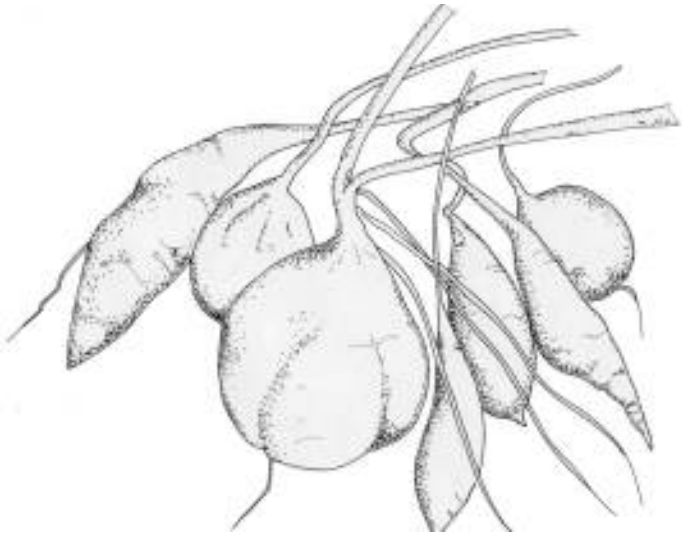
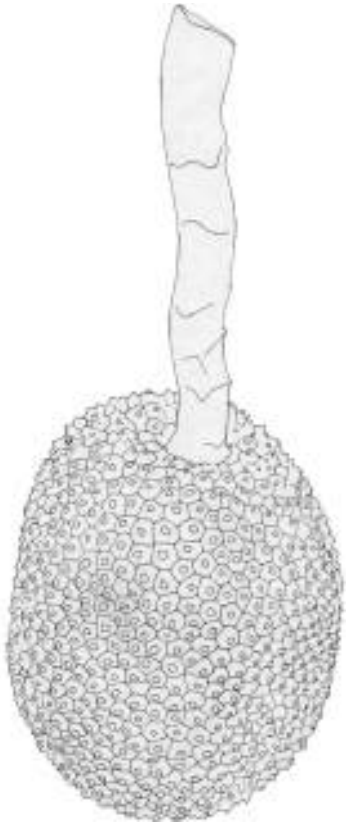


Growing food
in the
Southern Highlands Province
of Papua New Guinea



Bruce R French

Growing food
in the
Southern Highlands Province
of Papua New Guinea

The publication was originally compiled as a part of the
AFTSEMU (Agricultural Field Trials, Surveys, Evaluation and Monitoring Unit)
of the World Bank funded project in the Southern Highlands of Papua New Guinea in 1982.
It was only made available on a limited scale
and is now made available as a pdf document in 2006.

Dedication

This book is dedicated to God who made this rich variety of food plants, but also to the many village farmers who carefully grow and maintain them as they go about providing food for their families.

Bruce R French

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What is this book about?

This book is going to talk about growing food in the Southern Highlands Province of Papua New Guinea. It is mainly going to be about the foods that people grow and like and use. Not everybody in the Southern Highlands grows or uses the same food plants. Neither do they grow or use them in the same way. As well, each plant has different names in different languages. These differences will be explained. For the temperate, introduced crops like cabbage and carrot, there are many other books and sources of information about these.

Most of the food plants that people have already been growing and using, are very good plants. They are plants that suit the local conditions and have often already been selected to suit the pest and disease problems that may occur. They are food plants about which people should be proud and we should all learn more about them. Most of the plants of the Southern Highlands are already grown in other places in Papua New Guinea. Often the same plants occur in other countries in the tropical world. We can share what people in the Southern Highlands know about these plants with other people, and we can learn from people in other places to improve our knowledge.

As you travel around the Southern Highlands you can look at one plant and find that in some areas people never eat this plant. Then in a nearby area people harvest this plant from the wild as a self-sown plant but they eat it. Then in another area people actually grow this plant in their gardens and they may have chosen several different varieties. Sometimes a similar plant may also grow in Indonesia and they may have developed several new ways to cook and eat it. Now that people travel around more, village people are learning new things about their own traditional plants. So this book will try not to call plants “wild” or “cultivated” and it will try not to decide for village people whether the plants are important or not.

The name to use for plants is a problem. Most people in villages have names for plants in their own local language. And scientists around the world have agreed to give all plants a scientific name in the Latin language. But many of the food plants do not have a commonly accepted Tok Pisin or English name. The different names will be included, as well as a drawing to help get over this problem with names.

It is not very easy to decide whether a plant is traditional or introduced. Many plants have only come to the Southern Highlands since Europeans came to visit. Some of these such as Chinese taro and corn are now commonly grown and eaten. Other plants have simply been moved around from other areas within the province or from another language group.

Many village people who grow and use these plants every day of their lives will have better and more detailed knowledge than I have. They are the experts, but not many of them write books to share their knowledge with other people. The aim of this book is to do that on their behalf. Many different people have shown me around their gardens and shared information with me. For this I am very thankful.

Contents

Welcome to the Southern Highlands Province of Papua New Guinea

The Southern Highlands Province of Papua New Guinea is 26,000 km^2 in area and stretches from lowland valleys at 250 m altitude to Mt Giluwe at 4370 m altitude. It includes alpine tundra and lowland rainforest.

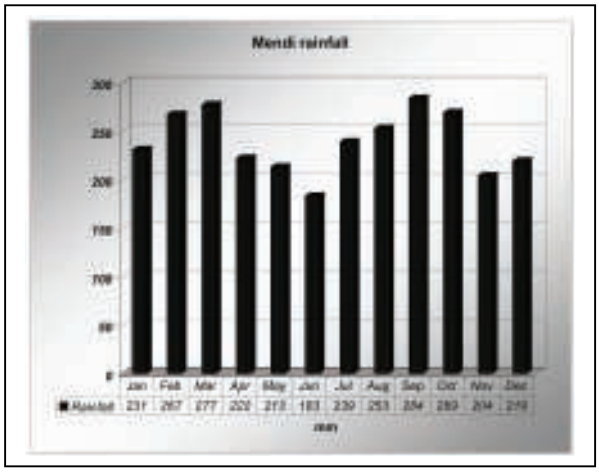
Most of the people live in the grassland valleys between 1450 m and 2100 m altitude. About 8% of the population lives below 800 m in forested valleys.

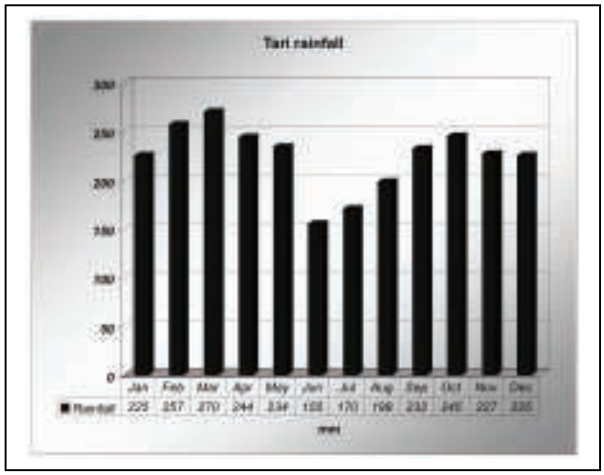
In the lowland valleys people grow sago, yams and other warmer climate crops while in the higher valleys sweet potato is the main food. At high altitudes, especially above 2100 m altitude European potatoes are becoming more common and in the higher rainforest wild karuka becomes an important nut crop. Bananas cease to be important above about 1600 m altitude.

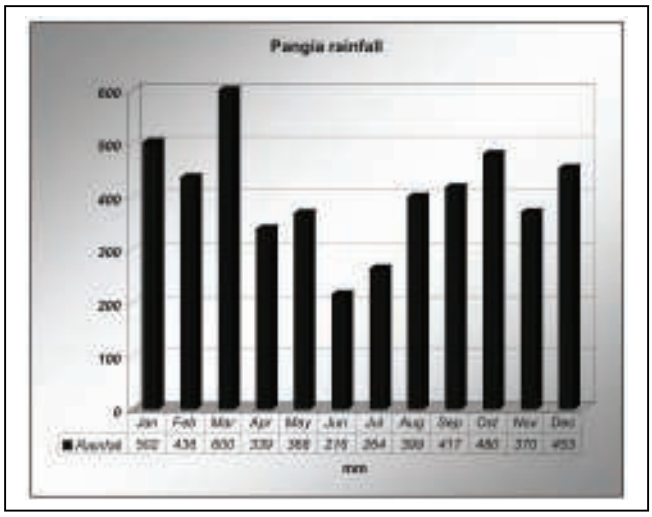
Some of the dramatic volcanic peaks include Mt Giluwe, Mt Ialibu and Mt Bosavi. There are long ridges of limestone country and because it is so rugged and divided is called “broken bottle” country. These areas have limestone sinkholes and underground streams.

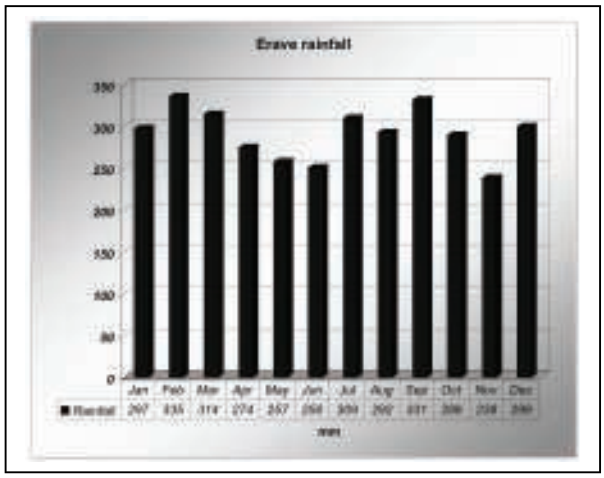
Lake Kutubu is about 21 km long and 3-5 km wide. It lies in a lowland valley between about 650 and 1300 m altitude.

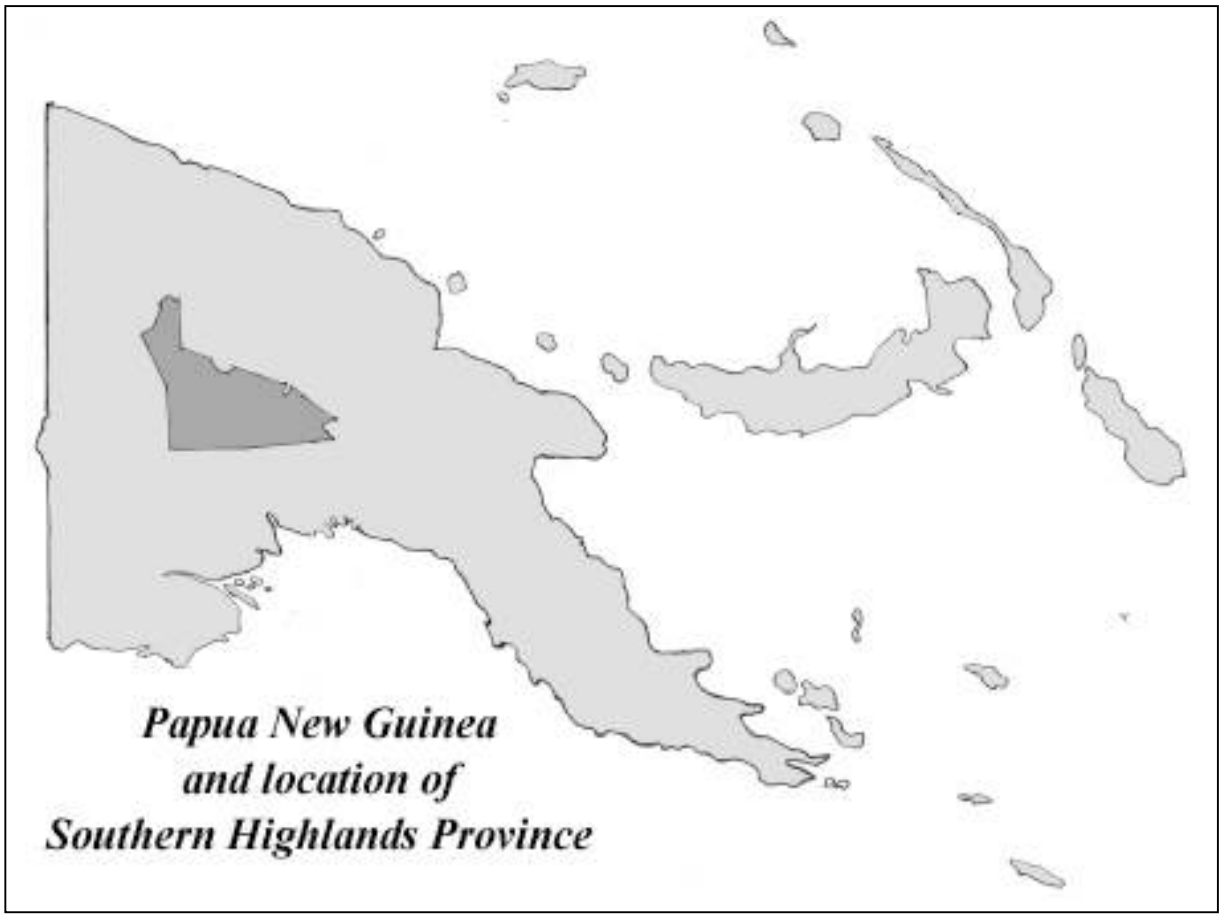
The Southern Highlands has a high rainfall and this is fairly evenly distributed throughout the year.



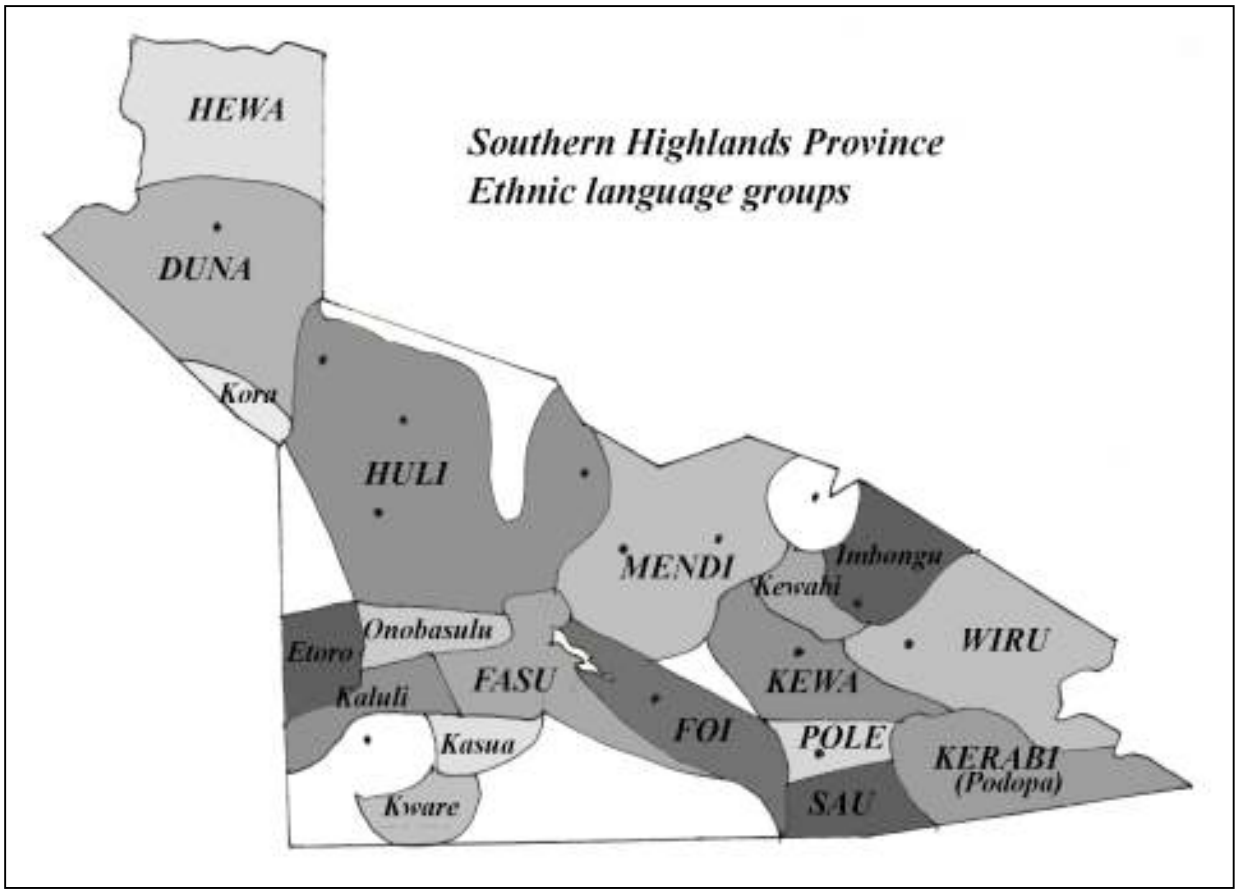




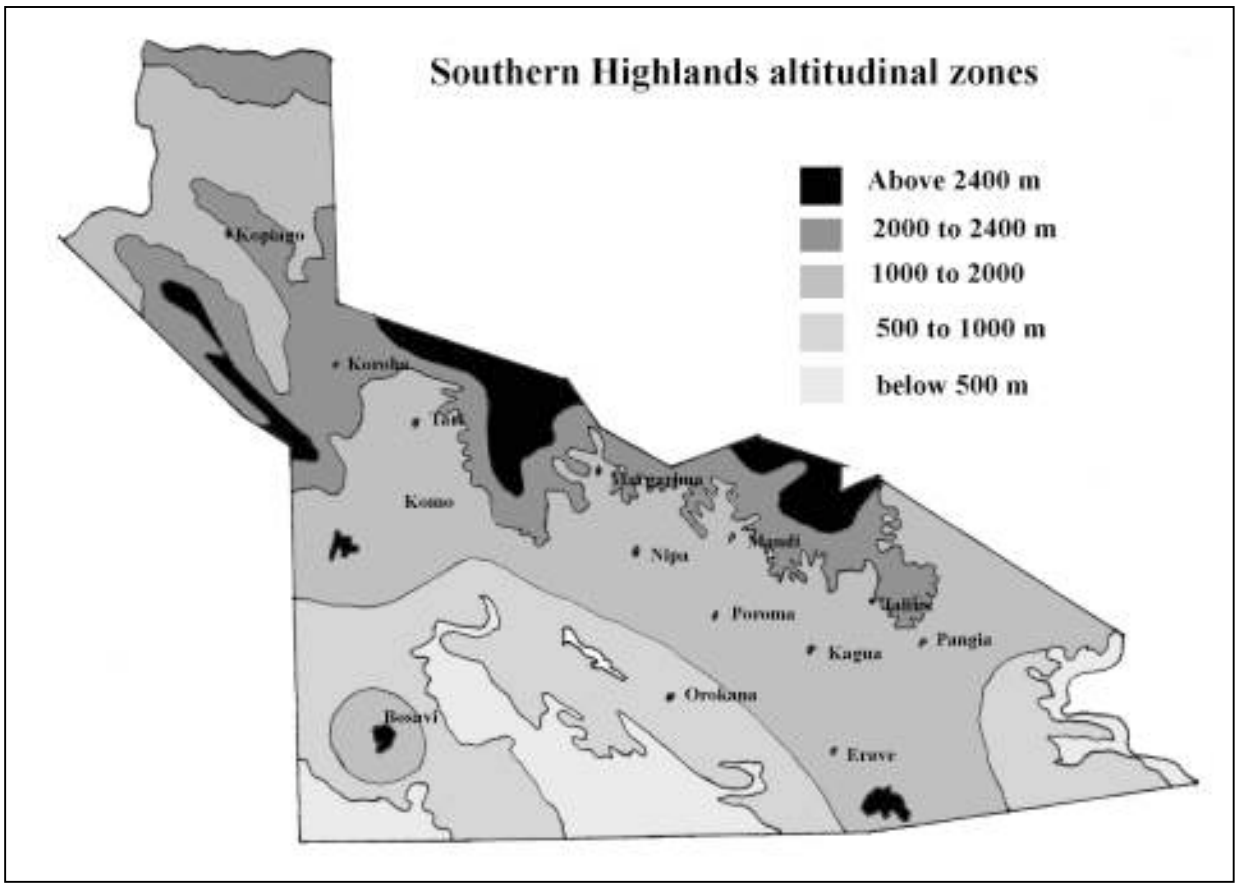




Papua New Guinea and location of Southern Highlands Province



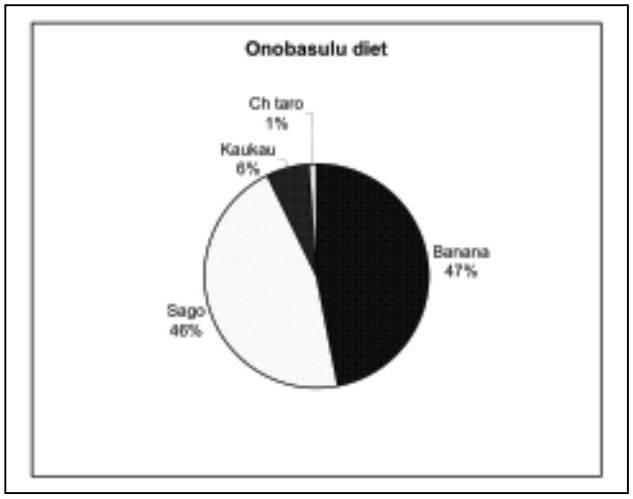
Southern Highlands Province
Ethnic language groups

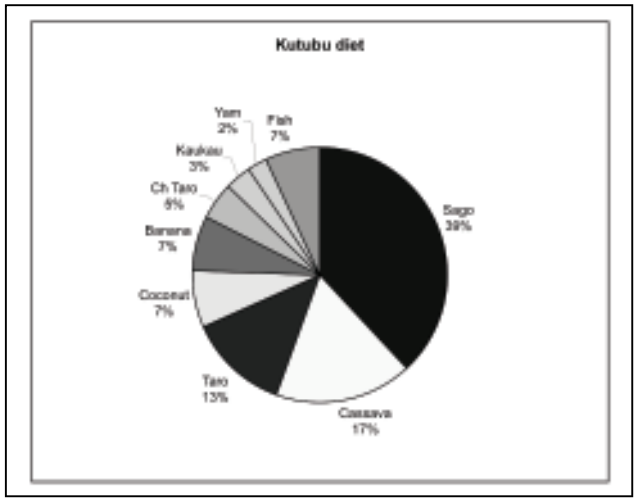


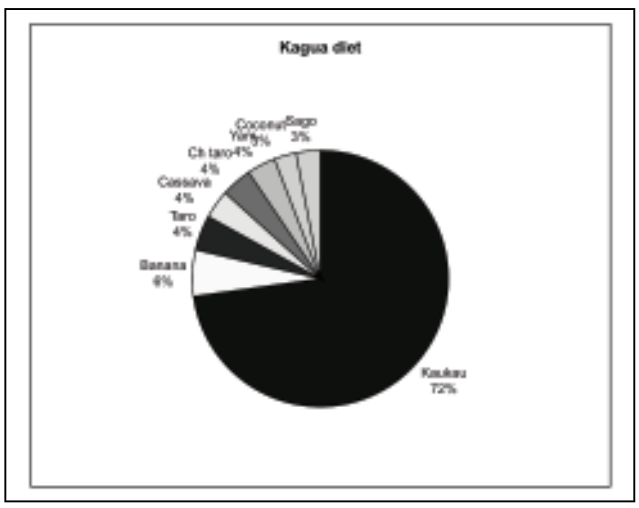
Southern Highlands altitudinal zones

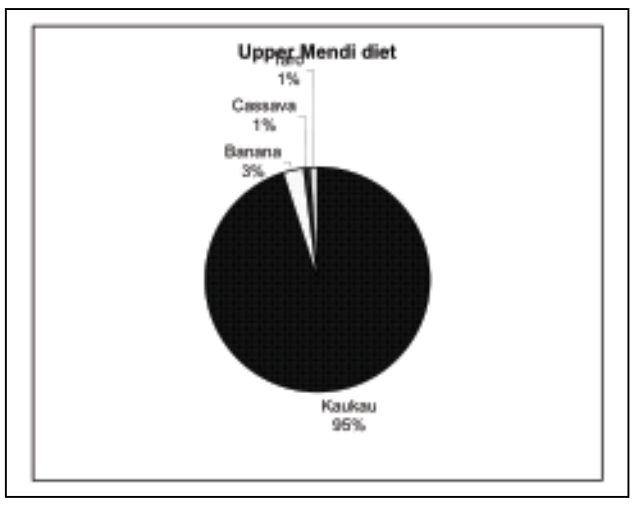
Ethnic language groups in the Southern Highlands

Language	Population	Location
Angal	18,614	Mendi & Lai Valleys
Angal Enen	22,000	Nipa
Angal Heneng	40,000	South Mendi
East Kewa	45,000	Ialibu, Kagua
Erave (Pole)	10,000	Erave
Fasu	1,200	South of Nipa
Fiwaga	300	SE of Kutubu
Foi	2,800	Kutubu & Mubi River
Folopa	3,000	Kerabi Valley
Huli	70,000	Tari
Imbongu	2,000	Ialibu
Kaluli	2,500	Mt Bosavi
Kasua	600	East of Mt Bosavi
Onobasulu	700	Between Mt Sisa & Bosavi
Samberigi	3,125	Between Kutubu & Erave
Umbu-Ungu	(34,154)	Near Tambul
West Kewa	45,000	Kagua & Mendi
Wiru	15,292	Ialibu









Food plant names for foods in lower areas of the SHP

English	Etoro	Kaluli	Onabasolo	Hawalisi	Foi
Sweet potato	Isaburu	Siapuru	Saburu	Halagulu	Agira
Banana	Gai'i	Magu	Mabur	Tolo	Ga
Taro tru	Nau	Diefele	Taro'o	Kopare	Aga
Sago	Wa ha'ro	Men	Nolu	Mene	Kui
Yam tru	Elebo	Dus	Diso	Kerisi	Hamanu
Chinese taro	Ruumabe	Fe/Wono			Yafane
Cassava		Isiapuru	Isaburu		Ira agira
Marita	Ka yo	Oka	Alakape	Oga	Abare
Aibika	Aso	Alek	Takaiya		Ga'ana
Rungia	Morowa	Gada	Kereba	Kapa	Sona
Coastal pitpit	Ode	Ol	Iolo	Anamu	Gebia
Highlands pitpit		Jun	Mafene	Yeni	Wasia
Sugarcane	Bai ile	Hon	Kono	Ase	Magi
Choko		Sioko	Sioko		Sogo
Breadfruit	Sirama	Silem	Siliman	Kapamu	Ugi
Amaranth		Kiworo	Kewaro		Gombo
Okari	Tukai'o	Uka	Favie	Iuwa	Yumu
Kumu musong					Haiya
Ficus pungens	Wek		Yali baie		Gofe
Winged bean		Paramka	Sai are		Dugaro
Tu-lip	Kopaiyo	Hawa	Kopaiyo	Yabare	Haginamu
Malay apple					
Climbing swamp fern		Sa			Tunane

Climbing swamp fern

Kumu musong

Tu-lip

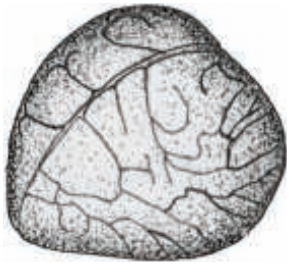
Okari nut

Food plant names for foods in lower areas of the SHP (continued)

English	Kware	Sau	Podopa	Samberigi	Fasu	Pole
Sweet potato			Kale	Tia	Suburu	Mondo
Banana			Ai	Pou	Kaputa	Kai
Taro tru			Ag	Ma		Ma
Sago			O	Hau	Asiba	Kawi
Yam tru			Dika	Mindi		Bira
Chinese taro			Taro	Dalo		Ma
Cassava			Nimake	Manita		Manita
Marita			Sina	Anga	Hase	Anga
Aibika			Soragele	Totomu	Sa are	Gabe
Rungia			Yoku	Tane	Sona	Tane
Coastal pitpit			We	Honi		Kuni
Highlands pitpit			Seria	Mini		Paundi
Sugarcane			Ho	Weli	Sao	Wali
Choko						Soga
Breadfruit			Sika	Balape	Sinima	Sika
Amaranth			Tano	Erari		Komba
Okari			Topo			Sarigi
Kumu musong			Kaiya	Nose		Poke
Ficus pungens			Huisi			
Winged bean			Pesai	Paro		Parpila
Tu-lip			Sake			Kangenamu
Malay apple			Hotung			Kama
Climbing swamp fern			Orare			
Nasturtium schlechteri						Kimbita
Waterdropwort						Taigia
Corn						Kuniga
Lima bean						Pesa
Cucumber						Wasagu
Castanopsis nut						Pai
Cyathea tree fern						Kenga

Choko

Malay apple

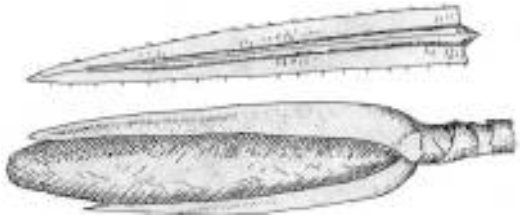


Breadfruit seed

Food plant names for foods in higher areas of the SHP

English	Huli	Mendi	Kewa	Wiru	Duna	Imbongu
Sweet potato	Hina	Okei/Hore	Sabi	Modo	Hina	Gai
Taro tru	Ma	Moio/Moa	Tabul	Mi	Ta	Me
Chinese taro	Lamba	Boli ma	Tabul	Kewami	Ta	Me
Banana	Hie	Ebred/He	Kai	Kaka	Hale	Meyal
Yam tru	Mandi	Bed	Bira	Nandi	Ere	Minje
Potato yam				Kung		
Cassava		Tapiok	Kevera bira	Oporaiyo	Irepuye	Oprai
Sugarcane	Tu	Wol	Wali	Tai	Angou	Po
Highland pitpit	Teabu	Koir	Pandi	Teiye	Tabu	Moi
Coastal pitpit		Rom	Alamo	Aua		Topene
Winged bean		Far/Parpila	Paro	Kalo		Almongo
Karuka	Anga	Ank	Aga	Ama	Anga	Amo
Marita	Abare	Opar	Dapu	Pangu	Apare	Neka
Rungia	Kereba	Taine/Tan	Rani	Pingi	Kereba	Geba
Aibika	Hapia	Husi/Olsum be	Egarani	Pangai	Kena	Geba wagi
Waterdropwort	Tigibi	Daige/Raigi	Ragia	Kuni	Tapura	Kuni
Highland kapiak		Suar/suar sur	Mail	Elu	Anugu	Minibi
Tu-lip				Koipopo tara	Kubi	Warapi
Sago		Hiwa/Obe hobo	Kogi	Ewa	Hiwa	Epawe
Amaranth	Aluba	Komp	Komba	Komba	Aluba awa	Kundu
Watercress	Awa	Wakari/ Ip komp	Pakimbita	Kambere	Lira	Komba
Bottle gourd	Bagwa	Pe hipap	Pe	Kiwa	Bawa	Mingi karumbi
Kumu musong	Poke	Tulup	Rulupa	Koiyo	Poke	
Blackberried nightshade		Sudagur		Pengo		Tekire

Highlands kapiak



Marita

Aibika

Tok Pisin: Aibika **Scientific name:** *Abelmoschus manihot* L.

Tok Ples names:

Huli - hapia	**Foi** - ga'ana	**Onobasolo** - takaiya
Mendi - olsumbe	**Hewa** -	**Etoro** - asa alek
Kewa - egarani	**Pole** - gabe	**Hawalisi**
Wiru - pangai	**Samberigi** - totomu	**Fasu** - sa are
Duna - kena	**Podopa** – soragele	
Imbongu -geba wagia	**Kaluli** – alek	

The aibika plant

The aibika plant is a shrubby plant that can grow up to 1.5 or 2 metres tall. The leaves are large and can vary in shape. The bush produces a number of branches and when it is old it sometimes produces yellow hibiscus type flowers and seedpods. The stalks can be green or have red colours on them. Normally the leaves are very dark green, but occasionally pale green types occur.

Where is aibika grown?

Aibika is very common and popular in Papua New Guinea. It is also grown in a number of the island countries of the Pacific, and in Indonesia. It is a plant well suited to hot tropical countries. In Papua New Guinea it grows quickly and easily in coastal areas, but grows more slowly in the

highlands. Above 1800 metres altitude above sea level, it only grows poorly and is often eaten by insects as fast as it grows.

Different kinds of aibika

Aibika plants vary in the shape of the leaves and in the amount of red colouring on the stalks and leaves.

