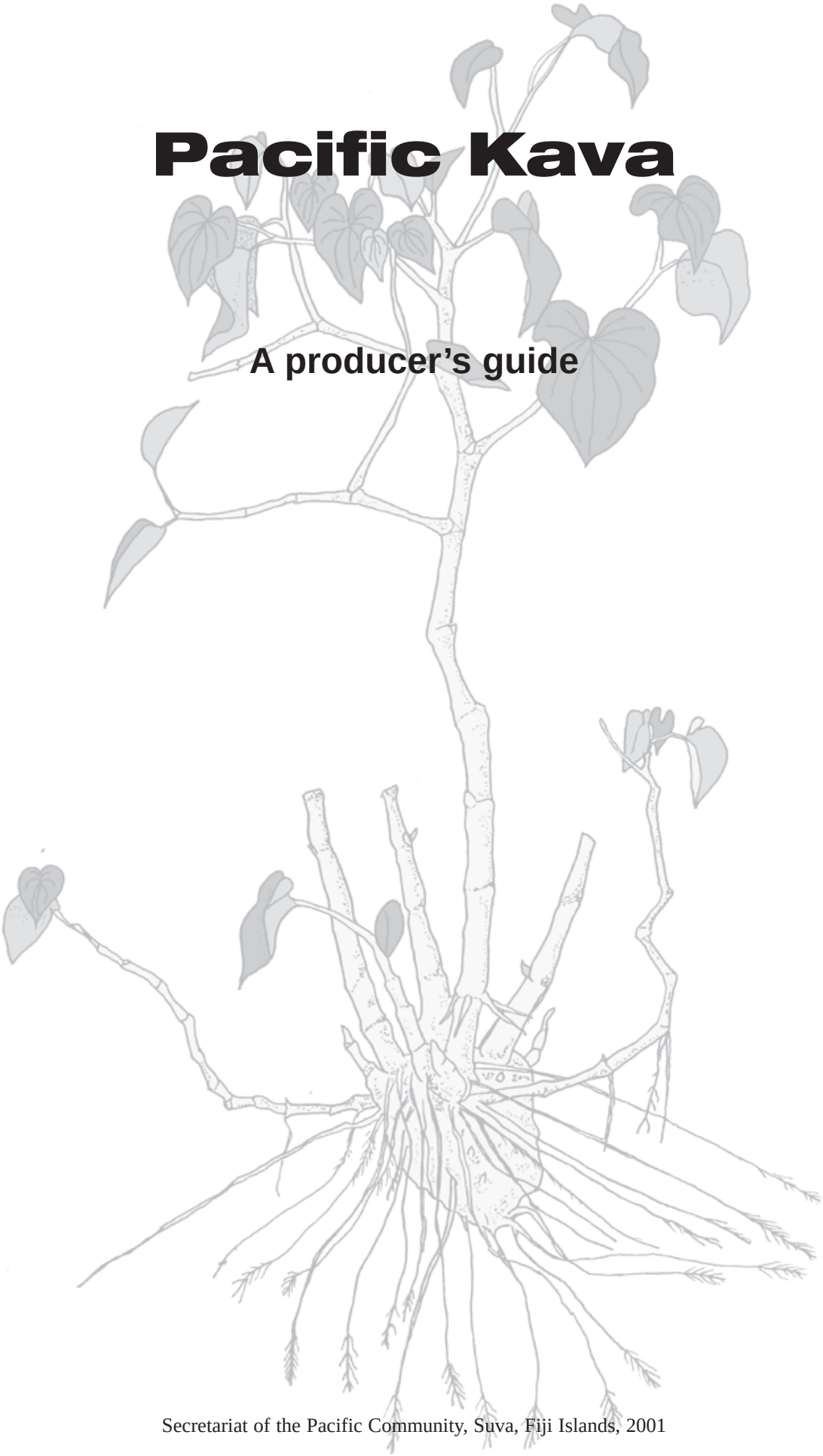
Pacific Kava

A producer's guide



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Contents

Introduction

Kava (*Piper methysticum* Forst. f.) is a Pacific plant species of the pepper family. Following its initial discovery, domestication and diffusion throughout the Pacific kava has become an integral part of Pacific Island religious, economic, political and social life. Its cultural significance is immense and these functions are still a vital part of life today. In recent years the uses have expanded, the range of kava products has diversified, and the demand for kava now comes from people all over the world. Kava has moved away from being a traditional crop for ceremonial and personal use. It is now an important cash crop both for the local market and for export.

Kava production in the Pacific has a long history. The plant has been domesticated for around 3000 years. There is a very large body of traditional knowledge about kava production. However, many farmers are unaware of the production systems used in other parts of the Pacific. This guide is for agriculture extension staff to use with farmers and for progressive farmers. It has been written to supplement traditional knowledge and to encourage experimentation, adaptation, and the use of improved farming practises. As the growing conditions for kava vary greatly throughout the Pacific, it is recommended that farmers experiment with new techniques on a small scale before adopting them on a large scale.

The guide contains the principles for producing high quality kava as a commercial crop for both the domestic and the export market. A range of improved farming methods is described. Producing the quality of kava needed for the export market has been a difficult challenge for Pacific Island growers and exporters. The guide includes chapters on the chemical properties of kava and on the standards that are recommended for the increasingly discerning domestic and export markets. These standards are especially important if Pacific Island farmers and exporters are to continue supplying the overseas pharmaceutical market. The production and marketing of high quality kava is essential if the industry is to grow in the Pacific.

This book is the result of a collaborative effort over a long period of time. Much of the technical information is based on previous publications by Dr Vincent Lebot. He generously allowed the reproduction from this material. Mr Jerry Konanui of the Association for Hawaiian Awa and Mr Jim Henderson of Puu'O'Hoku Ranch contributed the section on kava production methods in Hawaii. Other information has been adapted from the sources listed in the bibliography. The guide would not have been possible without the considerable input from many other contributors. The initiative and support of participants at the Regional Kava Meetings in 1997 and 1998 who recommended the writing of a production guide is appreciated. Dr Richard Beyer, Professor Bill Aalbersberg, Ratu Jo Nawalowalo, Reg Sanday, and Dr Ron Gatty are acknowledged for their advice and guidance. The contents of this publication and any errors contained therein remain the responsibility of the compiler.

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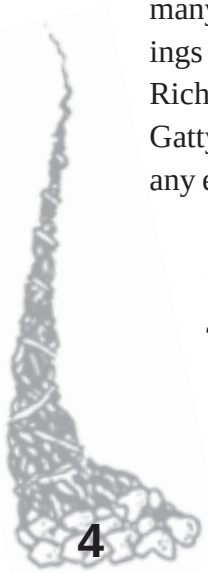


I. Production

A. Site selection

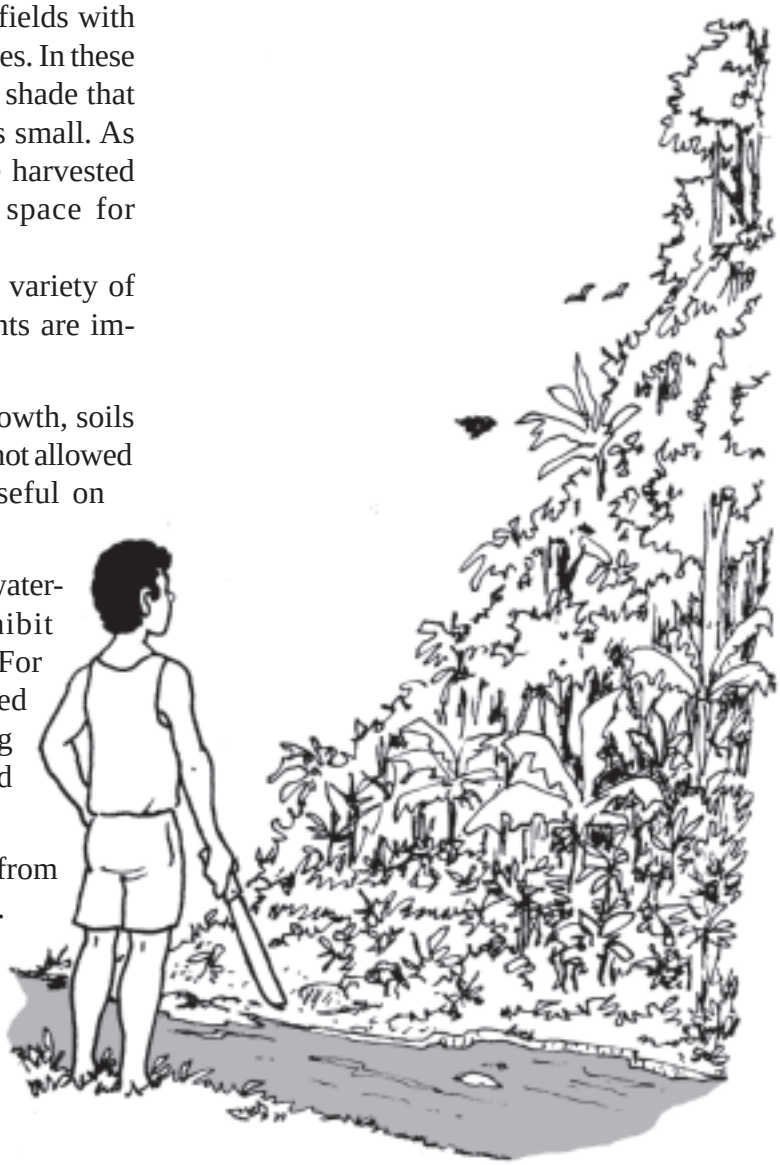
One of the most important decisions a farmer needs to make is selecting a suitable site for growing kava. Kava is a shade-loving plant. For the young plant to develop properly, care should be taken to shelter it from the sun's rays and the wind. The sun speeds up moisture loss from the plant and causes it to wilt. Winds bend stems and branches and may cause them to crack or break and thus encourage disease in the plant.

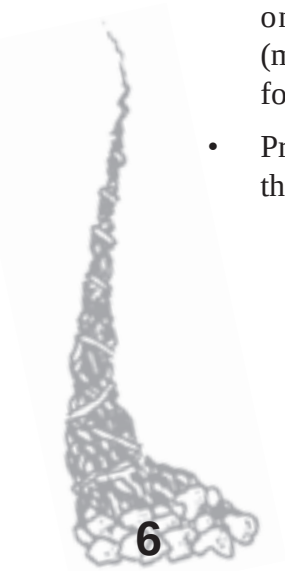
In traditional farming, the ideal site for growing kava is mixed cropping fields that have been recently cleared and planted. For example, kava can be planted in fields with taro, maize, yams and sweet potatoes. In these fields the other crops provide the shade that kava needs particularly when it is small. As these other crops mature and are harvested the kava plant gets additional space for growth.

Kava is grown under a wide variety of conditions but the following points are important.

- To allow for vigorous root growth, soils should be fertile and loose but not allowed to dry out. Mulch can be useful on some soils.
- Avoid soils that are prone to waterlogging since this can inhibit growth and cause root rot. For this reason kava is often planted on sloping land; ridging (mounding up soil) can be used for planting kava on flat land.
- Provide shade and protection from the wind for the young plants.

Kava is well suited for Pacific farming systems because it is flexible in its cultivation requirements and thrives in the shade during its first three years of growth. It grows well in traditional multicrop gardens, cut from the forest and partly shaded by taller crops such as bananas and papayas. In most islands of Vanuatu, organic kava production involves crop rotation, intercropping (with peanuts and sweet potato), and planting of windbreaks, shade trees, and leguminous tree species.





B. Planting material

There is a substantial diversity in kava cultivars of the Pacific. Many of the differences are in the appearance of the plant (plant morphology) such as the colour of the stem, length of the internodes, stem thickness, and shape of the leaves. There are also differences in the content of kavalactones in different cultivars. Surveys and research indicate that the greatest diversity of kava cultivars is in Vananau with 80; there are 13 in Hawaii, 12 in Fiji, 7 in Tonga, 6 in Samoa, 4 in Papua New Guinea, 3 in Wallis and Futuna, 3 in French Polynesia, and 2 in Pohnpei.

