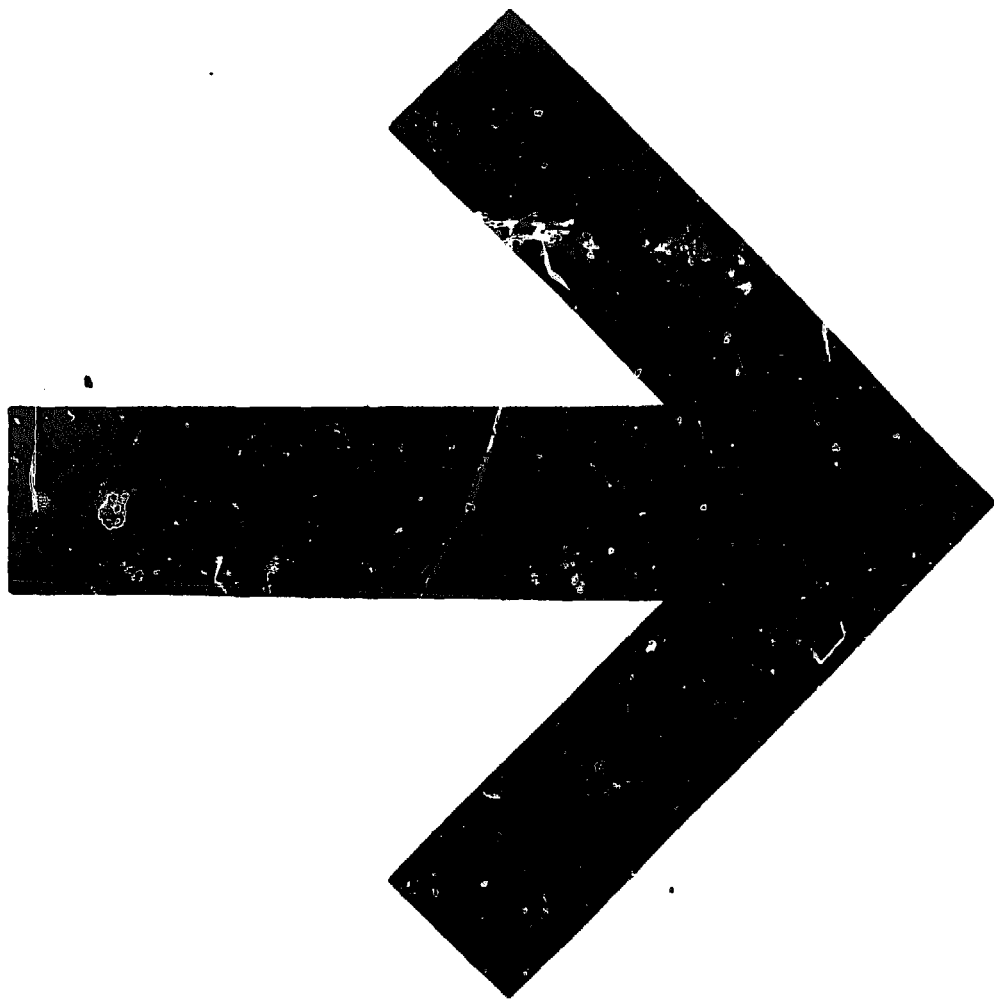
PREFACE

This manual is a translation and adaptation of "Les racines et les tubercules", published by the Agri-Service-Afrique of the Institut africain pour le développement économique et social (INADES), and forms part of a series of 26 booklets. Grateful acknowledgement is made to the publishers for making available this text, which it is hoped will find widespread use at the intermediate level of agricultural education and training in English-speaking countries.

The original texts were prepared for an African environment and this is naturally reflected in the English version. However, it is expected that many of the manuals of the series — a list of which will be found on the inside front cover — will also be of value for training in many other parts of the world. Adaptations can be made to the text where necessary owing to different climatic and ecological conditions.

Applications for permission to issue this manual in other languages are welcomed. Such applications should be addressed to: Director, Publications Division, Food and Agriculture Organization of the United Nations, Via delle Terme di Caracalla, 00100 Rome, Italy.

The author of this English version is Mr. A.J. Henderson, former Chief of the FAO Editorial Branch.



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ROOTS AND TUBERS

Many plants are grown chiefly
for their roots or underground stems.
These plants are generally known as
roots and tubers.

Roots and tubers are among the food crops,
that is, they are grown mainly for human food.

The food crops grown in Africa include:

- plantains;
- legumes such as beans, cow peas,
Bambarra groundnuts, groundnuts, soybeans;
- cereals such as sorghum, millet, maize, rice;
- roots and tubers.

Cereals are plants grown for their grain.

Three booklets have dealt with cereal crops:

- wet paddy or swamp rice,
- upland rice,
- other chief cereals of Africa,
such as sorghum, millet, maize, fonio.

In this booklet we shall deal only with
the main root and tuberous plants
which are grown as food crops in Africa,
that is, cassava, yams, sweet potatoes,
tania and taro (cocoyam).

The potato, which is also a tuber,
will be dealt with in another booklet.

CASSAVA

Description of the plant

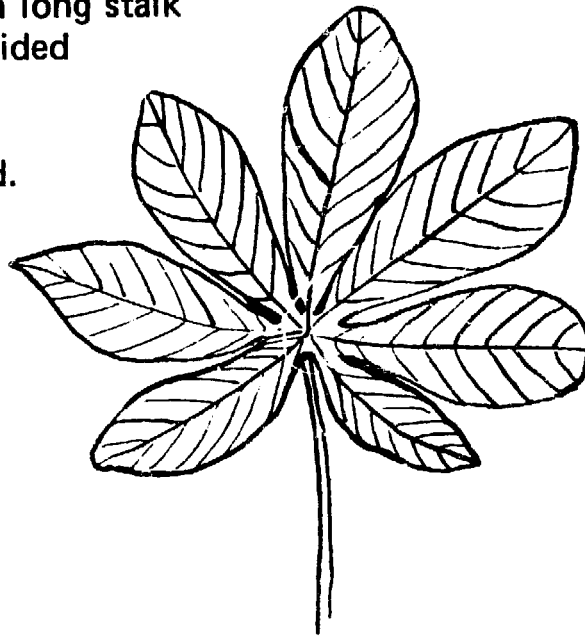
Cassava is a shrub
that is grown chiefly for its roots.

It has its origin in South America
and is now widely grown in tropical Africa.

At its base the plant consists of
one or more stems 2 to 3 centimetres in diameter;
usually each stem divides into three branches,
and each branch in turn divides into three, and so on.

When a stem is cut,
the sap that flows is white
and looks much like milk.
Inside the stem is pith.
The stem of cassava is not very hard;
it is easily broken by a strong wind.

Cassava leaves have a long stalk
and a much divided
leaf-blade.
The leaf veins
are green or red.



A yam leaf

The **flowers** are pink,
red, yellow or green.
There are both male and female flowers
in the same cluster.

The **fruit** is divided into three parts.
Each part contains a seed.
When the cassava fruit is ripe,
it opens.

The farmer **grows** cassava
chiefly for its **roots**.
Some of them become large and fat
by **storing up food reserves**.
Other thinner roots
continue to feed the plant.

Different kinds of cassava

**Cassava roots contain
a poison, prussic acid.**

Some contain a great deal of poison;
these are mainly the **bitter tubers**.
Others, the **sweet tubers**,
contain little poison.

**The poison can be removed
by thoroughly washing the root;
by drying it
or by cooking it thoroughly.**

Before giving cassava
to people or to animals,
it must always be well cooked.

Where is cassava grown?

● Climate

To grow well,
cassava needs a **warm, humid climate.**

If the rainy season is long,
cassava roots grow rapidly.

Cassava is also a plant
that will **resist drought.**

With less rain, the yield is small.

Cassava stems are not tough
and **dislike high winds.**

● Soil

Cassava is a very strong grower.
It will **grow even in very poor soil.**

But cassava grows best
in soil that is permeable,
not too compact,
in which air and water circulate well.
Then the roots fatten up and do not rot.

Cassava makes the soil poor.
Besides the fat roots that store up food,
many little roots take water
and mineral salts from the soil.

After a crop of cassava,
the field is very poor
and must be left fallow.

HOW TO GROW CASSAVA

The place of cassava in a crop rotation

Usually,
cassava follows several other crops.

For example,
first maize, okra, groundnuts are sown,
then plantains are planted,
and finally cassava.

In some places,
cassava is planted at the same time as yams,
or soon after.
The cassava cuttings are placed
in the sides of the mounds for yams.

In other places,
maize is grown between the cassava plants,
or beans, fonio or groundnuts.

It is better
not to grow several crops together.