Some of the leaf shapes look like this:

The narrow leafed types tend to compete less well with weeds. In some areas people tend to put the narrow leafed types in the middle of the garden, intercropped with kaukau, and the broad leafed kinds near stumps or logs and around the edges of gardens.

The pale green leafed kinds that occur only grow very slowly.

How do you grow aibika?

Aibika is normally grown from cuttings. Lengths of about 25cm (2 or 3 leaf joints or "nodes") of fresh green stem cuttings are used. These are simply stuck in the ground.

A fertile soil is needed. Therefore aibika can be planted in good soil in a newly cleared garden site, or it can be planted near houses where the soil fertility can be built up by adding scraps and compost and ashes.

The growth and colour of aibika leaves can be improved greatly by spraying the leaves each 2 or 3 weeks with a very small amount of the nitrogen fertiliser called urea, dissolved in water. (A 0.5% solution). This uses less fertiliser than putting it on the ground where it can wash away in the rain.

Picking out the tips of branches of aibika plants encourages the plant to produce more branches and therefore more leaves. But when you are harvesting leaves, you should not pick too many off the one bush at the one time. This is because it slows down the growth of more leaves.

If the soil is very fertile, older bushes, which are only growing a few leaves, can be chopped off. The stump left in the ground can then regrow into a new bush.

What insects damage aibika?

As aibika is such a nice food, it is not surprising that quite a few insects also enjoy it!

The insects damaging aibika can be sorted into 3 groups:

1. Leaf chewing insects

Cluster caterpillar	*Spodoptera litura*
Cotton leaf roller	*Sylepta derogata*
Shot hole weevil	*Oribius spp.*
Small black flea beetle	*Nisotra spp.*

Giant grasshopper	*Valanga sp*
Short horn grasshopper	*Phaneroptera brevis*

2. Stem boring insects

Aibika shoot boring grub	*Earias vitella*

3. Sap suckers

Nigra scale	*Parasaisettia nigra*
Cotton aphid	*Aphis gossypii*
A small flatid	*Colgar tricolor*
A small leaf hopper	*Euricania discigutta*
Hibiscus meal bug	

Cluster caterpillar

Cotton leaf roller

Aibika shoot boring grub

Short horn grasshopper

The most common insect, which can almost always be found on aibika, is the small shiny black flea beetle. It jumps when it is disturbed and chews small round holes in the leaves.

In the Highlands, small grey long nosed weevils (*Oribius spp.*) also commonly chew irregular shaped holes in the leaves.

Because aibika is related to cotton, three similar moths have grubs which damage both cotton and aibika. These are the cotton looper, cluster caterpillar and the cotton leaf roller. The grubs of the first one move by forming loops, the grubs of the second one group together in clusters, and the grubs of the third one roll the leaf by turning it downwards. They all chew leaves.

The aibika shoot boring grub (*Earias sp.*) is the grub of another similar moth. The moth lays eggs on the young parts of the plants and then when the grubs hatch they burrow into the stem.

The nigra scale is a small black scale like insect that gets on the top stems of the plant. It sucks sap weakening the plant. The hibiscus mealy bug has a white floury type growth over the insect. It gets on the stems, sucks the sap and can weaken plants.

How do you control the insect damage?

One simple sensible way to make the damage due to insects less serious, is to grow the plants as well as possible so that the plant grows faster than the insects damage it. Remember aibika likes warm places and fertile soil.

Oribius weevils are hard to kill with chemicals, but they can be caught and drowned in a tin of water that has a little kerosene on the top. As these insects breed slowly taking about one year for their life cycle, they can't breed up very quickly.

There are over 20 different kinds of aibika in Papua New Guinea and they all don't suffer the same amount of insect damage. So it is possible to pick out kinds that will be less damaged.

Chemicals to kill insects can be used but as they will also kill people they are dangerous. The chemical called carbaryl will kill larvae of cotton aphid, aibika shoot boring grub, cluster caterpillar and probably cotton looper and cotton leaf roller. But before you use chemicals you must

know a lot about them and how to use them. Also you mustn't eat any leaves for 7 days after spraying. It may be as simple, and safer, to pick the grubs off the plants. Particularly because people, especially children eat insects, it is better not to spray poisonous chemicals in food gardens.

What diseases does aibika get?

Aibika doesn't suffer from a lot of diseases. It can get a leaf spot due to a fungus, and it can get a white powdery mildew, also due to a fungus. But these don't seem to cause too much trouble and are not often seen. Sometimes the leaves get an irregular pattern of pale yellow patches amongst the green colour of the leaf. This is due to a virus but it does not seem to stop the growth very much. Cuttings rot off near ground level particularly if they are in wet ground. This is probably due to bacteria and fungi in the soil. In villages people plant a few extra plants to allow for this type of problem.

Other pests

On coastal areas near the main towns the giant African snail badly eats aibika. It is not known in the Southern Highlands Province and would only survive in lowland areas.

Harvesting and using aibika

The young leaves and shoots are picked. They can be boiled, steamed or fried. Cooked aibika leaves can be very slimy. If it is preferred to have them less slimy, they need to be steamed, such as in bamboo, or fried.

The food value of aibika

Aibika is a very good quality edible green. Not only does it have high amounts of protein, minerals and vitamins, the protein and energy proportions are in a good ratio. This means that it is balanced in a way that makes it easy for the body to use it efficiently.

In a 100 gram portion of the leaves that are eaten, there are the following amounts of the different types of food nutrients.

	Moisture %	**Energy cals**	**Protein g**	**Calcium mg**	**Iron mg**	**proVitA µg**	**provitC mg**
Leaves		47-103	2.6-5.7	580	3	90	118

This is twice as much Vitamin C as in a lemon and it is a good level of protein.

How much food is produced?

At the University of Papua New Guinea at Port Moresby, Dr Kesavan has measured yields of leaves of about t tons over and area of one hectare for one crop. This would be equal to harvesting 7kg of leaves from a plot 10 square metres in size.

Amaranth

Tok Pisin: kumu
Scientific names: *Amaranthus caudatus* L.
Amaranthus cruentus L.
*Amaranthus dubius*Thell
Amaranthus tricolor L.
Amaranthus lividus L.
Amaranthus viridus L.

Tok Ples names:

Huli - aluba	**Pole** - komba	**Hewa** -
Mendi - komp	**Samberigi** - erari	**Fasu** -
Kewa - komba	**Podopa** - tano	**Hawalisi** -
Wiru - komba	**Kaluli** - kiwaro	**Foi** - gombo
Duna - aluba awa	**Onobasolo** - kewaro	**Etoro** -
Imbongu – kundu		

The amaranthus plant

These plants are very quick growing leafy plants that grow in many countries of the world but are particularly suited to tropical countries.

They are mostly grown from seeds and the leaves either cut or the whole plant pulled up, then cooked and eaten.

Different species are used and these are often suited to particular places and climates. Weed species also occur which are not normally used for food.

The colouring of the leaves varies and they can be green, or have red and sometimes yellow colours.

In some countries the seeds of some kinds are eaten as a grain.

These two species seem to be the most important in the Southern Highlands.

Amaranthus cruentus

This one is often green and is more common in the higher areas.

It can be other colours on the leaves. Completely blue coloured kinds occur.

Amaranthus tricolor

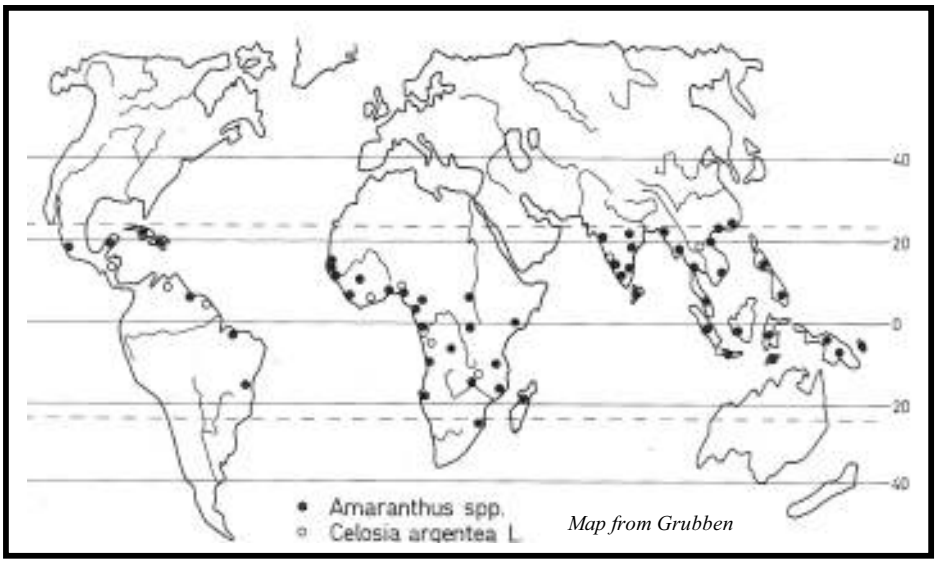
This one often has a red coloured mark in the centre of the leaf.

It tends to be more common in lower areas but is being introduced into higher places.

Where are amaranths grown?

Most people in most villages of Papua New Guinea grow and use amaranths. This is equally true in the Southern Highlands Province. Amaranths are also grown and used in most

countries of the tropical world. The map below shows some of the places where amaranths are important food.



Map from Grubben

Kinds of Amaranth

Village people can recognise the variety of amaranth that is commonest in their particular area. But different kinds of amaranths are being taken to different areas of Papua New Guinea. In the Southern Highlands people seem to have swapped their kinds of amaranth. At Erave, the people say that their traditional kind of amaranth is the one scientists call *Amaranthus tricolor,* and that the other one (*Amaranthus.cruentus*) is introduced. In the Mendi area people say exactly the opposite about the same two plants.

There are some differences in appearance between the kinds of amaranth. Often the colour or shape of the leaves gives some idea, but it is not always accurate. If you want to be sure about the different species you need to look carefully with a hand lens. These female flowers towards the bottom of the flower head are different.

A cruentus

A tricolor

A dubius

A caudatus

The kinds of amaranths don't seem to cross breed much with each other so that each kind remains fairly true to its original type. (They may have crossbred in the past to produce the different types.) So each kind in each area seems to remain much the same. Different ones have probably been brought in from other places. Also differences may be due to how they are grown.

How do you grow amaranths?

Amaranths are mostly grown from seeds. Sometimes people in the Southern Highlands grow them from cuttings. The seeds are collected from a mature dry seed head of an old plant. In the Southern Highlands, people often just store these dry flower stalks in their houses and then rub the flowers between their hands over the place where they want the plants to grow. This method is very

simple and works alright. If you want to collect the seeds it is fairly easy. The flower heads can be banged on a mat or piece of cloth. Then the rubbish can be blown out of this mixture by dropping it and blowing gently as it falls.

Amaranthus seeds are very small. A thousand seeds weigh about 0.3g. It is very difficult to sow such small seeds evenly over the ground. So there are a few different methods you can use to try and get the plants well spaced. One way is to mix the seeds with some sand and then when you sprinkle this along a row it will only contain a few seeds among the sand. The other way is to throw the seeds over a small plot of ground that will be a nursery. After 2 or 3 weeks the seedlings can be transplanted into the garden bed where they are to grow. If the seeds are just scattered over the garden, the small seedlings can be thinned out and either eaten of transplanted to a different spot.

It is important to be able to recognise an amaranth seedling when it is small. This is necessary so that it is not pulled out during weeding. Seedlings look like this:

Seedlings are transplanted when about 5-7cm tall.

What conditions do amaranth need to grow well?

Amaranths are tropical plants and like hot weather. Normally the hotter it is the better they grow.

They also like plenty of sunlight. Do not plant them in places where they will be shaded. The more sunlight the better they grow.

They need to have water most of the time they are growing. With the rainfall of the Southern Highlands, this is mostly not a big problem.

The soil must be fertile. If they are put in an old garden they will only grow very poorly. So you can either put them in a new garden site when it is cleared from bush, or you can build up the old ground by adding compost. The small gardens close to a house can often be built up to a good fertility by using the scraps and ashes and things that are left over near houses. Amaranths need high amounts of two special nutrients. These are nitrogen and potash. The ashes from fires are high in potash and that is probably why people in the Southern Highlands have learnt by experience to scatter seeds of amaranth over areas where they have burnt.

For amaranth seeds to germinate they need a temperature above 15-17^{o}C. In the higher areas of the Southern Highlands above 1800m temperatures on the average are probably below this during the months of June, July, August and September. It may be more difficult to get amaranthus started during these months although this has not been studied.

Plant spacing

In other countries a spacing of about 8cm x 8cm is used if the plants are to be harvested by pulling up the whole plant. If the harvesting is to be done by picking off the top leaves, a wider spacing is normally used. When the tops are picked out 3 or 4 times over the life of the one plant, a spacing about 30cm x 30cm is used.

As far as producing a large amount of food is concerned, the spacing is not very important. Having between 200 and 1,000 plants on each square metre gives about the same total amount of food. The main thing that varies is the size of the leaves. Mostly people like larger leaves so a wider spacing of 8cm to 10cm for plants to be pulled out is suitable.

For plants to be harvested by picking out the tops, they can be picked down to about 15cm high. Picking lower makes the plant flower later, but it also recovers more slowly from picking.

What is the growth of amaranth like?

Amaranths grow quickly. Seedlings come up above the ground in 3 to 5 days. They are 5 to 7 cm high and big enough for transplanting after about 20 days. The plants can be pulled out and used after 6 weeks. If they are harvested by picking out the tops, this can be started at 5 to 7 weeks and continued 3 or 4 times over the next 2 months.

Amaranths eventually stop producing leaves and grow flowers. Flowering occurs after about 3 months and seed can be recollected about a month later. Amaranths are called daylength neutral plants because they still produce flowers at about the same stage, irrespective of whether there are many or few hours of daylight. Because flowering stops harvesting of leaves, it is a problem, but there does not seem to be any easy way of slowing down flowering. Flowering can be delayed a little by picking out the tops down to a lower level. Also it is made a little later if plants are grown in the shade. But lower picking and growing in the shade mean the plants produce less food, so there is no point.

Plants need to be harvested and used when they are ready. If plants are left growing the amount of harvestable leaf gets less and the quality gets poorer.

Pests and Diseases

Amaranths have some pest and disease problems.

An insect called the beet webworm damages the leaves. The adult of this insect is a moth about 2 cm across the wings. The wings are brown with white stripes. The female moth lays eggs under the leaves and these hatch out after about 5 days to grow into smooth green caterpillars about 2cm long. These caterpillars eat the leaves and roll them up in a web. If needed, they could be killed by a chemical called carbaryl, but it is poisonous so needs to be handled carefully and people must not eat any of the plants for 7 days.

Another insect called the cluster caterpillar can also develop large numbers of caterpillars in some seasons and badly damage amaranth. This insect can breed up on other plants such as taro. The caterpillars stay together in groups and this gives them the name "cluster" caterpillar.

A caterpillar on a leaf

An adult moth

Spodoptera litura (Fab.) or cluster caterpillar

Other insects have not been studied. At Wapasali, people complained of mole crickets cutting off young plants and the young plants are probably chewed off by the black cutworm.

Some diseases also damage amaranths. Young seedlings can be killed off by damping off fungi such as *Pythium* and *Rhizoctonia*. These fungi attack the stem just near the ground level and cause the young plants to fall over and die.

Also a fungus called "*Choanephora cucurbitarum* grows on the flowers of pawpaws, pumpkins, taro and rice in Papua New Guinea and is known to be a problem with amaranths in other countries. On amaranths it produces a wet rot of the leaves. This fungus is blown by the wind from rotting plant material, where it is common, and then grows on the leaves of amaranth. The wet rotting leaves become covered with grey fungal threads which have black heads covered with a mass of small spores.

For both these diseases, the most practical village level control is to make sure plants are growing as well as possible because healthy plants get less damage. This means good soil, good sunlight and careful gardening. A few extra plants can be planted to make up for the ones that die.

Amaranth as food

Amaranth leaves are very good quality food.

They are also popular. In the year 1670 a man called Rumphius said that in Asia amaranth was "a captain among potherbs". Amaranths are now starting to receive a lot of attention by world scientists. They have started holding worldwide conferences just to talk about amaranths. Many people are starting to discover a plant that Papua New Guineans have had and enjoyed for a long time.

Amaranths should be cooked because they can contain high levels of oxalates and cyanides which could be harmful if eaten raw.

The amount of different nutrients in 100 grams of the part that is eaten are:

	Moisture %	**Energy cals**	**Protein g**	**Calcium mg**	**Iron mg**	**proVitA µg**	**provitC mg**
Leaves	**85**	**48**	**5**	**250**	**4.1**	**7.7**	**120**

How much will a small plot produce?

Yields of up to one kilogram of edible leaves have been harvested by pulling out plants from an area of one square metre.

If plants are picked 3 or 4 times over 6-8 weeks then two kilograms of edible leaves can be harvested.

From a plant that grows so quickly and is such good quality food this is a very high production.

What signs does a plant on poor soil have?

The two most important nutrients that amaranth needs for good growth are nitrogen and potassium. Plants need 16 different kinds of nutrients to grow properly and if any one runs out then the plant normally shows this shortage in some particular way. If these two run out for amaranth then the signs that the plant show are:-

Nitrogen - the oldest leaves near the bottom of the plant start going yellow. This is because the plant needs more nitrogen to grow more new leaves at the top and there is not enough nitrogen in the soil for it to get it from there. So it re-uses the nitrogen it used in the oldest leaves. These leaves therefore go yellow.

Potassium - When this is short the edges of the oldest leaves go yellow.

These shortages of nutrients could be corrected by adding some nitrogen or potash fertiliser but it is most likely too late for this crop. So you could learn a lesson and build up the soil better for next time. Green plant material well composted provides nitrogen. Legumes also build up nitrogen in the soil. Ashes provide potash.

If a lot of artificial nitrogen fertilizer is added amaranth can become high in chemicals called nitrates and these are poisonous. So nitrogen should be added using compost, beans or other natural means.

Banana

Tok Pisin: Banan **Scientific name:** Musa sp. (A and/or B) cv

Huli - Hie	**Foi** - Ga	**Onobasolo** - Mabur
Mendi – Ebred/He	**Hewa** -	**Etoro** – Gai'i
Kewa - Kai	**Pole** - Kai	**Hawalisi** - Tolo
Wiru - Kaka	**Samberigi** - Pou	**Fasu** - Kaputa
Duna - Hale	**Podopa** – Ai	
Imbongu - Meyal	**Kaluli** – Magu	

Bananas are not a major food in any areas of the Southern Highlands. People below about 1600 metres always have a few banana plants growing around their houses or in their gardens. There are not a large range of varieties used but people may have up to 10 varieties. Papua New Guinea is one of the major countries of the world for banana varieties and in the country there are about 500 different varieties.

As bananas are not one of the major foods within the Southern Highlands I will not explain the important principles of how to choose the best banana variety. This has been done in other books and publications and will not be repeated here.

Growing bananas

After choosing the type of banana it is important to grow it well.

A healthy sucker needs to be cleaned to be sure that insects or nematodes or fungal diseases are not carried from one garden to the new garden. Choose a straight sword-like sucker, not one that has leaves hanging out wide as soon as it comes through the ground.

The sucker needs to be put in freshly cleared ground where the soil is fertile, or the soil needs to be built up by putting compost and plant material in the planting hole. A hole 30 cm x 30 cm is suitable for most varieties.

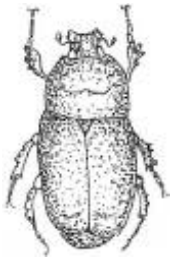
The spacing of the plant will depend on variety and whether it is being intercropped with other plants. Diploid (small traditional) plants can be 1.5 m apart and larger kinds need to be 2 m or more apart. Thought needs to be given to whether it is a kind that will be replanted within a year or left to grow as a large clump for several years.

Soils must be well drained and most bananas require a fairly fertile soil. For larger bunches of fruit, some suckers need to be removed on the kinds that sucker freely.

Pests and Diseases

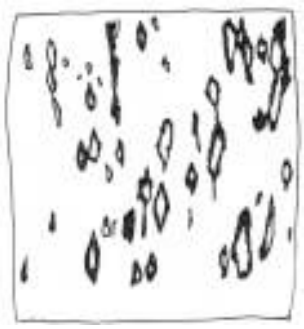
There are several insect pests and diseases that damage bananas.

Taro beetles (*Papuana spp.*)



These small brown and black beetles can dig very efficiently and damage the underground parts of banana plants as well as other root crops. They are hard to control. In the Mendi area these are called “Toink” and the curl grubs also damage plants. The grubs can be cooked and eaten.

Black Sigatoka leaf spot (*Mycosphaerella fijiensis)*



A yellowish green speck on the leaf turns into a streak and turns brown. The brown centre has a yellow ring around it. It is caused by a fungus and gets worse on "A" type bananas and in wet weather. Leaves can die off early. The edge of the leaf spot is black

Bananas as food

The large number of varieties of bananas in Papua New Guinea means there are kinds of bananas for many different purposes.

Some are sweet and soft and eaten fresh as a snack and baby food eg Cavendish.

Others are dry and starchy and need to be moistened in a soup.

Some varieties are quickly roasted in garden fires and eaten as snacks.

Others are boiled or baked and eaten as a main starchy staple eg Kalapua

	Moisture %	**Energy KJ**	**Protein mg**	**proVitA □g□g**	**Provit C mg*mg***	**Iron mg**	**Zinc mg**
Banana sweet	70.7	337	1.1	200	10	0.4	0.2
Banana cooking	65.3	510	1.3	113	18.4	0.6	0.1

Blackberried nightshade

Tok Pisin: Karakap **Scientific name:** *Solanum nigrum*

Huli -	**Foi** -	**Onobasolo** -
Mendi - Sudagur	**Hewa** -	**Etoro** -
Kewa -	**Pole** -	**Hawalisi**
Wiru - Pengo	**Samberigi** -	**Fasu** -
Duna -	**Podopa** –	
Imbongu - Tekire	**Kaluli** –	

The blackberried nightshade plant

This small plant related to a tomato is one of the common and important food plants throughout the tropics.

Growing blackberried nightshade.

This plant is sown by seed in some areas of the country, especially in the lowlands. But in the highlands it often just comes up naturally especially after grassland is burned with fire. In the high altitude areas at about 2400 m it is the first edible green to be ready when a new garden is established.

So this plant is common as both a sown and self sown vegetable in coastal areas and is common as a self sown vegetable in the high altitude areas but is much less commonly seen in the mid altitude zones between 800 to 1000 m.

Blackberried nightshade grows very quickly and produces lots of seed which also grow very easily. This means it can beat weeds and is one of the first edible greens in a new garden.

Seed germination 1 week
Plant establishment 8-10 weeks.
Harvested 5-8 times over a 6-8 week period.

Seeds are normally sown simply by broadcasting them, over newly prepared garden land.

As a food.

This plant occurs in many countries of the world and in many areas outside the tropics it is often regarded as poisonous. It has been tested in some tropical countries and no poison has been found.

In trials this plant has been found to produce large amounts of highly nutritious leaves under moderate fertility conditions.

Pests and diseases

In Papua New Guinea not a lot of insects have been recorded on this food plant but also they have probably also not been studied. The ones that are known to damage it include:

Potato tuber moth	*Phthorimaea operculella*
Soft scales	*Icerya seychellarum*
	Pulvinaria ubicola
	Saissetia coffeae

The only disease recorded on it is:

Bacterial wilt	*Pseudomonas solanacearum*

Probably some of the other diseases that affect tomato, potato and capsicum also affect it.

Food value in 100 g edible portion

	Moisture %	Energy KJ	Protein mg	proVita A g	proVit C mg	Iron mg	Zinc mg
Leaves	87.0	160	4.3	3660	20	1.0	
Fruit							

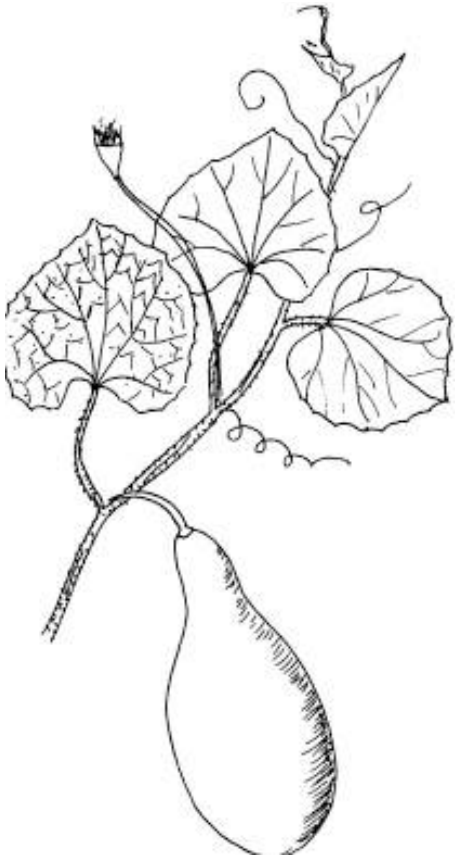
Bottle gourd

Tok Pisin: Botel **Scientific name:** *Lagenaria siceraria*

Tok Ples names:

Huli - bagwa	**Foi** - baru'u	
Mendi - pe hipap	**Kewa** -	
Wiru - kiwa	**Duna**	
Imbongu – mingi		

The Bottle gourd plant



This plant is in the pumpkin family. It can climb over logs by attaching the tendrils that grow out of the stem near the leaf. The leaves are large and have soft hairs especially underneath.

The plant produces male flowers first and these are on long stalks. These don't produce fruit. Further along the stalk female flowers on short stalks are produced. If these are pollinated by pollen carried by insects from the male flowers then fruit will be produced.

The seeds are brown and in the light green pulp of the fruit. The shape of the fruit varies.

Where are bottle gourds grown?

Bottle gourds have been grown for thousands of years in Africa, South America and are also grown in India, China and many Asian and Pacific countries.

They are also grown in many areas of Papua New Guinea.

In the Southern Highlands Province they are common in some areas such as the Upper Mendi Valley, but are grown sometimes in most places.

How does a bottle gourd grow?

It grows quickly and may start to flower 2 months after sowing the seeds.

When fruit start to develop the vine mostly stops growing. If the fruits are removed growth of the vine continues.

Young fruits can be ready for harvesting about 3 months after planting.

Young fruits when harvested will only keep for a very short time of about 1-2weeks.

Diseases

Bottle gourd leaves can get a white powdery type of growth over the leaves. This is due to a powdery mildew fungus. Sometimes as well the leaves and plant can die off early with leaves turning brown. This is called anthracnose. Both these diseases are less if plants are well staked up so that leaves dry quickly after rain. Also some kinds of bottle gourd get less damage.

Diseases	**Fungal cause**
Powdery mildew	*Oidium sp.*
Anthracnose	*Glomerella cingulata*

How do you grow bottle gourds?

The seeds are light brown colour and look like this.

They need to be spaced about 1metre apart.

They need to be in a sunny position so should not be put under yar trees or in shady places.

Preferably they should be allowed to climb over a trellis or logs so that the wind can dry the leaves quickly after rain.

The soils need to be fairly fertile because bottle gourds grow rapidly. Therefore they should be in newer gardns or in soil where the fertility has been built up.

They are killed by frost.

How to use bottle gourds, and their food value

Normally the young bottle gourd fruits are eaten as a boiled vegetable.

Sometimes the seeds are used in soups.

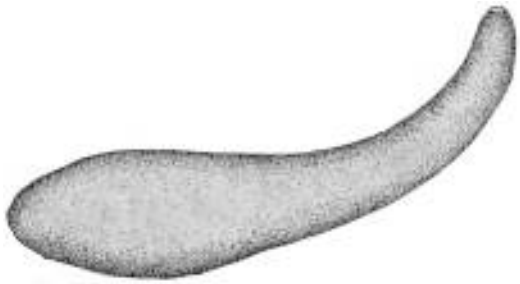
The young leaves are also eaten in some places.

Some kinds of bottle gourds can have a bitter taste.

The bottle gourd is a nice addition to the diet but it has little food value. The amounts of different food nutrients in 100 g portion of the part that is eaten are:

	Moisture %	Energy cals	Protein g	Calcium mg	Iron mg	proVitA µg	provitC mg	Zinc mg
Seed	97.0		0.2		0.1			0.2
Fruit pulp	93.0	88	0.5		2.4	25	10	
Leaves	83.0	180	4.4		7.4			

The mature fruit are dried and cleaned and used as containers. They make very good bottles and containers for seeds and other things.



Breadfruit

Tok Pisin: Kapiak **Scientific name:** *Artocarpus altilis*

Tok Ples names:

Foi - ugi	**Kaluli** - silem
Hewa -	**Onobasalo** - siliman
Pole - sika	**Etoro** - sirama
Samberigi - balape	**Hawalisi** - kapamu
Podopa - sika	**Fasu** - sinima

The breadruit tree

The breadfruit tree is a large tree often up to 15 or 20 metres tall. It has large, rough leaves that vary in how much they are divided around the edge. It produces male and female flowers separately but near each other on the same tree. It has a white sticky sap that leaks out from damaged parts of the bark.

Where is breadfruit grown?

The breadfruit tree is grown not only in Papua New Guinea but also in a number of other Pacific Island countries. It has also been taken to a number of other countries such as the West Indies.

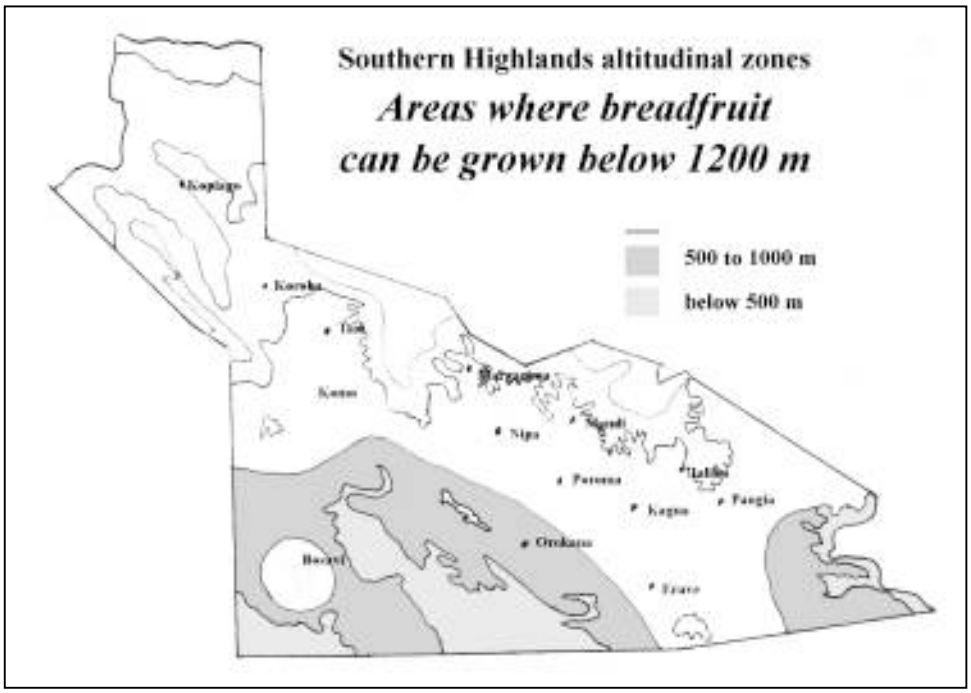
There is a famous story about one of the early explorers who tried to take a shipload of breadfruit trees to the West Indies. All the men on the boat refused to sail the ship any further so the crew were put off the boat on a small Pacific Island called Pitcairn.

But the breadfruit that is most common in the Southern Highlands is fairly different from the breadfruit that is grown on the coast and in other Pacific countries. This is because the people in areas like Lake Kutubu have picked out breadfruit that are full of seeds. It is these seeds which are eaten.

A breadfruit from Lake Kutubu looks fairly different from the breadfruit that many coastal people know. The outside of the Kutubu breadfruit has a lot of soft pointy spines all over the fruit. The breadfruits on the New Guinea islands have fruit with small rounded lumps all over them. The picture on the front is of a coastal breadfruit. The drawing below is a bundle of Kutubu breadfruit with some of the seed taken out and put in a bowl.

Breadfruit can be seen growing up to about 1200 metres altitude above sea level. It is not common at 1200 metres but becomes fairly common at places lower down.

The areas of the Southern Highlands Province that are below 1200 metres altitude are shown on this map. It is people in these areas that have breadfruit.



Breadfruit seeds

A breadfruit seed weighs about 5 grams and is about 3 or 4 centimetres across.

A seed looks like this drawing.

Growing breadfruit

Most of the seeded breadfruit is grown from seed. The seeds are often self sown by birds and bats. These trees just come up naturally. Trees are also planted by people and some trees are transplanted from where the seeds grew naturally. Normally seeds should be planted fresh before they have dried out.

Breadfruit can be grown from root cuttings and this method could be used if it were important to maintain a good kind of tree. This is the method used for the seedless types.