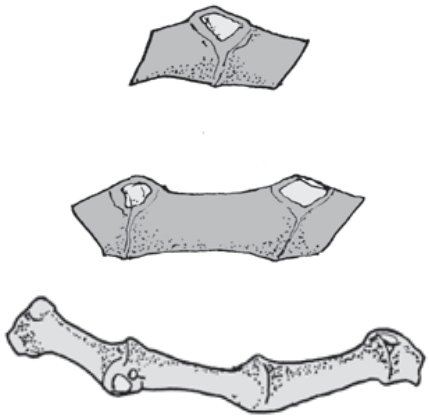
Despite this diversity kava in fact has a very narrow genetic base. This is because kava does not produce viable seed so there is no possibility of cross pollination to create new cultivars. The diversity of kava has been caused by farmers selecting mutant kava plants with desirable characteristics for personal and ceremonial use. This selection system began with the domestication of kava thousands of years ago and has produced the kava cultivars that we have today.

Experienced growers know that one of the most important decisions in producing quality kava is the selection of planting materials. The first aspect is that the cutting must come from a desirable kava cultivar, one with good drinking characteristics. Secondly, the cutting must be from a healthy and vigorous plant. Diseases can be spread from unhealthy kava plants to the surrounding plants and cause great losses.

The normal method of propagation is to use stem cuttings of one to four nodes in length, but the process varies according to area. Either shoots or stem cuttings can be used, and cuttings can be either planted in a nursery or directly planted in the field.

Planting material checklist:

- Carefully select planting materials from vigorous, healthy plants.
- Carefully inspect stems selected for cuttings to ensure they are free from mealy bugs and scale insects.
- Use the more rot-resistant woody mid-portion of the stem for good root and crop development.
- Avoid using the soft upper portion of the stem because it is prone to rot and does not easily develop roots and shoots.
- Do not use lateral branches for planting material because they will produce plants with horizontal stems.
- Do not buy planting material from unknown sources because it may carry plant diseases or may be of poor drinking quality.



One-, two- and four-node stem cuttings are often used for planting material.

C. Direct planting

In many Pacific Islands the traditional planting method has been to plant the stem cuttings directly in the field. There are a variety of techniques. A handful of one- and two-node cuttings can be planted together in a 30 cm (12 in) diameter circle. In some places, four- to six-node cutting are planted vertically with several nodes in the soil. Sometimes cuttings are rooted in loose soil before planting. Often the cuttings are planted and covered with soil and a layer of mulch to retain moisture since adequate moisture is critical for the root and shoot development.

However, direct planting of kava stems has been abandoned in many areas for the following reasons.

- Direct planted kava requires more planting material and longer pieces. The demand for planting materials is usually high and farmers want to use their planting materials efficiently so they can plant as large an area as possible or so they can sell planting material.
- Kava cuttings require moist conditions at the time of planting to develop shoots and roots. Drought or water stress during this early periods of growth can kill the emerging shoots and roots. Watering young plants is much more costly and time consuming in the field than in a nursery.
- The desired spacing can be difficult to achieve with direct planting because not all the cuttings will produce plants.
- Weed competition with young kava seedlings is a problem that requires considerable labour input and can slow the growth of the young kava plant.
- Young plants require shade and it can be difficult to provide sufficient shade in the field compared with a nursery.

D. Nurseries

Shortages of planting material caused by the expansion in production has stimulated interest in kava nurseries. In several countries nurseries are very successfully used for the propagation of kava and are preferred to the direct planting propagation method. Often when direct planting kava larger cuttings are used, germination of the cuttings is low, and later even plant survival is low. Nurseries use planting material more efficiently and there is a higher survival rate of the plants when transplanted to the field. One- or two-node cuttings, as well as larger cuttings, have been successfully used for propagation in the nursery.

It has been observed that root and shoot development can be affected by:

(a) the kava variety — some root more easily and quickly than others;
(b) the age of the plant — two- to three-year-old stems are the best; and
(c) the portion of the stem used — avoid the soft upper portion and very woody lower portion.

A study of the different kava varieties in Vanuatu showed that some varieties were more difficult to propagate than others. Varieties with short internodes provided cuttings which were very resistant to plant disease during sprouting and the early stages of growth. Cuttings from varieties with long internodes were susceptible to rotting before and after sprouting, particularly in the rainy season. In addition, the shoots of varieties with dark coloured stems developed very slowly.

If you want rapidly growing healthy vigorous young plants, careful management of the nursery is essential.

Location of the nursery

The nursery should be located on well drained land to avoid being waterlogged or flooded during heavy rains. There should be access to water for irrigation of the young kava seedlings during dry periods.

Soil for the nursery

Rich topsoil, sand and compost, and other media such as potting soil can be used. Potting soil has the advantage that it has been sterilised, which will reduce problems with soil-borne diseases attacking the young plants. Another good mix is 10 parts soil, 1 part sand, 1 part timber shavings or sawdust from untreated timber. It is important that the soil is loose and that it doesn't dry out. Heavy clay soil should be avoided in the nursery since it can become too wet and this encourages the development of fungus in the plants.

Some farmers plant the cuttings in beds of soil with compost. Others use plastic bags (polypots) that make it easier to transfer young plants to the field, but these are more expensive.

Shading is important for the kava cuttings in the nursery.

Watering

Keep the soil moist but not too wet. The nursery should be checked daily to ensure the soil doesn't get too dry. The use of sand, timber shavings or compost in the soil can help the soil from becoming too wet.

Weeding

Soil and sand used in the nursery will contain weeds and weed seed. These weeds should be carefully removed to avoid competition with young kava plants.

Shading

Kava requires shade. A structure with palm fronds is adequate for shade though 30–50% shade cloth can also be used. Remember not to place seedlings too close to the edge of the shade structure since it will expose them to direct sunlight at some times of the day.

Before the seedlings are removed from the nursery they should gradually be exposed to the direct sun for a week to avoid stress to the plants when they are put into the field. This process is called hardening off the plants. This can be accomplished by gradually removing the palm fronds from the nursery roof. The shade cloth can be removed for part of each day.

Time in the nursery

Plants are generally ready for transplanting when they are at least 30 cm tall (10–12 in). It is difficult to predict how long it will take the seedling to reach this size because of differences in soils, kava varieties, size of cuttings, quality of the cutting, and watering, but generally 3–5 months is sufficient. The seedlings can be kept in the nursery until conditions in the field are right but if transplanting is delayed the shading should be removed to avoid tall plants with weak stems.

Advantages of nurseries for kava

- Nurseries are adequately shaded to promote development and prevent the cuttings from drying out.
- Seedlings can be watered more easily in a nursery than in the field.
- It is easier to judge the desired spacing when you plant strong, healthy seedlings in the field.
- Seedlings can be placed in the field at a time when moisture and shade conditions are best for plant growth.
- Using seedlings can reduce initial weed competition problems in the field.
- Weeding time and other labour costs are reduced because the transplanted seedlings are bigger and stonger and need less care.

A well-maintained kava nursery.

Kava nursery methods

Choose the method that best suits your needs. Each method has its advantages and disadvantages.

Method 1: planting one- or two-node cuttings in nursery beds.

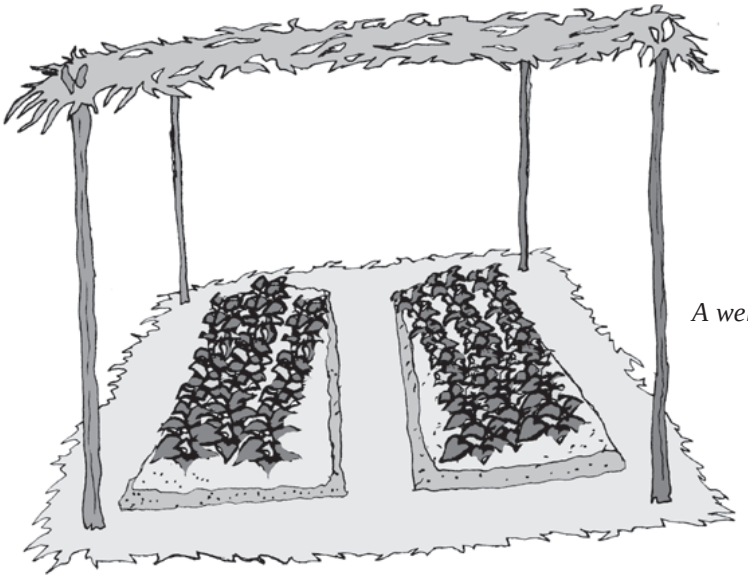
Take the cuttings when the plant is harvested. Select the woody mature stems, 2–3 years old, which are around the outside of the crown. Young (non-woody) cuttings tend to rot quickly whereas these woody cuttings are very rot-resistant. Woody cuttings are also less prone to damage when they are transported.

When the kava stem is cut into pieces use a sharp knife that makes a clean cut. It is very important to cut the stem near the node and not in the middle of the internode. The soft tissue in the internodes is prone to rot. The microorganisms which rot the inside of the stem seem to have difficulty getting in if only the hard internode is exposed.

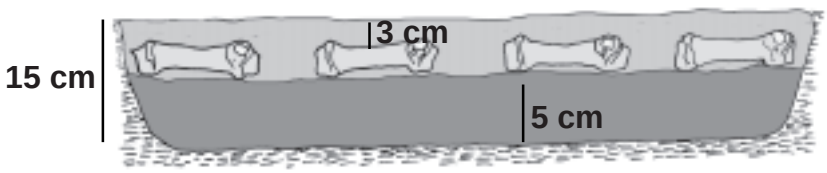
Two-node cuttings require more planting material but they will develop faster than one-node cuttings. When there is a shortage of planting material one-node cuttings can be but the disadvantage of one-node cuttings is that they will not develop as fast as two-node cuttings.

Dig a bed in the nursery 4 m (13 ft) long, 2 m (6˚ ft) wide and 15 cm (6 in) deep, and cover the bottom with a layer of soil very rich in organic matter or compost, to a depth of about 10 cm (4 in). Lay out the cuttings lengthwise and spaced about 10 cm (4 in) apart to make it easier when digging up and transplanting. Lay another layer of earth about 3 cm deep gently over the cuttings and water very thoroughly (see diagram below).

Cuttings should be horizontal with bud scars facing up. Whether the cuttings have one or two nodes, this method encourages a very high propagation rate and the seedlings will have vigorous root systems.



A well-shaded kava nursery.