Preparing the soil for cassava

To develop well,
cassava roots need soil that has been loosened
by the hoe or plough.
So till deeply, to 20 or 25 centimetres,
so that the roots can get well down.

After tilling,
at the beginning of the rainy season,
make mounds or ridges.
This breaks up the soil
and it stores up water;
the roots have plenty of loose earth
in which to develop.

**If fertilizers or manure are used,
work them into the soil
when it is tilled.**

**Yields are high
when the plant finds
plenty of nourishment in the soil.
Farmyard manure, compost and green manure
are the best fertilizers for cassava.**

**For green manure, sow leguminous cover plants
such as:
Crotalaria
Centrosema
Calopogonium
Phaseolus or beans.**

**Sow them a little before the rains,
and dig them in after 5 to 18 months of leafy growth.**

**You can also use
farmyard manure or compost.
These organic manures enrich the soil
with organic matter and mineral salts.**

**To complete the manuring,
you can apply mineral fertilizers
containing nitrogen, phosphorus and potassium. ¹**

¹The use of mineral fertilizers may be profitable if the farmer sells the cassava to *gari* or tapioca factories. Many experiments made in Ghana and Nigeria have shown that yields per hectare are increased chiefly by nitrogen fertilizers such as ammonium sulphate (21% nitrogen), urea (46% nitrogen) and phosphorus fertilizers such as single superphosphate (16 to 20% phosphoric acid), triple superphosphate (46% phosphoric acid) and ground natural phosphate (20 to 40% phosphoric acid). Potassium fertilizers such as potassium chloride (60% potassium) and potassium sulphate (50% potassium) have a less marked effect. However, the yield of cassava falls greatly when the soil lacks potassium fertilizers. If the farmer applies fertilizers and looks after his plantation well, the yield of cassava reaches 25 to 55 tons per hectare.

How to propagate cassava

**Cassava is propagated by cuttings,
by planting pieces of stem.**

The roots of cassava
are not used for making a new plantation,
and thus all the harvest can be eaten or sold.

**To make cuttings,
choose stems 2 to 4 centimetres thick,
from the strongest plants
which are not diseased
and which have already produced tubers.**

After the harvest,
tie the selected stems in bundles.
Wait at least 10 days before planting them.
Keep the bundles in a cool, dry place
until planting time.

**But remember
that the cuttings must not be made from the stems
until you are ready to plant.**

Cut each stem into pieces 20 to 30 centimetres long.
There should be 4 to 6 growth buds on each piece.
Each stem can be made into 4 or 5 cuttings.

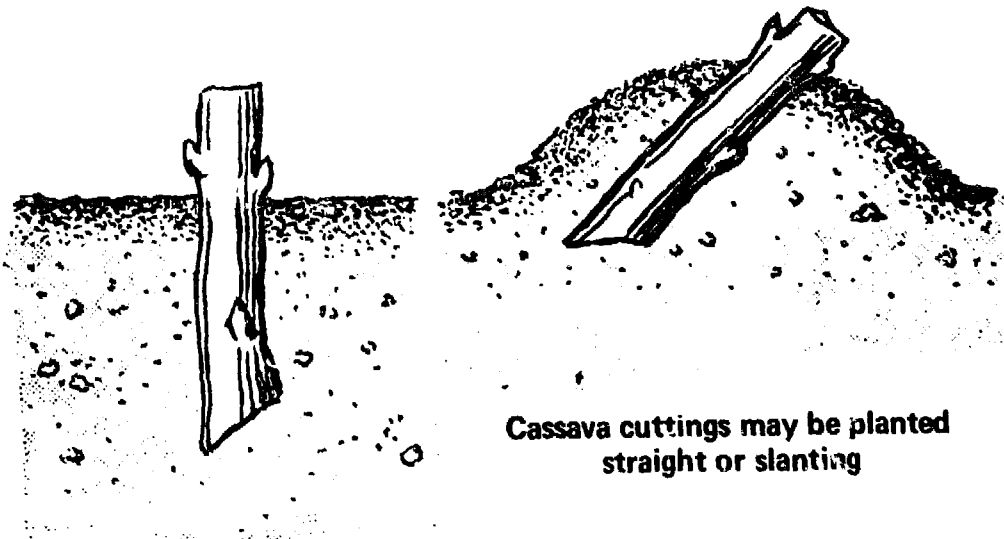
How to plant cassava

To plant cassava,
push into the soil the end of the piece of stem
that was nearer to the ground.

Plant the cuttings in mounds or ridges.

Plant when the soil is quite wet,
after the beginning of the rainy season.

Plant the cuttings either straight or slanting.
Push them well into the earth,
leaving only 2 or 3 buds above ground.



Cassava cuttings may be planted
straight or slanting

Press the earth well down round the cuttings.

Then the roots that develop
will be well nourished by the soil.

Usually the rows are 1 to 1.5 metres apart,
and the plants 1 metre apart.

With this spacing, there are between
7 000 and 10 000 cassava plants to the hectare.

But the number of cuttings to the hectare
varies with the region, soil and variety.

If cassava is planted at the right density,
the yield is heavy;
the roots occupy all the soil
and fewer weeds grow,
so that fewer cultivations are needed.

Looking after the plantation

CONTROL OF WEEDS

Weed when the cassava plants
are 20 to 25 centimetres high,
that is, 3 or 4 weeks after planting.

Weed a second time
1 or 2 months after the first.
Earth up the plants at the same time;
this greatly helps the formation of tubers,
and prevents the wind from blowing the plants down.

After this, the cassava plants are big enough
to prevent weeds from growing.

When rain spoils the mounds,
they must be remade.

When the soil of the mounds gets too hard,
break it up with a hoe,
so that water and air can get in
to nourish the roots.

CONTROL OF DISEASES

- **Mosaic**

Cassava is often attacked
by what is called **mosaic disease**.

Leaves of plants attacked by mosaic
look as though crumpled,
and show light spots.
If the attack is serious,
yields are sharply reduced.

**Means of controlling mosaic disease
are not yet known.**

**To avoid it,
do not take cuttings
from plants attacked by the disease.**

**Choose varieties of cassava
that have been bred for resistance to the disease.**

**To prevent mosaic spreading in a region,
burn all the plants attacked by the disease.**

● **Rot**

**Rot damages the roots,
especially after 10 months of leafy growth.**

**Rot often occurs
when the cassava field has been flooded
for several days.**

**The tubers turn soft
and give off an unpleasant smell;
they are no longer any good
for human or animal food.
This means a big loss to the farmer.**

**To avoid rot,
do not plant cassava
in a place that is often flooded.**

**If a cassava field is flooded after heavy rain
when the tubers are already ripe,
you must get the cassava out of the ground
very quickly, before it starts to rot.**

CONTROL OF PESTS

- **Rodents**

Agoutis, rats and rabbits
are the chief rodents
that may cause great damage
in a field of cassava.

These animals eat the stems,
the young shoots,
and especially the roots.

- **Wild boars, pigs and other animals**

Other animals
such as the wild boar and the pig
are equally damaging to cassava.

They are very fond of it,
and with their powerful snouts they push over the plants
and dig up large quantities of roots.

Control all these animals
by putting poison in the fields,
by laying traps,
or by digging deep ditches round the cassava plantations.

- **Insects**

- **In very dry regions,**
when cassava is planted a long time before the rains,
termites eat the cuttings.

To avoid this damage,
wait for the rainy season before planting.

Or you can dip the cuttings in insecticide
just before planting them.

- **Thrips** and certain other insects feed on sap by piercing the stems and leaves of cassava. Other insects eat the leaves and the young shoots. When they come in large numbers they may cause great damage. They are controlled with insecticides such as BHC.

- **Red spiders** are tiny red creatures no longer than 0.5 millimetre.

Large numbers of them live on the lower surface of cassava leaves.

The same red spiders attack castor oil, cotton and rubber plants.

They feed on the sap of the plant by piercing the leaves.

The leaves attacked get brown spots on the underside.

The plants attacked do not grow well, and do not yield much cassava.

To control red spiders, the plants may be **sprayed** with soapy water and nicotine, with rotenone, white oil, etc.

When diseases, animals and insects cause serious damage, you should **quickly inform the agricultural extension officer.** He will tell you what to do to control diseases effectively or to get rid of pests.

How to harvest and store cassava

HARVESTING

Depending on the variety,
harvesting of cassava for food may begin
from the seventh month after planting the cuttings
for early varieties,
or after the tenth month
for late varieties.

Before this,
the tubers are too small.
In addition, they still contain
too much prussic acid.

At harvesting time,
that is, between the sixth and the twelfth month,
each fully grown tuber of cassava
may weigh 1 or 2 kilogrammes,
depending on the variety.