People at Kutubu have several different named varieties of breadfruit. These seem to continue to produce a similar variety of tree even when grown from seed.

	Moisture %	**Energy KJ**	**Protein mg**	**proVitA µg**	**proVitC mg**	**Iron mg**	**Zinc mg**
Fruit	74.4	506	1.5	4	25	0.4	0.2
Leaves							
Flowers							
Seed	56.5	799	7.4	26	6.6	3.7	0.9

Cassava

Tok Pisin: Tapiok **Scientific name:** *Manihot esculenta*

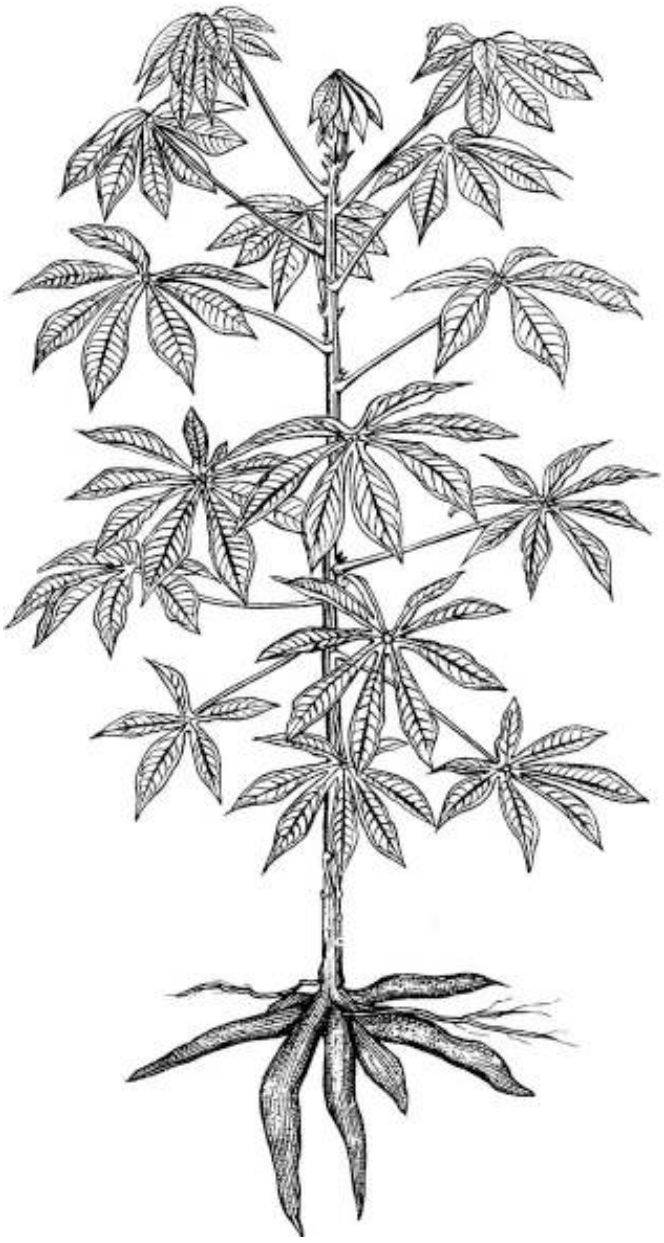
Huli -	**Foi** – Ira agira	**Onobasolo** - Isaburu
Mendi - Tapiok	**Hewa** -	**Etoro** -
Kewa – Kevera bira	**Pole** - Manita	**Hawalisi**
Wiru - Oporaiyo	**Samberigi** - Manita	**Fasu** -
Duna - Irepuye	**Podopa** – Nimake	
Imbongu - Oprai	**Kaluli** – Isiapuru	

The cassava plant

Cassava has been introduced to Papua New Guinea and to the Southern Highlands. It has become widespread because it is easily grown and requires little weeding, and will grow on a range of soils and in a range of climates. It also suffers little from pest and disease damage at present in Papua New Guinea.

Cassava has a long woody stalk with leaves that are divided like the fingers of your hand. The width and shape of these leaflets varies between the different varieties. The leaf is on a long leaf stalk that can be coloured red or green. Where the leaf falls off there is a raised leaf scar on the stem.

Below the ground several long fattened roots form. These continue to increase in size and store starch as the plant matures.



Planting cassava

Cassava is planted from sections of the stalk. Sections about 15-20 cm long of the more mature woody stem are cut and stuck into the ground. They can be completely buried or put at almost any angle and it affects the growth little. Soon roots form and leaves start to sprout from the stalk.

It is not necessary to dig a hole to plant cassava and on many soils where the soil is loose it can be planted without digging the soil first. Cassava does not suit waterlogged soils and preferably they should not be too shallow or stony.

Cassava grows best in the tropical lowlands but will grow up to about 1800 metres above sea level. Once the cassava plant is established it can withstand fairly long periods of drought so is useful to have in seasonally dry areas.

Cassava can be planted at any time of the year but to get started it needs moisture so is often planted near the beginning of the wet season. Because cassava can still grow satisfactorily in poorer soils it is often put last in a rotation after others crops have already been grown on the piece of land.

Cassava takes about 10 to 12 months to produce mature tubers in the lowlands although some varieties produce a smaller yield earlier. The plants can be left growing and the tubers stored in the soil for considerable time. Once the tubers have been dug they do not keep for more than a few days.

Cassava as food

Cassava, like a number of other tropical crops contains large amounts of a poisonous chemical called hydrogen cyanide. It is because of this poison that commonly in coastal areas wild unused cassava plants can be seen growing along roadsides and riverbanks. These kinds are too bitter to use. All cassava contains this chemical but some kinds contain larger amounts. It is because of this chemical that it is important to cook cassava well. The chemical gets destroyed on strong heating.

Cassava tubers are a starchy energy food but are lower in protein than some other root crops. The leaves however are very high in protein so the young leaves are good quality food providing they are well cooked.

Food value per 100 g edible portion

	Moisture %	Energy KJ	Protein mg	proVit A µg	proVitC mg	Iron mg	Zinc mg
Tuber	62.8	625	1.4	30	15	0.23	0.48
Leaves	82.0	382	7.1	11775	275	7.6	

Cassava tubers can just be baked in the ashes or boiled in water. Often people grate the tuber and make cassava cakes mixed with some coconut milk.

Castanopsis chestnuts

Tok Pisin: no name. **Scientific name:** *Castanopsis acuminatissima*

Tok Ples names:

Huli - pai	**Hewa** -	**Etoro** -
Mendi - pe	**Pole** - pai	**Hawalisi** -
Kewa -	**Samberigi** -	**Foi** - bai
Wiru - ka wongo	**Podopa** -	**Fasu**
Duna -	**Kaluli** -	**Imbongu** -
Onobasolo -		

The Castanopsis chestnut tree

This tree grows up to 40 metres tall and it can have a trunk 1 metre through at the base. Most trees have several suckers growing from their base and the roots of the tree are close to the surface.

The male and female flowers occur separately but they both occur on the one tree.

The tree has flushes of growth with new leaves having a slightly reddish colour.

The nut has a spiky type of covering around it and as it ripens this peels back and the nut falls. The nut is pointed, brown and slightly hairy. It is about 1.5cm long and has two large "seeds" inside.

Where do these chestnut trees grow?

They grow throughout Papua New Guinea. The most common place is between 1100 and 2300 metres above sea level but they can occur down to 500 metres in many places and are at the sea level in the South Coast of New Britain. Some people have suggested that they grow down as far as the afternoon clouds commonly come down.

Often these chestnut trees are more common on the boundary between the grassland and the forest. They form a thick covering of leaves that stops many smaller plants from growing underneath. As well they commonly grow in groups or clumps made up only of chestnut trees. From planes, these Castanopsis forests can be picked out because they have a distinctive yellowish brown colour. Under the trees there is usually a thick layer of fallen leaves.

Growing Castanopsis chestnuts

The seeds grow easily. Self-sown plants can often be found under large trees. These can be transplanted to where you want to grow a tree. Or you can set up your own nursery by planting some seeds and then transplanting them when they are big enough.

Although suckers are common near the base of trees they do not grow easily.

The chestnuts

A nut is quite small. One nut weighs about 1 gm and the edible seed inside weighs about 0.5g.

Small numbers of the nuts are eaten raw by children.

Mostly the nuts are cooked and eaten. If small amounts are available they are boiled in a container. If large quantities are available they are mumued. Cooked they taste like rice.

Cases have been reported of mouth ulcers and anaemia after people have eaten a lot of raw nuts. It is therefore safest to cook them.

Pigs like the nuts very much and in some areas such as Pangia people take their pigs out and tie them up under the trees in the bush during the nut season.

The tree as timber

Foresters call the tree Papua New Guinea oak because it is in the oak family and the timber looks like oak. It is a very valuable timber. The timber is hard and posts last a long time. People like it for house posts. The bark is used for walls, for insulation.

Chinese taro

Tok Pisin: Singapo; taro kongkong **Scientific name:** *Xanthosoma sagittifolium*

Tok Ples names:

Huli - lamba	**Kewa** - tabul	**Imbongu** - me
Mendi - boli ma	**Wiru** - kewami	**Pole** - ma
Mendi- moa sangaru	**Duna** - ta	**Samberigi** - dalo
Podopa - taro	**Kaluli** - fe/wono	**Etoro** - ru umabe
Foi – yafanei		

The Chinese taro plant

This plant looks a bit like taro tru but the leaves are bigger. The leaf is also divided near where the leaf stalk and blade join and there is a distinct vein around the edge of the leaf.

Under the ground the plant produces a ring of small corms around a large central stem or corm. It is these that are eaten.

These taro plants can grow up to 2 metres tall although an average plant is probably only a metre tall.

Where does Chinese taro grow?

Chinese taro will grow well from sea level up to about 1600 metres above sea level. Sometimes it is seen growing at higher places than that, but it doesn't produce very well.

Chinese taro is one of the newer taros to Papua New Guinea and it is still being introduced to some areas of the country. In the Southern Highlands it was brought in by the first people that landed at Lake Kutubu.

People in the lower areas of the Southern Highlands use Chinese taro very commonly. At Kutubu, Erave, the Kerabi Valley and similar lowland areas it is one of the most commonly used root crops.

Chinese taro is suited to high rainfall areas.

How is Chinese taro planted?

Chinese taro is normally planted by using the top piece of the main central corm or stem. It can also be grown by using the small side corms; or pieces of the corm can be used as long as they have some buds on them.

They can be planted at any time of the year but in dry areas the middle of the dry season should be avoided. Plants are spaced at varying distances but there is often about 0.9m x 1.5m between plants.

What conditions does Chinese taro like?

Chinese taro grows better in good soils especially ones with plenty of nitrogen. But is can be grown in relatively poor soils and still give a satisfactory amount of food.

This taro like most other taro family plants can also be grown in light shade. It is often grown near bananas and other taller plants.

The places where it has become a major crop mostly have a deep soil that has been washed there by water (alluvial) and a well-distributed rainfall. In these places it is a very easy crop to grow and requires very little maintenance or replanting.

When is the food ready and how is it harvested?

Sometimes a crop of corms can be harvested after 7 or 8 months but often plants take up to one year to grow a good crop. Where plants are on hillsides the corms are often harvested without actually digging out the whole plant. The soil is carefully dug away from the plant and the small corms are broken off the parent plant. The main stem is then covered to produce a new crop.

In areas like Kutubu and Erave, Chinese taro gardens stay in the same place for many years and corms are just harvested with only occasional or irregular replanting.

The corms will store reasonably well under dry cool well ventilated conditions. The corms will also remain in good condition if they are left growing in the ground and just harvested when needed.

Chinese taro as food

Mostly only the young corms are eaten. The main stem or corm can be eaten but often it contains oxalate crystals so that it burns the throat.

The young leaves can be boiled and eaten as an edible green or kumu.

Some idea of the amount of different nutrients that are contained in a 100 gram portion of the part that is eaten are given in this table.

	Moisture %	Energy cals	Protein g	Calcium mg	Iron mg	proVitA µg	provitC mg
Corms		**70-77**	**1.3-3.7**				
Leaves		**2.4-4.1**					

The corms are mostly peeled then boiled or roasted. Many people do not like Chinese taro as much as some of the other root crops but they grow and use it because it is easy.

Pest and Disease

Chinese taro suffers little from serious pest or disease problems. Sometimes the corms are damaged by taro beetles or rats. Sometimes the leaves are attacked by small sucking insects such as coconut scale and cotton aphid.

Corm rots, especially during storage, can be a problem if corms are damaged or poorly stored.

Chinese taro does not get the taro blight disease that is causing so much trouble with taro tru. But it can get some fungal leaf spots.

But because at present Chinese taro does not suffer serious pest and disease problems it should not be assumed that problems cannot occur. Root rot problems have occurred both in Ghana and East New Britain. These problems arose where soil fertility was low, plants were continuously replanted in the same area and a fungus such as *Corticium rolfsii* attacked the roots and virus like symptoms showed up on the leaves. Plants died.

What signs does a plant show when it is short of soil nutrients?

When nitrogen is in short supply plants are small with pale green leaves and short leaf stalks. Growth is slow.

Phosphorus shortage also makes plants small and growth slow but the leaves remain dark green.

Magnesium shortage results in a bright orange colour developing between the veins. The leaf dies.

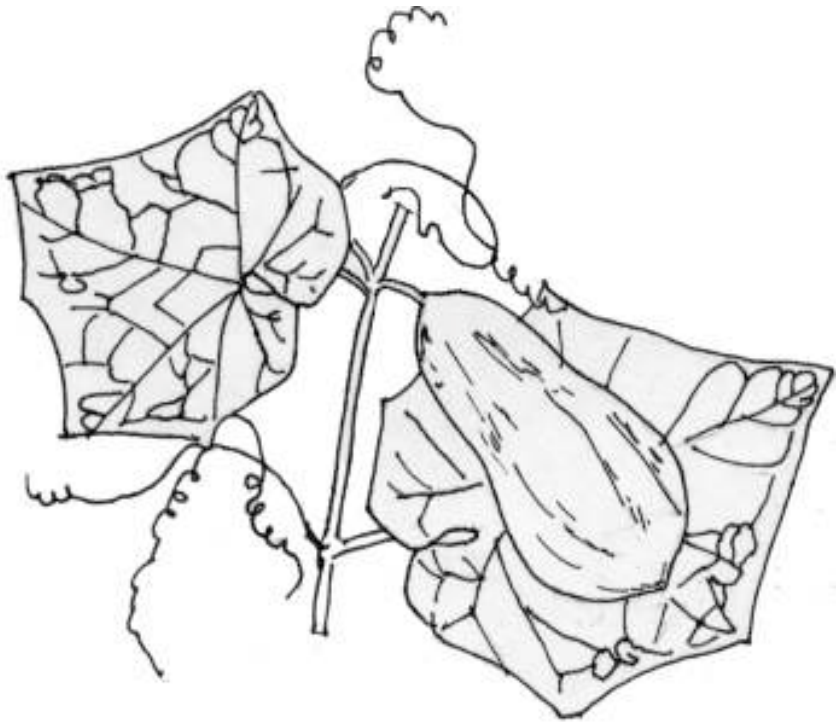
Calcium shortage causes old leaves to be thick and leathery but young leaves are small and twisted with dead and pale patches.

Choko

Tok pisin: Sioko **Scientific name:** *Sechium edule*

Tok Ples names:
Foi - soga sai

The choko plant



The choko plant belongs to the pumpkin family. The vine on which the leaves and fruit are produced can grow quite long. It can be up to 15m long. As well it has strong tendrils that can attach to fences and trees so that the plant can climb well.

The choko leaves are about 15-20 cm across and have a rough feel.

The choko fruit is produced in the angle where the leaf joins the vines. Fruit can be up to 20cm long and they are rough or irregular shaped on the outside. There are white and green fruited varieties. Some fruit have sharp spikes on the skin. Inside the fruit there is one seed about 4 cm long.

A choko plant produces a large thickened root tuber and the plant can regrow from this tuber and go on growing year after year.

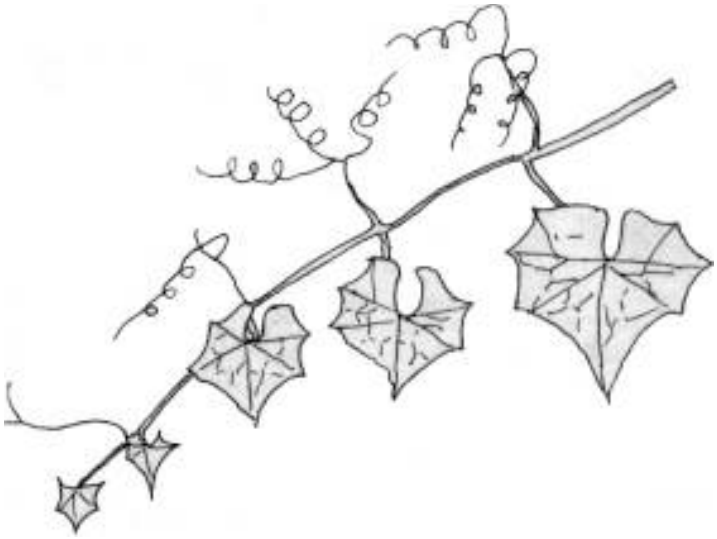
The importance of chokos

Although choko is a plant that was introduced to the Southern Highlands Province only in recent years it has become very popular and widely used in some areas.

Chokos will grow from sea level up to at least 22oom altitude. but at altitudes of about 800 to 1200 metres they grow particularly well and very easily. Therefore people like the Foi near Lake Kutubu, the Pole at Erave and the Podopa near Woposali have adopted choko tips as one of their main edible greens. In most of these areas the soft fleshy fruit are not particularly popular and are only

eaten occasionally. Also the large underground tuber that is edible has been tried by many people in these areas, it is not liked very much. The underground tuber is something like a yam but is softer and it is not eaten often.

Choko tips of the type that are eaten.



A choko fruit

Planting chokos

The choko fruit has one large seed inside. But the seeds cannot be dried out at all or it won't grow. Therefore the whole fruit is planted.

A choko fruit cut in half showing the seed inside.

Often chokos start to develop shoots and roots while they are still attached to the original plant. These eventually fall off and continue growing if they fall on soft moist dirt.

A choko fruit growing roots and shoots.

If the fruit is planted it is planted on its side and only lightly covered with soil.

Choko plants can be grown from cuttings of the vine.

In areas where chokos are important they often just keep growing from the original plants of from fruit that falls naturally. Therefore near Erave and Kutubu large choko gardens can be seen where people mainly only ever go to harvest and rarely replant.

Chokos need some support to climb over. This is normally most cheaply and easily done by planting it near a fence, tree or logs.

Production

Chokos need a reasonably well drained soil. But they can be grown under shade. In the lower altitude hotter places it seems as if shade is important for growing good chokos.

Plants take about 4 months from planting until fruit are produced.

Fruit can weigh 400 to 500 grams.

Tubers of 5 kg weight have been recorded.

Chokos as food

Normally the leaf tips, the underground tuber and the fruit are all cooked before eating. Sometimes the young seeds are eaten.

In 100 grams of the part that is eaten choko has the following amounts of nutrients.

	Moisture %	Energy cals	Protein g	Calcium mg	Iron mg	proVitA µg	provitC mg
Fruit	**89-92**	**6-8**	**0.8-0.9**	**10**	**0.4**	**650**	**20**
Leaves	**89**	**25**	**4**	**60**	**1.4**		**25**
Roots	**79**	**17-23**	**2**				

This means that the leaves are good food, the tuber is quite good and the fruit are poor for providing nutrients for people.

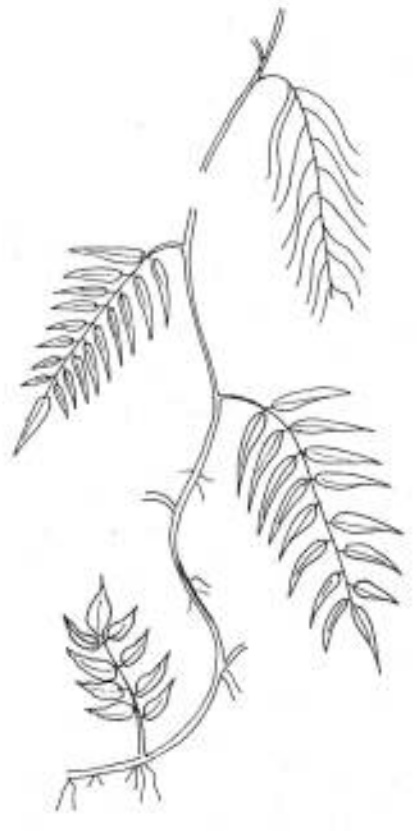
Climbing swamp fern

Tok Pisin: no name **Scientific name:** *Stenochlaena palustris*

Tok Ples names:

Foi	tunane sai
Kaluli	sa
Podopa	orare

The climbing swamp fern



It is a climbing fern with a thin smooth rhizome that climbs up sago palms and tree trunks. The fronds have several leaflets and they are often red in colour. The fertile fronds are thinner than the other fronds and they are produced at the top of the plant.

Where does it grow?

This fern grows in the lower areas of the Southern Highlands and in other coastal areas of Papua New Guinea. It also grows in other warm countries. It likes to grow in a warm, waterlogged, partly cleared forest site. Therefore it is suitable and common in sago type places. It cannot stand frost.

If you want to it is easy to grow from spores.

How is it used?

The young shiny leaflets are picked and cooked and eaten.

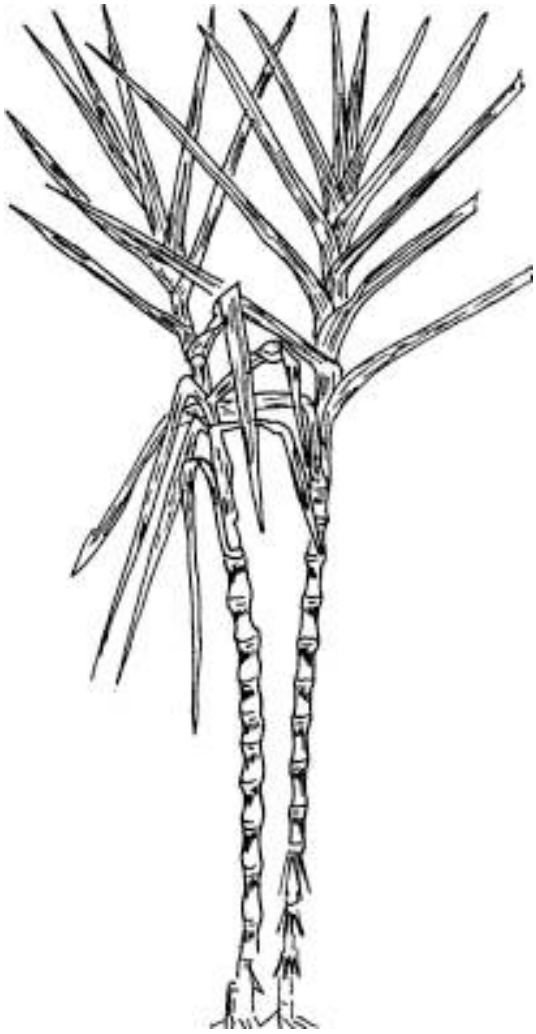
Coastal pitpit

Tok Pisin: Pitpit **Scientific name:** *Saccharum edule*

Tok Ples names:

Huli -	**Mendi/Poroma**- olomu	**Pole** - kuni
Samberigi- honi	**Podopa** - we	**Kaluli** - ol
Kewa -	**Wiru** - aua	**Duna** -
Onobasalo	**Teoro** - ode	**Imbongu** -
Hawalisi - anamu	**Foi** - gebia	**Fasu** -
Hewa -		

The pitpit plant



The pitpit plant looks like sugarcane to which it is related. Normally the stalk is thinner than sugarcane.

It can grow up to 3 metres high and produces suckers near the base so that normally a clump is produced.

At one season of the year it produces a seed head or flower that remains inside the top of the plant and is the part that is eaten.

Pitpits

In Papua New Guinea in Tok Pisin, several tall grass plants are called pitpit. Two of these are grown in gardens to be eaten as food. One of them is like sugarcane, it tends to grow at lower altitudes and it is therefore often called coastal pitpit or lowland pitpit. It is also sometimes called long pitpit because it is a taller plant. Its scientific name is *Saccharum edule* that means the sugarcane grass that can be eaten. It was given this name by a man called Hasskarl in the year 1842. This is the pitpit that this article is about.

The other pitpit that is grown for food is often called highland pitpit or short pitpit because it is a shorter plant and it grows better up in the highlands. Its scientific name is *Setaria palmifolia* and it is described in a separate article.

Occasionally the young shoots are eaten of the pitpit that is used for fences.

Where is coastal pitpit grown?

Coastal pitpit is grown throughout Papua New Guinea from the sea level up to about 1700 metres altitude.

It is also grown in some other countries. It is grown in the Solomon Islands, Vanuatu, and Fiji and also in Indonesia.

How do you grow pitpit?

Pitpit is grown by taking cuttings of the cane and sticking them in the ground. Mostly cuttings about 30-50cm long are used and they need to be planted in a moist soil. They easily dry out so need to be planted soon after cutting. These cuttings soon develop roots and produce a number of shoots so that a clump of canes grow.

Coastal pitpit stalks can be planted at any time of the year. It takes 6-9 months from planting till a crop is ready to harvest. But the time of flowering is coastal pitpit is controlled by the sun. Early in the year about February to March most plants develop a thickened clump of leaves at the top. When these are broken off and opened by removing the outside leaves the very fine yellow unopened flower is seen. It is this flower that is eaten

An easy way some people plant coastal pitpit is to cut a long pitpit stalk. Then at the places where they want to plant it in the garden they stick the stalk into the ground and chop off the longer top piece with a bush knife. They cut it so that about 15 cm is under the ground and 15 cm left sticking out of the ground. The longer piece is then stuck in the ground in another place and cut off again.

If the pitpit flower is not picked when it is ready it starts to go brown due to a fungal rot.

In places where the soil is very fertile the canes can be cut off after harvest and new shoots will sucker out around the base and grow to produce another clump.

Pest problems

Coastal pitpit is attacked by some insect and disease problems.

The most common and most important insect pest of coastal pitpit is borers boring into the canes. These are normally the larvae of the same moths that bore into sugarcane. Several different moths cause this damage because there are different moths in different places throughout the country. In the Southern Highlands it mostly seems to be a small white grub with black spots along its back. Its scientific name is *Chilo terrenellus.* If it eats its way up the stalk till it damages the growing point it can kill the stalk.

A number of different fungal leaf spots can be seen growing on the leaves of pitpit. They are mostly the same as the fungal diseases that grow on sugarcane. It is not known how important they are to growing good pitpit.

Coastal pitpit as food

In 100 grams of the part you eat there are the following amounts of nutrients.

	Moisture %	**Energy KJ**	**Protein g**	**Calcium mg**	**Iron mg**	**proVitA µg**	**provitC mg**
Flower	**92.4**	**120**	**4.3**	**25**	**2**	**0**	**35**

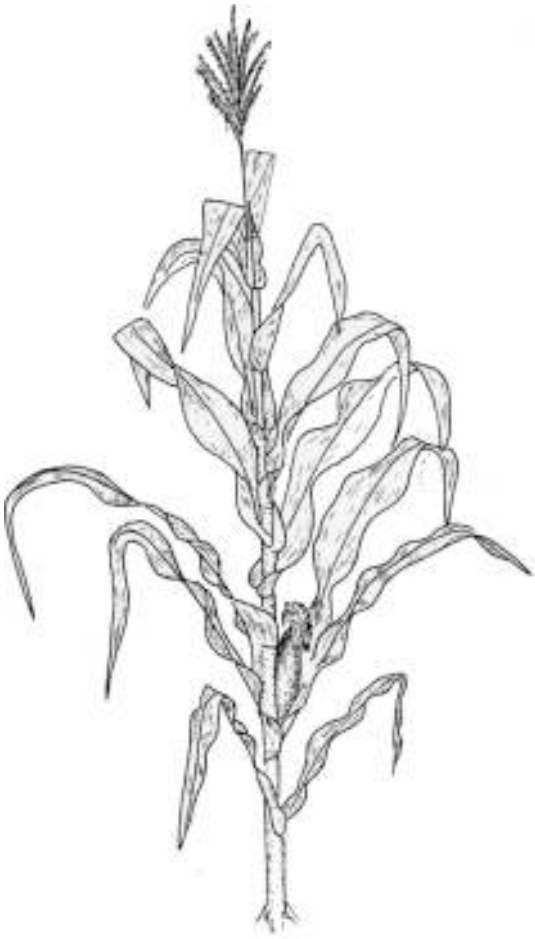
This means that coastal pitpit is only moderately good at providing energy but it is quite high in protein. It is therefore especially good as a body building food and can make an important contribution to the diet.

Young coastal pitpit flowers can be eaten raw. But they are fairly dry. In coastal areas one of the favourite ways to eat this pitpit is fried in grated coconut milk. The pitpit can be baked in its leaves over an open fire. Or it can be boiled or fried along with other greens.

Corn

Tok Pisin: Kon **Scientific name:** *Zea mays*

The corn plant



The corn plant is a grass family plant that can grow up to 2 or 3 metres tall. It has prop roots near the ground and these help to hold the plant up.

When it is nearly full grown it develops a cob (female flower) in the place where the leaves join the stem. It also grows a male flower at the top of the plant. When the cob is mature, the plant dies.

Sometimes corn is called maize. This is really just another name for the same plant. But there are special types of corn like sweet corn and popcorn.

The clump of corn seeds that grows on a stalk is called a corncob or an ear of corn. As it is growing, a stringy group of hairs comes out the top of the cob. These are called the tassel.

Getting corn seed

One of the important things for growing good corn is to get some good seed.

Corn has two types of seed. One is called hybrid seed and it can produce very well if it is grown under very good conditions. But you can't save your own seed to replant. This is because the

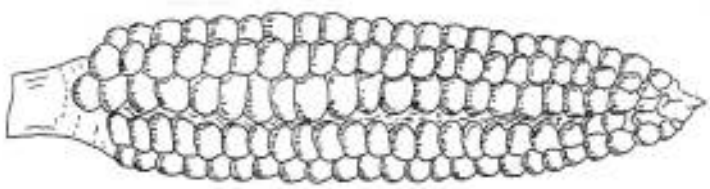
plants which come up may not be very good plants at all. Hybrid seed needs to be produced by a specialist. So you must buy hybrid seed from a seed producer.

The other kind of corn seed is called open pollinated. It is the kind most people in Papua New Guinea use. They save their own seed to replant. But most people in village gardens run into a problem when they save their own corn seed. The plants gradually get smaller and smaller until only very small plants with very small cobs are produced. These small cobs are nice and sweet but they don't provide much food. The reason for this is that in a village garden there is often only a few corn plants. Also the plants are often widely spaced and people just save one or two cobs to use for seed. So what happens is that the corn plants inbreed. Instead of pollen going around between several plants and then seed being saved from a few different cobs the pollen just goes to the flower on the same plant or to a few plants close by. So the seed becomes inbred and produces smaller plants.

The way to stop this is:

1. Save seed from a large corn garden. (Over 200 plants that are getting ready at the same time and close together in the same garden.
2. Collect your seed from a few different cobs and mix the seed together before planting.

If these two rules were followed when saving corn seed in a village a big improvement could be made in how much food is produced from corn plants.



A good corncob

As well as making sure that seed is looked after and collected properly, it is only sensible to start with a good type of corn that is suited to your area. Often the seeds that you buy in packets from stores have come from another country and is not suitable for Papua New Guinea. The Agricultural Officers have picked out some good kinds of corn for Papua New Guinea. You can get some seed from your didiman to start you off.

Planting corn

Corn needs fairly good soil. So there is no point in planting it in a fairly old kaukau garden. It can either be put in a freshly cleared garden or one where the soil fertility has been built up, such as around a house.

Most village people plant 2 or 3 seeds in the one hole. This is because they know that an insect called the black cutworm will probably eat off one or two, so one may survive. If all the plants grow and are not killed then the smallest plants are often pulled out. This is one way of dealing with seedling losses like cutworm damage. Some village people have found another way of stopping cutworm damage. They plant the seed and then put a bamboo container around it to protect it. People who have old fish tins use them for the same purpose after they have cut both the top and the bottom out of the tins.

A bamboo ring to protect young corn plants from cutworms.

The other thing that can commonly be seen is a person carrying a corncob and picking the seeds off to drop in the holes as they are made. This is the wrong way to mix and collect corn seeds and the reason has been explained above.

Why do corn leaves go dry?

Sometimes the leaves of corn, instead of remaining dark green, get dry brown marks. This can be either due to disease or due to the plant running out of the nutrients it needs to grow. (Old plants also turn brown naturally as they die off.) It is possible to learn to tell the difference between these marks.