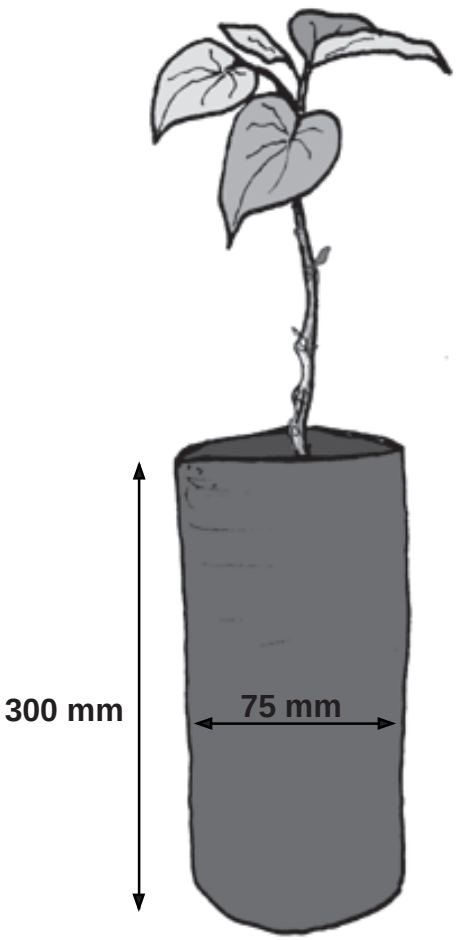


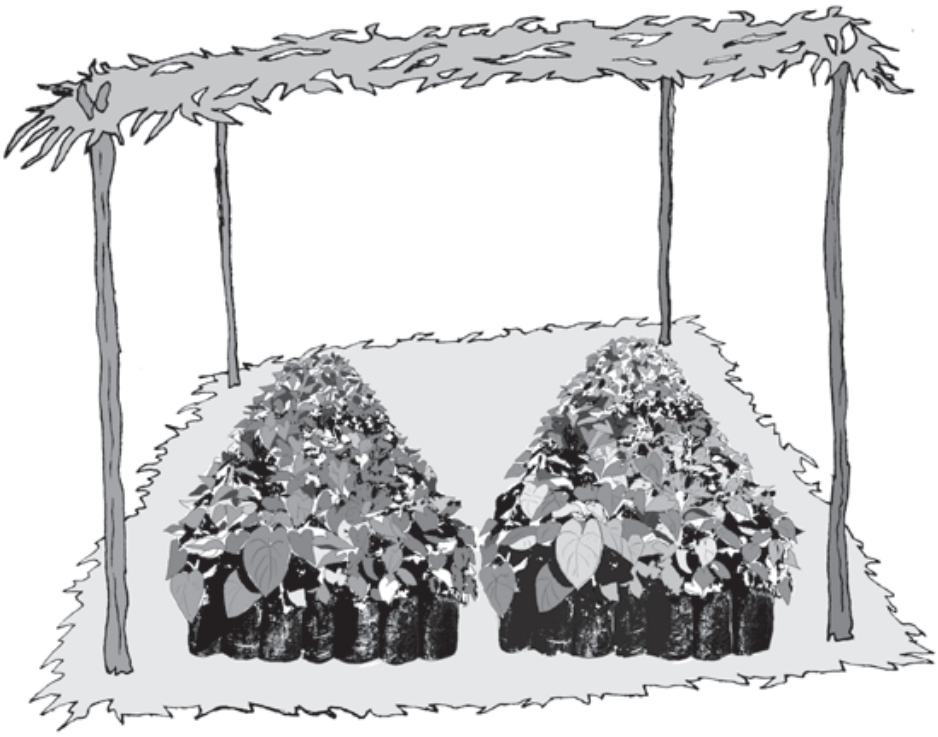
Cross section of two-node cuttings in the nursery bed.

Method 2: planting one or two node cuttings in plastic bags

This is the same as Method 1 except that instead of using beds the cuttings are placed in polypots. Polypots are strong black plastic nursery bags with holes in the bottom for drainage, and are available in a variety of sizes. Polypots are commonly used in commercial nurseries. The polypots for kava should not be too big or they become too heavy to transport. Use a 1 litre (1 quart) size bag that is approximately 7.5 cm (3 in) in diameter and 30 cm (12 in) tall to allow space for root development. The cuttings are planted horizontally in the polypot with the bud scar at the top.

Polypots are popular for kava nurseries because they keep the roots of the kava seedlings from growing together and this reduces the risk of damage to the roots when they are transplanted into the field. The disadvantage of this system is the cost of the bags and the cost of transporting seedlings in polypots to the field.





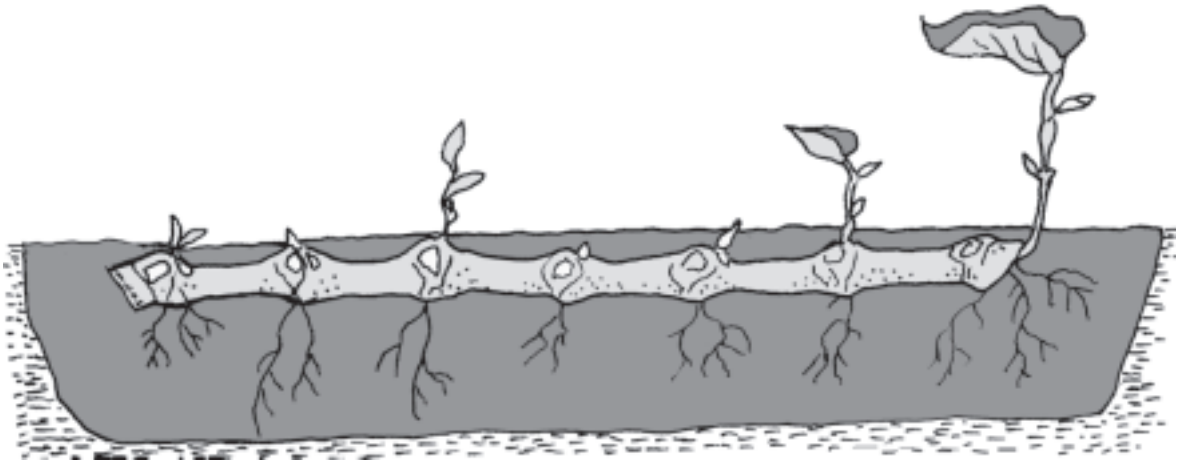
Kava cuttings growing in polypots in a nursery.

Method 3: germinating whole kava stems in the nursery beds

Kava harvesting, cleaning, cutting, and drying requires a lot of labour, but harvest time is also the best time to get the nursery beds established with fresh kava stems. Farmers in Vanuatu have developed a clever system that overcomes the labour bottleneck during this period.

Dig a shallow trench in the nursery approximately 15 cm (6 in) deep and 150 cm (5 ft) wide. Remove the soft upper stem and very woody lower part of the stem. Place the remaining middle portion of the kava stems in the trench and cover them with soil. Keep the soil covering the stems moist. Under these conditions the buds on the nodes will start to sprout and grow. After three to four weeks, one or two roots and leaf shoots will have emerged from each node.

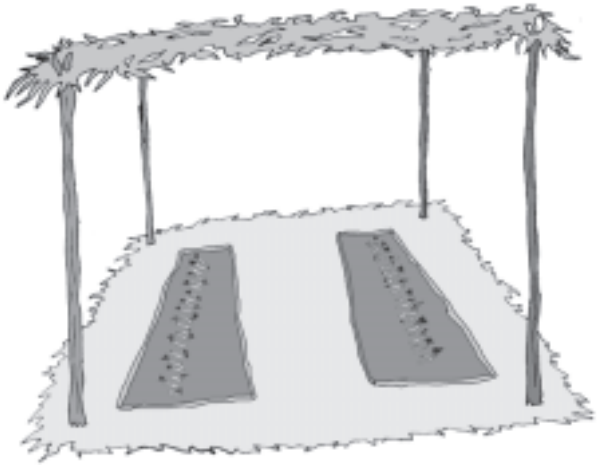
Place the stems in the nursery bed and cover them with soil.



Cross section of sprouting kava stems in the nursery bed.

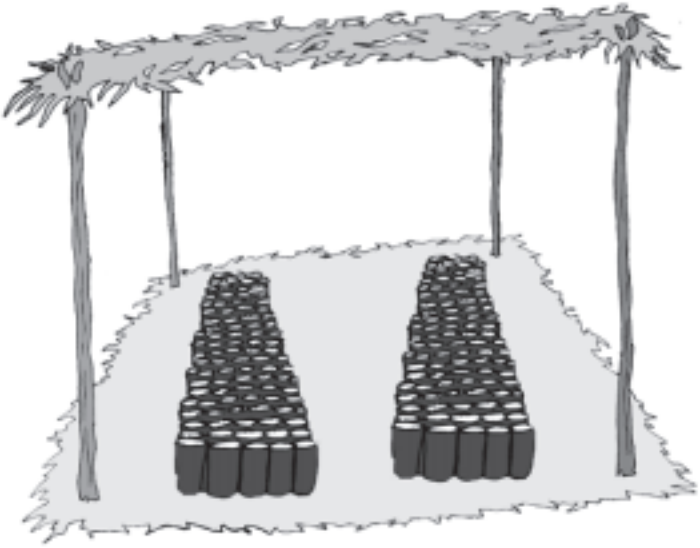
Carefully uncover the kava stems to reveal the shoots and roots that have developed from the nodes. Then cut the stems into one-node pieces, each containing a shoot with one or two leaves and roots. Place the pieces in polypots and put in the nursery to grow until large enough to be planted in the field.

This method overcomes the problems of fungus entering the individual one- and two-node cuttings that can cause them to rot and not sprout.

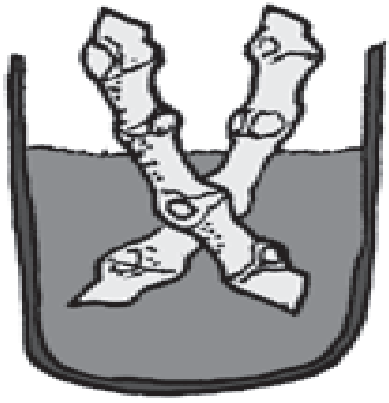


Kava stems in the nursery.

Method 4: planting four-node cuttings in plastic bags



Polypots in the nursery ready for kava cuttings.



Cross section of polypot with two cuttings.

Cut the middle portion of the kava stem into four-node cuttings. Plant two four-node cuttings upright in soil and compost in polypots that are 16 cm (7 in) wide and 34 cm (14 in) tall. Two of the nodes must be below the soil surface and the other two above. Although this method uses more planting material, the seedling will grow faster and be more vigorous.

Potted kava shaded by shade cloth.

Kava nursery with long cuttings in Pohnpei, Federated States of Micronesia, under tree shade.

E. Transplanting

Transplanting should be done when:

- the kava plants are 30 cm (12 in) tall so that they are large enough to avoid competition from weeds;
- moisture conditions in the field are good; and
- the land has been properly prepared and cleared of weeds.

Remember to gradually expose the plants to direct sunlight before removing them from the nursery.

Take care to avoid damaging the roots during transplanting when the polypot is removed and the seedlings are placed in the holes. If the soil is dry each hole should be watered before the seedling is placed in it. Even though the seedlings are 30 cm (12 in) tall they still can't compete with aggressive weeds. Keep the area around the seedlings free of weeds during this initial period. The plants must be well shaded to reduce competition with grass weeds and avoid moisture stress.

Take care after transplanting the kava seedlings. If there is a drought period after transplanting, water the plants to avoid moisture stress and possible wilting or death of the seedlings. The period after transplanting is critical. The plants need time to become properly established before they start to grow well in the field.

F. Planting and spacing

Preparing the soil

In traditional kava farming methods soil preparation is minimal, and involves simply and rapidly breaking the soil up with a planting stick. Kava often does not receive the care in cultivation normally given to root crops that require the soil to be broken up to a fine texture.

Normally, kava is planted together with root crops in subsistence gardens on recently cleared ground. As the kava grows farmers regularly ridge or mound up the soil around base of the plant to encourage the appearance of new shoots and discourages weeds.

Trials at Tagabe Agricultural Station in Vanuatu show that it is good to plant on ridges 80 cm (2˚ ft) wide and 40 cm (1˘ ft) high. The ridge permits good soil drainage and root growth.

G. Cropping methods

Intercropping

Kava's natural habitat is under the shade of large trees with a diversity of other plants, and it is still most commonly grown in association with other crops. Experience and research have shown that intercropping has its advantages. It is believed that intercropping can inhibit the spread of disease among kava plants whereas monocropping seems to encourage it. This is an important point in favour of intercropping because it can help prevent the establishment and spread of of devastating diseases like kava dieback.

There is no clear picture of the best combination of crops. It appears that more commonly than not kava is grown with many different crops in the same field.

In intercropping the crops are changed over the growth cycle of the kava. When the kava plants are small, intercrops that provide shade, such as taro and pigeon peas, are helpful. Later, when the kava needs more sunlight, intercrops such as sweet potatoes and peanuts which provide good ground cover are useful.

Kava and coconuts in Taveuni, Fiji Islands.

Kava intercropped with root crops, bananas, and coconuts in Vava'u, Tonga.