In small family plantations
you can harvest the tubers as you need them.
Without cutting the stems,
begin by taking the biggest tubers from each plant,
leaving the smaller ones time to fatten up.

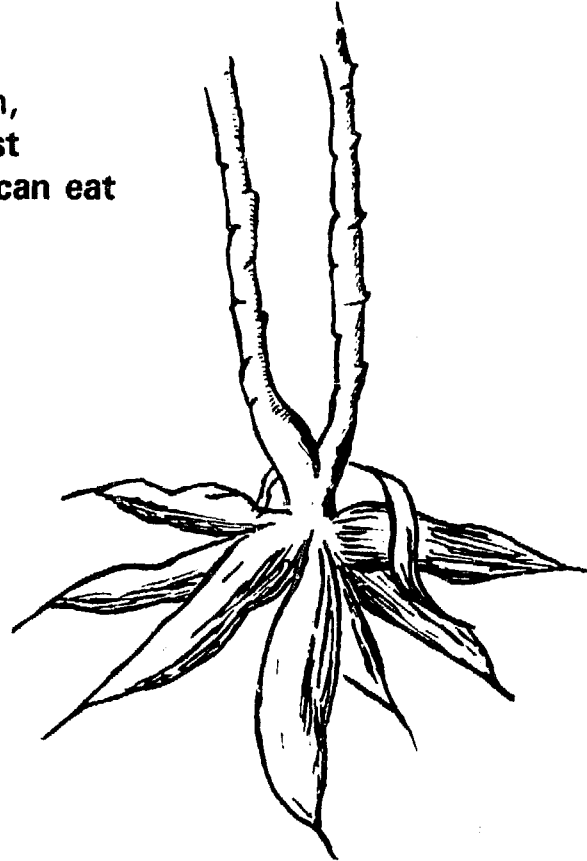
If you are selling to a factory,
you must harvest all the cassava at the same time.
The production of roots and starch is highest
18 to 20 months after planting.

STORING

Once lifted,
cassava cannot be kept for long.
The roots begin to spoil
as soon as they are out of the ground.

That is why
on a family plantation,
you should not harvest
more roots than you can eat
while they are fresh,
or sell immediately.

Cassava keeps longer
when it is left
in the ground,
but the soil
must not be too wet.



A cassava root

When you lift the cassava,
take good care not to break it.
Tubers damaged in lifting
go bad even more quickly.

THE USE OF CASSAVA IN FOOD

Many peoples of tropical Africa
make cassava their staple food.

Cassava tubers can be eaten whole.

But as a rule they are turned into **flour or paste**.

The reasons for this are:

- to get rid of the poison;
- to keep the cassava for a long time;
- to get foods with a more pleasant taste.

- **Fresh cassava and cassava paste**

For eating fresh,

the sweet varieties are chosen for preference.

The poison in cassava is mainly in the peel.

Wash the cassava carefully,

cut the roots into pieces and steam them.

To make a paste,

pound pieces of tuber in a mortar.

The pastes are known as *foutou*, *foufou*,
foufouin or *tchokoro*.

- **Dried cassava and cassava flour**

The fresh roots are peeled, sliced into rounds,
and dried in the sun.

Sometimes, instead of being sliced,

cassava is **grated**

and then pressed into **little balls** which are dried.

The balls and the slices can be kept for a long time.

To make flour,
the slices or balls are pounded in a mortar,
or ground in a mill.

This flour contains all the food elements of cassava.
Do not confuse flour with starch.

- **Cooked cassava flours**

Gari and *atchékè* are much liked in Africa.

To make *gari*,
peel and grate fresh cassava.
Then press it in baskets or sacks
for three or four days,
until it begins to ferment.
After rubbing it through a sieve,
heat it, dry, in a pot,
stirring all the time to prevent sticking.
Afterwards, remove impurities with a sieve.

To make *atchékè*,
cassava is prepared as for *gari*.
But the flour is steamed
instead of being cooked dry in a pot.

- **Starch and tapioca**

- **Starch**

After peeling, washing and grating the cassava,
the pulp is mixed with water.
Then the resulting liquid
is strained through a cloth.
This is done several times.

**The water that passes through the cloth
contains the starch.**
The liquid is allowed to stand for several hours.
The water at the top is removed
and the starch is left at the bottom of the vessel.

- **Tapioca**

The damp starch is used to make tapioca.

As in making *gari*,
the starch is heated in pots
and stirred all the time.

After cooking, it is allowed to get cold,
and then the tapioca is sieved
to separate the lumps of different sizes.

- **Cassava leaves**

In some places cassava leaves are much liked.

In southern Cameroon
cassava leaves are often eaten as a vegetable.
They are in fact rich in **vitamin C**
and mineral salts,
and contain some protein.

YAMS

Description of the plant

Yam is the name given to many plants with tubers belonging to the family of Dioscoreaceae.

Yams, or *Dioscorea*, are herbaceous plants.

Their **stem** consists of two parts:

an aerial stem

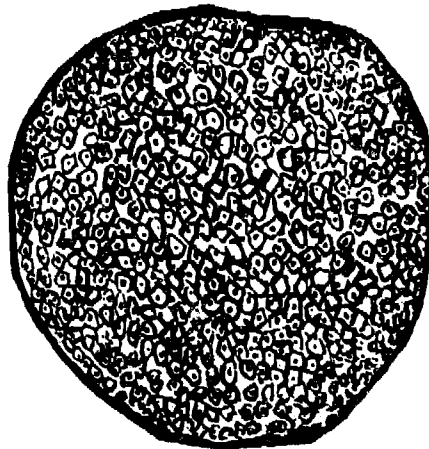
which climbs by winding round a stake
and lasts only a year;

and an underground stem

that can live a long time.

The **underground stem**

thickens to produce one or more tubers
called **yams**.



Cross section of a yam

The tubers contain reserves

to feed the plant

and enable it to produce fruits and seeds.

But the tubers are lifted before the plant makes seeds.

When they are ripe,

the tubers are brown in colour on the outside,
but the flesh is white, yellow or red.

Their weight varies between 2 and 5 kilogrammes.

In rich, well-worked, deep soil and on mounds,

yams can reach weights of 15 to 20 kilogrammes
and more.

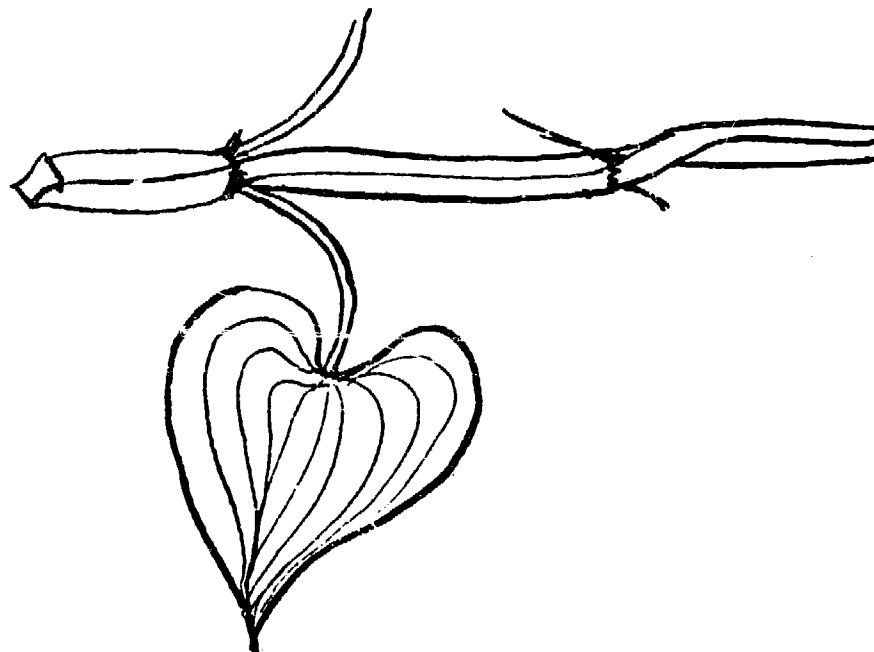
The aerial stem may be smooth,
may bear thorns,
or may be covered with little hairs.

Depending on the variety,
the aerial stem of a yam
may be round in section, or square.

The leaves are alternate or opposite,
smooth or hairy.

They are usually heart-shaped.

In certain species small tubers called **bulbils**
are found in the axils of the leaves.