Nitrogen

One of the commonest nutrients that corn plants run short of is nitrogen. A plant that is short of nitrogen has the older bottom leaves going dry. The dry brown mark is a distinctive shape. It starts at the tip of the leaves and goes in a V shape down the centre of the leaves.

A corn leaf showing nitrogen deficiency

Potassium

Plants that are running out of the nutrient potash go dry and brown along the edges. Also the leaves may be a lighter green than normal and sometimes they are twisted. Cobs get thinner at the top end.

A corn leaf showing potash shortage

Phosphorus

It is not as easy to be sure of a plant that is getting short of the other important nutrient called phosphorus. Plants short of phosphorus are smaller and the leaves are bluish green with red marks. But some leaves can be naturally reddish blue and leaves can change to these colours for other reasons.

Diseases are different from these marks because a disease is caused by a small living thing actually growing on or inside the plant. The things causing disease are very small but it is often possible to see the marks due to the disease.

Diseases

In the Southern Highlands one of the commonest leaf diseases on corn produces long yellow to brown spots on the leaves. It is called corn leaf blight and is due to a fungus. Often the spots start as pale soft watery looking marks that turn yellow and later brown and dead. The spots can join and the leaf dies early. In moist weather these spots produce dark green spores (or "seeds") in the centre of the spots. These spores can blow in the wind onto other corn plants. Also they can stay alive on old corn plants for many months. Therefore it is important to move corn to a new or different garden to help avoid the disease. As well it is important to get rid of old corn plants, to use clean seed and to look for kinds of corn that get the disease less.

A corn leaf with spots due to corn leaf blight

Corn rust

Two fungi cause yellow or light red looking lumps on the leaves of corn. These diseases cause the leaves to get dry quickly and therefore smaller cobs are produced. getting rid of old diseased plants helps reduce the damage to new corn plants. As well, a lot of the corn seed given out by didimen throughout Papua New Guinea in the last few years is of kinds that get this disease less.

A corn leaf showing small raised red spots of rust

Corn also gets some other leaf diseases but these have not been seen very often in the Southern Highlands. White long stringy patterns on corn leaves can be due to downy mildew fungus, a virus or magnesium deficiency.

Corn blister smut

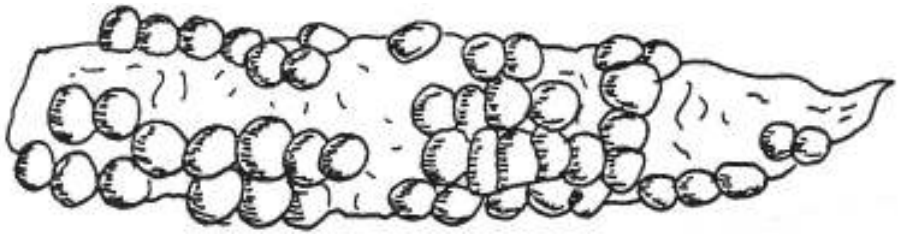
Diseases don't only get on leaves. One of the more serious fungal diseases that gets on corn in the Southern Highlands is called corn blister smut. It grows on the cob but can also get on the leaves. it causes large grey swellings and lumps on the corn cob. These lumps are filled with powdery grey spores and there is a silvery skin over them. It completely spoils the cob.

The spores can live in the ground for many years. This makes it hard to avoid the disease once it gets into an area. It can be controlled by using clean seed as the disease can be on the seed. As well it is important to pull out and burn any plants you see with the disease. Corn should also be planted into new or clean gardens.

A corn cob showing blister smut disease.

Sometimes corncobs can be poor for other reasons. Cobs can be harvested on which only some of the seeds have developed. This is because the other seeds were not fertilised by pollen. The reasons it was not fertilised are normally:-

1. There was not enough pollen around because plants were planted too far apart;
2. The silky threads of the tassel were not sticking out of the top of the cob by the time the pollen fell. This is mostly because the plant was not growing well enough.



A poorly pollinated corncob

Insects

Some of the insects that badly damage corn in other parts of Papua New Guinea do not seem to be a problem in most parts of the Southern Highlands. This includes the European corn borer and the corn earworm. Other armyworm caterpillars like the lawn armyworm only come in plagues occasionally.

The black cutworm is the grey or green caterpillar of a moth. The moth is brown on the front wings and yellow and brown on the hind wings. The caterpillars curl up and hide near the base of the plants of just under the soil during the day. Then at night they come out and chew off plants near ground level. One method of stopping them has already been mentioned.

A black cutworm caterpillar

The cutworm moth

Corn as a food

Most Papua New Guinea village people harvest corn from the gardens when it is in a fairly firm mature stage and eat it the same day. It is mostly roasted over the fire.

The food value of corn varies with the type of corn and its stage of maturity. An approximate value for corn as eaten in Papua New Guinea is below. It is the amount of different nutrients in 100 gms of the part eaten.

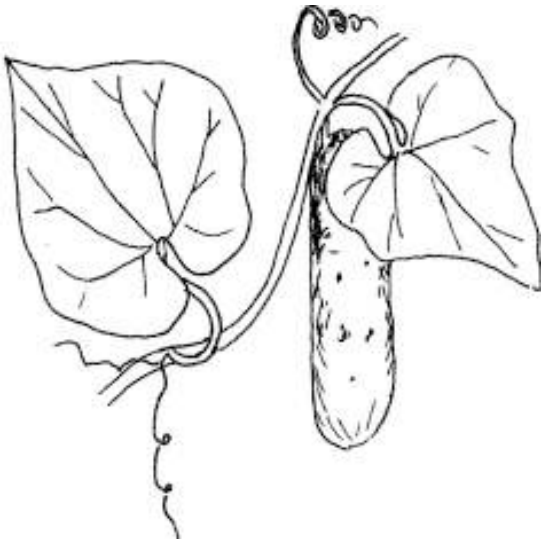
	Moisture %	**Energy cals**	**Protein g**	**Calcium mg**	**Iron mg**	**proVitA µg**	**provitC mg**
Seeds	**62.5**	**134**	**4.2**	**5**	**0.9**		

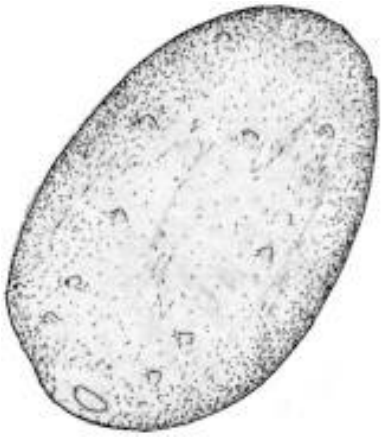
This means that corn is a food high in energy and quite high in protein. Corn should be included in the diet as often as possible because of this good food value.

Cucumber

Tok Pisin: Kukamba **Scientific name:** *Cucumis sativus*

Huli -	**Foi** -	**Onobasolo** -
Mendi -	**Hewa** -	**Etoro** -
Kewa -	**Pole** - Wasagu	**Hawalisi**
Wiru -	**Samberigi** -	**Fasu** -
Duna -	**Podopa** –	
Imbongu -	**Kaluli** –	





People in the highlands of Papua New Guinea claim that they have always had cucumbers. They maintain that they are one of their traditional foods. They have local names in Tok Ples languages. They are common and popular in most highland regions.

They are grown from sea level up to about 2200 m altitude.

Cucumbers are grown from seed and they are easy to grow. Mostly they are planted in new gardens when people have cleared and established a new garden. In many areas this is early in the New-year. So often cucumbers occur in large numbers.

Two or three seeds are sown with a spacing of about 1 metre square per plant but often they are intercropped with other plants. They are ready to harvest in about 6-8 weeks and produce about 10 fruit per plant.

People mostly eat them fresh for a snack in the garden.

Cucumbers suffer badly from mildew fungus on the leaves. Normally this means there are not enough tops for the young leaves to be eaten. The food value per 100 g edible portion is:

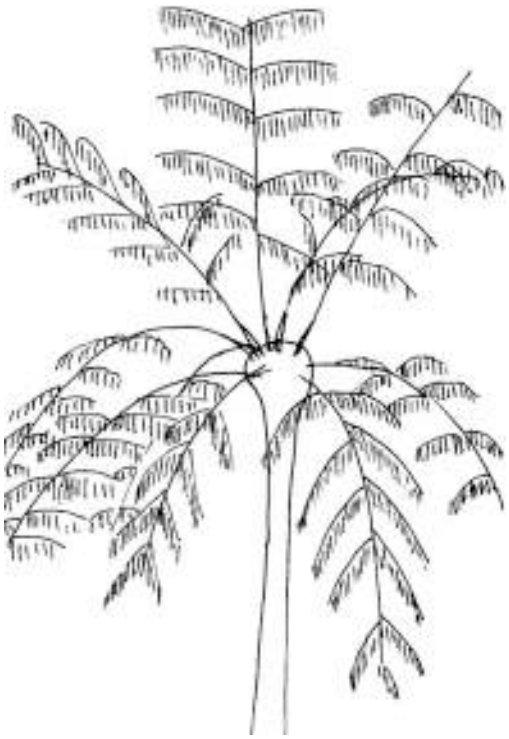
	Moisture %	**Energy KJ**	**Protein mg**	**proVit A**	**proVitC mg**	**Iron mg**	**Zinc mg**
Fruit	96.4	43	0.6	Tr	8	0.3	0.1
Leaves							
Seeds							

Cyathea tree ferns

Scientific names: *Cyathea angiensis*
Cyathea contaminans

Huli -	**Foi** -	**Onobasolo** -
Mendi -	**Hewa** -	**Etoro** -
Kewa -	**Pole** -	**Hawalisi**
Wiru -	**Samberigi** -	**Fasu** -
Duna -	**Podopa** –	
Imbongu -	**Kaluli** –	

There are at least 3 ferns that grow in the Southern Highlands and are used as food. They are mostly eaten with pig meat at pig kills.



Normally these tree ferns are not planted but are simply left and maintained when land is being cleared for gardens.

Dicliptera papuana

(Scientific name)

No common English or Tok Pisin name.

Tok Ples names:

Huli -	**Imbongu** - karamu
Mendi -Karint - kisomp	**Wiru** - (not eaten)
Mendi-Poroma -konsjola ma	**Foi** - garu baio
Kewa -	**Duna** -

The plant

This is a clumpy, much branched bush. Most people in villages recognise it as related to *Rungia.* It grows naturally along damp creek banks. It forms a leafy bush up to 1 metre high.

It produces flowers in clumps in the place where the leaves join the stem. The flower petals are blue.

There are small hairs on the leaves and stems. The stems have small grooves running along them.

A leaf tip of *Dicliptera*
drawn almost true to size

A flowering stalk
Flower with blue petals

How is the plant grown and used?

This plant is planted in gardens in some areas such as the Mendi valley above Mendi. In other areas such as near Lake Kutubu in the Foi area it is harvested from the wild but not planted. At Pangia the Wiru people never eat it.

It grows easily from cuttings of the stem. Normally a group of stalks are planted together to produce a clumpy bush.

The leaf tips are picked and cooked.

Ficus pungens

(Scientific name)

No common Tok Pisin or English name

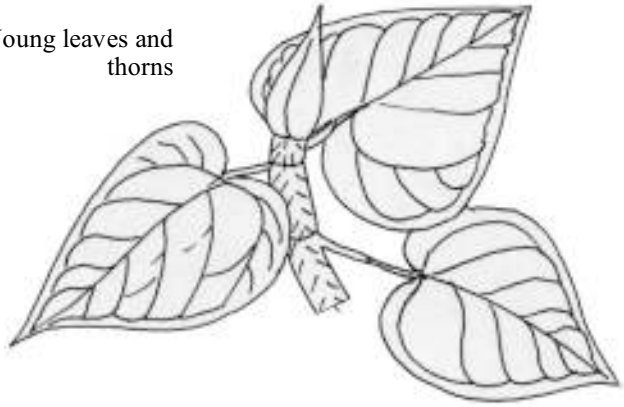
Tok Ples names:

Huli - hiyo, hoiyo	**Foi** - gofe	**Onobasalo**-
Mendi - wekima	**Hewa** -	**Etoro** - wek
Kewa -	**Pole** -wakia	**Hawalisi** -
Wiru - ongau	**Samberigi** -	**Fasu** -
Imbongu -	**Podopa** - huisi	**Duna** -
Kaluli - wek		

The *Ficus pungens* tree

This is a fig family tree and therefore has white milky sap inside. The other part of the scientific name "pungens" refers to the very sharp thorns that are on the small branches near the leaves.

Young leaves and thorns



It is a medium sized tree with large leaves about 25cm across. The young leaves are light green.

It grows small fruit on long stalks that hang down from the trunk of the tree. These small fruit are about 0.5cm across and are not eaten.

Small fruit hanging on stalks from the trunk

Where does the tree grow?

It only grows in the lower areas below about 1600 metres above sea level. It is common and used in areas like Tari, Poroma, Kagua and most of the lower areas. It mostly grows along the edge of rivers and beside drains and creeks. It mostly just grows naturally from seeds.

How is it used?

The young leaves are cooked and eaten. They are normally only eaten with pig at pig kills.

Highlands kapiak

Tok Pisin: Hailans kapiak **Scientific name:** *Ficus dammaropsis*

Tok Ples names

Huli -	**Foi** -	**Onobasalo** -
Mendi – Suar, Suar sur	**Hewa** -	**Etoro** -
Kewa - Mail	**Pole** -	**Hawalisi** -
Wiru - Elu	**Samberigi** -	**Fasu** -
Imbongu -Minibi	**Podopa** -	**Duna** - Anugu
Kaluli -		

The Highlands Kapiak plant

It is a fig tree. It grows to 9-13 m high. The large young leaves are eaten. The branches are strong and flexible and contain a milky juice. The tree has a single trunk without buttresses or aerial roots. It is often straggling. Seedling trees vary considerably in size of leaves and colour of young leaves and veins. The leaves are large. They can be 60-100 cm long. They are deeply corrugated with veins. The veins can be red or yellow. The fruit is large (15 cm across) and made up of large overlapping scale leaves. It ripens to a deep purple.

Where does Highlands kapiak grow?
Trees occur from 900 m to 2700 m but it is most common between 1600 and 1750 m altitude. It suits hardiness zones 9-11.

How do you grow Highlands kapiak?
Trees grow from seeds and are transplanted. Cuttings of branches do not normally establish.

Highlands kapiak as food
The young leaves are eaten with meat. The outside layer of the fruit is edible. The young fruit are boiled and eaten as a vegetable. In Papua New Guinea, leaves are fairly widely used at pig kills and for mumus in the highlands. Fruit are less widely eaten.

Highland pitpit

Tok Pisin name: Pitpit **Scientific name:** *Setaria palmifolia*

Tok Ples names:

Huli - teabu	**Imbongu** - moi	**Kaluli** - jun
Mendi - koir	**Foi** - wasia	**Onobasalo** - mafene
Kewa - pandi	**Pole** - paundi	**Etoro** -
Wiru- teiye	**Samberigi** - mini	**Hawalisi** - yeni
Duna - tabu	**Podopa** -seria	**Fasu** -
Hewa -		

The highland pitpit plant

This is a short, broad leafed grass family plant. The leaves have ridges running along their length. They also normally have a wrinkled section near the middle of the leaf. The leaf blade is short (30-40cm) and fat (6-8cm) and the leaves spread out along opposite sides of the shoots.

Normally a plant produces a clump of shoots due to both suckers near the base and buds growing from the side of the short stem.

A plant grows from 60cm to one metre tall.

Several different kinds of highland pitpit occur. These have different amounts of red, green and white colouring on the leaf and also where the leaves wrap around the stem.

It is the young tender tightly wrapped leaves inside the thickened base of the shoot that is eaten.

The wild relative from which the garden pitpit has been produced can often be seen growing in grassland around garden areas. It is a thinner plant often produces a flower and the young shoots are also eaten.

Where is highland pitpit grown?

Highland pitpit is common and an important food plant in many areas of Papua New Guinea.

It tends to be more important in the highlands. It grows and produces reasonably well between the altitudes of 400 and 2400 metres above sea level. It can be grown down to the coast.

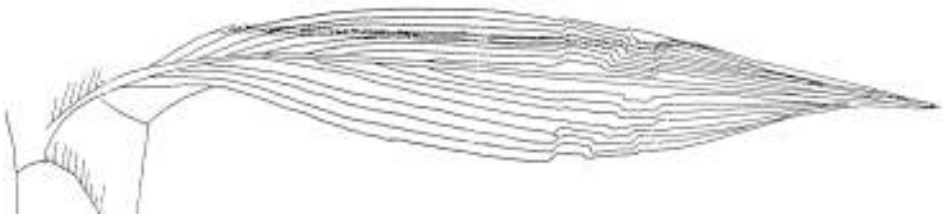
But Papua New Guinea is not the only country that grows this plant as food. It is grown in Fiji, Hawaii, Tonga and some other Pacific countries.

How do you grow pitpit?

It is grown by planting young shoots.

The young shoots are broken off the side of the plant. Shoots near the ground often have roots already growing on them so these shoots start growing more quickly. Portions of the stem can be planted because buds near the joints along the stem can produce new shoots.

This pitpit needs reasonably fertile soil and won't grow or produce well in old kaukau gardens. A leaf of a plant growing in good fertile soil is dark green.

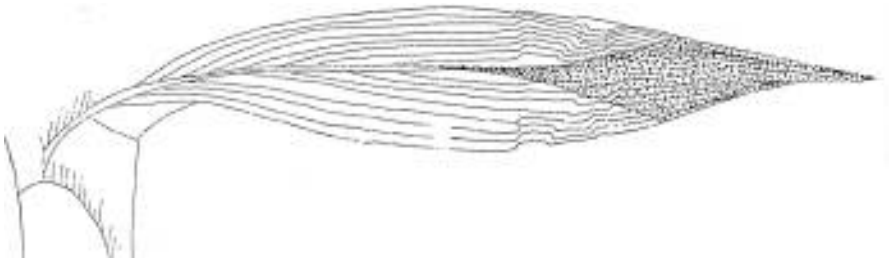


A normal, dark green pitpit leaf

Why are some pitpit leaves dry?

It is necessary to learn to tell the difference between a plant that is running out of nutrients (gris) and a mark due to a disease.

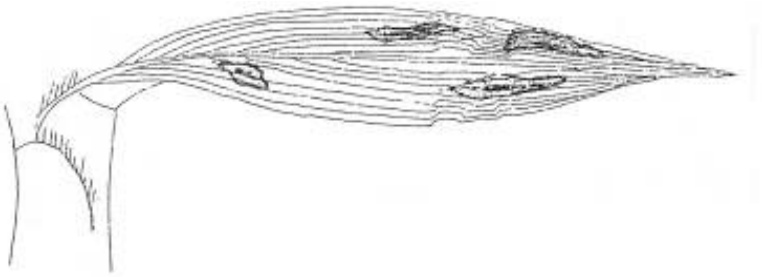
One of the commonest "dry" marks on pitpit is a leaf tip going dry and brown from the tip down. The dry mark extends in a V shape down the centre of the leaf. This is most likely nitrogen deficiency. It mostly occurs on older leaves and in older gardens.



A leaf going dry due to nitrogen deficiency

Sometimes leaves go dry along the edge. This is possibly potash deficiency.

Disease leaf spots can often be seen on pitpit leaves. The cause is most likely a fungus. The importance of these has not been measured. There appear to be two different types of leaf spots probably due to two different fungi.



The larger disease leaf spots look like this

Other fungal diseases also n on leaves. They are like small specks of tar that have been dropped on the leaf. They are due to another fungus but they don't appear to be important.

"Tar spots" on pitpit leaves

Two "rust" fungi have also been recorded on pitpit leaves.

Insects damaging pitpit

Borers get into pitpit and kill the shoots. These borers are mostly the larvae of the moths that bore into sugarcane and coastal pitpit. The amount of damage varies but it can sometimes be serious. A shoot of a plant that has been damaged by a borer goes dry and the shoot or whole plant can die.

Damage	Cause	Scientific name
Tar spot	Fungus	*Phyllachora sp.*
Rust	Fungus	*Uredo palmifoliae* Cummins
And	Fungus	*Uromyces leptodermus* Sydow
Leaf spots	Fungus	Probably fungi
Borers	Insect - moth	*Chilo sp.*

Wild highlands pitpit

In most areas in the highlands the wild relative from which the garden pitpit has been produced can be seen growing. Often it occurs along tracks and roadsides near creeks and in old garden sites. Most Southern Highlands people have a different name for this plant in their local languages. But they know it is the wild plant from which the better, fatter garden plant was produced.

The shoots of this plant are also eaten although they are mostly eaten raw by hunting parties and people walking through the area.

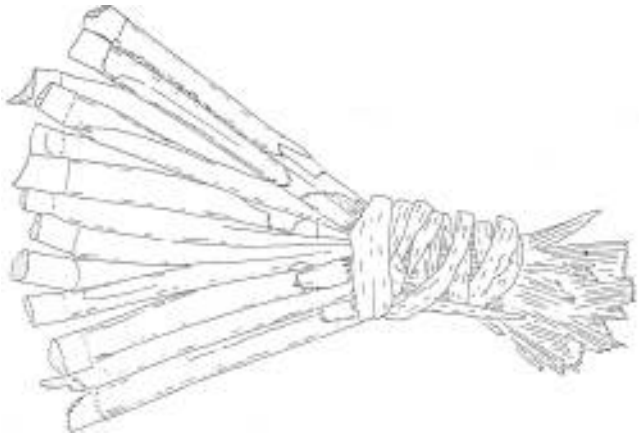
The plant also gets similar diseases to the garden variety.

Tok Ples names for wild highlands pitpit

Huli - embelali	**Imbongu** - pakal	**Onobasalo** -
Mendi - oba tago	**Foi** - medore	**Etoro** -
Mendi - tali tagur	**Pole** - ambu	**Hawalisi** -
Kewa -	**Samberigi** -	**Fasu** -
Wiru - ambu	**Podopa** -	**Hewa** -
Duna -	**Kaluli** - mufu	

Harvesting and use of pitpit

The young end and side shoots are harvested from pitpit plants. Sometimes these are tied in a bundle and sold in markets.



A bundle of pitpit shoots

The amount of the shoots that is eaten varies. The tough outside leaves are stripped off. These are normally fed to pigs.

Then the younger more tender inside of the shoot is eaten.

A shoot stripped for eating

At least in some of the higher places in the Province these young shoots are often eaten raw. But they can also be mumued in an earth oven or steamed in bamboo, or boiled or fried in a saucepan. Often they are eaten with a kumu called *Rungia.*

How much food is produced?

In trials between 8 and 18 kilograms of shoots have been harvested from individual plants over one year. These plants were spaced one metre apart. But only a third or less of these shoots were actually eaten as the outside portion was fed to pigs and the tender inside shoot eaten.

So a garden plot of pitpit of 10 square metres may produce between 25 and 60 kilograms of edible shoots.

Pitpit is often grown mixed with other crops in the food garden. it is also commonly grown in partly shaded places such as under yar trees. How much it produces in these situations is not known.

The food value of pitpit shoots

In a 100 grams portion of the shoots that are eaten there are the following amounts of different nutrients.

	Moisture %	**Energy cals**	**Protein g**	**Calcium mg**	**Iron mg**	**proVitA µg**	**provitC mg**
Shoots		**23-27**	**0.5-2.3**	**7-21**	**0.9-2**	**500**	**12-33**

(A 100g edible portion is about 5 large stripped shoots.)

This means that pitpit shoots are not very good as a means of getting energy and the protein content is probably higher than root crops like kaukau but not as good as most dark green leaves.

Nevertheless they are an enjoyable and reasonably nutritious food.

Job's tears

Tok Pisin: no name **Scientific name:** *Coix lachryma-jobi*

Tok Ples names:

Huli	hongo
Mendi	holo
Kewa	kola
Wiru	tiaku
Duna	nongo
Imbongu	kolgowa

The Job's tears plant

This is a grass that grows each year from seeds. It can be up to 2 metres tall. Near the ground it has thick roots that hold the plant up. It produces large seeds that turn grey as they get older.

Where it grows?

It grows wild in swampy places from sea level up to 2000 metres above sea level.

The seeds.

In many places the seeds are used for making necklaces. In the Mendi Valley the seeds are eaten regularly by children. In some other places the seeds are planted and the seeds used more commonly for food. The seeds are hard but they can be crushed and the flour collected. This flour cannot be used for bread unless it has other flour added because the bread won't rise.

The seeds store well, so they could also have some use as pig or poultry food.

Karuka

Tok Pisin: Karuka **Scientific name:** *Pandanus jiulianettii*

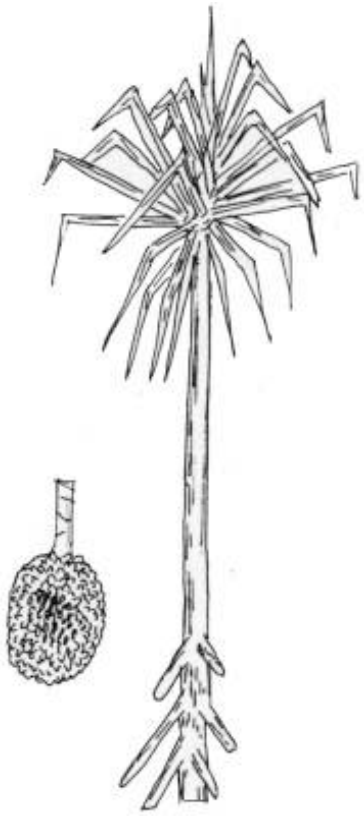
Tok Ples names:

Huli - anga	**Imbongu** - amo
Mendi - ank	**Pole** - maisene
Kewa -	**Wiru** - ama
Duna -	

Two species of pandanus are commonly used for the nuts that are eaten. They are karuka (*Pandanus jiulianettii* Martelli) and wild karuka (*Pandanus brosimos* Merr & Perry). At least 3 other species of pandanus are used occasionally in Papua New Guinea for edible nuts and marita pandanus is used for the long red fruits. The leaves of many other pandanus species are used for rain capes, sleeping mats, canoe sails etc.

This article is about cultivated karuka.

The karuka plant



The karuka tree is a tall palm like tree with a straight trunk and aerial prop roots at the base. Sometimes it branches near the top to produce 3 or 4 crowns of leaves.

The leaves grow in pairs opposite each other and they are twisted to look like a spiral going up the trunk. The leaves are long (3m) narrow, have spikes along the edges and are often bent at the tips.

The fruit is a round composite fruit 15 to 30 cm across which is made up of about 1,000 individual keys which contain the nut which is eaten.

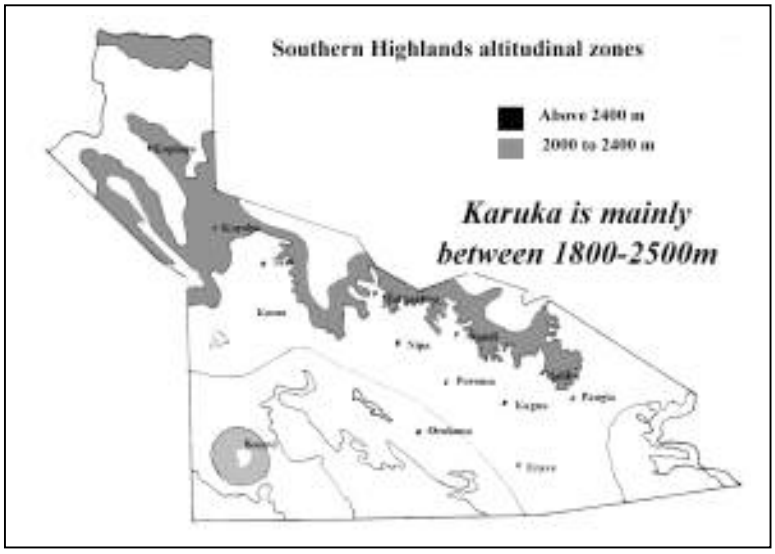
Karuka trees have male and female flowers separately on separate trees. Male trees produce a white flower but no fruit. They are not very common.

Where does karuka grow?

Karuka grows in several highland provinces of Papua New Guinea. It mainly grows at altitudes between 1800 metres and 2500 metres above sea level. Outside this range it often does not grow well.

Karuka is only grown in Papua New Guinea and the Indonesian province of Papua.

These areas for the Southern Highlands Province are shown on the map.



Southern highlands cultivated karuka zone

Within these areas, karuka has a special place where it grows best. Karuka needs fairly good soil fertility so it does best along the banks of small creeks; in the natural hollows that occur around the edges of hills, and around the edges of small clearings in the bush. Lots of karuka are seen out on knobs in the grassland but often these only bear small nuts.

Some areas produce good karukas, while karuka grows poorly in other places. In the Ialibu basin karukas don't do well, but out of Ialibu towards Pangia they grow very well. Near Pingirip in Upper Karint, karukas are grown in lines as boundary markers between garden plots.

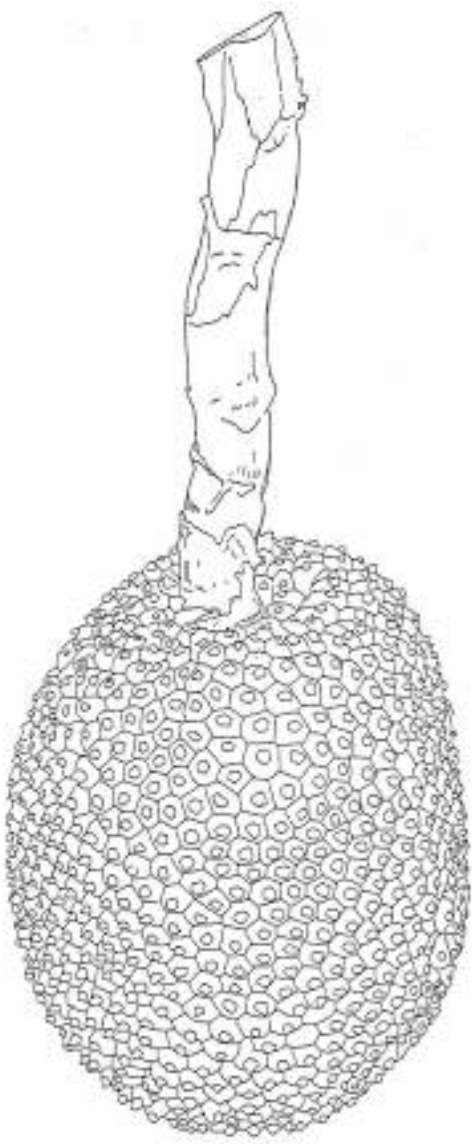
The karuka fruit and nut

One crown of leaves on the one branch of a karuka tree normally only produces one cluster of nuts (called a syncarp) during the one season. In fact, that particular branch normally only produces one bunch every second year.

On a branch that is about to bear fruit, the leaves are upright and clumped slightly together. The fruit bunch emerges from the centre of these leaves. It hangs close to the trunk amongst the dead hanging leaves. Large leaves (bracts) almost cover the fruit bunch while it hangs there.

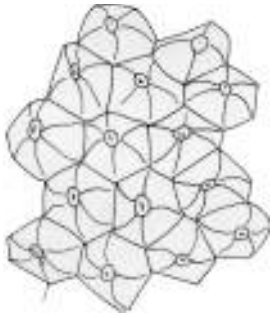
A fruit bunch hanging down from between the leaves and covered by dry brown leaves

While the fruit is being produced, the tree stops producing new leaves. A new sprout of leaves eventually shoots up in the centre of the clump and this is normally taken as a sign that the nuts are ready to harvest. The whole bunch is normally cut down with a bush knife. Often the tree has to be climbed to do this.



A karuka head

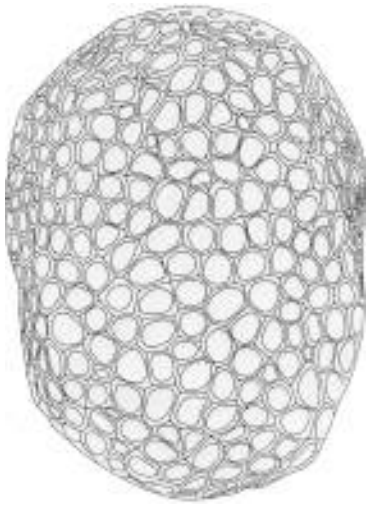
The outside layer of the fruit is burnt off in a fire. This allows the bristly ends of the individual keys to be seen.



A portion of the surface and after the skin has been burnt off

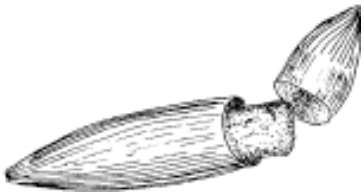
In the centre of the bunch is the stalk. This is surrounded by a spongy type material into which the ends of the individual nuts are inserted. This spongy layer (the mesocarp) has an appearance like honeycomb, when it is separated from the nuts. It can be cooked and eaten. It looks like this.