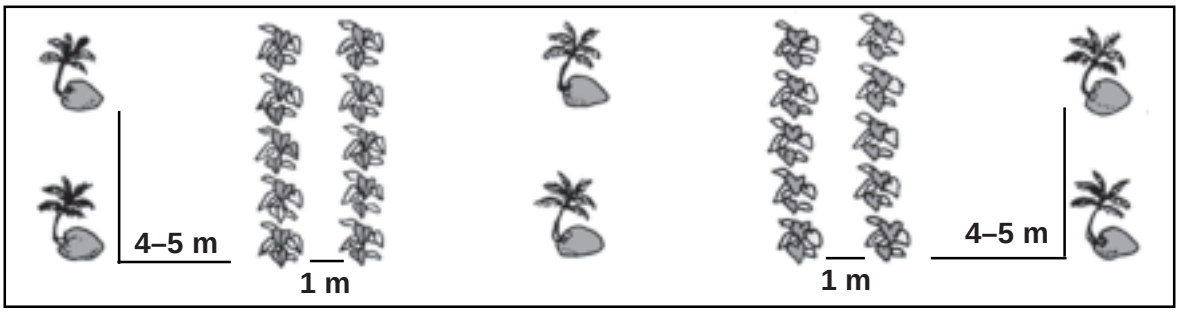
Kava and coconuts

Intercropping kava and coconuts is a common and natural association for Vanuatu. The spacing used is important. Coconuts have shallow, fibrous roots that extend along the ground well beyond the canopy of the fronds. These roots can compete with the kava plants and make harvesting difficult. Falling fronds or coconuts can also be destructive to the kava.

Depending on the size of the coconut palms and soil and water conditions, a distance of 4–5 metres between the coconuts and the kava may be necessary to avoid root competition. Ridging the kava can also help overcome root competition.

Spacing between kava plants in the row is often 2 m (6˚ ft), but 1 m (3˘ ft) may be sufficient.

Coconut–kava intercropping in Vanuatu.



The spacing of plants in coconut–kava intercropping.

Kava and sweet potato

The intercropping of kava and sweet potatoes is quite popular and effective in Vanuatu for a variety of reasons. The sweet potatoes cover the soil and crowd out the weeds but do not compete with kava for light. The sweet potatoes provide food from the plot for the farm family while the kava cash crop grows. Coconut frond mulch can be used around the kava plants to conserve moisture and supress weeds. The coconut frond mulch can also prevent sweet potatoes from growing too close to the kava and creating root competition.

A disadvantage of this intercrop is that rats are sometimes attracted to the sweet potatoes and they can also feed on the kava.

Kava and peanuts

Like sweet potatoes, peanuts provide good ground cover to suppress weeds. Peanuts can be a food crop or a cash crop for the farm family. There is also the advantage that peanuts are a nitrogen-fixing legume that enriches the soil.

Kava and ginger

Planting kava with ginger can be difficult because of the nematode problem associated with ginger. The same kinds of nematodes that attack ginger can also attack the kava. For more information on nematodes see page 24.

Kava and vegetables

Kava is sometimes grown with a variety of vegetable such as tomatoes, Chinese cabbage, English cabbage, capsicum, and eggplant. Kava is vulnerable to many diseases that may be associated with vegetables. There is concern that the diseases that attack vegetables can also be transferred to kava through the soil, water, wind and insects. Consequently growing kava with vegetables should be avoided.

Kava and taro

Kava is often grown with taro because it provides shade for the young kava plants. Care should be taken to avoid competition for water and nutrients when the two crops are planted too close together.

This form of intercropping has been quite successful on the island of Pentecost, Vanuatu, where the spacing used between kava and taro is 1 m (3˘ ft).

Kava and pigeon pea

Pigeon pea can be an effective plant for intercropping with kava. It is a vigorously growing legume that fixes nitrogen in the soil and the leaves can be used as a nitrogen-rich mulch. It will provide shade to the kava and function as a windbreak. The pigeon pea can be planted while the kava seedlings are growing in the nursery. This way the pigeon pea

Kava can be planted between rows of pigeon peas for shade when the plants are young.

will be large enough to provide shade by the time the kava is planted out in the field.

The pigeon pea and kava are planted in alternate rows. For good shading, which is needed when the kava is young, the pigeon pea can be planted densely and then thinned as the kava grows.

Monocropping

Monocropping of kava is not encouraged in the Pacific Islands because this method has the potential to promote the development and spread of disease and it is not good for long-term soil fertility.

Although good coverage of the soil by the kava plants is desired, close planting and little spacing between plants can lead to problems. Closely planted kava monocropping in high rainfall areas creates a lack of air circulation between plants and damp conditions develop that lead to onset of disease.

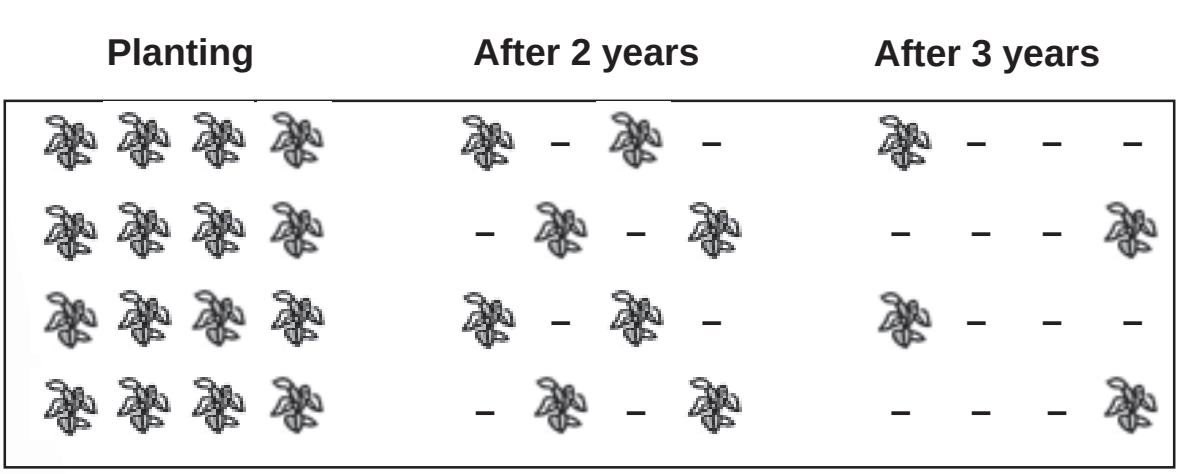
In Vanuatu, young farmers looking for a quick income are developing monoculture systems for kava (see diagram below). Fields are planted at a very high density of one plant per square metre (10,000 plants per hectare) and after two years of growth, half of the plants are uprooted to allow more space for the 5,000 remaining plants. After another year, when the plants are three years old, half of them are harvested and 2,500 plants are left to grow for up to five years. According to these farmers, this intensive system does not affect kava growth. Vanuatu's volcanic soils are rich but more research is needed to understand the advantages and disadvantages of this system.

H. Soil and plant nutrition

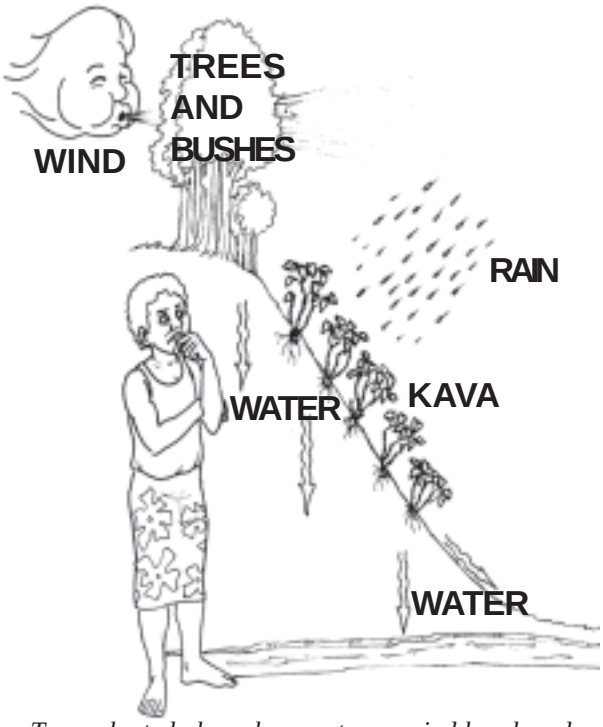
The soil should have good drainage. Even though kava can be grown on a wide variety of soils, the plant prefers deep, loose soils, moist but well drained. The roots of kava have little tolerance for the oxygen starvation that occurs in poorly drained or heavy clay soils. In poorly drained soils the plant is also susceptible to bacterial or fungal diseases. Kava is often grown on hillsides, where drainage is much better than on the valley floor.

Being a plant of forest habitats, kava requires soil rich in organic matter, which provides the nutrients it needs. Kava is a very heavy feeder. Its vigorous growth depends on rich soils and attention to soil fertility management. Traditionally the planting of a kava crop starts with the clearing of the forest, but in most areas this is not a practice that can continue. In Pohnpei State, in the Federated States of Micronesia, the continued clearing of forests for kava has become a major environmental issue. In Vanuatu, for example, a kava crop is planted after two rotations of peanuts, which improve the soil, assist in weed control, and provides extra income for farmers.

Kava has a very limited root system compared to other plants that live as long or grow as big as it does. The root system does not extend very far laterally from the plant or very deep since it doesn't have a tap root. To find nutrients that are not mobile in the soil, roots must grow into new soil. This only happens during the first three years of growth. After three years of growth, the roots have taken



The removal of plants over time in the kava monocrop.



Trees planted above kava act as a wind break and help to prevent soil erosion.

all the nutrients from the soil. The kava plants can then suffer nutrient stress making the plant highly susceptible to disease. After two to three years, composting, mulching, and the addition of animal manure are needed to maintain healthy vigorous plants. This is essential in areas prone to disease problems.

Key points for soil fertility

- Mulching provides nutrients and prevents moisture loss.
- Manure from pigs, chickens, cattle or horses, makes good fertiliser.
- Compost can help maintain soil fertility.

I. Weeding

Weed competition is a major problem in kava production and has led to the use of herbicides. But herbicides should be avoided, for these reasons:

- There has been insufficient research into herbicides for kava production.
- Kava is known to be very sensitive to some herbicides, resulting in wilting even when the herbicide is used some distance from the plant.
- The use of herbicides is prohibited on kava marketed as organic.

The weeding hoe should not be used too close to the kava plant. Serious damage can be caused to the surface roots and adventitious roots from the stem and to the young shoots. It is best to weed between the rows or ridges starting about 50 cm (20 in) from the edge of the plant.

There are many strategies to avoid weed competition in kava:

- Raise seedlings in a nursery and transplant young plants into the field to avoid competition when the kava plant is very small;
- Use intercrops such as sweet potatoes or peanuts that provide good ground cover between the plants and between the rows. When one crop is harvested replace it with another one so that full ground cover is maintained over time.
- Use black plastic mulch to reduce weeds and maintain soil moisture. Black plastic mulch is available in rolls a meter wide. It is laid down on the top of a row and secured with soil around the edges. Holes are made in the plastic and the kava is planted in the holes.
- Use mulch on the soil. The mulch can be made from dried weeds of species that will not resprout. Palm fronds can also be useful.

Black plastic sheets can be used to suppress weeds and retain moisture.

Cut grass is a useful mulch.

J. Water requirements

The cultivation of kava is recommended only in high rainfall areas. Kava requires average temperatures ranging from 20 to 30°C and high humidity. At altitudes of less than 400 m, the plant requires annual rainfall of over 2200 mm. At higher elevations kava requires less water but even so it seems to need at least 1800 mm. This does not rule out its cultivation in locations with a very marked dry season, provided that the drought does not last too long, or irrigation is provided.

It is very important to plant at the beginning of the rainy season so that the plant can gain maximum benefit from rainfall during the critical months of growth. The first six months of growth are when kava is most susceptible to moisture stress.

- Kava is sensitive to drought stress and also to being too wet.
- Young plants should be watered well.
- Mulching will help reduce soil moisture loss. To avoid retaining too much moisture and encouraging disease do not use mulch during extended periods of rainfall.
- Shading young plants will reduce moisture stress.
- In windy areas use windbreaks to conserve moisture.