Piece of yam stem

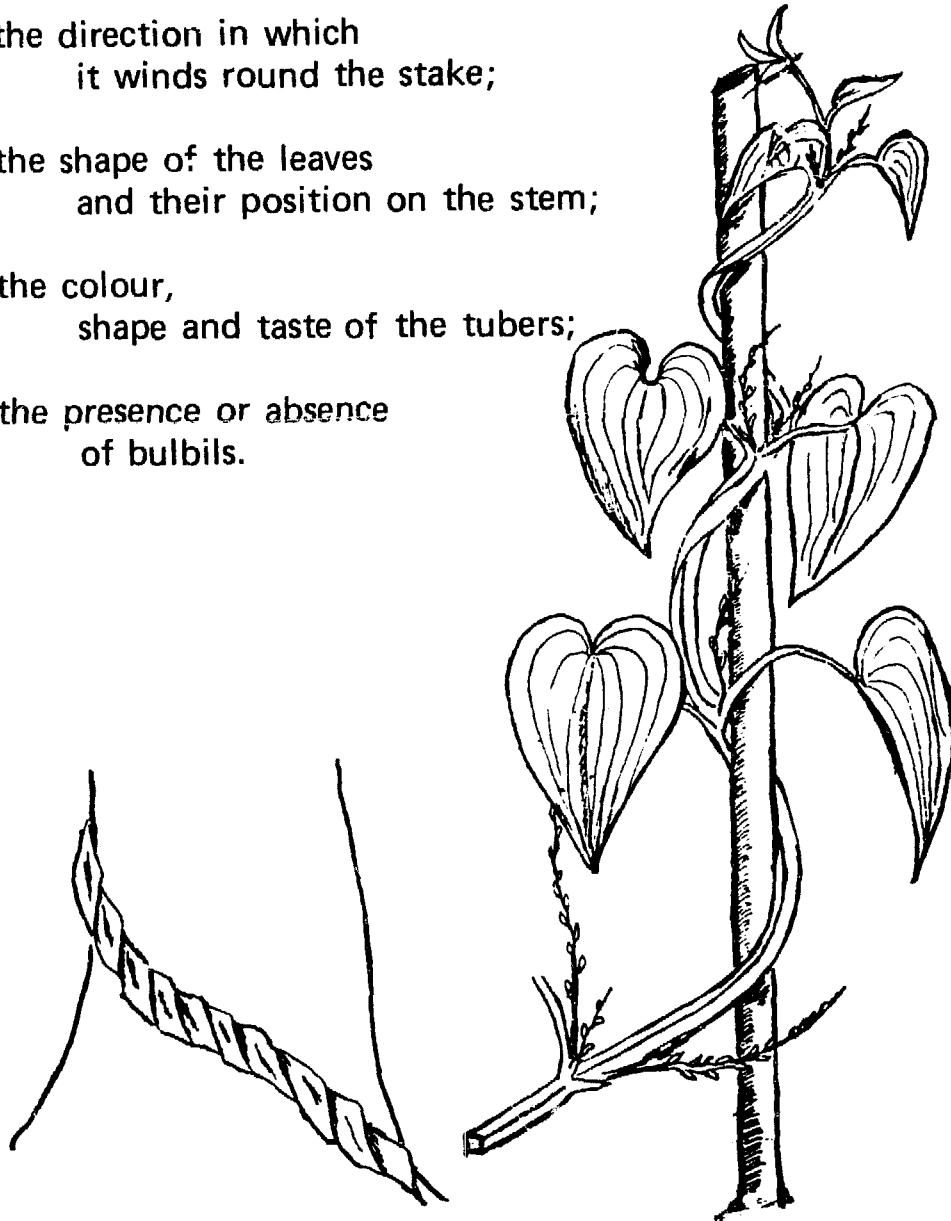
The flowers, white, green or red,
are arranged in clusters or in spikes;
the male flowers are separate from the female flowers.
Some varieties of yam
bear male and female flowers at the same time;
others bear only male or only female flowers.

The fruits are divided in three parts
and each part contains two seeds.

There are many varieties of yam

To recognize them we look at:

- the section and appearance of the aerial stem;
- the direction in which it winds round the stake;
- the shape of the leaves and their position on the stem;
- the colour, shape and taste of the tubers;
- the presence or absence of bulbils.



Yam stem winding round a stake

Yams may be classified in six groups:

- *Dioscorea alata*

The stems wind in a counterclockwise direction.

They are smooth and thornless.

They are four-sided.

The leaves are simple and opposite.

The aerial stems and the leaf-stalks are winged.

Each plant of *Dioscorea alata*

often produces only one tuber,
more rarely two tubers.

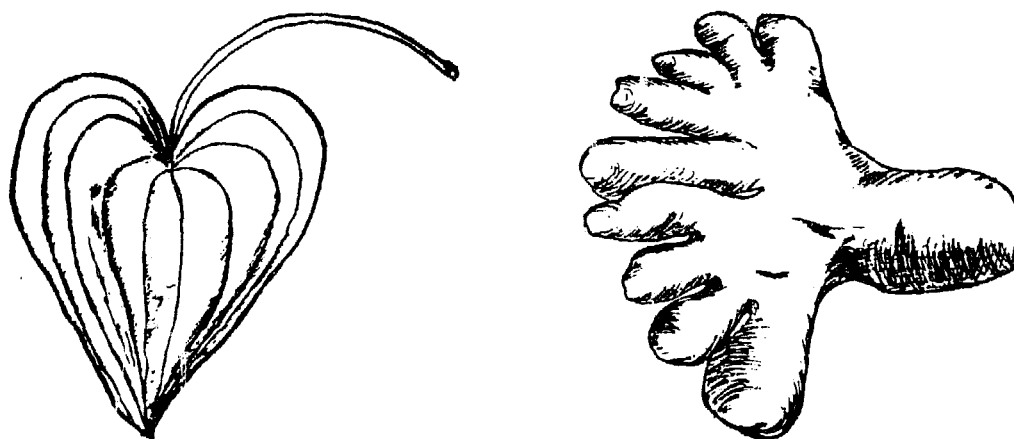
The tubers are covered with rootlets.

This variety is quite robust,
and gives a big yield.

The tubers stand transport well
and keep well.

This is a late or medium early variety of yam.

The growing period is 8 or 9 months.



Leaf and tuber of
Dioscorea alata

This variety is generally called the water yam.

Other names are:

Ivory Coast: *bètè-bètè* and *nza*
Guinea: *gbra-gué* (Malinké)
or *khabi-gboueli* (Soussou)
Benin: *sakarou* (Bariba)
Mali and Senegal: *danda-ba* (Bambara)

● *Dioscorea cayenensis* (Guinea yam)

There are great differences
among the varieties of *Dioscorea cayenensis*.

Some are early varieties harvested only once;
they are usually planted

when the rainy season has already begun.

In west Africa these varieties are harvested
between November and January.

In Ivory Coast they are called *lokpa*.

**Other varieties, late or medium early,
are harvested twice.**

These yams are planted early,
often before the rainy season has begun.

The first harvest is about 6 months after planting
(August-September).

The mature tuber or tubers are removed carefully,
and the roots left undisturbed.

The second harvest is taken 4 to 6 months later
(December-January).

Only the tubers from this last harvest
are used for planting.

The medium early varieties are:

gnan and *klinglé* or *krenglé*,
which grow in 6 to 7 months.

The late varieties are:

sepelo and *kangba*,
which cannot be harvested before 8 or 9 months.

**The stems of *Dioscorea cayenensis*
wind in a counterclockwise direction.
They are round and often have thorns.**

As a rule, each plant produces
one yellow fleshed tuber,
the shape of which is very varied.

● *Dioscorea dumetorum*

**The stems wind in a clockwise direction.
They are oval
and are generally covered with hairs.
The leaves are alternate;
they have three leaflets.**

**This variety is well suited
to conditions in savanna country;
it withstands drought well
and even sometimes comes through brush fires
without much harm.**

Each plant of *Dioscorea dumetorum*
may have several tubers.
The tubers have no rootlets,
but are smooth except for
wrinkles running across them.

● *Dioscorea trifida* (cush-cush yam)

This yam is still little known in Africa.

**The stems wind in a clockwise direction.
They are four-sided.**

The leaves are alternate
and deeply divided into three to six lobes.

Each plant produces
several small, elongated tubers.

● *Dioscorea esculenta*

**The stems wind in a clockwise direction
and have thorns.**

The leaves are alternate and are entire,
or deeply divided into several lobes.

This is a late variety
that grows in 9 to 10 months.

Each plant produces
a large number of small tubers —
between 30 and 40.