The honeycomb looking spongy central portion that can be eaten

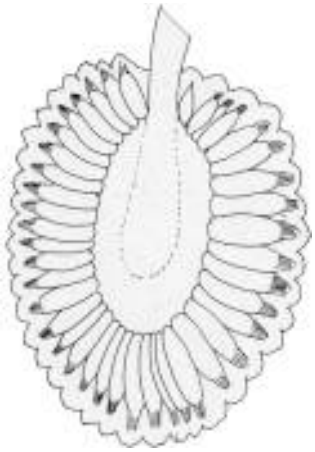


The individual keys or nuts can then be separated and broken open to get out the kernel that is eaten.

A single shell and kernel looks like this:



If a karuka fruit is cut in half, the different layers look like this.



How do you plant karuka?

There are some different ways of planting karuka.

One of the common ways is to cut the top section off one branch of a mature tree that has several branches. When planted in moist fertile soil it quickly develops roots and becomes established. This method has two advantages. You can be sure that the new tree will be exactly the same as the old one because it is vegetative propagation. Also old trees with a number of branches tend to have smaller clusters of fruit because the fruit are competing on the same plant for their requirements.

Sometimes karukas develop young suckers or shoots near the ground. When these are seen, they are broken off and replanted.

Karuka can be grown from seeds. It is best to wait till the nuts are fully ripe and start falling naturally from the tree. These nuts are taken and planted while fresh. They are planted in the shell with the bristles uppermost.

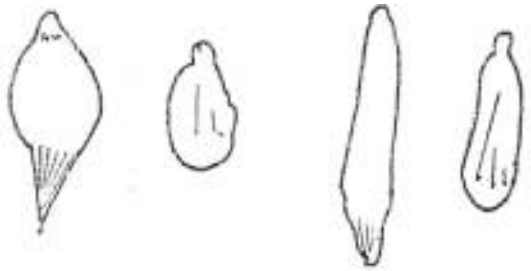
Normally the seeds are established in a nursery and then transplanted to their permanent sites a few months later. Karukas can start to produce nuts 5 or 6 years after planting. They can keep producing for probably 50 years.

To produce good sized nuts the karuka plantation needs to be kept free of weeds.

Varieties

There are many varieties of karuka. Up to 20 varieties are maintained by some growers. One farmer near Paip in the Mendi Valley knew 35 varieties.

One of the most noticeable things that varies is the shape of the nut and kernel. Two kinds are drawn below.



Most varieties are roasted before eating but one or two varieties are eaten uncooked. All varieties can be mumued. All varieties can be smoked and stored.

All varieties tend to fruit at the same time but some kinds get ready to harvest more quickly than others.

Varieties differ in their height, number of branches, thickness of the shell of the nut, and a little bit in their general appearance and colour of leaves and bark.

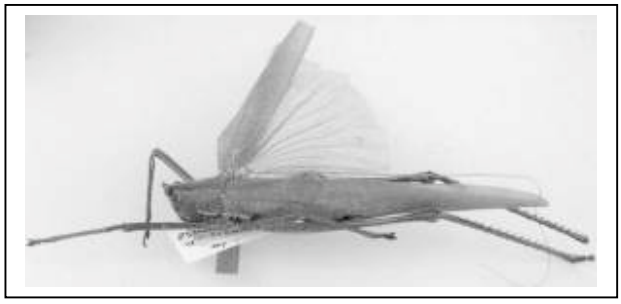
Pests and Diseases

Karuka have some pest and disease problems.

At least 4 different kinds of fungal diseases can be seen damaging the leaves. There is a sooty mould that makes irregular black patches over the surface of the leaf. It is really only growing on the rubbish left on the leaf surface by small insects. Another black leaf mould grows in thin straight streaks along the middle of the leaves. It only seems to grow on some varieties and village people seem to use it as one indicator to help them recognise the different varieties. These two diseases probably do not cause too much trouble.

There are also two yellowish leaf spots, one clear and sharp and the other faint and irregular that can commonly be seen on the leaves. They seem to vary both with variety and time of the year.

One of the serious insect pests of karuka are longhorn grasshoppers.



These grasshoppers climb the trees and chew the leaves. Damage can be severe and by eating out the growing point of the tree they can actually kill the tree. Similar longhorn grasshoppers damage coconuts on the coast.

Village people try to reduce the damage by pushing grass and leaves in between the leaves near the crown to stop the insects getting in.

The grasshoppers lay eggs in the grass and rubbish near the base of the tree. In coconut plantations clearing around the bottom of the tree then spraying, is used. Control of these insects in karuka has not been studied.

A large black grub also damages karuka by burrowing into the bunch of fruit and causing it to fall before the bunch is ripe. It eats the spongy layer and the fruit goes black outside.

Occasionally wood boring grubs burrow into the aerial prop roots of karuka.

A fungal disease has also been recorded growing on karuka nuts.

Pests	**Cause**	**Scientific name**
Black leaf mould	Fungus	*Lembosia pandani* (Rostr.)Thiess
Sooty mould	Fungus	*Meliola juttingii* Hansf.
Leaf spot	Fungus	
Diffuse leaf spot	Fungus	
Fungus on seeds	Fungus	*Macrophoma pandani* Berl & Vogl
Longhorn grasshoppers	Insect grasshopper	*Segetes gracilis*
	Insect grasshopper	*Segistidea montana*
Cockroaches	Insect	*Periplanata americana* (L.)
Caterpillar	Insect	
Wood borer	Insect	

Possums are another problem with karuka. People build platforms up the trunk of the tree to stop possums climbing up.

For karuka nuts stored in houses, rats and cockroaches are the two main problems. These pests can be controlled by hanging the nuts in the smoky areas above the fire. But if nuts are left too long in this position they start to develop a smoky taste that is not liked.

Storing and using karuka

Karuka nuts can be harvested before they are fully ripe by climbing the tree and cutting the whole bunch. When this is done, the fruit bunch is cut in half the central pink portion cooked and eaten and the two halves with the outside skin burnt off can be stored in a platform above the fire. These halves can be mumued with hot stones and the nuts eaten.

Two varieties at least can be eaten fresh without cooking.

The whole fruit bunch can, if desired be stored in damp waterlogged ground for a few months if there are too many fruit to use at the one time. These fruit are collected again and cooked and used as if they had just been harvested.

Particularly for nuts harvested ripe there are two ways to use them. They can be eaten fresh after cooking. Or they can be dried and stored and eaten later without cooking. When the nuts are harvested ripe the individual nuts are pulled out from the central honeycomb looking spongy material. This central piece can be boiled if only a few are available, or mumued if a lot are available. It is then eaten. The individual nuts can be roasted by tying them along a stick and holding them over a fire. If they are to be stored they are sun dried. To dry the nuts they are put out daily in the sun and taken into the house at night. After they are dry they can either be stored in the shell for about 6 months or if it is wanted to store them for 1 or 2 years, they are normally shelled and only the kernels stored. These can be stored by filling up a bamboo, or by making a container of leaves.

A leaf container for storing karuka

Sometimes karuka nuts that have been harvested ripe are stored for up to 6 months by putting the individual nuts in the ground, separated and surrounded by soil. When they are taken out they taste like fresh nuts.

Karuka as food

In 100g of the part eaten there are the following amounts of different nutrients.

	Moisture %	**Energy cals**	**Protein g**	**Calcium mg**	**Iron mg**	**proVitA µg**	**provitC mg**
Kernel	**9**	**540-700**	**11.9-14.1**		**419**		
Centre			**8.5**				

This means karuka are good quality food.

Amount of food produced

An average karuka fruit can be about 6kg weight. It is about 25cm high and 20 cm across. It contains about 1000 separate nuts. After burning off the outside and removing the stalk, the weight is about 5 kg.

A single kernel weighs about 0.5g.

The weight of edible kernels in a fruit is about 8% of the total fresh weight or about 0.5kg.

Season

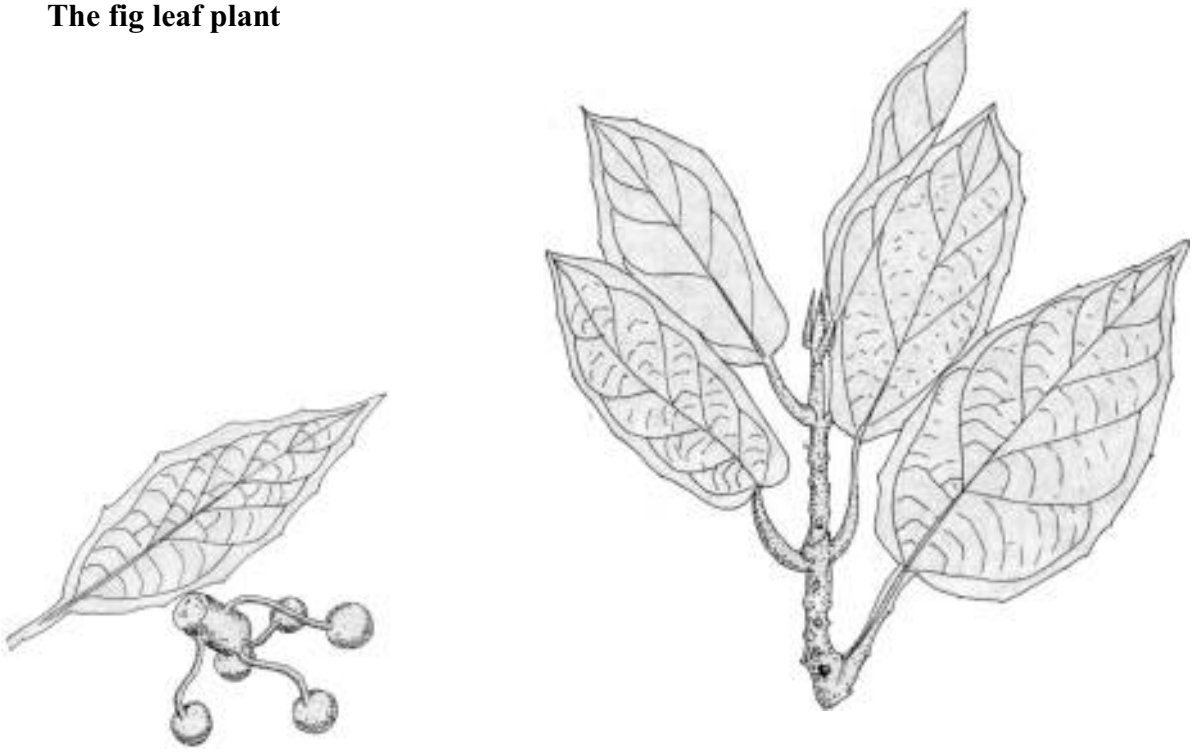
Karuka is seasonal. The season is often about February but it may vary from December to May. Sometimes there is a second small season about July. Often trees only bear a good crop every second year. Normally any individual branch of a tree only has a bunch of fruit every second year. If it does have two bunches two years in a row, these bunches of nuts are usually small.

Kumu musong

Tok Pisin: Kumu musong **Scientific name:** *Ficus copiosa*

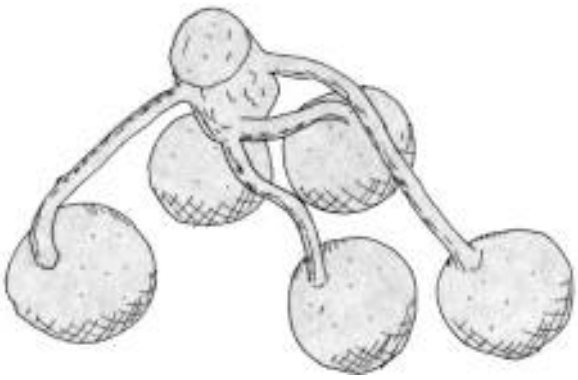
Huli - Poke	**Foi** - Kaiya	**Onobasolo** -
Mendi - Tulup	**Hewa** -	**Etoro** -
Kewa - Rulupa	**Pole** - Poke	**Hawalisi**
Wiru - Koiyo	**Samberigi** - Nose	**Fasu** -
Duna - Poke	**Podopa** – Kaiya	
Imbongu -	**Kaluli** –	

The fig leaf plant



This is one of the commonly used figs throughout Papua New Guinea. In some areas of the country this tree is planted, pruned and carefully looked after. At Tari in the Southern Highlands, for example people grow this tree from cuttings and use it as a dividing hedge between garden plots. It is pruned to keep its shape and the leaves are regularly harvested and eaten.

But as well this fig tree grows widely naturally in many areas of the country and is commonly used for food.



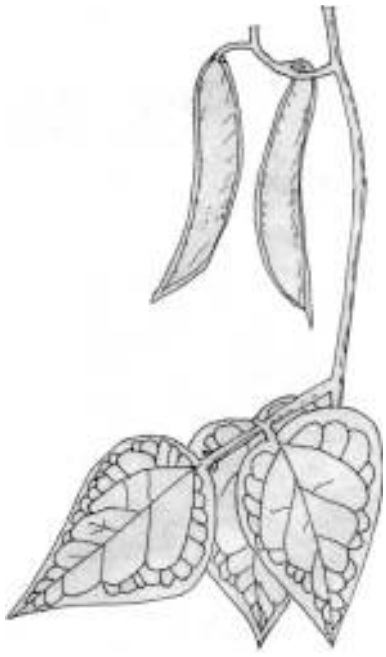
Lima bean

Tok Pisin: **Scientific name:** *Phaseolus lunatus*

Huli -	**Foi** -	**Onobasolo** -
Mendi -	**Hewa** -	**Etoro** -
Kewa -	**Pole** - Pesa	**Hawalisi**
Wiru -	**Samberigi** -	**Fasu** -
Duna -	**Podopa** –	
Imbongu -	**Kaluli** –	

What is this bean like?

This is vigorous climbing bean that can keep growing for some years. The leaves are slightly rounded at the base and pointed at the tip. The flower is white or yellow. The keel of the flower is twisted which helps tell the difference between this bean and Lablab bean. The pods are flat and have 3 or 4 seeds that vary in colour. The seeds are large. The pods are long (10 cm), flattened and curved. The curved pods were considered to be like the moon, so were given the Latin name *lunatus* or moon. The seeds have a short round hilum where the seed is attached to the pod. The seeds also have lines going out from this point across the bean seed. It is one of the traditional beans in the highlands of Papua New Guinea.



Where does it grow?

It most commonly occurs between 500 metres and 2100 metres altitude in the highlands, but it will grow up to the limit of cultivation at about 2700 metres. It needs a soil temperature of above 15.5°C for the seeds to germinate and a day temperature of about 22°-30°C for satisfactory flowering. It does not suit waterlogged soil.

How is it grown?

It is grown from seed. Coloured seeds are often hard to get to grow but white seeded kinds start growing easily. So for coloured kinds, it is important that they are planted when regular rain occurs as the water washes away some of the chemicals that stop the bean growing.

When is food produced?

Young pods can be harvested about 3 months after planting beans.

What is the food like?

Leaves tend to be bitter and seeds can also contain poison. They should be cooked and the cooking water changed. White seeded varieties have less of this problem than the highly coloured seeded kinds.

The food value in 100 g of the edible portion

	Moisture %	Energy KJ	Protein g	proVitA µg	provitC mg	Iron mg	Zinc mg
Seed dry	12.0	1407	19.8	**Tr**	**0**	**5.6**	
Seed cooked	**67.2**	**515**	**6.8**	**37**	**10.1**	**2.5**	**0.8**

Diseases and pests

A rust fungus grows on the leaves. The fungus is called *Phakopsora vignae.*

Malay apple

Tok Pisin: Laulau **Scientific name:** *Syzygium malaccense*

Huli -	**Foi** -	**Onobasolo** -
Mendi -	**Hewa** -	**Etoro** -
Kewa -	**Pole** - Kama	**Hawalisi**
Wiru -	**Samberigi** -	**Fasu** -
Duna -	**Podopa** – Hotung	
Imbongu -	**Kaluli** –	

What is the plant like?

This is a medium sized tree up to 20 m tall. The tree is cone shaped with branches being shorter near the top.

The leaves are dark green, thick and glossy. They are 15-50 cm long and 7-20 cm wide. The leaves have short thick leaf stalks.

The flowers are in showy clusters with bright red stamens. These fall off and form a carpet of red under the tree.

The fruit are up to 8 cm long, rounded in shape and white to red in colour. The skin is thin and the flesh crisp, white and juicy. The fruit contains one round seed.

Growing Malay apples

Malay apples are a tropical and coastal fruit tree. They grow from sea level up to about 1,000 m altitude. This means it only occurs in the lowland areas of the Southern Highlands.

Trees are normally grown from seed. Seeds need to be fresh. Where termites are a problem damaging seedlings, growing them in light shade reduces the problem. Plants can be grown by budding, grafting, layering or cuttings. Aerial layering is probably the most common method for vegetative propagation. Budding onto rootstocks of the same species has proven successful, but they are rarely successful if rootstocks of related species are used. A spacing of 10 m between trees is suitable.

Food value per 100 g edible portion

	Moisture %	Energy KJ	Protein g	proVitA µg	provitC mg	Iron mg	Zinc mg
Fruit	91.1	105	0.4		**15**	**0.4**	

Malay apples do not have a lot of nutrients but are a nice refreshing snack.

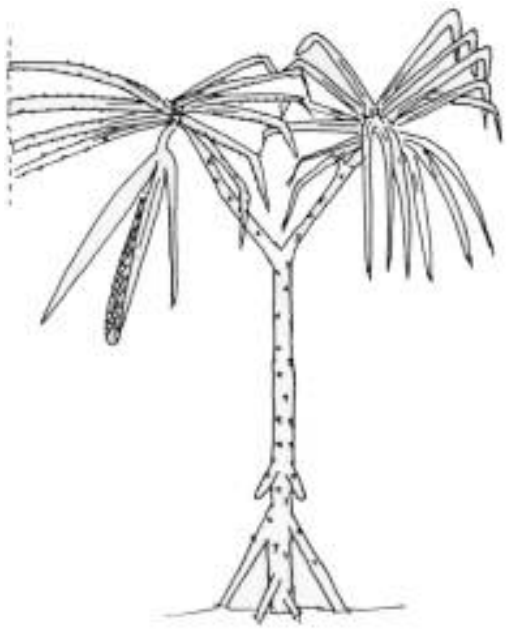
Marita

Tok Pisin: Marita **Scientific name:** *Pandanus conoideus*

Tok Ples names:

Huli - abare	**Foi** - abare	**Onobasalo** - alakape
Mendi -	**Hewa** -	**Etoro** - ka yo
Kewa -	**Pole** - anga	**Hawalisi** - aga
Wiru - pangu	**Samberigi** - anga	**Fasu** - hase
Duna -	**Podopa** - sina	
Imbongu -	**Kaluli** - oka	

The marita pandanus plant



This pandanus is a short tree with several branches. Near the base it has several prop roots that help hold the plant up.

The leaves are between 1 and 2 metres long and about 10cm wide. There are thorns along the edges of the leaf.

Trees may have up to 8 or 10 main branches. Trees grow up to about 5 metres tall. There are spikes on the trunk and branches.

The fruit are long (30 to 60 cm) and mostly red although yellow kinds occur. The fruit is hard and has small lumps or spikes over the surface. The fruit grows at the ends of the branches between the leaves and it has 3 straight leaf like bracts along the edges.

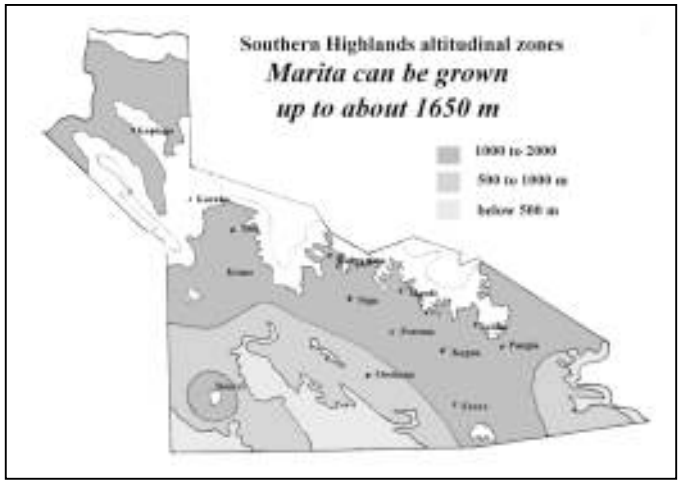
The leaves grow opposite each other but are twisted to look like a spiral.

Where is marita grown?

Marita is grown throughout Papua New Guinea from sea level up to about 1650 metres altitude above sea level.

It is only grown in Papua New Guinea.

In the Southern Highlands it is grown by people in all the areas that are at the right altitude.



Areas where marita could be grown in the Southern Highlands

In these areas, people often plant marita along the roads and walking tracks. It is also planted in most gardens and serves as a reminder that the land is owned by the person who planted the marita. So, often marita plants belonging to one person are scattered in lots of different places.

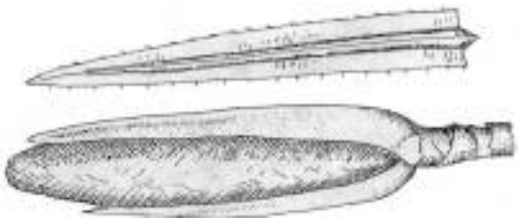
How do you plant marita?

Marita pandanus are normally planted from suckers or cuttings. The end of a branch can be cut off and used as a cutting. A new shoot normally sprouts out of the branch just below where the end was cut off. The cutting will soon develop roots and become established when it is planted.

A more popular method is to use a sucker or shoot growing from the plant down near the ground. The sucker is seperated from the parent plant then replanted in its new place. These suckers grow more quickly and can bear fruit after 18 months to 2 years. A cutting off a branch may take up to 4 or 5 years before it produces a fruit.

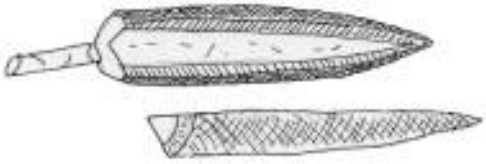
How is marita used?

A marita fruit is harvested when the colour starts to change to a brighter red or yellow. Sometimes it also starts to crack slightly at this stage. The fruit is cut from the branch.



A marita fruit

A ripe marita fruit is normally split into 3 sections along its length. Traditionally this was often done with a knife made from the sharpened leg bone of a cassowary.



A fruit split open

Then the central yellow stalk and pith area are dug out. The outside hard red layer is then cooked. Preferably it is cooked using hot stones although sometimes it is boiled in a saucepan. After cooking for about half an hour the hard pits are squeezed from the soft red juice by squeezing through the hands. Water is added to make an oily red soup.

Squeezing marita with water

The soup is then eaten. Sometimes it is eaten, by dipping green leaves or sago into the soup. At other times it is eaten with a spoon made from the marita leaf. Some people just suck the cooked juice from the seeds. As well, some people use the oily juice to cook food in.

The pits or seeds are thrown away normally to pigs.

A harvested marita fruit will only keep for about one week. After cooking it will only last for about 12 hours.

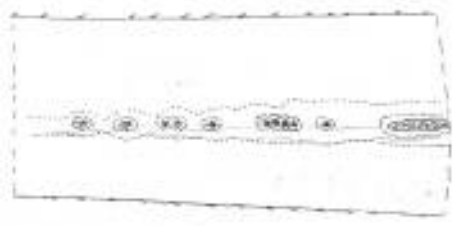
When is the marita season?

Marita is a seasonal crop but the fruiting season is not a short clearly marked one. The main season goes from about October to March but individual trees can bear almost throughout the year. Near the sea the marita season is longer and more spread out but as the places increase in altitude above sea level the season becomes more distinct.

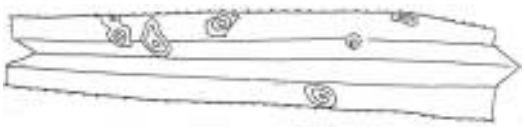
The marita season is an important occasion. During the season people often use marita twice a day.

Diseases, insects and other pests

Some diseases can fairly often be seen on the leaves of marita pandanus. Two fungi are common. One causes a black leaf mould that grows in a line along the leaf. The other one causes a brown dead spot that has a yellow ring around it. It is not known how much damage these diseases cause.



Black leaf mould



Leaf spot

In marita areas fruit which still aren't ripe sometimes "stink nating" going soft and squashy. They are mostly just cut off the tree and left to rot. The cause is not known. It is probably a bacterial disease.

The larvae of an insect can often be seen eating marita leaves. If it eats the growing point it can kill the branch or the tree. This insect can get so bad that a poor marita season results.

In some areas tree kangaroos can also do serious damage to fruiting marita.

The food value of marita.

Not very much is known about the food value of marita.

Often the red colour in plants is a chemical called carotene that produces vitamin A. In marita the red colour is not carotene.

Marita appears to have a fairly high oil content.

Naranjilla

Tok Pisin: temeta ? **Scientific name:** *Solanum quitoense*

The naranjilla plant

This plant is a small shrub that grows about 1 or 2 metres high. It has fine hairs over it and also thorns.

The leaves are large and green with small brown hairs on them.

The fruit are round and about 5cm across. They are covered with white hairs that can easily be rubbed off. These fruit are produced in groups along the stem and branches of the shrub. The fruit are an orange colour on the outside and the flesh inside is green.

How is it used?

The fruit have a slightly acid taste. They are mostly used for drinks and sweet dessert dishes.

How is it grown?

Inside the fruit there are lots of seeds. These can be sown to produce new plants. The plant can also be grown from cuttings. The cuttings need to be about 15cm long. When the cuttings have been collected they should be dried for a few days to let the cut surface heal. This stops the cuttings from rotting when they are planted. They can then be planted in moist soil.

Where is it grown?

The naranjilla is a South American plant. It is grown in some of the highland areas of Papua New Guinea. In the Southern highlands it is grown in the Pangia district near Mele village. The people there know and use it. It has probably only recently been introduced. It grows best in the medium altitude areas of the tropics. In other countries it grows between 800 and 2000 metres above sea level.

Pests and diseases

In Papua New Guinea these haven't yet been looked at. As the plant is in the tomato and potato family it will probably suffer from root knot nematode and bacterial wilt.

Food value of 100 g edible portion

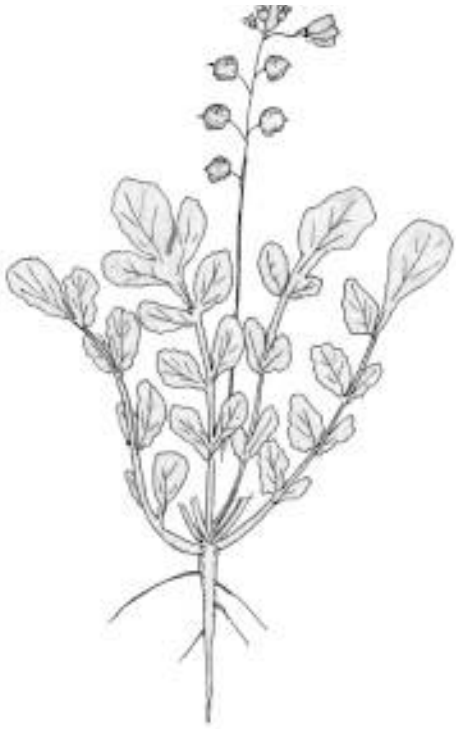
	Moisture %	**Energy KJ**	**Protein g**	**proVitA µg**	**provitC mg**	**Iron mg**	**Zinc mg**
Fruit	**88.5**	184	1.0	**100**	**67**	**0.5**	

Nasturtium schlechteri

(Scientific name)

Huli -	**Foi -**	**Onobasolo -**
Mendi -	**Hewa -**	**Etoro -**
Kewa -	**Pole -**	**Hawalisi**
Wiru -	**Samberigi -**	**Fasu -**
Duna -	**Podopa** –	
Imbongu -	**Kaluli** –	

The *Nasturtium schlechteri* plant



This is a cabbage family plant with yellow flowers and short seedpods. The leaves are divided and it has a taproot.

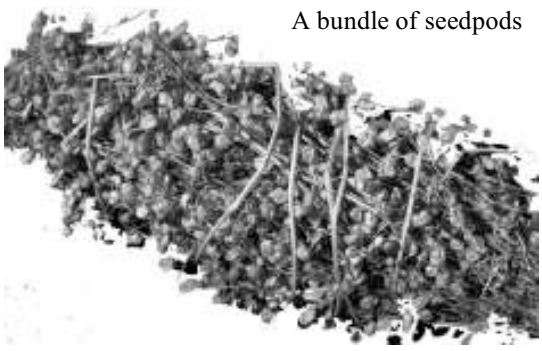
It grows in Papua New Guinea and it is common in highland areas from 1000 to 2,200 m altitude but it also grows down to the coast.

The seeds are normally broadcast over the garden. *Nasturtium* (*Rorippa) schlechteri* is grown as a vegetable in gardens in the highlands. Because it has a well-developed taproot, the plant does not transplant easily.

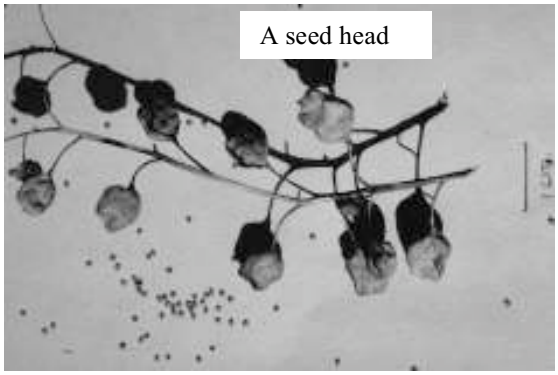
Plants are harvested after 4-6 weeks.

The leaves and whole plant are cooked and eaten.

It appears to be damaged by similar insects to cabbage such as cabbage cluster caterpillar, black cutworm and diamond-backed moth. Sometimes this damage can be severe.



A bundle of seedpods



A seed head

Okari

Tok Pisin: Okari **Scientific name:** *Terminalia kaernbachii*

Tok Ples names:

Pole - sarigi	**Hewa** -
Samberigi -	**Kaluli** - uka
Podopa - topo	**Onobasalo** - favie
Foi - yumu	**Etoro** - tukai'o
Fasu -	**Hawalisi** - iuwa

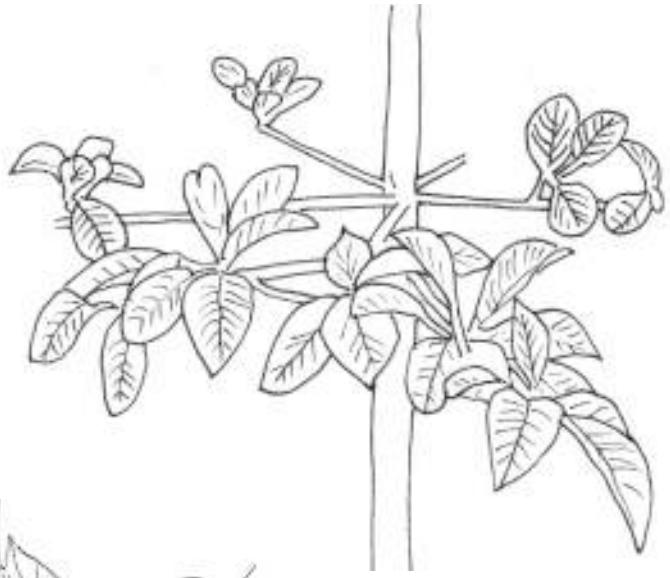
The okari nut tree

This tree grows up to 40 m tall. The tree has distinctive type of branching where branches come out in several "layers" along the trunk. The branches also have short thick twigs along them and the leaves tend to be in clusters near the ends of branches. The leaves are large (25cm x15cm) and have reddish brown hairs underneath.

At the ends of the branches the tree produces a long flower shoot and the fruits develop on it. A number of fruits can grow on the end of the one twig.

The fruits are flattened and green when young. As they ripen they change to a red colour.

Inside the fruit is a hard shell and the kernel is inside this shell. It is this kernel or nut that is eaten.



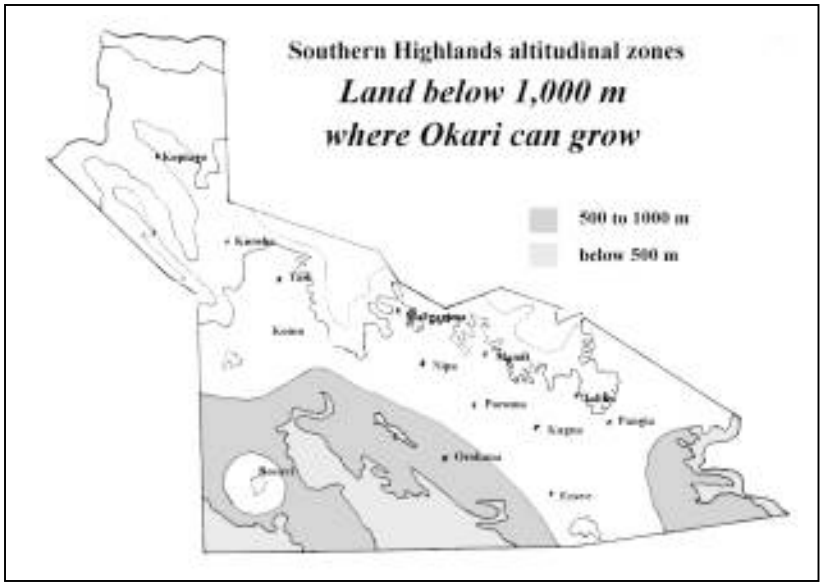
One layer of branches with clumps of leaves of an okari tree

The end of a branch showing young fruit, flowers and the large leaves

Where do okari nuts grow?