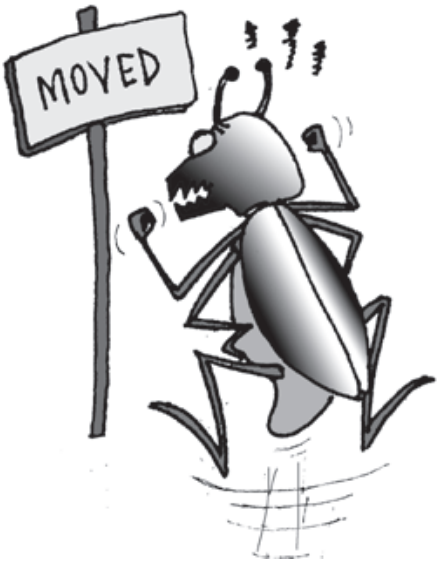
K. Pruning

Each node of the lateral branches sprouts roots and they root easily on contact with the soil. Allow this to continue without interference for at least the first 10 months of growth. At about one year the lateral branches should be trimmed just beyond the root growth from the last node and at the point where a new shoot has sprouted. The trimming of lateral roots encourages the development of the root system rather than the shoots which is preferable since the roots are the valuable harvested part of the plant.

L. Pest and disease management

Insects

Kava weevil (*Elytroteinus subtruncatus*) and other types of weevils that burrow into the root-stock and stem.
Control: change planting site



Ants (many species)
They can attack during the dry season and establish mealy bug colonies that feed on the bark and attract fungi and bacteria.
Control: irrigation

Slugs and snails (many species)
These pests can damage emerging shoots of young plants.
Control: apply snail bait

Nematodes

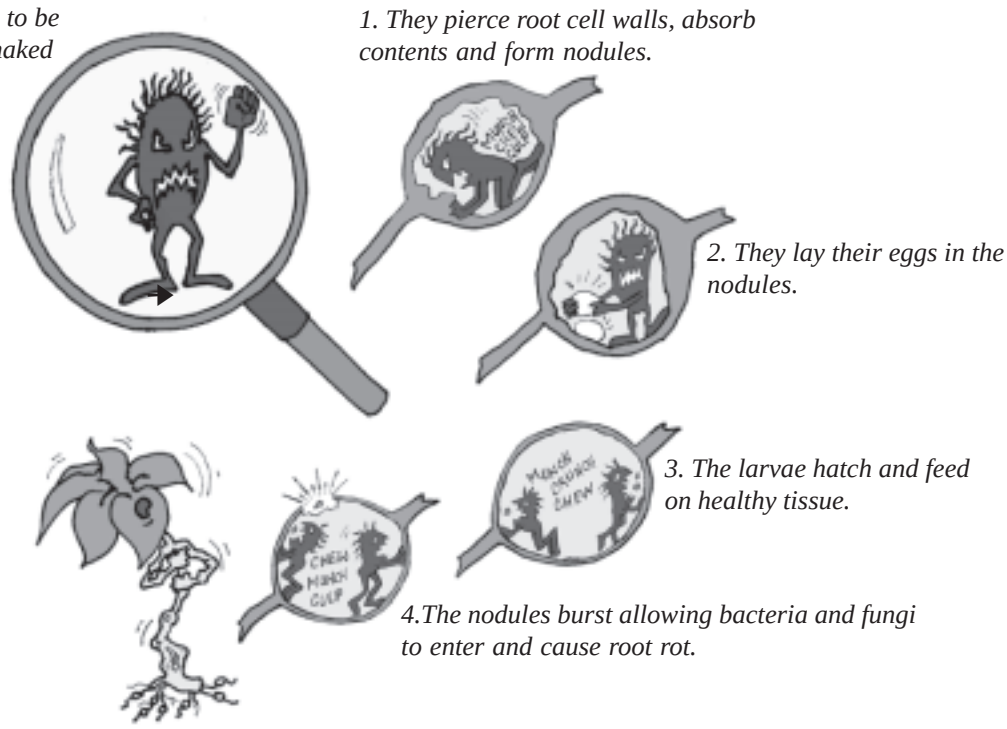
Nematodes are microscopic worm-like pests that can attack the roots of crops. Nematodes are found all over the Pacific, and 28 species have been identified in kava. Because there are so many kinds of nematodes farmers may be familiar with the symptoms of some species but not others. Nematodes are too small to be seen with the naked eye so the symptoms can be confused with diseases that have similar symptoms.

For example, the root knot nematode (*Meloidogyne* spp.) of which four have been found in kava, produces nodules or lumps on the roots which may grow up to 1 cm (˚ in) in diameter. The nematodes pierce the cell walls and absorb the contents, disturb the tissue and lay their eggs in it. As soon as they hatch out, the larvae move towards the healthy tissue to feed, which aggravates their harmful effect. When the nodules burst they are quickly infected by a form of root rot, which can cause the death of the plant. If the nematode attack is severe the plant stops growing, wilts, and dies. Plants that have been attacked are very susceptible to falling over or lodging.

To help avoid nematodes use healthy planting material; avoid planting material taken from infected plants. The determining factor is the choice of a clean planting site where there are no harmful nematodes.

Root knot nematodes are controlled by intercropping with nematode-deterring crops such as turmeric (*Curcuma longa)* and marigold (*Tagates* sp.*)*. To avoid the development of epidemic nematode populations, plants are usually spaced 2 m (6˚ ft) apart to allow intercropping. The weed problem that occurrs in widely spaced kava plants can be partly solved by establishing a cover crop such as sweet potatoes or unstaked yams.

NEMATODES
are too small to be seen by the naked eye.



1. They pierce root cell walls, absorb contents and form nodules.

2. They lay their eggs in the nodules.

3. The larvae hatch and feed on healthy tissue.

4.The nodules burst allowing bacteria and fungi to enter and cause root rot.

5. The plant wilts and dies.

A kava plant affected by dieback.

Kava dieback

A major constraint to the intensification of cropping systems today is kava dieback disease, in which some of the stems rot from the apex or from the nodes to the stump.

Evidence from Vanuatu suggests that kava dieback is linked to low soil fertility and plants which are weak due to nutritional stress. Kava grown on well-drained fertile soils do not often develop kava dieback. To avoid kava dieback attention should be given to growing kava on fertile soils, and any infected plants should be removed. It seems clear that the spread of the disease is being facilitated by monoculture and that growers should be encouraged to intercrop below a tree canopy — in other words to maintain traditional intercropping planting methods.

Recent studies (Davies, 1996) have shown that kava plants inoculated with the cucumber mosaic virus (CMV) developed symptoms of dieback. It appears that kava dieback may be caused by:

- CMV only;
- an interaction between CMV and another virus;
- two or more strains of CMV interacting; or
- an interaction between CMV and a non-viral pathogen.

A number of different plants can be infected by CMV, including the following weeds: *Ageratum conyzoides* (goatweed); *Commelina diffusa* (wandering jew); *Gomphrena globosa* (globe amaranth); *Lantana* spp.; *Physalis angulata* (wild cape gooseberry); and *Solanum nodiflorum* (small flowered nightshade). To reduce the risk of CMV, weeds that carry CMV should be removed from the kava production site and surrounding areas.

Cultivated crops that can be infected include: *Capsicum annum* (peppers); *Cucumis* spp. (including rockmelon, honey dew, and cucumber); *Cucurbita spp*. (including pumpkin, squash and marrow); *Lycopersicon esculentum* (tomato); *Musa* sp. (banana); *Nicotiana tabacum* (tobacco); *Passiflora edulis* (passionfruit); *Vigna spp*. (including asparagus bean, black-eyed pea and cowpea); and *Zea mays* (corn). In an area known to have CMV, take care when choosing crops for intercropping; insects could transfer CMV from other infected plants to kava.

See the SPC Pest Advisory Leaflet on kava dieback for further information

Fungi

Twenty species of plant fungi have been identified on kava, but not many have been recorded as having any economic impact on production.

On recently cleared land, the remains of tree trunks and stumps may be infected with a fungus which lives in the soil and attacks the root system of kava plants. It then spreads from plants to plant by contact. The first symptoms of infection are wilting and rotting of leaf blades. The fungus lives as a parasite in the rootstock and root rot develops quickly, causing the plant to die within three weeks. This fungus has not been identified, but even when it is, it is unlikely that any very effective treatment will be found. It is best to be careful in the choice and maintenance of the site.

II. HARVESTING

A. Harvesting and yields

Harvesting and post-harvest handling account for 40% or more of the labour involved in kava production. Particular attention should be given to harvesting, handling, and drying the kava since these operations have a major effect on the quality of the kava and the price.

Kava is traditionally harvested at age three or four years, but for local ceremonies plants may be grown for over ten years before harvesting. When kava is grown as a commercial crop the decision as to when to harvest is more complicated.

- Some farmers want to obtain the maximum yield per hectare rather than the maximum yield per plant. They increase the number of plants per unit area, provide better soil fertility, and harvest some of the plants when they become too crowded. The remaining plants are allowed to grow for a few more years before harvesting. There are dangers in this approach, such as the risk of the development and spread of kava dieback or other diseases.
- In general, the kavalactone content of kava increases with age (kavalactones are the active compounds in kava). There are six kavalactones in kava that occur in various concentrations. However, some research indicates that kavalactone content depends more on the type of soil, the availability of nutrients for plant growth and the kava variety than on the age of the plant.
- It is not only the total kavalactone content that determines the quality of the kava but also the proportion of each of the six different kavalactones or the chemotype of the kava cultivar (see Kavalactones, page 33). Different varieties of kava have different chemotypes. As the kava export market develops it will be important to produce kava with a specific kavalactone.
- The kavalactone content is different in each part of the harvested plant. The kavalactone percentages of dry weight are 15–20% in the lateral roots, 8–12% in the stump, 5–8% in the basal stems, 2–5% in the stems and less than 1–2% in the leaves.
- The rootstock (stump) and roots become larger over time, although soil fertility, adequate rainfall and the kava variety are more important factors than plant age in determining yield. The green weight of individual rootstock varies from 5 to 50 kg. In the measurement of 1500 plants in Vanuatu, three-year-old plants yielded about 10 kg of fresh material; 70% was the rootstock and basal stems. The remaining 30% of the harvested plants was the roots. The harvested portion of the plant includes the lateral roots, the rootstock, and part of the basal stems.

A proud Fijian farmer with his harvested kava.

B. Harvesting techniques

The first step is to remove the upper part of the plant. Cut the stems above the first node. From the stems there will be adventitious roots extending directly into the soil. Take care to harvest these small roots without breaking them, since they are valuable.

The rootstock is the enlarged portion of the plant at the base of the stems. Depending on the variety the thickness of the rootstock can reach 30 cm (1 ft) to 60 cm (2 ft), and some creeping roots may measure over 2 m (6˚ ft) in length. You will need to carefully dig around and under the rootstock and roots to harvest the plant. Care should be taken not to break the thin fragile roots. A digging fork with flat blades like the ones used for harvesting potatoes is ideal for harvesting kava since it normally doesn't cut or damage the thin roots.

Kava is often planted on ridges, or soil is mounded around the plant. It is easier to harvest plants in ridges or mounds.

Transporting kava to the market in Pohnpei FSM.

III. Postharvest handling and marketing

In general you must take care not to damage the kava plant before it is dried. Physical damage or bruising of the kava can cause rot that affects its quality.

A. Washing

After you have dug up the the rootstock and roots, wash them carefully in water to remove the soil particles. Access to sufficient water for washing the kava and moving the bulky freshly harvested kava to a water source can pose a problem. If the kava is washed in a tank a small quantity of soap should be added to the water for easier cleaning.

B. Cutting and sorting

After the kava is washed, it is ready to be cut up and divided into the various plant parts before drying. The basal stems (the first 20 cm (8 in) of the stems) are cut from the rootstock, peeled and cut into pieces. The roots are removed from the rootstock, which is then peeled, and the peeled rootstock is then cut into small pieces. Each part of the harvested kava is kept separately because kavalactone content and the price for each of the plant parts is different. For more details see pages 32-33. For this reason kava buyers for the local market or exports require that the kava be separated into basal stems, peeling of root stock, chips of root stock and roots.