It is popularly called the white man's yam.
Names for it are:

Ivory Coast: *brofié mbou* (Abbè)
 bofoué shié (Attié)
 brofoué douo (Baoulé)
Togo and Benin: *anago-té* (Ewé-Mina)

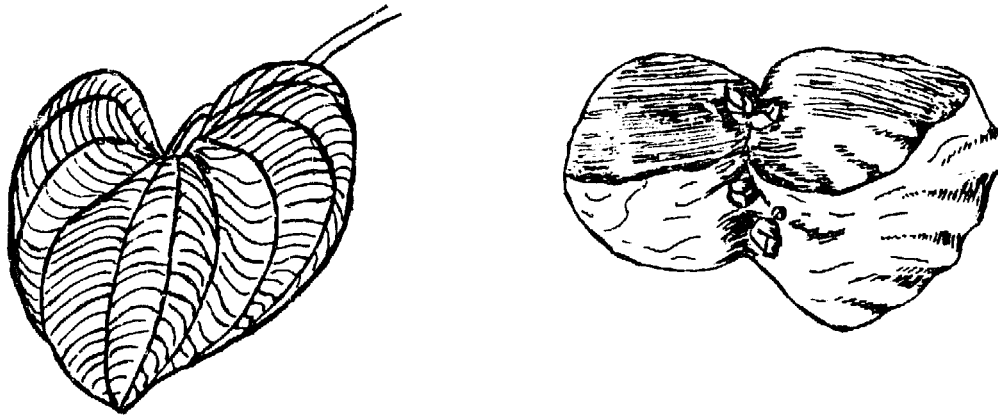
● *Dioscorea bulbifera*

This variety of yam grows in 9 months.
It is chiefly grown in western Cameroon.
Names for it are:

Guinea: *danda* (Malinké)
 danié or *dana* (Soussou)
Mali: *danda* (Bambara)
Togo: *nbanioké* (Kabrai)

**The stems wind in a clockwise direction
and are thornless.**

The leaves of *Dioscorea bulbifera* are alternate, large and hairless.



Leaf and aerial tuber of
Dioscorea bulbifera

Little aerial tubers, called **bulbils**, are to be seen in the axils of the leaves.

These bulbils develop by the transformation of buds.

They may be as much as 10 centimetres long. They have white, firm flesh and are good to eat when cooked.

These bulbils store food reserves, just like underground tubers. The underground tubers are smaller.

Where are yams grown?

- **Climate**

To grow well,
yams need a warm, humid climate,
with abundant, prolonged rain.

Yams cannot be grown
in very dry regions,
or where the sunlight is too strong.
Yams need shade
during the early stages of growth.

This is why in Africa,
yams are grown in regions
between the dense forest
and the dry, treeless savanna.

- **Soil**

Yams grow well
in rich, deep, permeable soil
that is not too sandy.

The tubers do not grow well
in heavy soils.

Swampy land that is flooded
for several days during the rainy season
is not suitable for growing yams.

HOW TO GROW YAMS

The place of yams in a crop rotation

It is best to plant yams
at the beginning of the rotation,
as a first-year crop
after clearing the land.

If yams are grown
after a long fallow,
they find plenty of mineral salts in the soil,
and yield many good tubers.

How to prepare the soil for yams

Before planting yams,
the soil must be well prepared.

- Clear the land before the rainy season.
Cut down the trees, cut the branches.
Stack the trees and branches and burn them.

Do not cut all the trees.
Leave some of the little ones.
They can be used as supports
for the aerial stems of the yams.
These natural supports
will later be supplemented by stakes.

- Till the land to a depth of 20 to 40 centimetres.
- At this time add organic manures,
well-rotted farmyard manure,
compost or green manure,
at 10 to 40 tons a hectare.

Inorganic fertilizers

may be used to get a greater yield.

The amounts vary according to the country, region, or even the soils in the same field.

Research stations like IRAT¹

make a special study of food crops, and advise farmers.

In Liberia, it is known that the application of potassium (K) fertilizers is valuable in increasing yields.

In Nigeria and Ghana, the agricultural service advises that yams should be given the following fertilizers:

250 kg/ha ammonium sulphate;
65 kg/ha single superphosphate;
215 kg/ha potassium chloride.

The farmer who wants to make progress should all the time ask for advice from the agricultural service.

- In many African countries, yams are planted in mounds 30 to 40 centimetres high and 1 or 2 metres apart. **These mounds are made at the beginning of the rainy season.** The soil which has thus been well loosened holds plenty of water.

Sometimes the mounds are only made 2 or 3 months after planting. **This earthing up encourages the development of tubers but takes a lot of work from the farmer.**

¹ Institut de recherches agronomiques tropicales et des cultures vivrières.

If the soil is fairly deep
and is deeply tilled,
it is not always necessary to make mounds.
In that case, more tubers can be planted
and the density is greater.

**Yams are planted
at the beginning of the rainy season.**
Plant them 5 to 10 centimetres deep,
1 metre apart in all directions,
or 90 centimetres by 1 metre.
This gives the tubers
plenty of room to fatten up,
and the plant makes use
of all the rainy season water.

How to propagate yams

Many kinds of yam bear flowers
which fruit and produce seeds.
So it is possible to obtain new yam plants
by sowing these seeds.

But this way of propagating
is no use to the farmer.
**The new plants grown from seed
are not always like the parent plants.**
Often the yield is less,
the tubers are much too small and of bad quality
and contain a poison called dioscorine.

For all these reasons,
it is better to propagate by cuttings.
But here care is needed
Take cuttings from ripe tubers,
and not from the aerial stems,
as is done with cassava.
These root cuttings make plants
which are like the parent plant,
and give good yields.

**For the cuttings use pieces of tuber
or small whole tubers.**
To get regular sprouting and good yields,
the cuttings (whether whole tubers or pieces)
should weigh between 250 and 400 grammes.

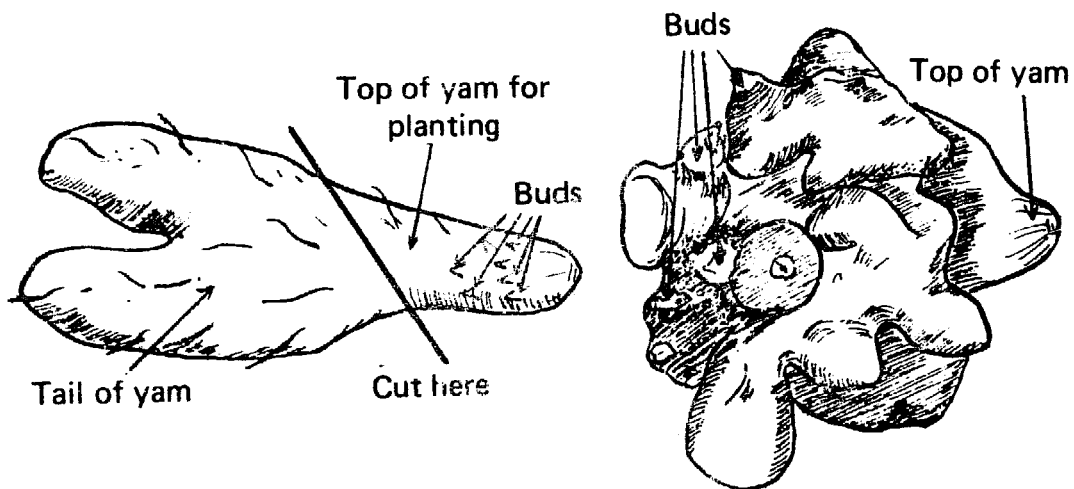
The amount of yams planted
represents a considerable part
(about a quarter) of the harvest.
That much of the harvest must be set aside
and well stored for use in planting later.

Plant only fully ripe tubers.
It is best to use the part of the tuber
nearest the crown.
This top of the tuber contains many growth buds
and shoots more quickly than the rest of the tuber.
For this reason, tops of tubers
must all be planted in the same field.

The remaining yam tubers
are planted in another field.
They sprout less quickly.

With the *Dioscorea bulbifera* variety of yams, the bulbils can be planted in the same way as tubers. Wait until they are quite ripe, when they are easily removed from the stem.

Do not plant tubers or bulbils that are damaged, rotten or diseased.