The okari nut tree grows in the lower areas of the province below about 800 metres altitude. Some trees growing near Erave (1100m) only have a few fruit on them although the trees grow well. The best yield of nuts comes from the lower areas such as the lower Podopa villages, the Hawalisi area and the lower Foi.

Places where okari could be grown in the Southern highlands

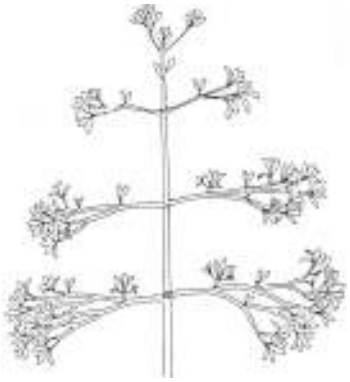


Other trees like Okari

Several trees with the name Terminalia are used in Papua New Guinea for edible nuts. These include the Java almond and Talis. All these trees have the same distinctive type of branching. The branches come out in layers and they have thick twigs that come out at right angles.

A diagram of the type of branching of trees called Terminalia.

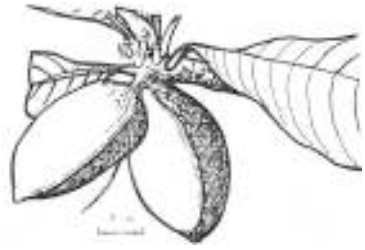
Okari and some other nut trees like it have this type of branching



What is an Okari fruit and nut like?

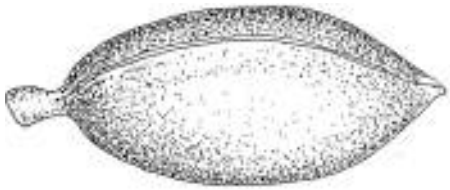
The okari fruit is a green, slightly flattened fruit that becomes dark red when ripe. The outside layer is soft and fleshy.

Two young green fruits on a twig



A mature fruit can be up to 20cm long and 10cm wide. It is oval in shape and slightly flattened.

A ripe red okari nut fruit

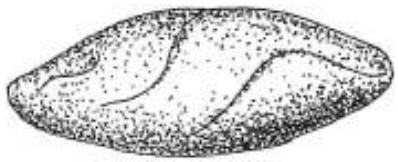


This fruit is split open with an axe to reveal the kernel that is inside the hard shell. The shell has ridges and holes in it.

A shell without flesh around it looks like this.

It is the kernel inside the shell that is eaten. The kernel can be 7-8cm long and 3-4cm wide.

A kernel looks like this. It is white inside with a brown layer of skin over it.



The kernel is made up of coiled leaves that make up the seed. A kernel can weigh up to 10 grams in weight. These are eaten either raw or after a slight roasting.

Growing trees and producing nuts

Okari nut trees are normally grown from seeds. The trees grow very fast and they can increase in height by up to 2 metres in one year. But trees need to be fairly old before they produce many nuts. Twenty year old trees often only produce a few nuts.

Pest problems

Not a lot of insect or disease problems have been recorded on okari nut trees, but these may not have been well looked at.

Trees can get a leaf spot due to a fungus.

They can also get sooty mould fungus growing over the surface of the leaves. This is a black sooty like covering over the leaves. This fungus is really only growing on the rubbish left behind by small insects and can be rubbed off the leaf. But it can block out the sunlight.

Some larvae of moths belonging to the armyworm family have been recorded eating leaves of Okari nut trees.

Pest problem	**Cause**	**Scientific name**
Leaf spot	Fungus	*Cercospora sp.*
Sooty mould	Fungus	*Lembosia terminaliae* Hansf.
Larvae on leaves	Insect – larvae of moth	*Aiteta iridias* Meyr.
Insect for mould	Insect	*Perissopneumon* mealybug
Borer termite	Insect	*Neotermes sp.*

Pandanus antaresensis

(Scientific name)

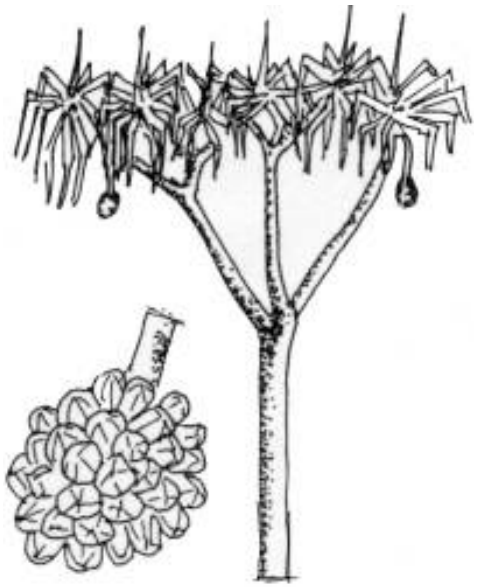
No common Tok Pisin or English name. Sometimes called wild karuka.

Tok ples names:

Huli -	**Imbongu** - kupili
Mendi - pem, pembras	**Kewa** -
Wiru -	**Duna** -

The plant

A branched screwpine with crowns normally at the same height. Fruit are large clusters made up of groups of 5 nuts. The kernels are small and hard to extract. When ripe the fruit turn red and the nuts drop individually.



This pandanus grows naturally between about 1600 and 2500 metres altitude in the highlands.

It often grows in swampy places.

Most trees have a number of widely spaced branches. At the top of these there is normally a shoot of leaves making a point which points upwards.

The leaves are often a light green. They have thorns along the edge, although the thorns are normally less about the middle of the leaf.

The cluster of nuts hangs down below the leaves on a long stalk.

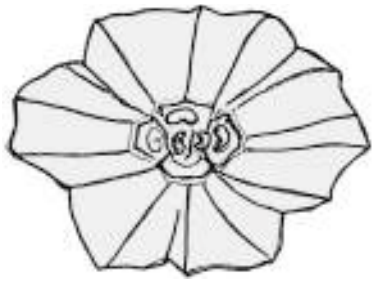
The pandanus fruit

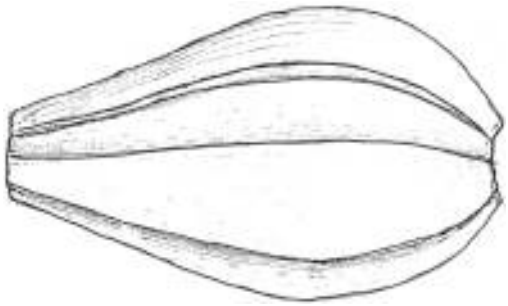
The fruit of this tree is made up of clusters of nuts grouped together in groups of 4 or 5 nuts. Together they make up a round knobby cluster about 30cm across.

The whole fruit cluster looks like this picture at the right.

As the fruit matures the cluster turns an orange colour and the small groups of nuts fall, one by one.

An individual group of nuts that fall down look like this.





As the nuts dry out, lots of hairy looking fibres can be seen.

The shell is hard and must be broken with an axe or a stone.

The nut inside is small.

Because the shell is hard and the nut small some people don't eat these nuts at all. Other people only eat them sometimes. But some people plant these pandanus trees near their gardens and they like the nuts to eat.

Potatoes

Tok Pisin: Peteta **Scientific name:** *Solanum tuberosum*

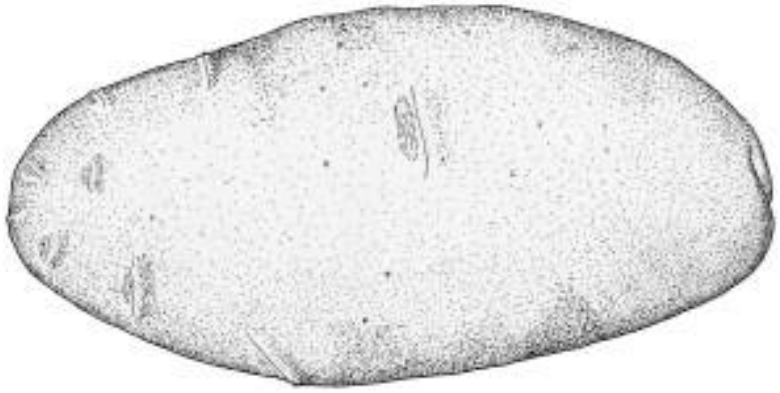
Tok ples names:

Huli -	**Kewa** -	**Imbongu**-atepote
Mendi-Karint- aswis	**Wiru** -	
Mendi-Nipa - aspos	**Duna** -	

The potato plant

This is a short bushy plant that grows up to about one metre tall. It is branched and has wings on the stems. The leaves are made up of several leaflets of different size and shape.

Under the ground it produces a cluster of tubers. These tubers have buds or "eyes" around them and these are grouped more towards one end. New stalks can grow from these buds.



Many kinds of potatoes produce flowers at the top. They are normally white or light blue. These flowers are replaced by round green berries that contain the seeds. Normally these seeds are only used for breeding new kinds of potatoes.

Where are potatoes grown?

Potatoes can be grown from about 1200 metres altitude up to at least 2750 metres altitude. They only start to become important in subsistence above about 2000 metres and over 2400 metres are becoming the staple food crop. People past Margarima towards Tari, and people in Upper Mendi towards Tambul grow potatoes as one of their main crops. In these areas potatoes and wild karuka can be seen growing together.

Potatoes have a shorter time to maturity than sweet potato especially at the higher altitudes. Therefore it has advantages as a root crop. Above 2700 metres sweet potato often won't develop tubers, but potatoes grow well. Below 1200 metres potatoes often won't develop tubers. Erave, which is lower than this is colder than other places at the same altitude so potatoes can still be grown there.

Potatoes tend to need higher soil fertility than sweet potato. Potatoes will only grow very poorly in old sweet potato gardens. For good production they need to be planted in newer gardens cleared in the bush or in places where the soil fertility has been built up.

Because one of the serious potato diseases called bacterial wilt spreads in the sap of it is important to plant potatoes widely spaced and not in rows. The disease cannot spread when potatoes are planted like other crops mixed throughout the garden.

PESTS AND DISEASES

Potatoes suffer seriously from a few diseases.

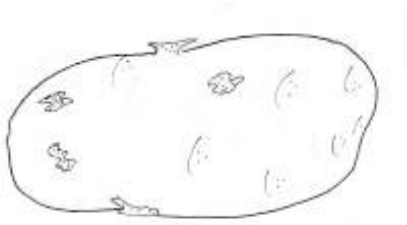
Bacterial wilt

The most serious disease damaging potatoes in Papua New Guinea is a disease called bacterial wilt. With this disease the leaves and top of the plant start to wilt and collapse. The whole plant finally collapses and the tubers rot. So no food is harvested. If plants that are starting to wilt are quickly harvested the tubers can be eaten. But they should not be replanted because the disease bacteria will spread in the potato. If one of these tubers is cut in half and then squeezed drops of milky liquid that contains bacteria can be seen in a ring around the tuber.

Target spot

This disease is easy to see. This disease is produced by a fungus. This causes black dead spots to develop on the leaves. These spots often have a pattern of rings in them and this is why it is called Target Spot. Sometimes it is also called Early Blight because the leaves can die around the edge. When plants get this disease, the leaves die off early. Tubers are therefore smaller. It gets worse in wet cool places.

Common scab.



On the skin of the tuber small brown spots can develop near the "breathing pores". These can then turn into a corky scab. This is due to a fungus. It gets worse in low fertility soil. It only spoils the appearance of the tuber.

Potato blight

This fungus disease can kill off the leaves and turn the potatoes rotten. The disease does not have distinct spots like target spot but more irregular dark spots. It blows in the wind and starts growing on leaves when the weather is cool and moist with cloudy days. The disease spreads fastest when temperatures are 18° to 22°C and the humidity is high. It needs moisture on the leaves for several hours. Planting potatoes mixed with other crops in a garden is important to reduce the disease. Some varieties of potatoes get the disease less. Crops can be sprayed but this must be done before the disease arrives.

Rungia

Tok Pisin: **Scientific name:** *Rungia klossii*

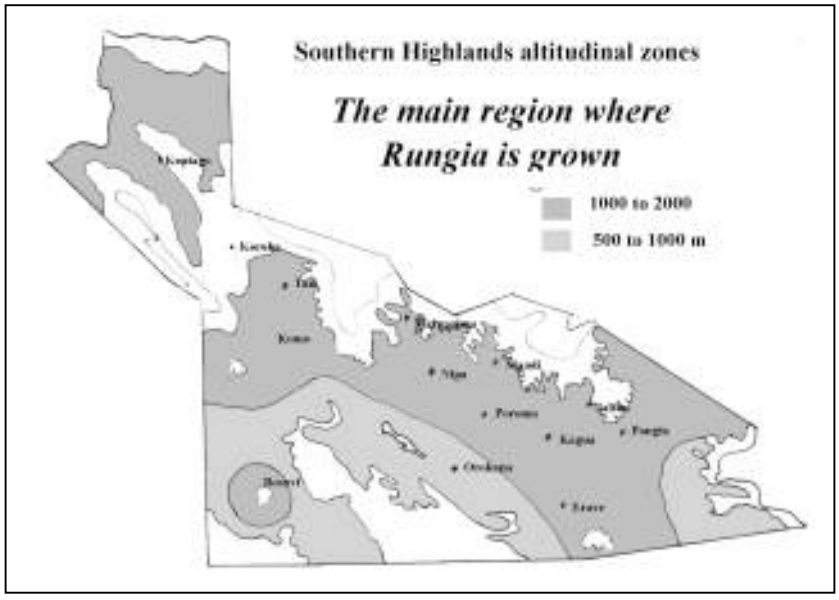
Tok Ples names:

Huli - Kereba	**Foi** - Sona	**Onobasolo** - Kereba
Mendi – Taine/Tan	**Hewa** -	**Etoro** - Morowa
Kewa - Rani	**Pole** - Tane	**Hawalisi -** Kapa
Wiru - Pingi	**Samberigi** - Tane	**Fasu** - Sona
Duna - Kereba	**Podopa** – Yoku	
Imbongu - Geba	**Kaluli** – Gada	

The Rungia plant

Rungia is a small clumpy much branched leafy vegetable. Dark green and yellow and green marked leaf colours occur. It grows to about 40 cm high. It produces a pale blue flower. At least 20 different varieties occur being distinquished by size, shape and colour of leaves.

It mostly grows from 1000 to 2000 metres altitude but will grow down to sea level. It is only known from Papua New Guinea and Papua Province of Indonesia.



Plants are grown from rooted stems or cuttings. It only occurs as a cultivated plant. Some wild and relatively short-lived plants can be found in old garden sites. It needs reasonably fertile soil, preferably moist but will grow in most soils. The young leaf tips are eaten raw or cooked. It requires a fairly fertile soil and a damp area. Plants are put about 50cm apart. It is mostly grown in mixed cropping situations with sweet potato or *Setaria* pitpit. The plant is grown from cuttings that are about 25 cm long and a clump is sown together. These stems often already have roots developing from the nodes or quickly develop roots. Rungia is planted at any time of the year. Regular picking keeps branches short and productive of leaves. It grows reasonably slowly. Once established, the young tips (2 or 3 leaves) are picked regularly. The shoot tips and upper leaves are harvested starting about 2-4 months after planting and continuing at 1-2 monthly intervals for 2 years or more. Regular picking keeps branches short and productive of leaves.

It grows reasonably slowly. Yields can be 2 kg/plant/year. The harvested tips weigh about 0.8 g each. If the plants were spaced at 50cm spacing this would give a yield of 4 kg per square metre of garden. The leaves are eaten raw or cooked. After harvesting they will not keep very long. (2-3 days).

The leaves are eaten raw or cooked. It is one of the main and most popular greens in the highlands of Papua New Guinea.

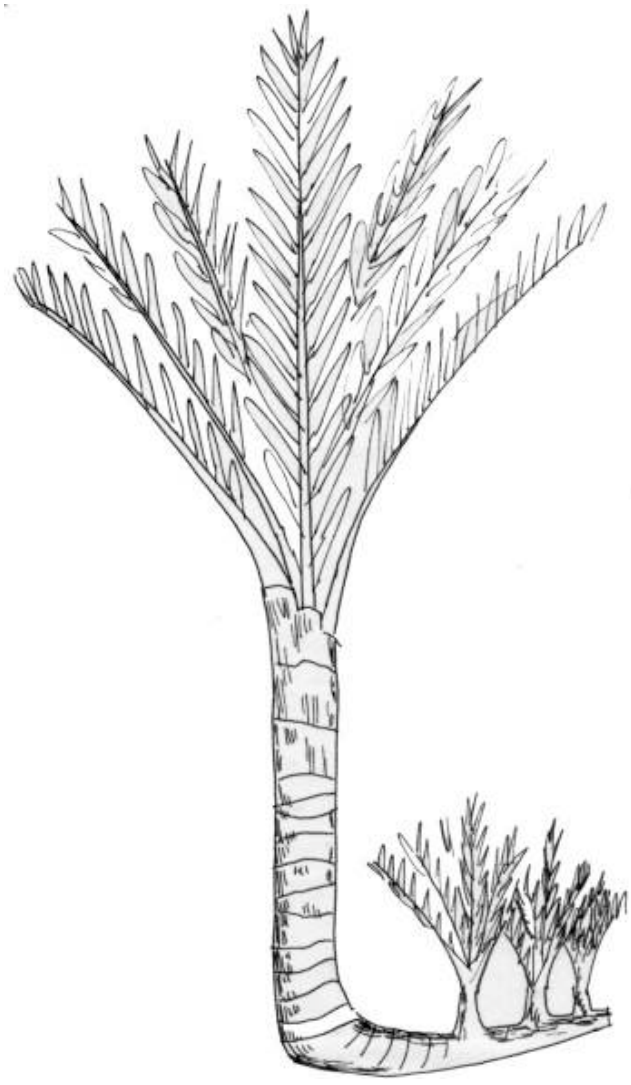
Sago

Tok Pisin: Saksak **Scientific name:** *Metroxylon sagu* Rottb.

Tok Ples names:

Huli -	**Foi** - kui	**Kaluli** - men
Mendi -	**Pole** - kawi	**Onobasolo** -
Kewa - kogi	**Samberigi** - hau	**Etoro** - wa ha'ro
Wiru - ewa	**Podopa** - o	**Hawalisi** -mene
Duna -hiwa	**Hewa** -	**Fasu** - asiba
Imbongu – epawe		

The sago palm plant



Sago thorns

The sago palm grows up to 10 or 25m tall and is nearly a metre across the trunk. It produces suckers around the base. After about 15 years the main trunk produces a very large flower at the top and then the trunk dies.

The centre of the trunk is filled with starch. The plant also produces useful building materials. The fronds are very good house roofing material.

The sago palm common in Papua New Guinea also grows in Indonesia and Malaysia.

Where does it grow?

Sago palms grow in the lower areas, up to about 1200m.

In the Kutubu area (Foi and Fasu) sago is the staple food. In other lowland areas of the Kaluli, Onobasolo, Etoro, Hawalisi, Pole, Podopa and Samberigi peoples it forms an important supplementary staple but not the main food.

But sago isn't planted just anywhere in these places, it is planted in special sago sites. Often these are along the banks of creeks, like in the Kaluli area, or in the bottoms of valleys such as the Kerabi Valley near Erave. At Kutubu, the sago groves fill up large swamps.

Sago doesn't like to be in a very wet swamp and doesn't like to be in a dry place. Often sago sites are just slightly too wet for gardening.

Varieties of sago

People in Hegiso village near Kutubu recognise and have names for at least 34 varieties of sago. These vary from having no thorns, up to ones with very long thorns on the bases of the fronds. The height, shape, toughness of the bark, and length of the fronds varies. Some palms mature quickly, some have many suckers and the taste and colour of the starch varies.

Near Bosavi and Erave the people only recognise a few kinds of sago.

Planting sago

In the Southern Highlands practically all sago is planted. One or two varieties will grow fairly easily from seed, but most kinds are planted from suckers.

To plant sago, the planting site near a creek or in a damp place, is first cleared of trees and rubbish. Then a sucker of a suitable variety is chosen from an old sago clump. Often the fronds of the sucker are up to 3m high. It is first checked to see if the sucker is old enough. Suckers ready for planting have a tough woody connection to the base of the old palm. This is chopped through with an axe. The sucker is then simply taken to a new site and planted in a shallow hole. If several palms are being planted, they should be about 7 m apart. The only other attention the new palm needs is an occasional weeding to cut back rubbish when it gets too thick.

Growth of sago palms

In the Southern Highlands it takes 12 to 15 years for a sago palm to grow big enough to cut down. Palms in poor soil grow more slowly.

Normally, one main trunk grows up, but several small suckers may shoot up around the base. Sometimes these suckers spread out and the space between the palms becomes crowded. Too much competition between clumps slows down the growth of the main palm, so the grove needs to be thinned out. This is very easily done. A small hole (10cm x10cm) is cut with an axe into the top of the trunk of a sucker that is not wanted. This hole lets the sago beetle in and the sago grubs that develop quickly kill out the sucker. They don't get into the main palm or other suckers unless a hole is made. After a few months when the sucker is seen to be dead it can be split open to provide a feed of sago grubs.

There is no simple way of telling when a palm is ready to harvest. By experience people learn to recognise how big each variety should be before it is ready to harvest. If the palm were left too long it would produce a very large flower at the top and then die. This flower would use up all the starch in the trunk so that there would be nothing to harvest. As long as the flower

has only started to grow and the seeds haven't yet formed on it, the palm is still suitable for harvesting. Sometimes when people are in a hurry to use a palm that isn't quite ready, they cut a hole to check how much starch is stored inside. But sago grubs must not be allowed to get in.

After the palm has been cut and harvested another sucker grows more quickly than the others and becomes the new main trunk. It still takes about the same time to get mature.

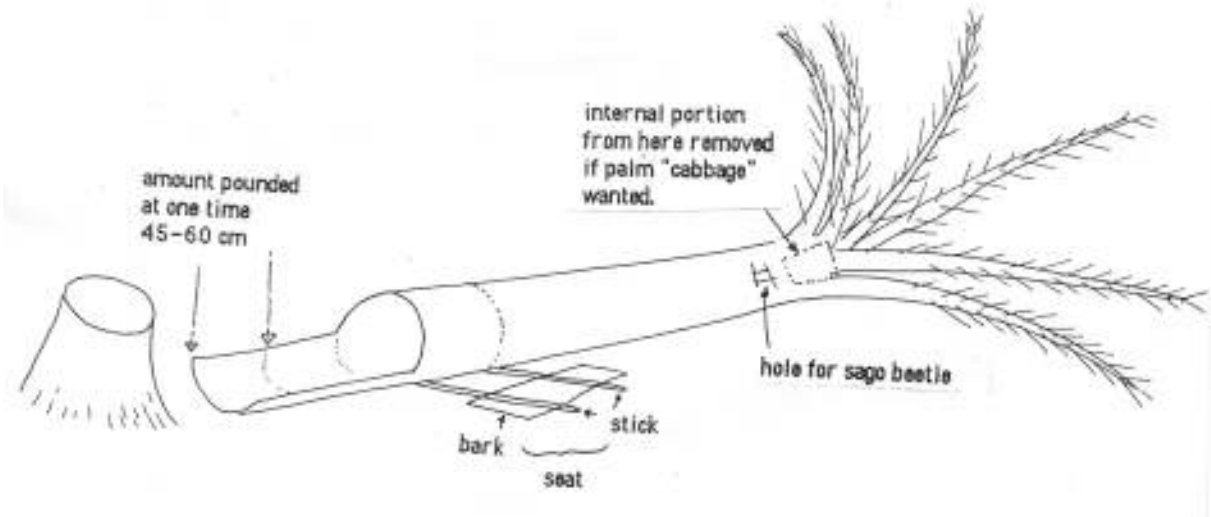
Harvesting sago starch

First the sago palm is cut down. Mostly this is men's work. Then the bark is split off the trunk for about one metre along its length. Normally this bark is carefully laid out at the sides propped up by logs so that it both makes a seat for the person to sit on and a mat for the shredded pith of the trunk to fall onto.

Sago in the trunk of the palm is all mixed up with the fibres of the plant. So this pith has to be shredded up into small pieces and the starch is then washed out. Special tools are made for pounding up the trunk. They need to be light, strong and with a hard stone (or metal) head.

In areas where sago is the main food, sago is women's work. The women sing special songs while they work. In areas where sago is not the main food, both men and women pound sago.

The normal method of pounding sago is to sit at the side of the trunk, hold the sago pounder in both hands and lift it above your head, then chop it down so that it just scrapes a thin layer off the edge of the trunk. When a pile of shredded up trunk has been made, it is carried away to be washed. If a lump of the pith breaks off it is often chopped up with a bush knife or axe.

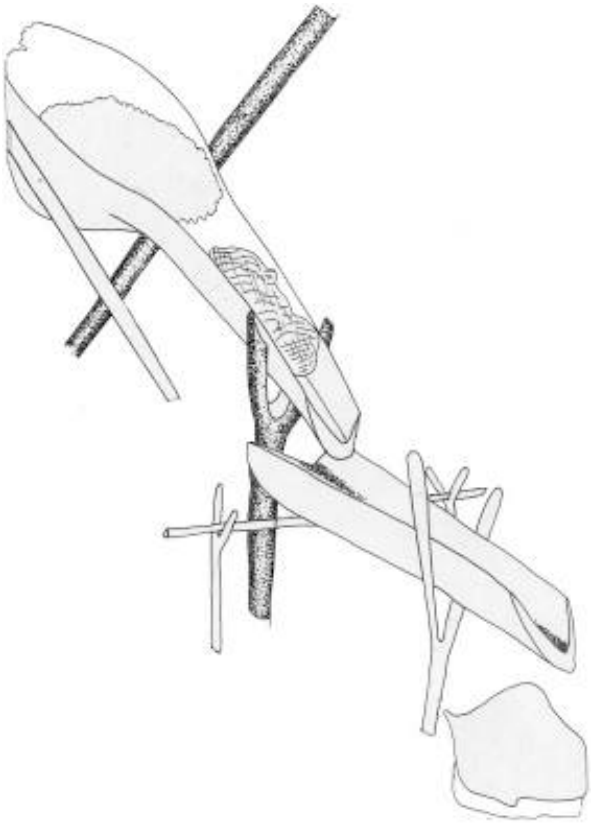


Sago pounders

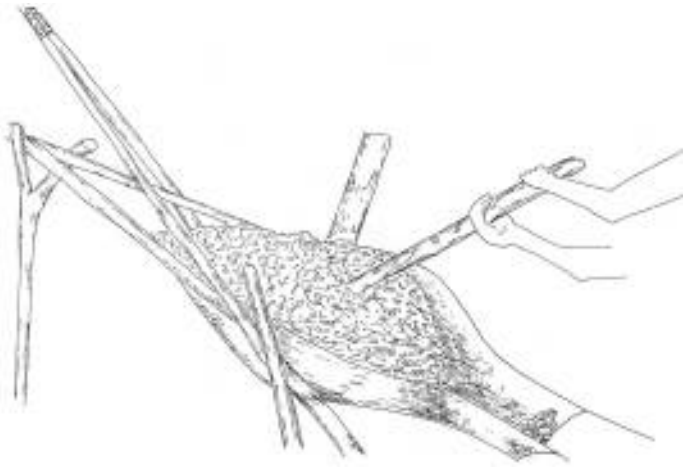
Sago washing

A framework is set up for washing sago. It needs to be near water. If no convenient creek is nearby, a hole can be dug in the ground as this quickly fills with water in most sago places. The water needs to be clean or the starch gets a bad colour and taste.

The washing framework is mostly built using the bottom section of the midrib of the sago fronds.



The shredded pith of the palm is put into the bowl made by the fronds and the starch is washed out by banging it with a stick and pouring water over it. The filtered starch is allowed to settle out in a bowl. It is then dried and taken home.



Sago storage

Some people store sago for long periods. Near Mt Bosavi, most Kaluli people always have some sago in storage. People near Erave and Woposali occasionally store sago. People at Kutubu don't seem to store sago often. The sago to be stored is wrapped up in a tight bundle using

leaves and bark. It is then buried in the mud. It will keep for one or two years. Sago that has been stored has a slightly different taste, but it is still quite good to eat.

Sago cooking

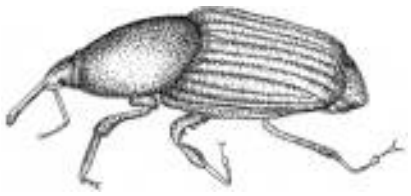
Most people in the Southern Highlands simply fill up a bamboo tube with sago starch and bake it near the fire. Sometimes sago is cooked wrapped in leaves. The bamboo tube is then split open and the sago eaten, along with greens and other foods. Occasionally people add leaves such as "tu-lip" leaves, or okari nuts. There are lots of other interesting ways sago can be cooked and used, but people in the Southern Highlands don't seem to use these.

Extra food from sago

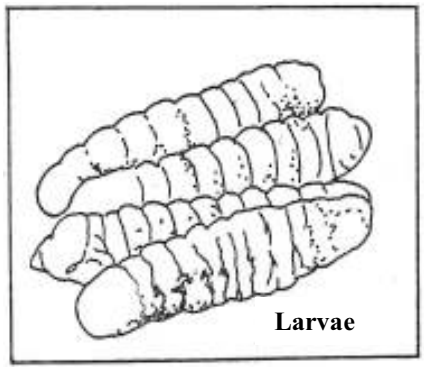
At the top of the trunk of a sago palm there is a bundle of young tender undeveloped leaves. This is often called the palm "cabbage". It can be cut out and cooked and eaten. It is good food.

Sago grubs, and sago starch go together. Sago grubs are grown in several different ways in sago areas. Normally the top and bottom sections of the trunk are left for sago grubs to grow in as these sections have less starch and more fibre and are therefore harder to work. As already described, sago grubs are grown in suckers that are being killed. If too many palms are ready at one time, the extra ones are cut down for grubs to grow in. Sometimes a poor tasting or very fibrous palm is left for grubs to grow in. Particularly near Bosavi, sago grubs are also cultivated in another palm called the fishtail palm (waiyo). It takes about 2 months for a harvest of grubs from the time the beetles are first let in.

Sago grubs are the larvae of a beetle. They are good food.



Beetle



Larvae

Pupae

Sago as food

Sago is a very good energy food. But it has very little of the growth food (protein) or health food (vitamins and minerals). Therefore in sago areas it is particularly important to pay special attention to the other foods that make up the diet.

The food value of 100g of the food eaten is:

	Moisture %	**Energy cals**	**Protein g**	**Calcium mg**	**Iron mg**	**proVitA µg**	**provitC mg**
Starch	20-45	285	0.2	30	0.7		
Grubs	70.5	181	6.1	461	4.3		
Cabbage							

Yield and work required

One sago palm may last an average family (6 people) for 4 weeks. It is worked in sections of 60cm to 100cm of the trunk and 6 to 8 of these sections can be got from one palm. A typical routine would be for a woman to spend 3-4 hours pounding and washing one section and this would produce about 20-25kg of starch that would last the family for about 3 days.

Drawing by Celia Bridle

Sugarcane

Tok Pisin: Suga **Scientific name:** *Saccharum officinarum*

Tok Ples names:

Huli - Tu	**Foi** - Magi	**Onobasolo** - Kono
Mendi - Wol	**Hewa** -	**Etoro** – Bai ile
Kewa - Wali	**Pole** - Wali	**Hawalisi** - Ase
Wiru - Tai	**Samberigi** - Weli	**Fasu** - Sao
Duna - Angou	**Podopa** – Ho	
Imbongu - Po	**Kaluli** – Hon	

The sugarcane plant

A tall thick stemmed clumpy grass. It has many nodes. It grows 1-6 m tall. It spreads 100 cm wide. A large number of different cultivars occur. The leaves are long and narrow. They taper to the tip. They are rigid and droop at the tip. The cane varies in thickness, length of nodes, colour etc. The stalks have distinct nodes and the bottom of the leaf is wrapped in a sheath around the stalk. The flower is brownish. The flower is surrounded by dense, silky, white hairs.