C. Drying

Lay the rootstock and the roots out to dry in the sun after cutting them into small pieces. The pieces of stem, peelings, and chips should be thin slices to accelerate the drying process. The valuable thin long roots are not cut up before drying. Never dry kava on the ground but always on raised platforms to avoid mixing it with dirt, insects, grass or other foreign matter. Metal roofing sheets are often used as a drying platform to increase the temperature and keep the kava clean.

Drying kava on raised metal roof sheets in Fiji Islands.

Drying in the sun gives a good quality product but may not be possible if there is frequent rain. If it starts to rain the kava will get wet and it may become discoloured or rot. In the rainy season, use a solar hot air drying method instead. Kava can also be left to dry more slowly in the shade.

Several drying technologies have been developed and tested in Vanuatu. Two are presented here: the clear and black plastic cover, and the vented roof design drying facility.

Analysis of the composition of kava rootstock indicates that fresh material on average is 80% water. In very humid climates, the recovery of dry kava from green kava is about 25%. Tests carried out on drying times and weight losses showed that a sample of cut-up fresh roots weighing 10 kg placed in the sun to dry for 10 hours followed by 14 hours in

the shade over 3 days weighed 2 kg at the end of the experiment.

The speed of drying depends on the water content of the fresh root, and the dryness of the air (relative humidity).

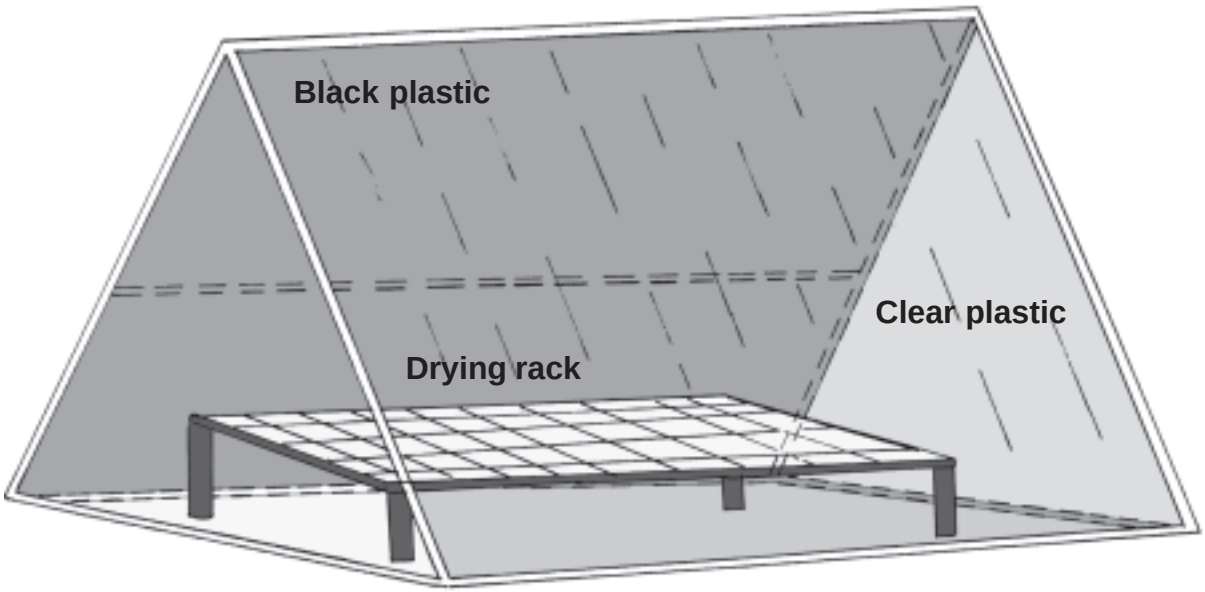
To avoid any risk of mould, the dry product should not contain more than 12% moisture. To test for moisture content, bend a dried root — if it is sufficiently dry it will break but if it needs further drying it will not break. It seems that if the root breaks the moisture content is actually about 6% moisture.

After drying, the basal stems, rootstock peelings, rootstock chips and roots are packaged separately in 25 kg polypropolene woven bags (similar to flour sacks) which permit the pieces of kava to continue to dry.

Kava drying on screen racks in Vanuatu.

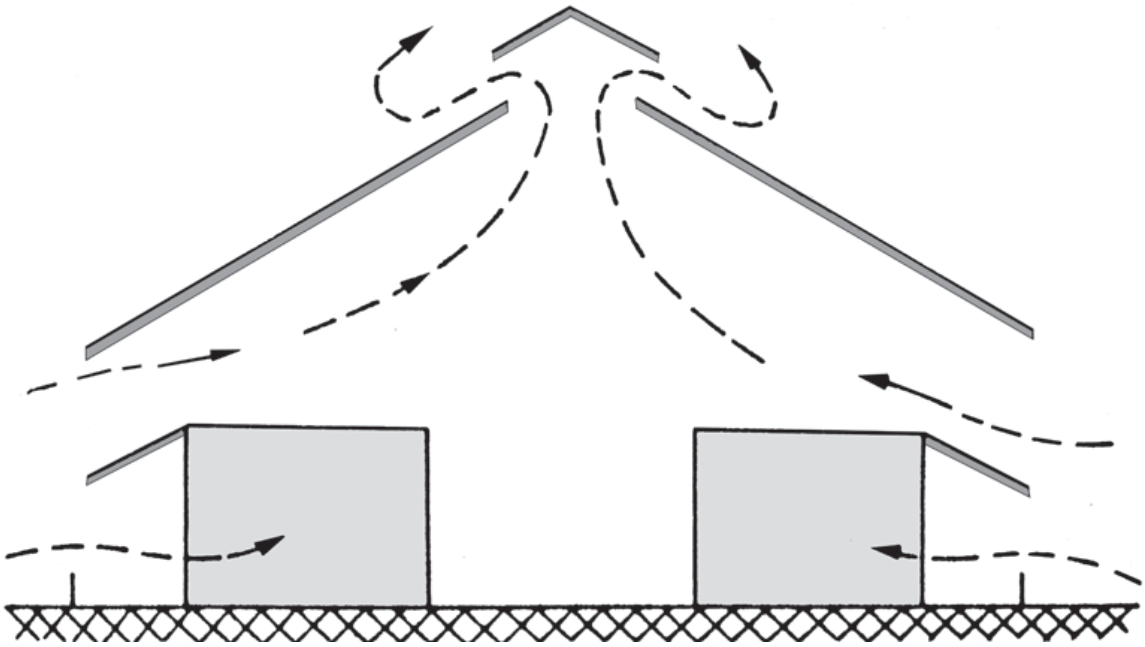
Drying technologies

Clear and black plastic solar dryer



This is a simple and cheap drying technology that increases the temperature because it encloses the drying platform and the black plastic absorbs the rays of the sun. The clear plastic panels should face the sun. This structure also protects the kava from rain.

Vented roof design solar dryer



This is a permanent building for drying kava. It has a vented roof made of clear fibreglass and the sides are also vented. The design increases the air temperature while maintaining air flow to speed the drying of the kava. This building also protects the kava from wind and rain.

A kava drying shed in Samoa with clear plastic roof and vents on sides.

D. Storage

Storing kava is similar to storage of other dried agriculture commodities.

Dried agricultural products are *hygroscopic*: they attract and absorb moisture from the air particularly in high humidity climates such as the Pacific. A dried product left in the open will continue to absorb moisture until there is no further movement of moisture in or out of the product, when the kava is said to have acheived *equilibrium moisture content*. Unfortunately, in the high humidity environment of the Pacific the equilibrium moisture content of kava allows the deterioration of the commodity, and development of fungus and a mouldy smell, which results in a low quality or useless product.

The storage of kava requires special attention to avoid loss in quality. Kava moisture content needs to be monitored during storage. Kava will need to be dried again if it is stored for a few months. Kava can be stored, but the following points should be considered.

- After kava is dried it will start to very slowly absorb moisture from the high humidity air unless it is protected in a moisture-proof container.
- Dried kava can be stored at any temperature below 50°C if it is kept in moisture-proof containers.
- Well-ventilated storage areas are not suitable for extended storage of kava in a high humidity environment.
- The moisture content of the kava must be monitored and tested by smell, looking for mould, and noticing if the roots bend rather than break.
- Although kava can be redried if necessary, multiple drying will cause the quality to deteriorate.

Drying kava on black plastic in Tonga before pounding.

Kava storage in Suva Fiji at kava exporter Pharmakava.

E. Commercial parts of the kava plant

There are five commercial products from the kava plant: basal stems, chips of the rootstock, roots, peeling of the rootstock and residues. The kavalactone content of each part of the plant is quite different. (There may have been some confusion in the past between the peelings of the rootstock, which are high in kavalactones, and peelings of the basal stem, which are low in kavalactones.) The five commercial products and approximate kavalactone ranges are:

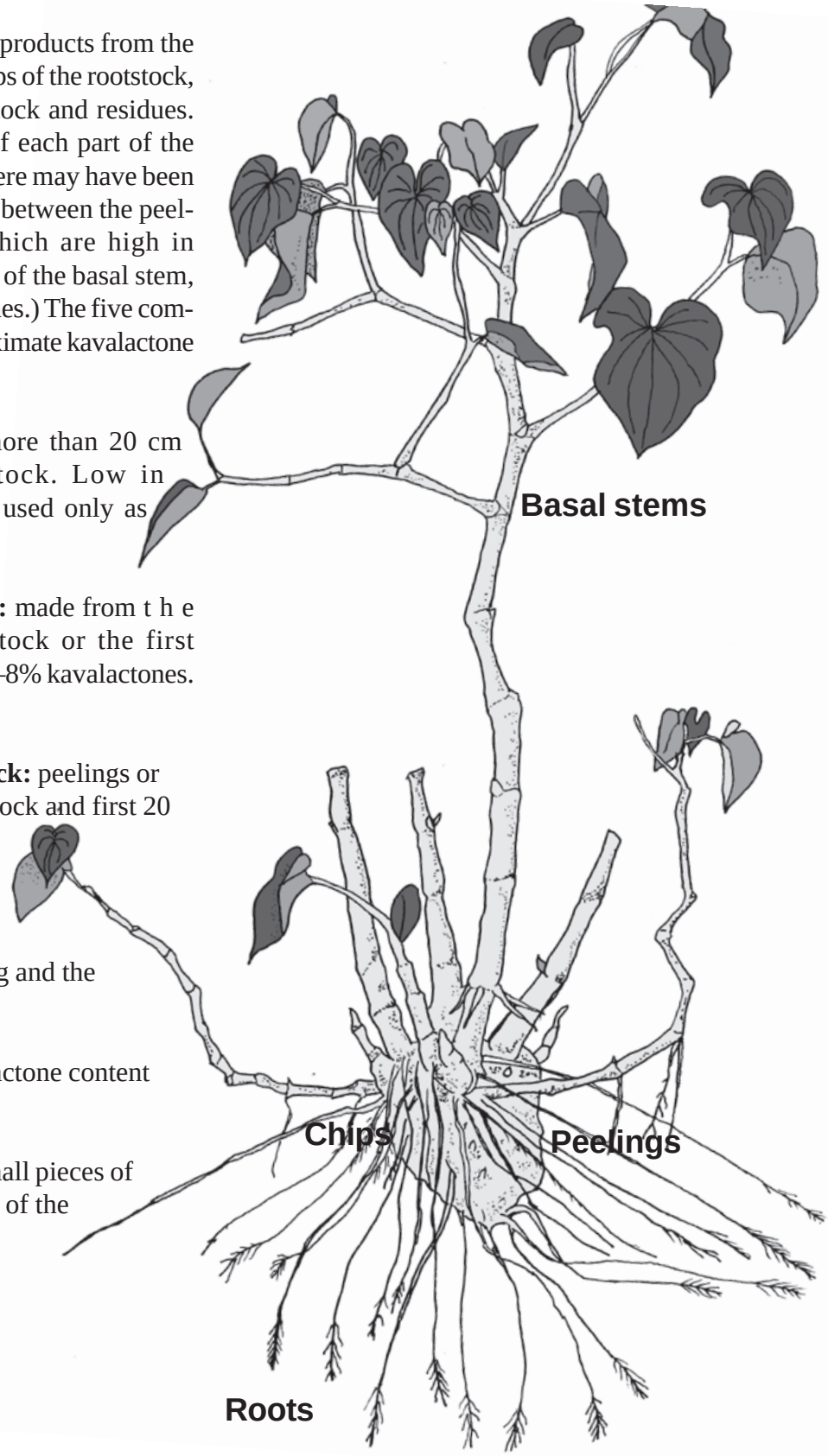
Basal Stems: stems more than 20 cm (8 in) above the rootstock. Low in kavalactones (3–5%) and used only as planting material.