Small yam tuber used for planting

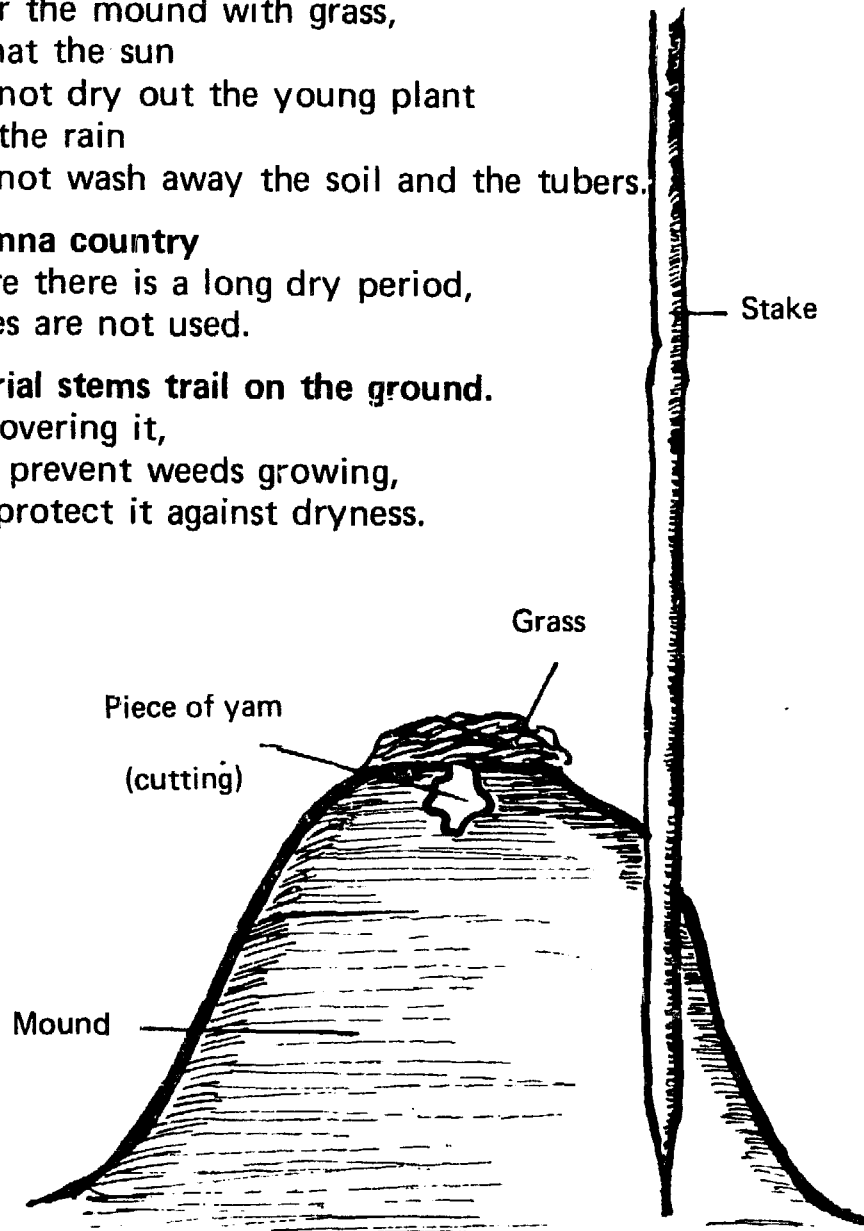
How to plant yams

The bulbils, pieces of tuber or small tubers are planted in the top of the mound at a depth of 5 to 10 centimetres, and covered with soil.

When there is too much sun or the light is too strong, cover the mound with grass, so that the sun will not dry out the young plant and the rain will not wash away the soil and the tubers.

- In savanna country where there is a long dry period, stakes are not used.

The aerial stems trail on the ground. By covering it, they prevent weeds growing, and protect it against dryness.



A yam mound

Looking after the plantation

CONTROL OF WEEDS

For a good harvest,
hoeing must be done two or three times
during the early stages of growth.

When this cultivation is being done,
the mounds are remade at the same time.

Later, the abundant vegetation of the yams
prevents the growth of weeds.

It is then not necessary to hoe.

CONTROL OF DISEASES AND PESTS

Yams have few diseases.

However, rodents, some insects
and fungi cause damage.

**Damaged tubers rot quickly
and cannot be kept for long.**

Harvesting and storing yams

HARVESTING

Depending on the variety,
yams are harvested 6 to 12 months after planting.

Lift the tubers
when the leaves and stems turn yellow and dry.

Do not leave the ripe tubers
too long in the ground,
otherwise they become bitter and may rot.

With some varieties, only one crop is harvested.
Others are harvested twice.

At the first harvest, after 6 months,
the biggest tubers are lifted.
The second harvest
is taken 3 to 6 months after the first.

Or the crop may be harvested
as and when needed.

STORING

**Early varieties, such as *lokpa*,
do not store well.**
These yams should be eaten
immediately after lifting.

**Late varieties,
such as *Dioscorea alata*,
may be stored for 5 or 6 months.**
But they must be kept dry
and protected from rats and other rodents.
They should be under a roof,
on dry ground
or on boards supported on posts.
To prevent rot,
the tubers should not be heaped up too much.

THE USE OF YAMS IN FOOD

Yams are the staple food
of many peoples of Africa.

Yams are eaten fresh,
or are treated and preserved.

Most varieties of yams,
especially the wild species
that are not cultivated,
contain a poison (dioscorine).
But this poison is removed
by washing the yams several times in salt water
and by cooking them well.

**This is why yams must never be eaten raw,
but only when they are thoroughly cooked.**

- **Fresh and mashed yams**

When yams are eaten fresh,
either boiled or fried,
peel them first,
cut the tubers into pieces
and **wash them carefully.**
The boiled yams are pounded
to make mashed yams.

- **Dried yams and yam flour**

The fresh tubers are peeled, sliced,
and dried in the sun.

Sometimes yams are steamed
before being dried in the sun.
And sometimes after a meal,
the remains of *foutou* (mashed fresh yams)
are carefully gathered up
and made into little balls
which are then dried in the sun.

Like cassava,
the slices or yam and the balls of *foutou*
can be kept for a long time
once they have been well dried.

To make flour,
the slices or the little balls
are pounded in a mortar, or ground in a mill.
The flour thus produced
is used to make a dough.

SWEET POTATOES

Description of the plant

The sweet potato is a climbing herbaceous plant. It may live for several years, but often it is harvested after 3 months, without waiting for it to flower.

The stems may grow to 2 or 3 metres in length; they are thin and climbing or creeping. They have nodes at varying distances apart. It is thought that the varieties with short inter-nodes yield more heavily than those with long inter-nodes.

The leaves vary greatly in size and shape. Depending on the variety, they may be entire, heart-shaped or deeply divided with three, five or seven lobes. The leaf veins and the leaf-stalks are green or red.

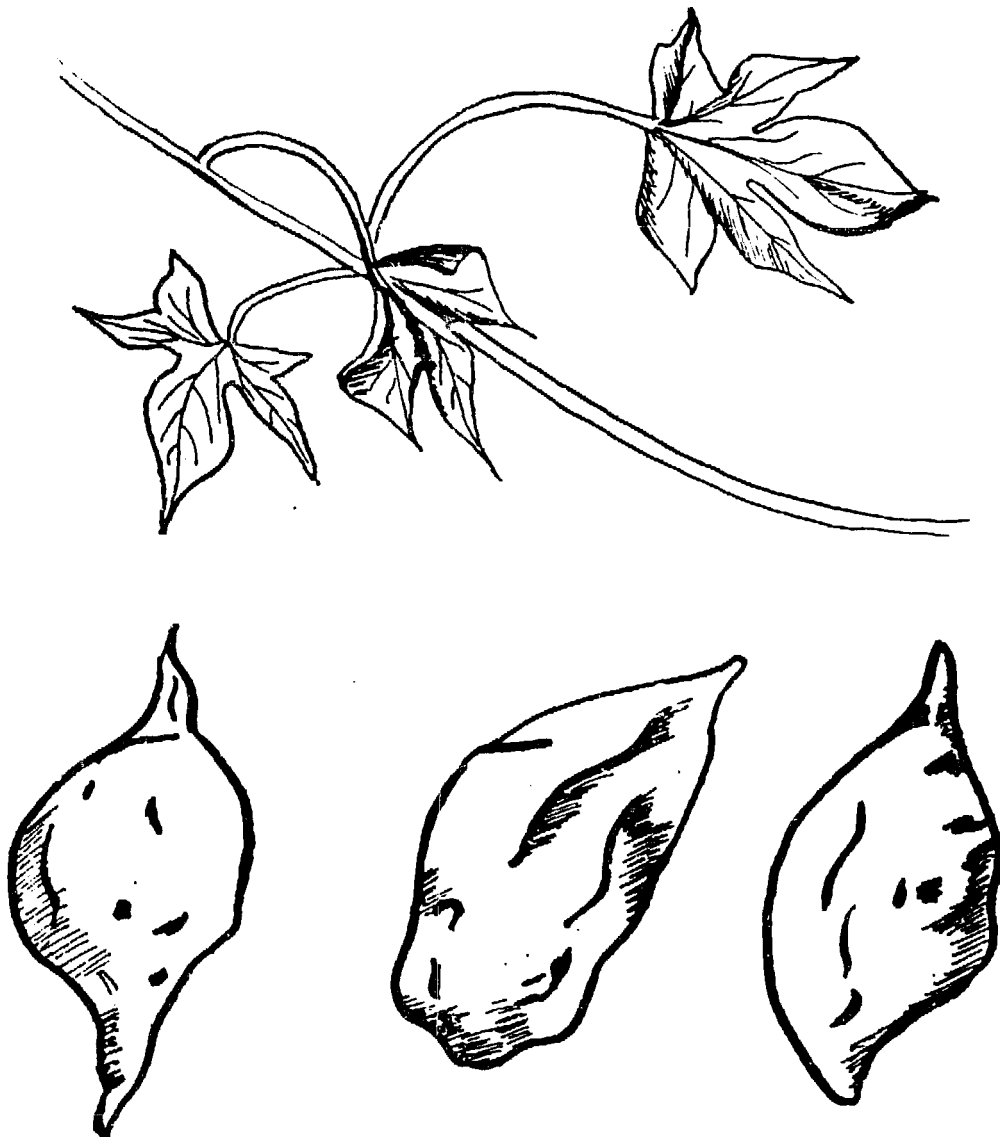
The flowers, usually violet, sometimes white, are clustered in the leaf axils. Many varieties of sweet potato in cultivation do not have time to produce flowers and fruits before the harvest.