Drawing Celia Bridle

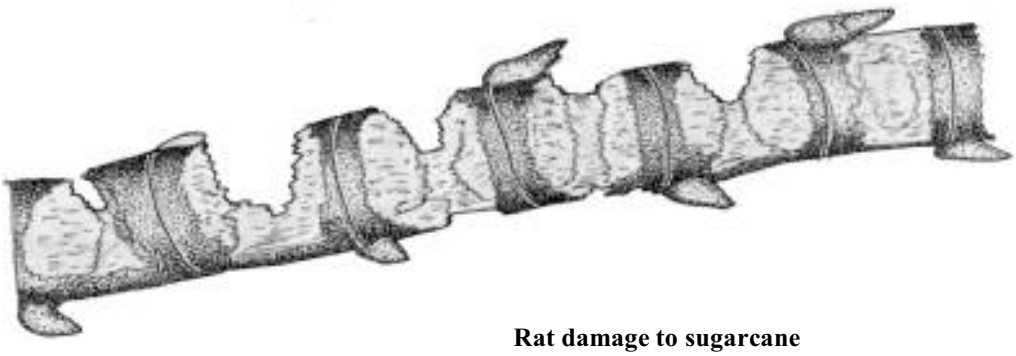
Where does sugarcane grow?
It is a tropical plant. It occurs throughout the country of Papua New Guinea. It grows in all areas of the Southern Highlands and is an important snack food and ceremonial plant. It needs a temperature over 21°C for sprouting. It is frost sensitive. It suits hardiness zones 9-12.

Growing sugarcane
Sugarcane plants are mostly grown from tops of canes. They can be grown from sections of the stalk or division of the rootstock. It requires a good fertility and good rainfall. Plants can be ratooned or cut back if the soil fertility is high. Tall cultivars need staking. Plants mostly take 14-18 months until they are ready for harvest.

Sugarcane as food
The sugarcane stems are chewed.
The flowers can be cooked and eaten before the flower opens.

Pest and disease
Sugarcane suffers damage from many insects and can also get several leaf spots and other diseases. One of the most worrying group of insects are the borers. These often get started by hiding behind the leaf sheathes and then boring into the canes. Village people often strip off the older leaves to prevent this occurring.
Because sugarcane has been growing in Papua New Guinea for many years, the diseases and the plant have come to some form a balance where the diseases and leaf spots occur but they don't always cause serious damage.

Rats can cause considerable damage to sugarcane.



Rat damage to sugarcane

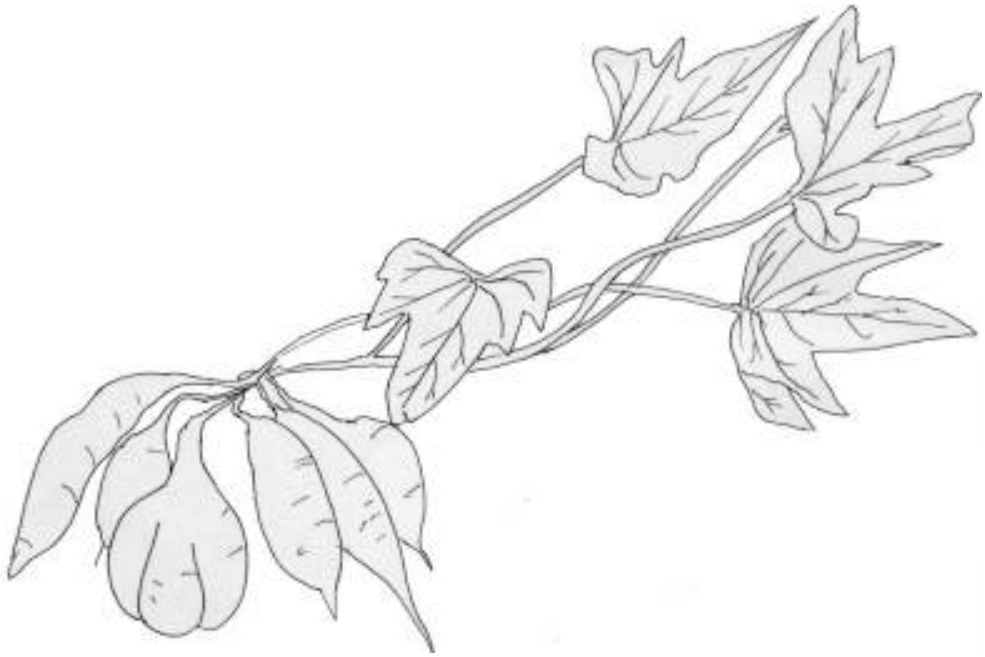
Sweet potato

Tok Pisin: Kaukau **Scientific name:** *Ipomoea batatas*

Tok Ples names:

Huli - hina	**Imbongu** - gai	**Hewa** -
Mendi-Karint-hore	**Foi** - agira	**Onobasalo** - sabaru
Mendi- Nipa -okei	**Pole** - mondo	**Etoro** - isaburu
Kewa - sabi	**Samberigi** - tia	**Hawalisi** - halagulu
Wiru - modo	**Podopa** - kale	**Fasu** - halagulu
Duna - hina	**Kaluli** – siapuru	

The sweet potato plant



In Papua New Guinea the sweet potato plant is a very variable plant. It has leaves borne singly along the vine and produces thickened tubers under the ground. But leaf shape, vine length, tuber size shape colour and taste are some of the many things that vary to give the large number of varieties seen throughout Papua New Guinea.

Growing Sweet Potato

Sweet potato is grown from the tips of vines. In some areas people put three runners in together. People often argue a lot about how many tops should be planted together. It does not greatly affect the amount of sweet potato produced whether plants are put closely together or more widely apart, but the size of the tubers varies. For larger sweet potato tubers, plants need to be more widely spaced.

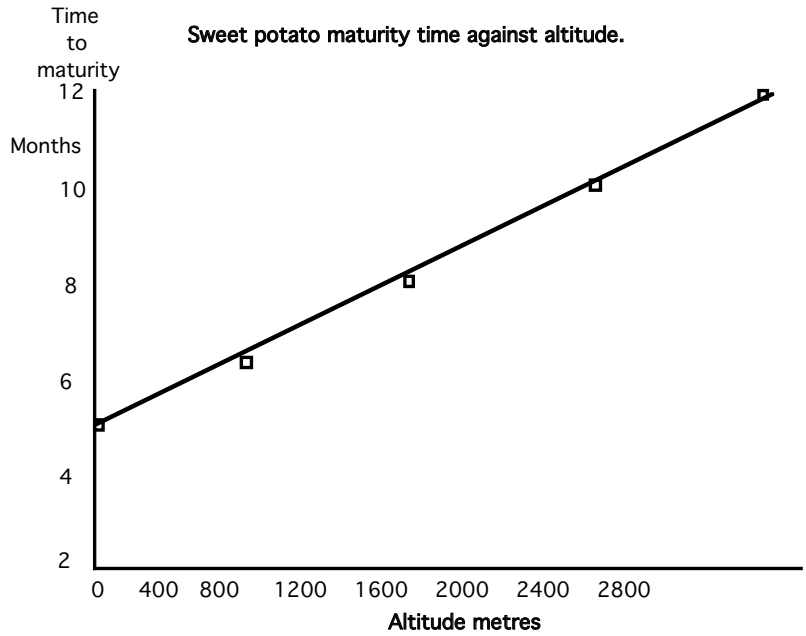
Sweet potato cannot stand water-logging. For tubers to form, there must be lots of air in the soil. If the soil becomes too wet the sweet potato will grow lots of vines and leaves and produce very few tubers under the ground. So probably the individual practices that different sweet potato growers have developed in different areas of the country are methods they have learned by experience to suit their soil and rainfall patterns. Where the soil is heavy with lots of

clay it is more important to build mounds or ridges. In some places in Papua New Guinea where people have sandy soils they simply plant sweet potato on flat ground or sometimes with very small mounds. This works well enough for those soils as long as there is not a lot of rain causing the soil to be waterlogged. Once sweet potatoes have passed the particular time in their growth when the tubers are formed, they will not later produce tubers so only tops grow and the few tubers that have formed grow large.

Sweet potato also has another problem. Sometimes they grow too much top and produce little food under the ground. This occurs where the soil is very rich in nitrogen as this favours top growth but not storage of starch in tubers. Often when people see this occurring, especially in coastal areas they go through the garden and remove some of the top growth either by breaking it off or banging it with sticks. If a second crop of sweet potatoes is produced in the same garden it normally doesn't happen a second time as nitrogen quickly gets used up by plants or washed away in the rain. This problem is most common in new bush gardens.

In most areas of Papua New Guinea people go through their gardens several times harvesting the tubers. They take the large ones, then allow the smaller ones to continue growing before they are harvested later. In many areas after the third harvest pigs are allowed to forage in the gardens and eat the vines and tubers. This is one efficient way to clean up gardens but it is possibly for pigs to spread some diseases from one sweet potato crop to other areas if not careful. eg Sweet potato black rot.

In the Southern Highlands probably the most significant factor affecting sweet potato production is the height of the garden above sea level. The higher the garden, the colder the temperature and therefore the more slowly the sweet potato grows. In coastal areas there are some sweet potato varieties that will produce some tubers within 6-8 weeks. But the Southern Highlands Province has no land this close to sea level. In the high mountain gardens, sweet potato can take over 12 months to be ready to harvest.

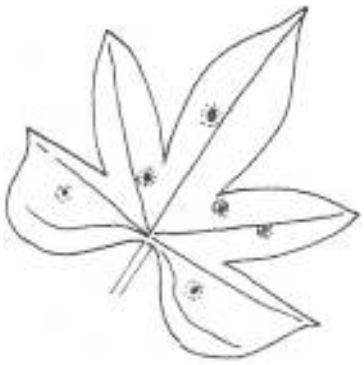


The other serious problem is that sweet potato cannot tolerate frost so during times of drought, when the skies are clear and frosts occur, the loss of crop can be very serious. People in these high altitude regions need to have some crops like Swedes and turnips that can be used for pig feed at normal times but could then be eaten when frosts kill other crops.

Plants can grow with a wide range of rainfall patterns and in different soils. Sweet potatoes are not tolerant to shading. Under shaded conditions, both foliage growth and storage root production are decreased. Some cultivars can be selected for increased production under mild shade but not heavy shade. The survival of cuttings at planting is also reduced under shaded conditions. Under shaded conditions plants become more climbing and have fewer leaves but these are however larger. With increasing shade less tubers are produced and these grow more slowly. Sweet potato tends to be responsive to potassium fertiliser. This potash can be provided by ashes from the fire or after burning. Cultivars are often selected for yield under low fertility conditions. Under lowland conditions in the tropics sweet potato tubers undergo active tuber enlargement from 6 to 16 weeks. Weed control is essential especially during early stages of growth. The rate of ground coverage by foliage varies greatly with growing conditions and cultivar but once ground coverage has occurred weed control is less of a problem. It suits hardiness zones 9-12.

DISEASES

Leaf spot

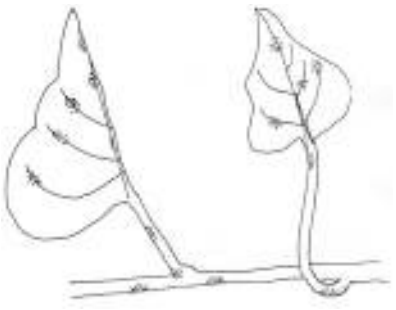


Small angular brown spots develop on the leaves of sweet potato. They are due to a fungus.

The spots are mostly on the older leaves and they become more common in old garden sites where soil fertility is getting low. They are also worse in the wet season.

Leaves fall off slightly early but the disease appears to do little damage.

Scab



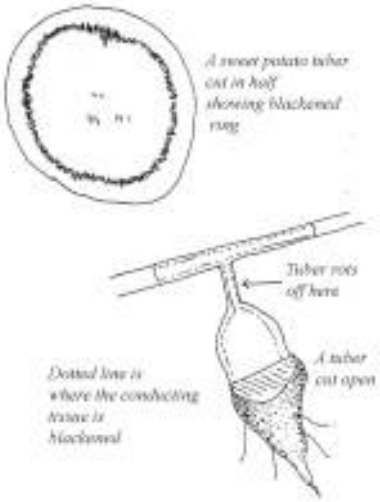
Brown scabby spots can often be seen on the veins of the leaf and along the vine of the sweet potato plants. The leaves become twisted and often the tips of the branches stick upright.

Some varities of sweet potato get the disease less than others. Most varieties of sweet potato in Papua New Guinea seem to have a sufficiently high level of resistance to this disease for it to not get too bad. The yields are reduced.

It normally becomes obvious when the garden is losing its fertility (gris). So instead of trying to get rid of the disease the most important thing to do is to improve the soil fertility. This can be done by using compost or mulch, by fallowing the ground and allowing deep rooted plants to bring nutrients back to the surface, and by growing soil improving crops like beans and legumes.

Fusarium wilt

In the Upper Mendi and Upper Karint areas sweet potato tubers are rotting and plants are growing leaves only. The stalk which joins the tuber to the plant has rotted off. If the tuber is cut in half or if the stem is cut open a dark brown ring can be seen. This ring is because a fungus has got into the plant and blocked the conducting cells where food and water pass up and down the plant. Normally it is root knot nematode which first damages the skin and lets the fungus get inside. The very small worm like nematodes inside the roots do not form these galls.

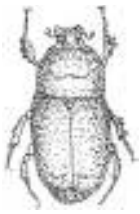


Insects

A range of insects including grasshoppers chew the leaves of sweet potato. In the lower regions where sweet potato tops grow quickly this may not be serious but in higher and colder places these insects can compete with the sweet potato, making yields less.

Sweet potato weevil

Some of the more serious boring insects include the sweet potato borer and taro beetles. The sweet potato weevil cannot dig so can only get to tubers by cracks in the soil or when tubers are near the surface. Covering up these tubers and filling in the cracks stops damage. Taro beetle can dig easily and is very hard to stop.



Taro beetle

The sweet potato hornworm hides in the shade under leaves and eats them. It gets worse in dry areas and mostly occurs below 1500 m altitude. It can be caught and killed.

Taro hornworm

Sweet potato as food

	Moisture %	Energy KJ	Protein g	proVitA µg	provitC mg	Iron mg	Zinc mg
Tubers boiled	72.0	363	1.1	1705	15	0.6	0.3
Tubers baked	72.9	431	1.7	2182	24.6	0.5	0.3
Leaves	86.3	168	3.9	1700	58	2.9	

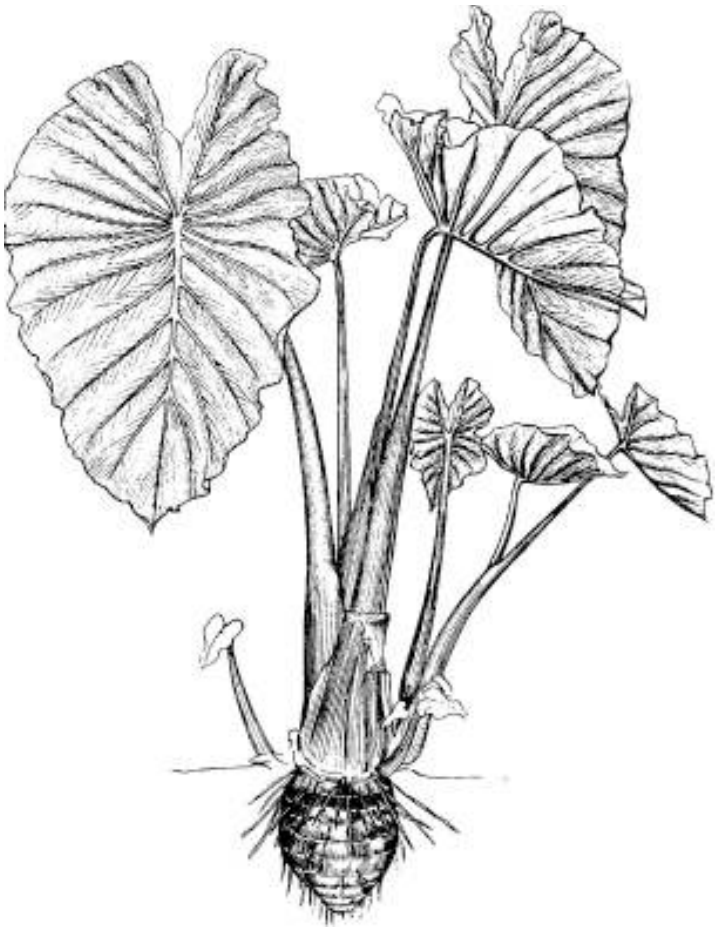
Taro

Tok Pisin: Taro tru **Scientific name:** *Colocasia esculenta*

Tok Ples names:

Huli - ma	**Imbongu** - me	**Kaluli** - diefele
Mendi - moa	**Foi** - ega	**Hewa** -
Kewa - tabul	**Pole** - ma	**Onobasalo** - taro'o
Wiru - mi	**Samberigi** -ma	**Etoro** - nau
Duna - ta	**Podopa** - ang	**Hawalisi** - kopare
Fasu -		

The taro plant



The taro tru plant is an upright plant with large leaves carried on a long, often striped petiole.

The petiole joins this large leaf blade away from the edge towards the centre of the leaf.

At the ground level it has a large fattened base to the stem that is called a corm. Around this corm small buds produce a circle of suckers or small side plants.

As plants get older, particularly if a dry period occurs, the taro plant will produce a lily type flower in the centre.

Where does taro grow?

Taro will grow from sea level up to about 2300 metres altitude. This means that most gardeners in Papua New Guinea have the chance to grow taro if they want to. In fact most families in the Southern Highlands grow at least some taro.

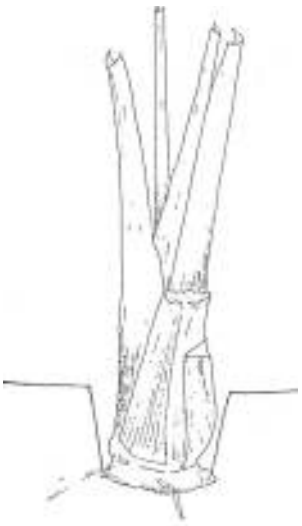
Taro needs some special conditions to grow well. It needs to have a fertile soil, and it needs plenty of water. Because taro can also stand a reasonable amount of shade, it is particularly suitable for growing in newly cleared rainforest in places with high rainfall. Near Mt Bosavi, the Kaluli people have these conditions and they have also developed a special gardening technique. They clear the undergrowth, plant their taros and bananas, then cut the trees down over the top of the crop. The taros and bananas grow up through the fallen leaves and branches. The Huli people near Tari often grow taro along the edges of the drains that they are so specialised at digging. Here the taro can get moisture and good fertile soil. In other areas of the Province people find the right conditions for taro either at the bottom of a deep limestone sinkhole such as on the Nembi plateau or at Erave, or beside a creek or river or at the bottom of a small valley. Sometimes taros are put near houses where the soil fertility can be built up with household scraps and rubbish.

How can you grow taro?

Taro is grown from the top piece of a corm, or from side suckers. As a general rule, larger tops grow faster and give larger corms. Often when side suckers are used they are stored in a nursery beside a creek until needed.

The top or sucker is planted in a hole. The hole should be 10-20 cm deep. Normally it is made with a digging stick or a spade.

A normal spacing for taro is to put one plant on each square metre of ground.



A taro top in a planting hole

Taro can be planted from cormels or from the top of the central corm. Other sections of the corm could also be used but this is not commonly done. Flowering of taro and seed production can lead to new cultivars. The general growth pattern is for an increase in top growth, in terms of leaf number, leaf area and petiole length, to continue for about 6 months under tropical lowland conditions then for each of these to decrease and tuber storage to continue to increase. Corm weight increases significantly from 5 to 11 months. Starch content also increases with time but protein content declines over the corm development period.

Taro can be grown under flooded conditions but root rots develop if the water becomes stagnant. For flooded cultivation, the land is cleared, ploughed, cultivated and puddled. The aim is to get a field that is flat with embankments allowing the impounding of water. Planting is done into 2-5 cm of standing water.

For dryland taro, the soil is prepared by digging, unless a fresh bush fallow is used where the natural friability of the soil allows plants to be put into the undug soil in a small hole that is prepared. Plants are put into a hole 5-7 cm deep or deeper. Mulching to store moisture and reduce weed growth is a good idea.

Setts from corms or the main stem normally give higher yield than that from cormels or the side suckers. The greater leaf area and root production may be responsible for this. Setts of about 150 g are optimum.

The time of planting is normally done when rain is likely. Planting is done shortly after the rainfall has become regular, if seasonally distinct wet and dry seasons occur. Higher rainfall, higher temperatures, and higher hours of sunlight, improve production and help decide what is a good season to grow taro well.

Taro is sensitive to weed competition throughout most of its growth, but it is more critical during early growth up to 3 - 4 months. About 7-9 weedings are required, to keep the crop clean under tropical lowland conditions, where flooding is not used. Near the end of the taro plants growth is is also important to weed the garden so that corms store starch and fatten well. Mechanical weeding needs to be shallow to avoid damaging the taro roots near the surface.

Taro produces the most food under full sunlight, but it can still grow under moderate shade. Under shaded conditions it grows more slowly and develops less cormels or side shoots. They need plenty of rain and are not good as surviving drought.

Taro residue has a chemical can reduces the germination and growth of other plants, for example, beans.

Taro does best with high fertility, and is improved with the addition of NPK fertiliser.

Spacing affects total yield, and marketable, harvestable yield, of corms. Close spacing gives more food but smaller corms. Where spacings of 30 cm x 30 cm are used, giving about 110,000 plants per hectare, a very large amount of planting material is required. A spacing of 60 cm x 60 cm in more common. Wider spacings of 90 cm x 90 cm gives less food.

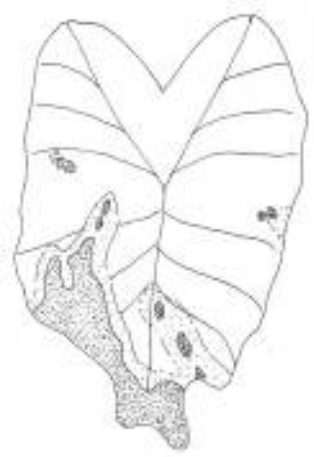
Taro as food

Food value per 100 g edible portion

	Moisture %	**Energy KJ**	**Protein g**	**proVitA µg**	**provitC mg**	**Iron mg**	**Zinc mg**
Corms	66.8	1231	1.96	3	5	0.68	3.2
Leaf stalks	93.0	101	0.5	180	13	0.9	
Leaves cooked	92.2	100	2.7	424	35.5	1.2	0.2

Diseases

Taro blight



This is a fungus disease that produces dead spots on the leaves. Often the spots run down the leaf in a line, and there is a yellow border around the spots. The edge of the leaf away from the spots often dies.

It is this disease that has caused so much trouble in coastal taro growing areas like Manus and Bougainville.

In most of the Southern Highlands this disease does not cause much trouble because the altitude and cool temperature stop the disease spreading. Diseased plants can be seen in lower villages (below 800m) such as Boro.

Taro shothole

This is another fungus disease that looks quite a lot like taro blight. It has round dead spots that have a yellow ring around them. Often there is a hole in the centre of the spot where the dead leaf tissue has fallen out.

This disease is commonly seen on taro plants in the Southern Highlands. It never gets bad enough to kill the leaves or the plant, but it does some damage.

Brown leaf spot

Irregular but almost round reddish brown blotches can often be seen on older taro leaves. They are due to another fungus.

The spots don't seem to do a lot of damage to the leaf and the growth of the plant does not seem to be seriously affected.

Dasheen mosaic virus

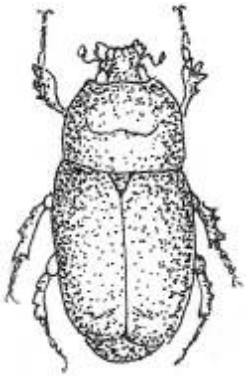
This disease often shows itself on taro leaves as a fine feathery yellow and green streaking pattern around the veins of the leaf. The leaves can also become slightly wrinkled.

It is caused by a very small particle called a virus. These viruses are spread between plants in the mouthparts of small sap sucking insects such as aphids.

It does not get as serious as other virus diseases of taro in coastal areas, but it can be seen in the Southern Highland gardens.

INSECT PESTS

Taro beetles



These black or brown beetles are 2-3cm long and seem to occur wherever taro is grown in Papua New Guinea. Their front legs are specially adapted for digging and they burrow under the plant eating the corm. The larvae or grubs also live in the soil and eat taro. There are several different kinds of taro beetle.

The only place where damage seems less is in very damp sites. Taro beetles can also damage a number of other plants.

Taro hawkmoth

This large green caterpillar can often be found under the edge of a taro leaf eating the leaf. It has a pale stripe along the side, 2 large "eye" spots and a long pointed brown horn at the end.

Although it can be found in most taro gardens in the Southern Highlands it never seems to develop large numbers such as occur in some lowland gardens in the dry season.

A similar hawkmoth caterpillar with a distinctive striped pattern along its body can also be seen in some taro gardens.

These caterpillars are large and can easily be caught and killed by hand.

Tu lip

Tok Pisin: Tu lip **Scientific name:** *Gnetum gnemon*

The tu lip tree.

In Tok Pisin this small tree is called tu lip. As people in Holland and other countries grow a flower called tulip, we need to point out that the two plants, or their names have nothing in common. The "tu lip" tree has no common English name although in some countries it is called jointfir. Scientists use the Latin name of *Gnetum gnemon*. This name was given to it by a famous botanist called Linnaeus more than 200 years ago.

People in Papua New Guinea call it "tu lip" because of the way the leaves are arranged. It has two leaves (tu lip) opposite each other along the branches. Often the branches also come out in pairs opposite each other.

What does a tu lip tree look like?

It is a small tree often only 8-10 metres high. It is a fairly straight tree with one trunk that has branches spread out along its length. The branches are not very long so that the tree does not spread out very wide. The fresh young leaves have a slightly brownish green colour and are in pairs. The older leaves are dark green and shiny.

When the tree has fruit it can be covered with green nut-like fruit that turn red when ripe.

The male and female flowers are separate and are on different trees. So only female trees bear fruit. The flowers are grouped on spikes that develop near the base of the leaves. The flowers are yellow.

This tree, in common with some other closely related plants that are called *Gnetum,* has rings or hoops at the places where the leaves occur. These can be seen in this picture.

A tu lip tree has ridges running across the trunk that can help you recognise the tree

This is a drawing of the tree

Why is the tu lip tree so useful?

The young leaves of the tree are eaten and are a very popular green vegetable. They are very good quality food. They have been described as one of God's good gifts to Papua New Guinea.

The nut like fruit and seeds can be eaten. They are also very good food value.

The bark of the tree is good for making ropes and nets.

The timber can be burnt green, as firewood.

The timber will last for a long time when used for posts in wharves in fresh water.

Where does the tu lip tree occur?

It grows wild in lowland and lower mountain regions of Papua New Guinea. People in these areas look after it and leave it growing when they are clearing new gardens in the rainforest. They often transplant seedling trees into their gardens and they also grow their own trees from seed.

But the tu lip tree is common in a number of other Asian and Pacific Island countries. Another famous botanist called Rumphius spent many years in Asia. In the year 1670 he commented on the tu lip tree in his notebook. The picture and his comments are reproduced here.

What is the food value of tu lip?

In 100 grams of the part you eat the following amounts of different kinds of food occur.

	Moisture %	Energy cals	Protein g	Calcium mg	Iron mg	proVitA µg	provitC mg
Leaves	**75.4**	**43-90**	**3.9-6.4**	**266-330**	**2.7-7.7**	**5900-7100**	**113-200**
Fruit	**80**	**66**	**5**	**163**	**2.8**	**600**	**100**
Dry seeds		**345**	**12**			**0**	

This means that the leaves are very good quality food. The fruit and seeds are also very good quality food. If you eat a nice big bowl of these leaves they will provide a lot of your body-building and your health food needs.

How do you prepare the food?

The young tender leaves are picked and boiled or fried.

The red fruits that are about 2.5cm long can be eaten raw but they are tough.

The seeds of the ripe fruits are eaten roasted, boiled or fried. Before cooking the seeds it is necessary to either remove the tip or crush the seed, or seeds can explode on heating.

The young flowers including the young fruits are sometimes cooked and eaten.

Because the parts eaten can contain irritating substances the various parts are normally cooked before being eaten.

How do you grow tu lip trees?

Tu lip trees often grow wild. You can find a small wild plant in the bush and transplant it to where you want it.

You can also grow trees from seed. Collect a very ripe red fruit from a tree. It has one seed inside. If you simply plant it the seed sometimes takes a long time to start growing. You may have to wait 6 months. This is because the seeds have a hard outside layer and it is difficult

for moisture to get in to start the seed growing. To get the seed to start growing more quickly you can carefully file a small hole through the outside layer of the seed.

If you are going to plant several trees they should be planted about 6m apart.

Because this tree grows naturally under larger trees in the rainforest it is suited to growing in places where there is some shade. Therefore you can plant the tree in a partly shaded place if you want to.

If you want to you can grow trees from cuttings. This means you take a small branch off a tree and plant it in warm moist soil where it will develop roots and grow.

How much food?

The leaves of very small seedling tu lip trees in the rainforest are harvested of their young leaves as people walk past. So an early harvest can be gained. Like many tropical trees, tu lip trees grow by producing flushes of new leaves throughtout the year. So leaves are not always equally available. In fact many tulip trees have fresh young leaves for picking at one main season of the year.

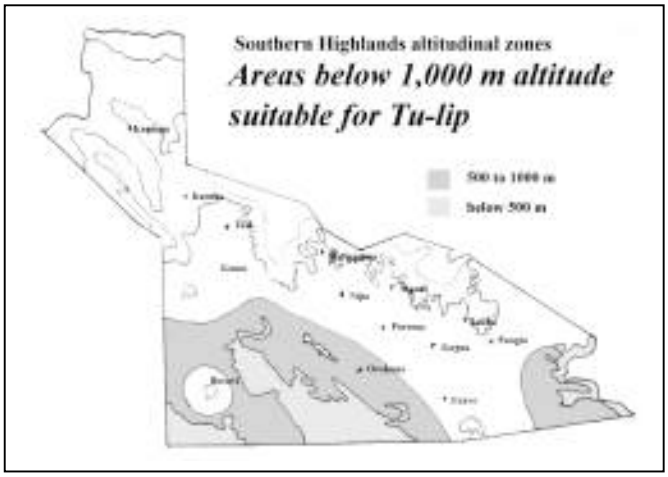
Tu lip in the Southern Highlands Province

Tu-lip is an important and popular edible green in the lower areas of the Southern Highlands Province.

Some of the names for it in the languages of these lowland groups of people are:-

Foi - hagenamu	**Etoro** - kopaiyo
Pole - kangenamu	**Hawalisi** - yabare
Podopa - sake	**Hewa** -
Kaluli - hawa	**Fasu** -
Onobasalo - kopaiyo	**Samberigi** -

Tu lip grows from sea level up to about 1000m altitude. These areas for the Southern Highlands Province are shown on the map.



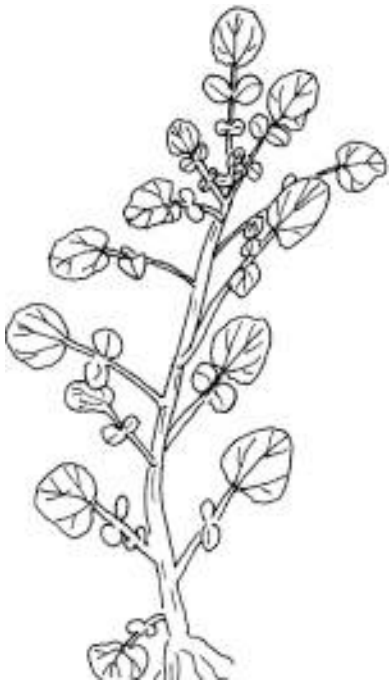
It is not equally important in all these areas. At Erave people harvest it out of the bush where trees grow naturally. But they don't use it a lot. At Podopa villages, like Woposali and Boro, and Foi villages such as Hegiso, trees are grown in and around the villages. People in these areas recognise and have names for 3 or 4 different varieties. Near Bosavi, the Kaluli people mainly harvest leaves and seeds from wild trees. Although trees are rarely planted the self sown trees are protected when clearing bush for gardens and they are look after in gardens.

Watercress

Tok Pisin: Wara kebis **Scientific name:** *Rorippa nasturtium-aquaticum*

Huli - Awa	**Foi** -	**Onobasolo** -
Mendi – Wakari/ Ip komp	**Hewa** -	**Etoro** -
Kewa - Pakimbita	**Pole** -	**Hawalisi**
Wiru - Kambere	**Samberigi** -	**Fasu** -
Duna - Lira	**Podopa** –	
Imbongu - Komba	**Kaluli** –	

The watercress plant
It is a small leafy plant that grows in water and lasts for several years. It has hollow stems and forms roots freely from the nodes. It branches freely. The leaves consist of 3 to 7 pairs of small leaflets then a larger leaflet at the end. The flowers are small and white and grow grow in a cluster. Flowers are not always produced and need days with more than 12 hours of sunlight to form. A small narrow curved seed pod about 2 cm long can develop. It grows attached to the banks of streams.