Chips of the rootstock: made from t h e peeled rhizome or rootstock or the first 20 cm (8 in) of the stems; 3–8% kavalactones. Used for drinking.

Peelings of the rootstock: peelings or skin of the rhizomes/rootstock and first 20 cm (8 in) of the stems. It has been preferred for export because of its high kavalactone content (7–11%). Used for drinking and the pharmaceutical market.

Roots: very high kavalactone content (8–16%).

Residues: the mixed small pieces of the other commercial parts of the kava plant of variable kavalactone content. Used for drinking.



F. Kavalactones

Fifteen kavalactones have been isolated from kava. Each kavalactone has a different physiological effect.They are divided into the major kavalactones and minor kavalactones. The six major kavalactones account for 96% of the fat soluble extract from kava and are considered to be the most important active ingredience. They are: demethoxy-yangonin, dihydrokavain, yangonin, kavain, dihydromethysticin, and methysticin. Kavain, for example, is rapidly absorbed by the body and quickly creates a feeling of relaxation. Dihydromethstysticin and dihydrokavain are very potent and produce nausea and long-term drowsiness. These two kavalactones are found in high concentrations in the famous 'tudei' kava cultivar of Vanuatu, which is known to make the drinker feel drunk for two days. For more details of the different effects of each kavalactone read the research by Lebot (see biblography).

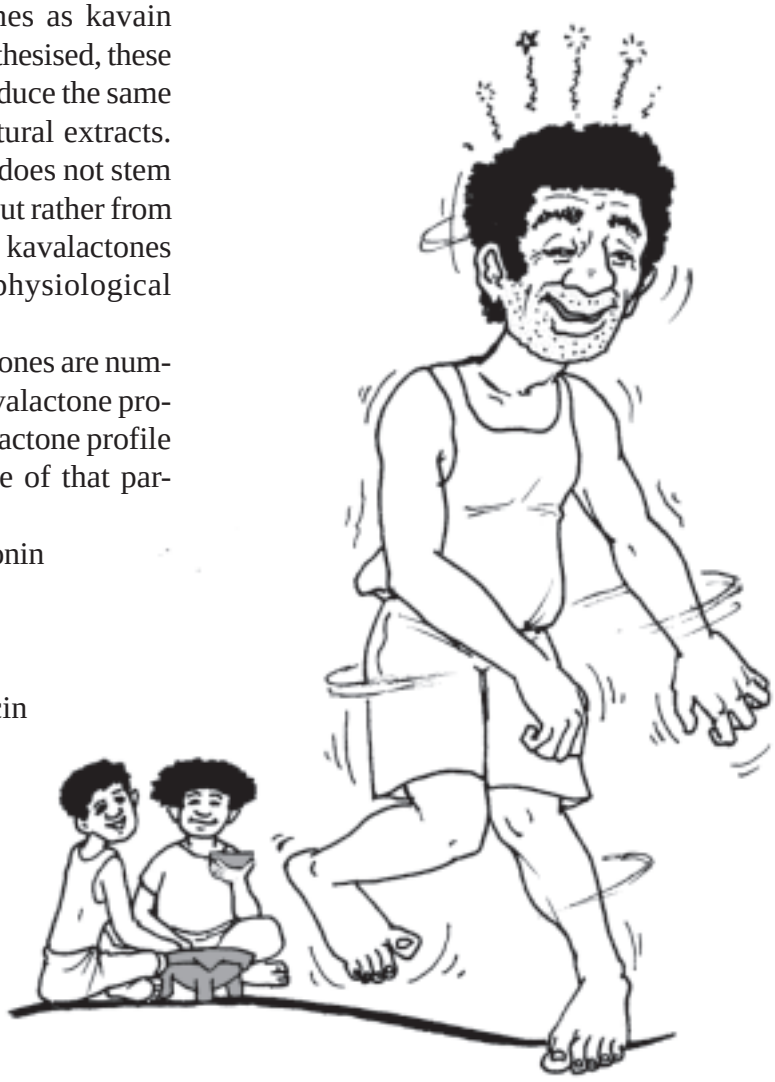
Although such kavalactones as kavain and methysticin can now be synthesised, these artificial kavalactones do not induce the same physiological effects as the natural extracts. The efficacy of kava evidently does not stem from a single active substance but rather from a mixture, a blending of several kavalactones that results in a synergistic physiological effect.

Chemotypes: The kavalactones are numbered and used to define the kavalactone profile of kava cultivars. The kavalactone profile is referred to as the chemotype of that particular kava cultivar.

1 = demethoxy-yangonin
2 = dihydrokavain
3 = yangonin
4 = kavain
5 = dihydromethysticin
6 = methysticin

The chemotype of a kava cultivar is defined by listing, in decreasing order, the proportion of the six major kavalactones. Normally the first three kavalactones in the code for the chemoptype represent over 70% of the total kavalactone content. Consequently buyers and producers pay attention to the first three kavalactones of the chemotype. For example two popular chemotypes in Vanuatu are 246531 and 426135, both of which have dihydrokavain, kavain and meththysticin as the first three kavalactones.

The chemotype of a kava cultivar may not be important for the local drink market. However there is interest by the pharmaceutical industry in Europe to buy only kava with certain chemotypes. Hawaii, in the development of its kava industry, is increasingly cultivating the preferred chemotypes. In the future most kava producers and international



kava exporters will need to pay attention to the production of preferred chemotypes. Kava content and the chemotype can be determined by analysis in the laboratories of the Institute of Applied Sciences of the University of the South Pacific in Suva.

Fresh kava rootstock, when prepared by mastication, pounding or grinding, yields a greenish milky solution that is considerably stronger in kavalactone content and taste than the grey mixture obtained from dry roots. The main factor determining the psycho-active impact of kava is the degree of separation in water of the resinous active ingredients called kavalactones. The active substance in this resin, insoluble in water, becomes available to the drinker after emulsification. However, this emulsion is not stable and infused kava is therefore a suspension of lipid-like compounds rather than a real emulsion.

The resinous compounds are present in each cell as microscopic drops of kavalactones that are dispersed when the root tissues are pounded or ground, macerated and infused. When the beverage is ingested, thousands of these microscopic particles are absorbed rapidly through the stomach membrane to the bloodstream. If the emulsion is rich in active compounds, this will induce a rapid and pronounced psycho-active effect.

The resin becomes more fluid when temperature increases and if hot water is drunk after absorbing kava, the effects will be magnified. Kavalactones are soluble in alcohol and there is a synergistic effect when a drinker mixes the two beverages.

Kavalactones cause a greater biological effect when given in combination, possibly because constituents are more readily absorbed when consumed as part of a mixture. The pharmacological effect of kava is dose-dependent. Kava and its constituents have been shown to have sedative, hypnotic, anticonvulsant, muscle relaxant, anaesthetic, antimycotic, and anxiolytic properties. Clinical trials with standardised kava extracts have shown pharmacological activity comparable to benzodiazepines (e.g. Valium). Benzodiazepines are the most commonly used pharmaceuticals for anxiety. Kava products are used as a substitute and have fewer side effects and have not been shown to be addictive or to lead to dose tolerance.

Key points:

- The kavalactone is the chemical responsible for changing how you feel.
- 15 kavalactones have been identified.
- The mix of kavalactones in a kava variety is known as a chemotype.
- Each part of the kava plant has a differrent mix of kavalactones. Scientists are not sure but it seems that you need a mixture of differrent kavalactones to achieve a particular effect. Naturally produced kavalactones are still much stronger than the synthesised kavalactone.
- How you prepare the kava drink and what you drink after the kava changes the effects of kava on your body.

G. High quality kava

How to improve the quality through good harvest and postharvest practices

Age

Kava should be at least three years old when harvested for an acceptable yield and kavalactone content.

Cleaning

Wash kava in clean running water, or in a tank of water with a bit of household detergent if running water is not available. If you can still see dirt on the kava it is not clean enough.

Drying

Dry kava on a clean surface such as metal roof sheets.

Mildew and mould will grow on the kava if it is too damp. Although you may not see it, it could be present by the time the kava reaches your buyer. If the kava is brittle (snaps when bent) it is dry enough to prevent mould growth.

Remember that kava will attract moisture in the high humidity conditions of the Pacific.

Heat Damage

Do not dry your kava at temperatures too hot to touch (above 70°C). Kava that is overheated can become discoloured and it will have less value to the buyer.

Sorting

Buyers will pay on the basis of the class of kava, so the different classes should be kept separate. However the price also depends on the kavalactone content that buyer expects. The laboratory at the Institute of Applied Sciences at the University of the South Pacific campus in Suva, Fiji, offers quality kavalactone analysis at a reasonable price.

Foreign matter or kava residues

Do not try to add kava residues, pounded leaves or other adulteration to the kava. Most buyers have equipment to detect foreign matter or spent kava. It will be detected and your reputation as a reliable supplier of quality kava will be damaged.

Kava ceremony in Tonga.

Appearance and aroma

The kava should appear clean and not discolored and have the characteristic aroma of kava without the smell of mould.

Storage

Do not store your kava near strong smelling substances such as petrol, spices, or kerosene that can affect the aroma of the kava. Store in new polypropylene bags in a clean, well-ventilated area and off the floor.

Remember, you will have higher quality kava if it:

- is at least three years old;
- is clean and free of soil;
- is dry;
- is not heat-damaged;
- is free of mould and mildew;
- is separated into peelings, chips, and roots;
- contains no foreign matter or spent kava;
- has good appearance and aroma;
- is stored in clean bags under good conditions.

H. Quality specifications

The quality of an agricultural product is always an important issue. In the world of international trade, sellers and buyers rely on quality specifications to facilitate the trading of products. A quality specification is a pre-sale agreement on the quality of the product which is to be traded. Quality specifications exist for most internationally traded products. An essential part of quality monitoring is taking representative samples of consignments and testing of samples. The quality specifications are enforced by the industry and/or by legislation and licensing of exporters.

There is no established physical or chemical quality specification for kava exported to the pharmaceutical industry. The result has been that buyers and importers have experienced problems and possible rejection of exported kava when there are quality-related problems.

Kava has been traded for many years both domestically and between islands of the Pacific without a quality specification. Instead the quality is based on the buyer examining the kava before purchasing it. The farmers and middlemen who sell the kava have learnt through experience the factors kava buyers and exporters are looking for so that they can get the best price. But there have always been problems and the farmer, the middlemen and the buyers have all suffered.

More recently, developed countries have become involved in the international trade of kava. Furthermore, more advanced analytical techniques have been introduced which have led to the introduction of detailed, indisputable quality specifications for kavalactones

As we get to know more about the chemical make-up of kava, we have been able to develop a set of quality specifications (standards) which can be checked and verified anywhere in the world.

The establishment and use of a quality specification for kava can protect Pacific Island kava producers and traders in the event of a dispute over quality. SPC funded the Institute of Applied Sciences of the University of the South Pacific in 1995 to develop a draft quality specification for kava. These specifications are explained in the following pages.

The kavalactone analysis in a laboratory at the University of the South Pacific.

Background information on quality specifications

This is an explanation of each of the factors that are normally included in the quality standards of a commodity. They include: physical and chemical characteristics for kava.

Description

The offical description for a quality specification normally contains the botanical name and a brief description of the product. Thus adulteration means that the product does not conform to the specification and the purchaser may reject the consignment. It can be difficult to visually detect adulteration but there are tests that can detect when other vegetable matter has been added. Adulteration has been common in the food industry and a number of instances have been reported in which kava has been adulterated with 'spent' (used) kava and other matter.