**The most important part of the plant is the roots,
because they can develop into tubers.**

The tubers

are parts of the **creeping roots**
that have built up **food reserves**.

These tubers are produced at points
where the roots cease to spread out near the surface
and turn downward into the soil.
By making mounds that are not too wide,
the formation of tubers is helped.



Leaves and tubers of sweet potato

Varieties of sweet potato

Varieties of sweet potato differ greatly
in the number, shape and size of their tubers
and in the colour of the peel
and flesh of the tubers.

Sweet potatoes may be round or elongated.
In colour they are white, yellow, red or violet,
with soft or firm flesh.
They may weigh between 0.3 and 3 kilogrammes.

Where are sweet potatoes grown?

● Climate

Sweet potatoes grow well
in **warm, sunny and humid regions.**
At the same time,
they withstand drought very well.
For that reason, they are suited to dry savanna country.

Sweet potatoes need **regular rain** to grow,
especially when the leaves are coming into growth.
But if there is too much rain
at harvesting time,
the tubers rot.

● Soil

The sweet potato will grow in poor soils.
The most suitable soil
is a light, well-drained, sandy loam.
If the soil is too rich
in organic matter and nitrogen,
the plant produces a great deal of useless stem and leaves,
and only after a long time produces
a very few tubers.

HOW TO GROW SWEET POTATOES

As a rule,

sweet potatoes are grown on ridges or mounds after deep tilling.

This way is better

than growing them on the flat.

The mounds and ridges

protect them from too much moisture.

The ridges are made about 75 centimetres apart.

But it is still better to plant sweet potatoes

on round mounds 30 to 40 centimetres high and 1 metre apart.

The mounds should be made as narrow as possible.

This forces the plant

to bend its roots downward quickly.

In bending,

the roots build up food reserves

and develop tubers.

The farmer must know his varieties well.

He must know how long they take to form tubers, and see to it that the harvest will be in the dry season.

It is better to plant several times, at intervals,

so that the whole plantation

does not become ready for harvest at the same time.

By doing this, you can lift the sweet potatoes as and when you need them.

Propagation of sweet potatoes

Sweet potatoes are propagated from cuttings or from tubers.

● Propagation from cuttings

Propagation from cuttings is possible only when the sweet potatoes remain in the field all through the year. The cuttings should be 20 to 40 centimetres long, with three to five growth buds.

It is best to take them from the tips of young stems.

Take the cuttings only when you are ready to plant them, and keep them in the shade until they are inserted in the soil.

Propagation from cuttings is the most economic way of increasing your plants.

Plant cuttings at a slant, leaving 3 or 4 centimetres above ground, and press the soil down firmly.

If you plant them on mounds, you can put four or five cuttings in a circle on each mound.

This will give you a planting density of between 15 000 and 30 000 plants to the hectare.

● Propagation from tubers

If you do not have any plants of sweet potatoes with enough leafy growth to provide cuttings, you can propagate from tubers.

In this case,
**the tubers must be made to sprout
in a cool nursery bed.**
If the tubers are large,
cut them into several pieces.
After about a month,
remove from the tubers
the young shoots that are 15 to 20 centimetres long
and plant them.

This method of propagation from tubers
is usually done only on a part,
say one third, of the area
on which sweet potatoes are to be grown.
Later, cuttings from the plants thus obtained
can be used to enlarge the plantation.

Looking after the plantation

CONTROL OF WEEDS

**One or two cultivations
in the early stages of growth are enough.**
In 4 to 6 weeks after planting,
the plant's own leafy growth will closely cover the soil.

When cultivating,
remake the mounds at the same time.

CONTROL OF DISEASES AND PESTS

**Sweet potatoes attacked by diseases and insects
yield only a small harvest of poor quality.**

**You must wait 3 to 5 years
before growing sweet potatoes again
on the same field.**

● Rot and fungi

Diseases that kill the growing plants
are caused chiefly by various fungi.
Some fungi make the leaves turn yellow and wither.
Other fungi make the stems or tubers rot.
Signs of the disease
are yellow leaves and black marks
inside the stems and tubers.

Other fungi cause the young plant to rot.
It stops growing.
The roots and the tubers already formed
turn black.
It is not long before the whole plant
wITHERS and dies.

To control most forms of rot,
you must choose resistant varieties.
Do not use for propagation cuttings or tubers
taken from plantations attacked by rot.

**Do not grow sweet potatoes on the same soil
2 years in succession.**

● **Insect pests**

Sweet potatoes may be attacked
by certain insects,
especially by weevils.

The adult insects eat the leaves,
stems and tubers.

The female insects lay their eggs
in the stems or roots;

the larvae tunnel into the tubers.

Serious damage is caused by weevils.

To control the weevils,
use insecticides.

Before planting tubers and cuttings,
dip them in a solution of Dieldrin.

In places where harvested sweet potatoes are stored,
they can be fumigated with phostoxin in tablets.

Yields of sweet potatoes and storing

YIELDS

Depending on the varieties of sweet potato and on the way they are grown, yields vary from 4 to 7 tons per hectare on average. On a modern and well-cared-for plantation, yields may be much higher, and may even be more than 20 tons per hectare.

STORING

The length of time for which sweet potatoes can be kept differs with the varieties and the harvesting season. If they are harvested in dry weather, the tubers may be stored for 2 or 3 months.

But part of the harvest may be destroyed by rot during storage. Damaged tubers are most quickly attacked. Damp conditions encourage rot.

To prevent rot, dry the tubers in the sun for a time after harvesting.

For good keeping, the tubers of sweet potatoes should be harvested when they are quite ripe, when the stems and leaves have turned yellow. Take care not to damage the tubers. Remove all diseased and damaged tubers. Dry the tubers in the sun. Store them under cover in a dark, dry, cool, well-aired place. Put them on dry ground or on boards supported on posts, and do not heap them up too much.

SWEET POTATOES IN HUMAN FOOD

**Sweet potatoes are of great value
as an energy food.**

**The sweet potato,
especially the coloured varieties,
contains vitamins.
The yellow ones are the richest in vitamins.**

**The tubers contain much starch,
and this can be extracted from the tubers
in factories.**

**The sweet potato can also be used
for making alcohol.
The leaves of the plant are used for food,
both for people and animals.**

TANIA AND TARO

Tania and taro are alike.

They belong to the same family,
the Araceae.

But tania and taro are two different plants.

- **Tania** goes by
the scientific name of *Xanthosoma*.
It is grown chiefly in Cameroon.
- **Taro** (or cocoyam) goes by
the scientific name of *Colocasia*.
It is grown all over Africa.

Description of the plant

Tania and taro are distinguished
by the shape and arrangement of the leaves.

- **Tania or *Xanthosoma***

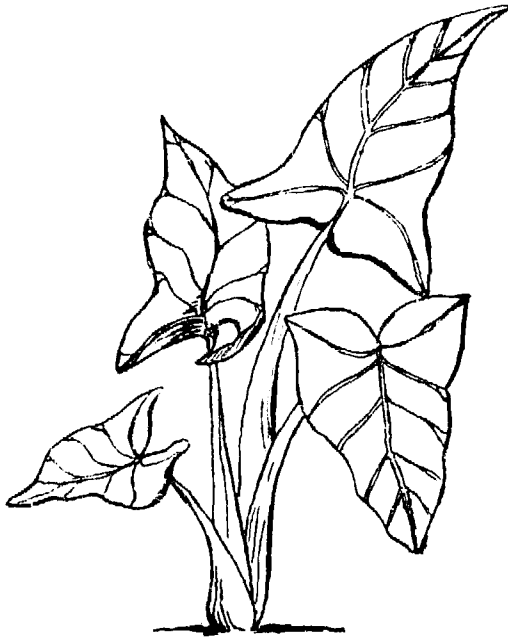
Some varieties of tania have an aerial stem.