Where does watercress grow?
This is a temperate climate crop. It is common in tropical highland creeks especially those flowing off limestone hills. (pH 6.5-7.5) It needs to be in running water. In the tropics it occurs from about 1000 m up to at least 2900 m altitude. It grows in streams, ditches, lakes, swamps, and marshes.

Growing watercress
It is grown from cuttings planted along the edges of clear running water. Cuttings of 10-15 cm long are suitable. The plant has roots along the stem at the node and cuttings quickly form roots in water. A spacing of 30 cm is suitable. This small plant keeps living for many years once established. It can also be grown from seeds. Plants can float on the water. It will not tolerate drying out. Watercress has a high phosphate requirement.

Harvesting can occur 4 to 6 weeks after planting. Regular picking encourages branching and increases production. Tips 5-10 cm long are harvested. This can be repeated every 4-6 weeks.

The leaves and stems are eaten raw or cooked and have a spicy flavour.
Cooking should be used if the water in the stream is not pure and clean.
The seed can be germinated to produce sprouts. The seeds can be ground to make a mustard flavouring.

Food value per 100 g edible portion

	Moisture %	**Energy KJ**	**Protein g**	**proVitA µg**	**provitC mg**	**Iron mg**	**Zinc mg**
Leaves	95.0	63	2.4	960	**35**	**3.4**	**0.1**

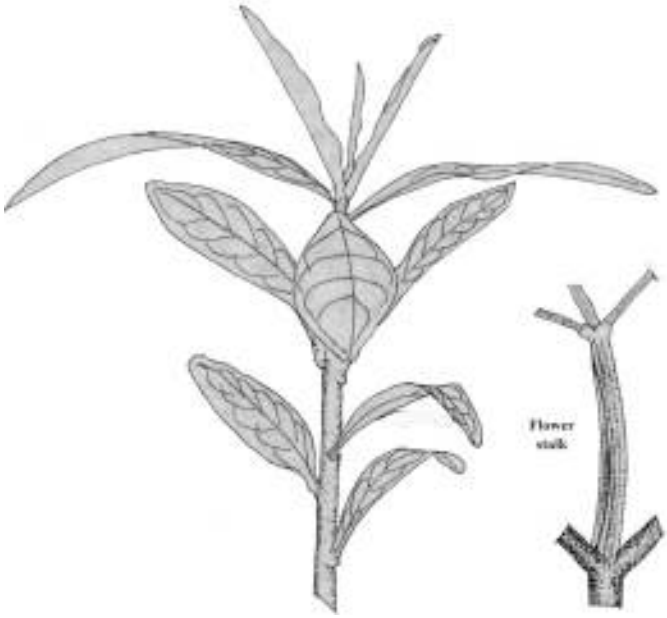
Waterleaf

Tok Pisin: **Scientific name:** *Talinum triangulare*

The waterleaf plant

This plant is a small shiny leafed plant that grows up to about 60cm tall. The leaves have very short stalks and are fairly soft and light green in colour.

The plant produces a flower stalk at the top. This stalk is triangular shape. A clump of pale pink flowers with 5 petals grows at the top.



The plant grows upright and has a number of branches.

Where is waterleaf grown?

Waterleaf or *Talinum* is grown in a number of tropical countries. How long it has been in Papua New Guinea is not known, but it has only recently been brought from the Gazelle Peninsula to the Kutubu area in the Southern Highlands. It is grown in Africa, South America, Indonesia and the Philippines. It suits the lowlands probably below about 1000 metres altitude as it does best in hot places.

How do you grow waterleaf?

Waterleaf can be grown from seeds or cuttings.

The seeds are very small and black. It takes 4000 seeds to weigh one gram. It is not easy to collect seeds because the seed capsules split open very easily and the seeds drop out. Also plants don't always produce seeds readily. But you can collect seeds and grow plants from seeds. This is easiest by sowing seeds in a small nursery then transplanting the small plants when they are about 5-8cm high. With very small seeds like these, it is best to mix the seeds with dry sand before sowing. Then a small amount of the seed/sand mixture can be sown and the seeds will not be too close together. Seeds will grow in about 6 days.

Another way to grow waterleaf is to use cuttings. Cuttings of 15-20cm long can be taken from the older, but not the woody part of the stem. The leaves should be taken off the cuttings. The cuttings need to be planted in warm moist soil. They should be about 20cm apart.

Older waterleaf plants can be cut back and allowed to sprout again.

Is waterleaf in any way special?

Waterleaf is one of the plants scientists call C4 plants because it has some special ways of moving food around and storing food inside the plant. This means it can normally grow very fast if it is given the right conditions. The conditions these types of plants prefer are high temperatures, high soil fertility, plenty of sunlight and sufficient water. But even though the plant grows best under these conditions it doesn't have to have them. It can grow reasonably well under lower soil fertility conditions and is very good at surviving dry times and will grow with a little shade.

How is waterleaf used?

The young tender leaves and tips of branches are picked off. Sometimes they are eaten raw in salads, but more commonly they are cooked. The bottom part of the leaves sometimes turns slightly brown on cooking and the cooking water can become a little coloured. It is best to steam the leaves in bamboo.

The leaves have a slightly sour taste and are a little slimy.

Pests and diseases

In other countries few pests or disease problems have been noticed. These have not been looked at in Papua New Guinea.

How much food is produced?

In other countries, waterleaf plants are ready to start picking after about 4 weeks. Leaf tips may be picked every two weeks for up to a year. Normally the top shoots are picked out first, to lket the side shoots grow.

Up to 5kg of edible tips have been harvested from one square metre area of plants over one year.

Food value.

Waterleaf leaves are a quite reasonable quality green leaf vegetable.

The amount of different nutrients that it contain in each 100-gram portion of the leaves that are eaten is shown in this table.

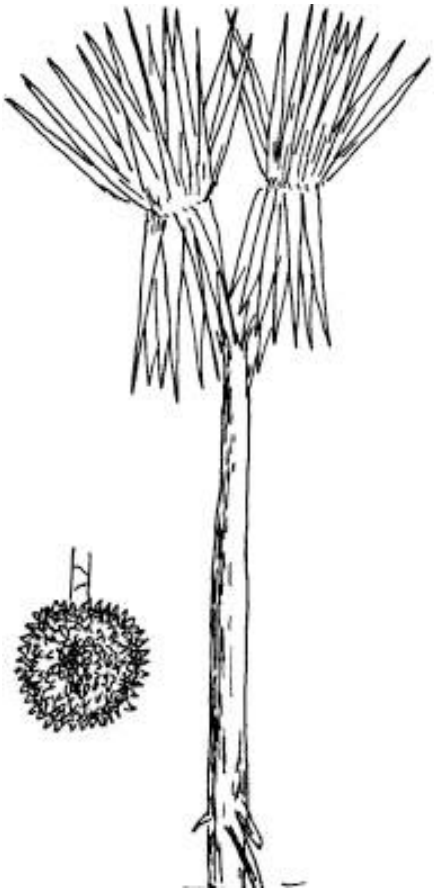
	Moisture %	**Energy cals**	**Protein g**	**proVitA µg**	**provitC mg**	**Iron mg**	**Zinc mg**
Leaves	**91.0**	**105**	**2.4**		**31**	**5.0**	

These leaves contain reasonably high levels of the chemical called oxalates. This is the chemical that causes some taro plants to burn your throat and it occurs fairly commonly in tropical leafy vegetables. Too much of it is not good.

Wild karuka

Tok Pisin: Karuka **Scientific name:** *Pandanus brosimos*

The wild Karuka plant



The wild karuka plant looks a lot like the cultivated karuka. The leaves are bigger and normally they point straight up instead of bending over at the top.

The trunk of the tree is straight like palm but it can have some branches near the top. The leaves are long and have thorns along the edge. Dead leaves normally hand down around the top of the tree.

The fruit is a round cluster of nuts. The ends of the individual nuts come to a sharper point than in cultivated karuka. The shell of the nuts is very hard.

Different varieties of wild karuka are recognised. These have different shaped nuts. Other small differences are also noticed by village growers.

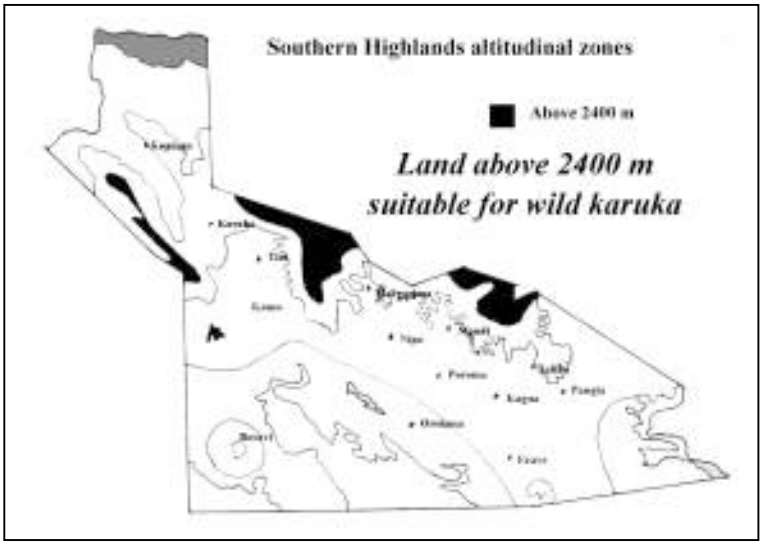
Sometimes another pandanus that grows in grasslands and bush in the highlands is also called wild karuka. This pandanus has much larger individual nuts. It has the scientific name *Pandanus antaresensis* and is described in a separate article.

Where does wild karuka grow?

Wild karuka (and cultivated karuka) only grows in Papua New Guinea. Wild karuka only grows in the high mountain areas although sometimes people transplant an occasional tree down to lower places where they have their gardens.

It grows between 2500 and 3100 metres altitude above sea level. These areas for the Southern Highlands Province are shown on the map.

Southern Highland wild karuka zone



In the Southern Highland Province wild karuka can be seen growing beside the roads that go to Tambul, Kandep and through the Tari gap. It is also in the bush in other high mountain bush places but you have to walk in to see it.

Often plants are just scattered singly through the bush.

Who owns the wild karuka?

Normally the wild karuka belongs to the clan on whose land it is growing. Different clans have different areas of wild karuka. The pattern may vary in different places but the commonest method of looking after wild karuka in the SHP is as follows. The clan own the karuka. Individual people within the clan are given permission to look after different sections or trees. These people clear the bush near the base of the tree and build traps to stop tree kangaroos. When the tree bears fruit, the person who has been looking after that tree is allowed to share out that fruit with the other people in his clan. At karuka nut time often lots of friends come from other places to eat karuka.

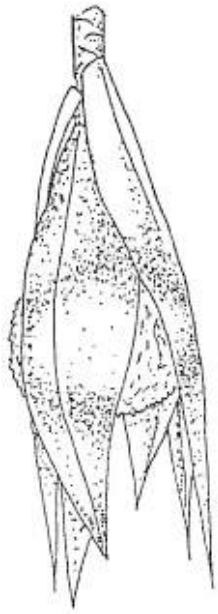
What does the fruit look like?

As a wild karuka plant is getting ready to produce a bunch of nuts the leaves at the top of the tree go tightly together and stick straight up. Then the top of the leaves become a red colour. (With cultivated karuka the top of the leaves change to a white colour.)

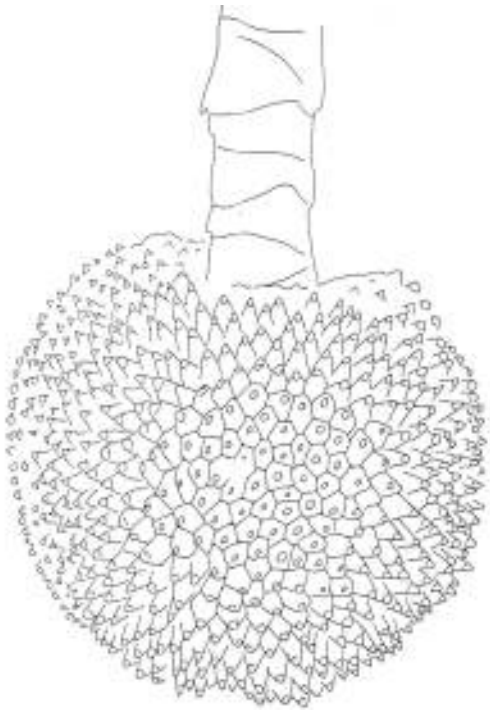
The round clump of nuts grows out of the top of the tree amongst the leaves then falls over to hang near the trunk amongst the dead leaves. The fruit has green leaf like bracts over it.

If these green bracts are taken off, the clump of nuts that make up the fruit, look like the picture below.

A fruit still covered by bracts

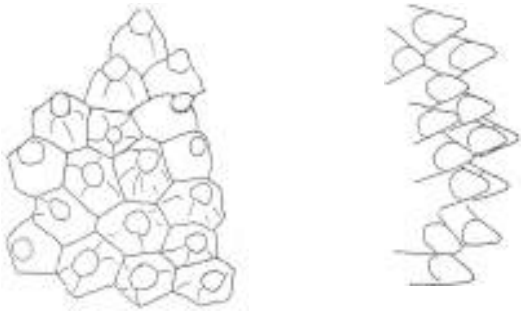


A wild karuka fruit



Looking at the surface of the fruit close up.

Front view Side view.



Harvesting karuka

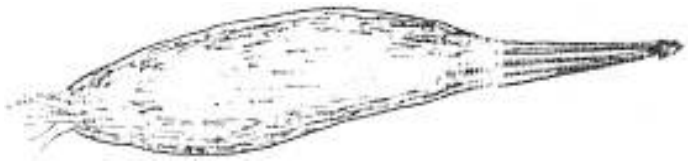
Sometimes the wild karuka fruit is not harvested by climbing but the nuts are allowed to fall. At least when the first few nuts start to fall people know the karuka is ready for harvesting.

The shells of wild karuka nuts are very hard. They are broken with a stone or axe. Sometimes the nuts are buried in the ground to let the shells soften before breaking them open to eat the kernel.

During the wild karuka season families often go to the bush and take their pigs. They build temporary houses from the leaves of karuka and stay in the bush living off karuka nuts and wild animals.

The inside of a wild karuka is very similar to a cultivated karuka. The soft spongy layer around the nuts between the stalk and the nuts can also be eaten.

The wild karuka nut looks much like a cultivated karuka nut except that the outside is a little bit rougher with fibres and the end with the fibrous hairs is longer and has a sharper point.



The wild karuka season

It is not easy to say when the wild karuka season occurs. It is possible to have a good season for cultivated karuka and yet in the same area to have a poor season for wild karuka. All places do not have a good wild karuka season in the same year. But the probable pattern is that the season is either at Christmas or mid year or it can occur at both times. Also trees probably only have a clump of fruit every two years.

Pests and diseases

Wild karuka does not seem to get many leaf spots even when it is planted next to a cultivated karuka that has many disease leaf spots. Other diseases of wild karuka seem very rare but because the plants are scattered and spread around in the bush, it may be that trees simply avoid the diseases.

Tree kangaroos are a problem with wild karuka the same as they are with cultivated karuka. People build similar traps to stop them climbing the trees.

Winged bean

Tok pisin: Asbin **Scientific name:** *Psophocarpus tetragonolobus*

Huli -	**Foi** -	**Onobasolo** -
Mendi -	**Hewa** -	**Etoro** -
Kewa -	**Pole** -	**Hawalisi**
Wiru -	**Samberigi** -	**Fasu** -
Duna -	**Podopa** –	
Imbongu -	**Kaluli** –	

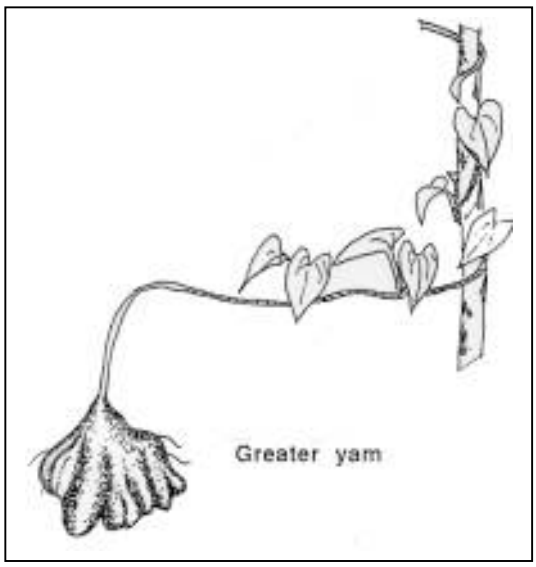
Yams

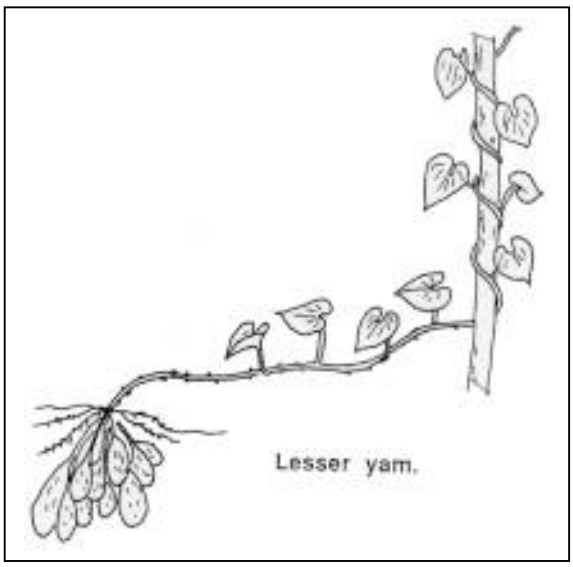
English	Tok Pisin	Scientific names
Greater yam	Yam tru	*Dioscorea alata*
Potato yam		*Dioscorea bulbifera*
Five leaflet yam		*Dioscorea pentaphylla*
Lesser yam	Mami	*Dioscorea esculenta*

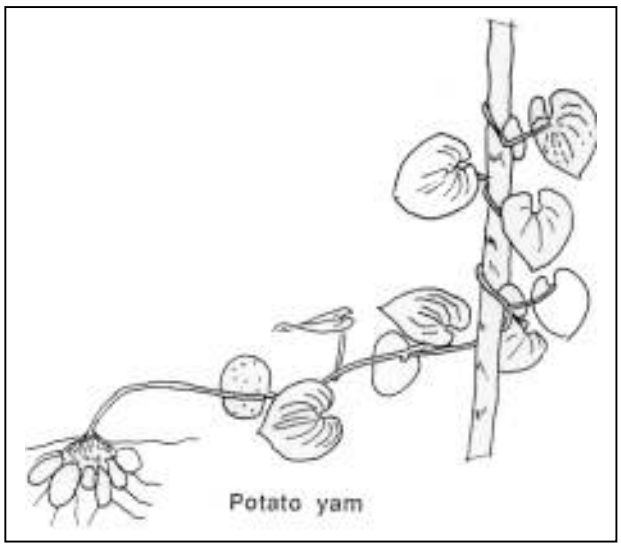
Tok ples names: (Mainly for greater yam)

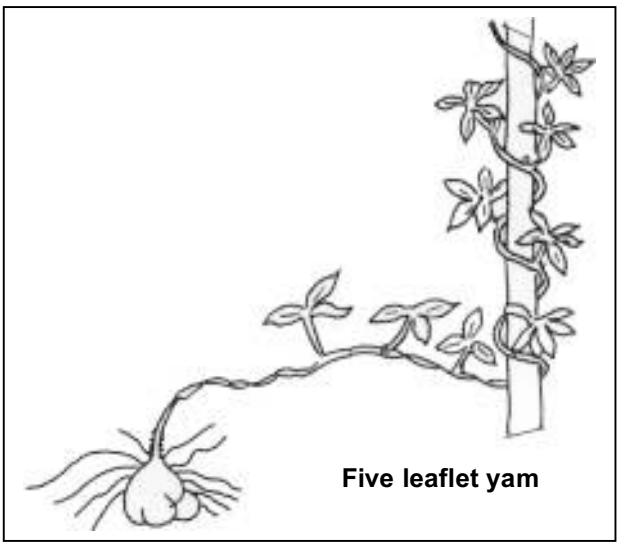
Huli - mandi	**Foi** - hamanu	**Onobasalo** -
Mendi - bed	**Pole** - bira	**Etoro** - elebo
Kewa - bira	**Samberigi** - mindi	**Hawalisi** - kerisi
Wiru - nandi	**Podopa** - dika	**Fasu** -
Duna - ere	**Kaluli** - dus	
Imbongu - minje	**Hewa** -	

Four species of yams are grown and used for food in the Southern Highlands but often naming in villages and naming by scientists does not agree. Many village people regard potato yam and Five leaflet yam as varieties of greater yam.









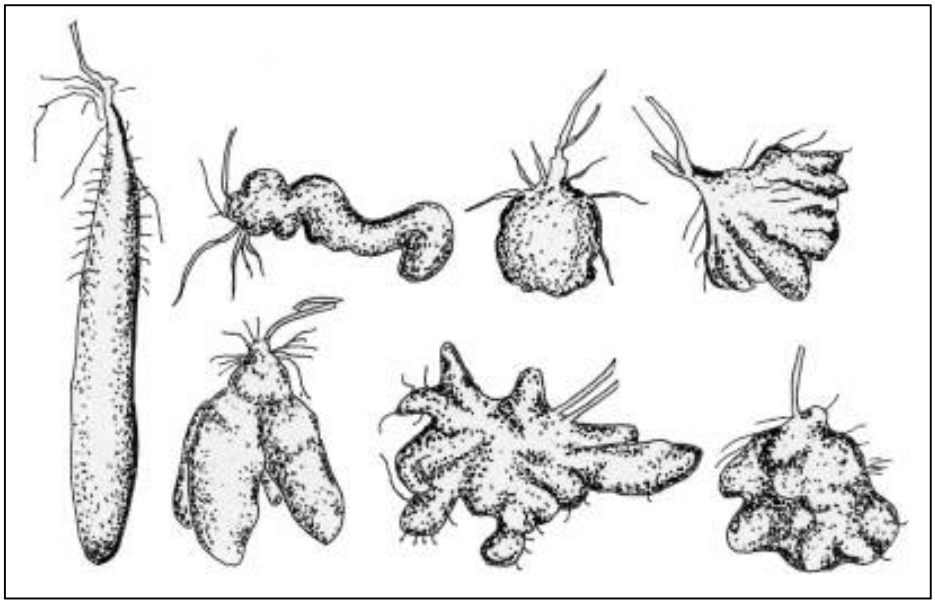
What is a yam plant like?

All yams have long creeping vines that wind around sticks.

Greater yam.

The greater yam has a stem with wings on the sides making it square in shape. The heart shaped leaves are in pairs along the vine. Under the ground it normally produces one fairly large tuber. These tubers can be many different shapes.

Some of the tuber shapes of Greater yam



In most places in Papua New Guinea the Greater yam is called yam tru in Tok Pisin. At Madang it is called mami.

It is not easy to know all the different varieties of yams but there are some rules which are fairly often true. These rules can help a little bit to understand the types of yam tru.

Some guidelines about varieties of Greater yam.

Yams that are red inside are normally red at the top of the stalk that holds the leaf.

Plants with a number of stems near the ground often have tubers that are branched. They sprout more easily.

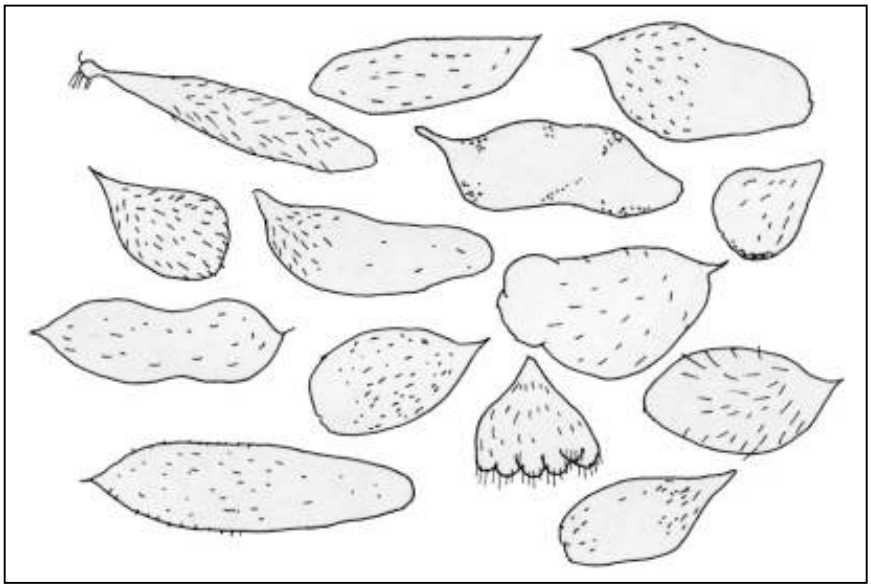
The more the young stem branches, the less deep the tubers are in the ground.

Leaves that are fatter and shorter indicate fatter yams, often angular in shape and with surface roots.

Lesser yam

The Lesser yam is called mami in Tok Pisin in most areas of Papua New Guinea except Madang. It has a round thorny vine and a smaller more rounded leaf. The leaves are borne singly along the vine. Under the ground there are a clump of tubers. But there are also some very sharp thorns just under the ground, so be careful! The tubers again vary in shape, size and colour. One of the most noticeable differences between kinds is the amount of roots or hairs over the surface of the tubers.

Some of the tuber shapes of Lesser yam



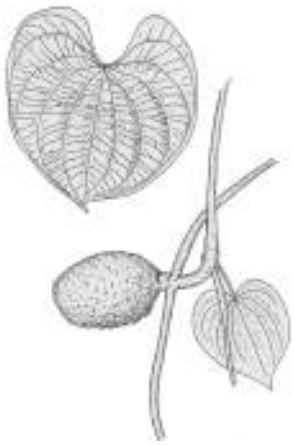
These are some of the kinds from Dreikiker at East Sepik.

They were described by Dr.B.Allen at the 1981 Food Crops Conference.

Potato yam

This yam has a very long smooth vine that often climbs up trees especially near where the grassland and forest meet. Along the stem it produces round or lumpy potato like aerial tubers. (bulbils) They are in a branch where a leaf stalk joins the stem. There is also a tuber under the ground. Some people eat the aerial tuber and plant the tuber that is under the ground. Other people eat the underground tuber and plant the aerial tubers. This may depend on varieties.

An aerial Tuber (bulbil)



Five leaflet yam

This yam has a leaf that is divided like the fingers on your hand. The number of leaflets can vary between 3 and 7 but there are mostly five. The leaves look a bit like cassava but they grow on a long vine that winds up a stick. There are also wild types that grow in the bush. This yam often has small aerial tubers (bulbils) along the vine.

Where do yams grow?

Most yams are truly tropical plants so they grow better in coastal areas. Also yams are well suited to growing in areas where there is a distinct wet and dry season. The pattern of growth of yams suits these climates. They can grow lots of leaves at the beginning of the wet season, store up food in the tubers as the leaves dry off with the approach of the dry season then the yams can be stored during the dry period.

The Southern Highlands doesn't have this type of weather and is not real yam climate, but yams are still quite often grown in some areas. But they only grow below certain altitudes.

Yam	Altitude above sea level
Greater yam	0-1650 metres
Lesser yam	0-800 metres
Potato yam	0-1700 metres
Five leaflet yam	0-1800 metres

The only place that I have seen Lesser yam growing in the Southern highlands is near Pupitau and Boro Villages down the Kerabi Valley past Erave. The people at Boro have yams as their main food.

Some of the places in Papua New Guinea where yams are important include Maprik in East Sepik; the Eastern Highlands; near Port Moresby; the Trobriands in Milne Bay; and Moorehead in Western Province.

Around the world there are about 10 million tons of greater yam grown each year in hot tropical countries. Practically all of these are grown in subsistence gardens similar to those in Papua New Guinea.

A man who collected Lesser yams from many different countries of the world found that the kinds of Lesser yams in Papua New Guinea were the best in the world.

How do you grow yams?

Yams are normally grown from tubers. With Lesser yam, one of the smaller tubers is often planted whole. With greater yam, any reasonable sized part of the tuber can be planted. Mostly the top piece is used because it produces new shoots the quickest and will grow the biggest tuber by harvest. But if a middle piece or a bottom piece of the tuber is cut off and stored carefully it too will produce new shoots and can be planted. Greater yam, potato yam and five-leaflet yam all sometimes produce aerial bulbils along the vine. These can be used for planting but do not always produce a big underground tuber in the first year.

A sprouting lesser yam

A top piece of greater yam

Although many yams often produce long flowers and both male and female flowers can be found on separate plants, these hardly ever produce true seeds that will grow. This is because of the different number of chromosomes that yams have and it makes yam breeding almost impossible.

A male flower of Greater yam

Planting practices

It is common practice in many areas to plant the yam piece upside down. The probable reason for this is to give the shoot and roots time to develop and get established away from the sun and wind, so that the plant does not dry out. People in yam areas have their varieties classified as to whether they are planted at the top or the bottom of the hole, and whether the shoot is pointed up or downwards. The reasons for this are not fully understood but village people have probably learnt by experience.

Yams must have a well-drained soil with plenty of air in the soil. So yams will not normally grow on heavy clay soils or in areas with a lot of soil moisture. The soil can be improved for yam growing by putting leaves and other plant material in the planting hole, by making a mound above the hole, or by planting on a hillside. In some very loose sandy soils such as near Port Moresby yams can just be planted in flat un-mounded soils without digging a special yam hole but these situations are not common.

Yams should also have sticks to climb up. It is best to have a stick that is twisted or branched because the vine can slip down a very straight stick. Normally a stick 2 metres tall is sufficient. It needs to be a strong stick, firmly fixed in the ground. Yam varieties vary on the type of vine growth they have. This affects where the stick needs to be placed.

A long straight yam tuber often has a long unbranched vine with few leaves on the bottom section

A broad irregular shaped yam tuber often has several branches and grows leaves early

The fat irregular yams can have the sticks near the mound as a thick clump of vines and leaves soon develops. But if the stick is put beside the mound of one of the long ceremonial yams the vine will often reach the top of the stick before it has produced more than a couple of leaves, and will then fall back down to produce its leaves on the ground. The stick often needs to be put at some distance from the yam hole. The tip can be picked off the vine if branching is wanted earlier.

It may be that the long vine yams are more common in forest areas and the shorter branched vines in grassland areas.

In some areas yam vines are allowed to creep over the ground and do not have sticks to climb. This method only works satisfactorily in dry places like the Markhum Valley and Central District because diseases of the leaves and vine can cause serious damage in wetter places. Where yams do not have sticks to climb plants need to be more widely spaced. Under most circumstances the amount of food produced can be doubled by allowing yam vines to climb up sticks.

Potato yam vines are very long and heavy and it is often most easy to allow them to climb over logs or up trees.

People in the Sepik area grow some of the largest yams in the world. They do this by putting together all the important principles of yam growing.

The method used by Sepik people to grow large ceremonial yams

Pest and disease problems

The diseases of yams have not been well studied and are not well understood. Diseases on the leaves can be seen in almost all yam gardens and on all kinds of yams. Village people don't understand about disease so say the leaves died off early because of "fire" or lightning, or because garden taboos were broken.

Anthracnose is caused by a common fungus and starts as spots but leaves and vines soon blacken and fall off. *Phyllosticta* leaf spot has a dark brown ring around a light brown spot and often there is a hole in the centre. *Cercospora* leaf spots tend to have a yellow ring around a brown dead spot.

These leaf spot diseases get worse in wet weather and under poor growing conditions. They often start on older leaves but can then spread to younger leaves and vines. There is a lot of obvious difference in the level of resistance to these diseases between the yam species and varieties.

In some areas of Papua New Guinea yam leaves develop mottled yellow patterns on the leaves and the vines stop growing. This disease is due to a virus. I have not seen it in the Southern Highlands Province.

Root rots of yams have also not been well studied in Papua New Guinea. Rotting of yam tubers either in the ground or in storage can occur due to a fungus that is common in Papua New Guinea (*Botryodiplodia theobromae)*. It can cause wet rot, soft rot and brown dry rot. Handling tubers very carefully is important in stopping this disease.

Insects.

The larvae of a hawkmoth can be seen eating leaves in some yam gardens. It is a caterpillar with a long point on the end and it looks a bit like similar ones that are more commonly seen eating taro and sweet potato leaves. This one forms a pupae case in amongst the yam leaves and eventually hatches out to a moth.

Rats.

Rats can be a big problem with stored yams unless the yams are well looked after.