It may reach 1 metre in length
in the adult plant.

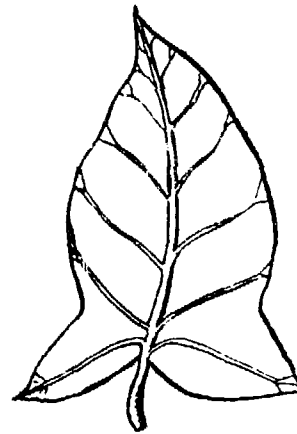
The leaf blade of tania is divided by a notch
which makes the leaf arrow-shaped.

The leaf-stalk is attached to the edge of the leaf
at the middle of the notch.

**The leaf is bigger than the taro leaf;
it is more sheath-like,
thicker, stiffer and more shiny.
It is permeated with a sort of wax.**



Tania (*Xanthosoma*) plant



Tania leaf

**The leaf-stalks are long, stiff and thick.
They are flattened
at the part attached to the leaf.
The leaf-stalk of tania
is a direct continuation of the midrib.**

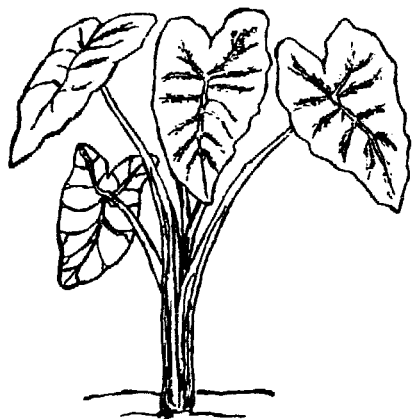
**As a rule,
the underground stems and tubers
are well developed.
They weigh between 1 and 5 kilogrammes
and are rich in starch.**

● **Taro or cocoyam (*Colocasia*)**

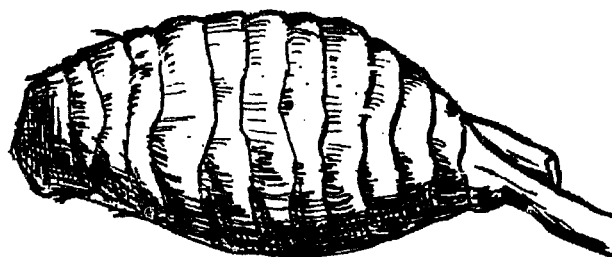
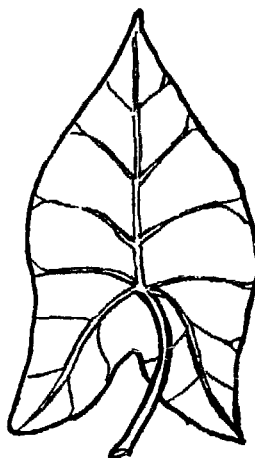
Taro never has an aerial stem
as is the case with some varieties of tania.

Taro leaves are a lighter green
and **less shiny** than those of tania.
They are smaller.
The leaf blade is thin and flexible.
The leaf-stalk is thin, flexible
and has no sheath.

The leaf-stalk is not a continuation of the midrib,
as with tania.



Taro (*Colocasia*) leaf



Taro tuber

The taro leaf-stalk
is not attached to the edge of the leaf,
but near the centre of the leaf blade.

The underground stem varies a lot.
It may be round or flat,
branching or not branching.

As with tania,
the underground stems of taro
often produce **secondary tubers**,
but they are smaller.
Unlike what happens with tania,
it is chiefly the bigger, central tuber
that is used for food.
It remains tender when ripe,
at harvest time.

There are many varieties of taro,
as there are of tania.
The tubers may be
large or small,
with flesh that is yellow, red or white,
hard or soft,
that becomes floury after cooking, or doughy.

Where are tania and taro grown?

- **Climate**

Tania and taro require a **warm, humid climate.**
But tania suffers more from drought than taro.
If you live in a region with not much rain,
it is better to grow taro
than tania.

- **Soil**

Tania and taro need **well-loosened soil**
that is very cool and rich in humus.
Some varieties can even be planted
in land that is often flooded.

HOW TO GROW TANIA AND TARO

In general, the same methods are used for both plants.

Propagating

Tania and taro are usually propagated from **small tubers** or **pieces of tuber**.

Sometimes the **suckers**, or new shoots that appear some distance from the parent plant, are used.

With tania, pieces of the **aerial stem** can sometimes be used, or the main tuber if it has become too hard to eat.

The tubers, pieces of tuber or of aerial stem are cut into pieces 10 to 15 centimetres long; the leaf-stalks are cut at about 10 centimetres from the junction with the leaf.

Planting

Tania and taro may be planted by themselves. Or they may be **planted with other crops in the same field**.

For example, they can be grown in the shade of a plantation of plantains. They can also be grown under the dense foliage of big forest trees.

Because tania and taro have large leaves, they may be used as a **cover crop** when starting a new cocoa plantation.

Planting is done at the beginning of the rainy season
in rather shallow holes.

When grown alone,
the distance between the holes
may be 60 centimetres in all directions,
or else 60 centimetres by 80 centimetres.

When grown with other crops,
for example, when tania and taro
are used to shade young cocoa trees,
the distance between the holes
varies between 50 centimetres and 1 metre.

Looking after the plantation

Tania and taro require very little care.
One or two cultivations in the early stages of growth
are all that is necessary before the harvest.
Often the plants are lightly earthed up
when these cultivations are carried out.

Harvesting

Depending on variety, tania and taro
are between 6 and 14 months in the field.

The tubers are ripe and ready for harvest
when the leaves turn yellow
and the plant begins to wither.

The fully ripe tubers should be harvested
in dry weather.

If you harvest during the dry season,
the tubers may be left in the earth
for some time and will not spoil.

When the field is wet,
the ripe tubers must be harvested quickly.
They may sprout
and will then be no good for human food.

**Each tania or taro plant
may yield several harvests
during one crop period.**

**As a rule, the harvests should be organized
as follows:**

● **For tania**

The first harvest begins
about 3 months after planting.
Three months after this first harvest,
you can take three or four additional harvests
from each plant.
After each of these additional harvests,
wait 2 or 3 weeks
before taking tubers again from the same plant.

● **For taro**

The first harvest begins
6 to 8 months after planting.
After that, harvest again
two or three times from the same plant
at intervals of 2 or 3 weeks.

When harvesting

dig out the soil right up to the plant,
take the biggest tubers
and detach them from the parent plant.
Then fill in the hole.
Let the young tubers develop
before harvesting again.

Storing the tubers

The harvested tubers are cleaned
and can be sold fresh.

But **tania** and **taro** tubers
may be kept for some time,
and eaten as and when needed.

To keep the tubers
for some months after harvesting,
you must prevent them from rotting.

To do that, put the tubers on dry ground,
or on boards supported on posts,
in a **well-aired, dry, cool place**,
sheltered from the sun and rain.

TANIA AND TARO IN HUMAN FOOD

The leaves of tania and taro are used in human food as vegetables.

They may also be given to animals as fodder.

With tania, the main underground stem is too hard to be eaten. Only the tubers are used for food.

With taro, the underground stems often bear tubers. The central tuber, which is the biggest and yet soft, is the one chiefly used for food.

SUGGESTED QUESTION PAPER

FILL IN THE MISSING WORDS

- Cassava is grown chiefly for its
- After a crop of cassava, the field must be left
- never has an aerial stem.
- Yams and cassava contain
- To propagate yams, plant
- The roots of cassava become large and fat by storing up
-
- It is better to plant sweet potatoes on
- To propagate cassava, plant
- Sweet potatoes are a food rich in
- The leaves of can be eaten.

ANSWER THE FOLLOWING QUESTIONS

- When should organic manure be applied?
- What is the place of yams in a crop rotation? Why?
- What are the chief diseases and pests of sweet potatoes?
- How do you control the diseases and pests of sweet potatoes?
- What is the place of cassava in a crop rotation? Why?
- What plants with tubers are grown where you live?
- How do you propagate sweet potatoes?
- When should yams be harvested?
- What is the purpose of crop rotation?
- How is cassava harvested where you live?
- What do you do to get rid of the poison in cassava tubers? Or in yams?
- Why is weeding necessary?
- How do you store your harvest of yams? Sweet potatoes? Tania and taro?
- How do you choose the cuttings of cassava and sweet potato?

Draw a leaf of tania and one of taro, showing the difference between them.

Explain the difference between a tania leaf and a taro leaf.

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