Physical properties

A series of simple physical tests can give a quick, easy assessment of quality. For instance, because the appearance of kava is well known, discoloration, insect fragments, tobacco, stones and other vegetable matter can be easily detected. Kava aroma is also well known and common contaminants such as diesel, petrol or spices can be detected very quickly by simply smelling the kava. A lack of aroma may indicate staleness.

Flavour

This can be tested informally by simply preparing a solution and assessing it. A taste panel can score the flavour using a previously acceptable product for comparison. In so doing, very small differences can be assessed and the flavour profiles can be assessed objectively. Taste panels in which as many as 20 panellists assess flavour, appearance, and aroma can be used for dispute resolution.

Filth

Soil adhering to the product can be removed and measured. Soil contains a very large number of bacteria and unfairly adds to the weight of the kava. It is important to remove as much soil as possible from the kava to ensure that the bacterial level is as low as possible and to ensure that the purchaser does not in effect pay for soil.

Moisture

The keeping quality of vegetable matter depends to a large degree on the moisture content. Reducing the moisture content below 12% is essential. Above this figure the kava is likely to become mouldy. If the roots break when bent that is a good indication of low moisture content. There are also oven-drying techniques used in the laboratory to determine moisture content.

Chemical characteristics

Ash

Ash testing is one of the 'indicator tests'. It gives a guide to other characteristics such as age, cleanliness, moisture content and contamination with other plant material. The test is inexpensive and simple and is a means of verifying other tests.

Kavalactones

The most important the characteristic of kava for international buyers is the kavalactone content. Six kavalactones are tested for each part of the plant. Experience indicates that for the root and rootstock, the range of values obtained for each kavalactone is fairly narrow. Values falling outside these accepted values may indicate blending with other less valuable parts of the plant, blending with 'kosa' or previously used kava residues or contamination with other plant material. Furthermore, values outside these ranges would indicate that the kava is not of export quality.

Proposed kava quality specifications

These are the draft physical and chemical quality specifications based on research at the Institute of Applied Sciences of the University of the South Pacific.

Description

Kava will be the roots, rootstock, basal stems or scrapings derived from the plant *Piper methysticum*. It will be sound, clean and substantially free from filth, soil and other contaminants.

It will be prepared in accordance with good manufacturing practice and will not contain vegetable matter derived from other species, insect fragments, or any other extraneous matter. It will have the following physical and chemical properties.

Physical characteristics

Colour

Kava will have a characteristic light brown/grey colour.

Aroma

Kava will have the aroma characteristics of the product. The aroma will be free of extraneous aromas indicating contamination with other plant material, solvents or other volatile matter.

Flavour

In the event of dispute, kava samples will be subject to a taste panel assessment using the triangular taste test. There will be at least 20 panellists and results will be subjected to statistical analysis. Statistically significant samples will be treated as contaminated.

Filth

Using standard methods heavy filth will not exceed 0.63% on a dry weight basis. Heavy filth exceeding 0.63% but less than 0.7% will be considered to be second grade. Heavy filth exceeding 0.7% will be rewashed and redried.

Moisture

The moisture content will not exceed 12.54% when dried to constant weight at 105°C. Moisture content exceeding 12.54% but less than 12.88% will be considered to be second grade kava. Kava samples with a moisture content in excess of 12.88% will be redried.

Chemical Characteristics

Ash

The ash content will not exceed 5.36% when organic matter is removed at 440°C. Samples exceeding 5.36% but less than 5.93% will be considered to be second grade kava. Samples with an ash content in excess of 5.93% will be washed and redried.

Kavalactones

A quality specification for kavalactone content is still under development and it is very difficult to specify because of the great variations between kava varieties. The important point, especially if large consignments are involved, is the need for both buyer and seller to test the kavalactone content. Once the results are available prices can be accurately negotiated.

I. Advanced processing

For kava to be used in the pharmaceutical industry the kavalactones must be extracted so that they can be contained in capsules for easy use by patients. In the pharmaceutical industry the most commonly used method for extracting kavalactones is the *solvent extraction method*. Kavalactones are insoluble in water, so extraction is done with volatile solvents. Volatile solvents are used because they don't leave a residue in the kavalactone extract. The volatile solvents are recyclable by evaporation and distillation, but are flammable, and thus should be handled carefully. The extracted kavalactones are in the form of a dark thick viscose substance that is not easy to use directly. It is combined with an inert substance such as starch to create a powder with 30% kavalactone content that is then placed in capsules.

Steps in the solvent extraction process:

1 – Dry matter
2 – Crushing
3 – Reduction to fine powder
4 – Maceration, hot or cold in a solvent
5 – Filtration
6 – Elimination of solid residues
7 – Evaporation and recovery of solvent
8 – Extraction of a brown coloured resin
9 – Resin mixed with a base to create a 30% kavalactone powder

The kava residues from domestic consumption still contain significant levels of kavalactones. Processing offers the potential to extract the kavalactones from these residues, which are normally discarded. A suitable economical extraction method, perhaps using a combination of organic solvents, needs to be developed.

Another method of processing is *spray drying*. Spray drying is a well-established agro-industrial technique that produces water soluble powders such as milk powder that are easy to handle and store. This technology is well suited to kava because the powder dissolves in water and it is more rapidly absorbed by the body in this form than in capsules. This technique is expensive however, and requires an investment of about US$500,000 for a small spray drying unit capable of processing about one tonne of fresh roots per day.

Steps in the spray drying process:

1 – Fresh root
2 – Crushing
3 – Filtration
4 – Fresh juice
5 – High pressure pump
6 – Spray drying
7 – Water-soluble powder obtained

Much of the attraction of kava is the ceremony attached to its preparation and social consumption in the Pacific. For the local market and export there is a need for a high quality, pre-dried, ground kava for those who want to consume kava in this manner.

Ready-to-drink extracted kava with other tropical flavours is now available. There are also kava candies and other novel products on the market. These products have not generated significant consumer demand, however.

There continues to be interest from the private sector in establishing kavalactone extraction facilities in the Pacific. One facility was established in Port Vila but it is no longer functioning. Another facility was established in Savusavu, Fiji Islands, but at a time of a decline in the market and demand was not sustained. Currently there are plans to relocate this plant elsewhere in the Pacific region. The key aspect in the establishment of viable processing facilities is that they must be connected directly to the company that will further process the kavalactone extract and produce the final product. Large pharmaceutical and natural products companies have substantial investments in their own processing facilities to use with a wide variety of raw material. They prefer to use their own processing facilities to control quality and in order to add value to the raw material themselves.

J. Marketing

There are several distinct markets for kava, but in all markets there is a demand for high quality kava.

Domestic drinking market

The local market is still the most important market for kava in terms of total size and cash value. At the village level there is still a substantial amount of production for household and village consumption. Middlemen often buy at the village or villagers bring their kava to sell at markets in the urban centres. There is an increasing demand for pounded kava sold in packets for local consumption in kava shops and in private homes.

This market is also less risky than the export market for the buying and selling of small quantities of kava. Producers know the buyers and the prices they will get.

Export market

Kava exporters have emerged to serve a number of markets. The exporters usually have their own buyers, who purchase the kava at the village from known producers of quality kava. Some large growers sell directly to the exporters. On occasion large growers form partnerships with overseas kava buyers and processors. The exporter make the growers aware that they must follow many of the princples outlined in this publication for production of high quality kava in order to receive a good price.

Drinking market: The main drinking markets are in the Pacific, such as Fiji Islands, Vanuatu, New Caledonia and Tonga. There is also kava drinking in Australia, New Zealand, the United States particularly in California, and Canada.

Pharmaceutical market: In Germany and France kava has been a prescription drug for many years, prescribed in capsule form for patients with psychological problems. As previously explained, the kavalactones are considered a natural replacement for other drugs such as Valium that relieve the symptoms of stress. This market is very precise. Buyers seek kava with a specific chemotype and the pharmaceutical laboratories process the kava to make a capsule with an exact kavalactone content. There has been a consistent demand for high quality kava for this market.

Nutritional supplement market: In the United States many non-prescription herbal remedies are considered nutritional supplements by the Federal Drug Administration, and kava recently became popular in this market. Kava is packaged in capsules, as teabags, and added to other beverages. This market saw a dramatic growth particularly in 1998, but since then the demand has declined. Kava became a 'fad' in the herbal products market which meant that people tried it once. If a product in this market is poor quality, people quickly lose interest, and the market fades as quickly as it appeared. Some authorities believe that the lack of a standardised, high quality kava product for the consumer contributed to the decline in consumption in the US market.

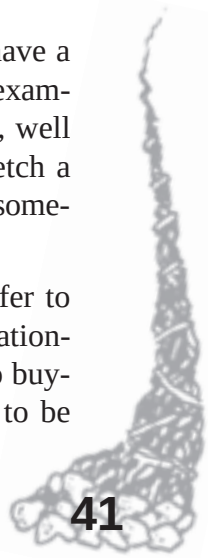
Buyers

The export market demands high quality. The buyer is interested in finding the lowest price possible for a high quality kava. Buyers will discuss purchases with exporters in several countries before negotiating a quantity and price. They prefer to buy sorted kava rather than pounded kava so they can verify the quality immediately

Price is related to three factors:

Quality: High quality kava will have a higher price than low quality kava. For example, kava that is clean and free of soil, well dried, with a fresh kava aroma will fetch a higher price than kava that is dirty, only somewhat dry, and mouldy smelling.

Consistency: Buyers of kava prefer to establish more long-term business relationships with kava exporters. Not only do buyers want high quality, they also want to be



able to buy kava of consistently high quality. This is how a grower, middleman or exporter establishes a good reputation. Customers will keep coming back to purchase more kava. However, if the quality of your kava is not consistent then buyers will find suppliers who are more reliable.

Part of the plant: The roots and peelings are higher in kavalactones and demand a higher price than the chips and stems. International buyers often prefer the peelings, which they feel are better value and have the quality kavalactone they need.

Supply and demand: When there an is abundant supply available for the market, prices will be lower. Conversely, when supply is low the prices will rise. A good example of the effect of supply and demand on kava prices was seen during 1998. Buyers from the United States herbal market made substantial purchases in 1998 and prices moved to very high levels. However by the end of 1998, there was very little kava being purchased for the export market and prices declined substantially.

Marketing of fresh kava at "The Kava Store" in Port Vila, Vanuatu..

IV. Conclusion

There is good potential for growth in the local and export kava market. However, the future growth and development of the kava industry needs attention in the areas of production, research and marketing.

Production research

It is often debated which is more important: markets or production? It would appear that further market opportunities are constrained by production, as the large domestic market restricts the amount available for export.

Kava needs attention as a commercial crop. Effective cropping systems adapted to the local conditions need to be developed for smallholders as well as for large-scale plantations.

Organic kava production systems need further study because of the high value niche market for organic products.

There are also major bottlenecks and needs for agronomic research:

- Establishment of national germplasm collections needed.
- Selection of kava varieties of the best chemotype and kavalactone content. Hawaii has undertaken this and only good chemotypes are promoted for production.
- Development of reliable tissue culture techniques and micropropagation systems for virus-free planting material. Hawai‘i has made progress in this area but the survival rate of plants from tissue culture is still only 50%
- Identification, prevention and control of existing kava pests and diseases, including dieback, and a comprehensive study of the epidemiology.
- Determining the suitability of kava monocropping by smallholders in the Pacific.
- Kava fertility management for maximum production and sustainability.

Processing research

Further research into appropriate processing techniques for the smallholder and for large-scale production is necessary. Appropriate equipment and packaging techniques are also needed. Among the different processing techniques to be studied, priority should be given to the improvement and development of spray drying techniques, ultra-high temperature treatment, and identifying the ideal combination of organic solvents for the treatment of residues from domestic consumption. National Kava Councils should be established to encourage intiative and coordinate development of the industry.

Facilitation of marketing activities

Inconsistent supply and poor quality of kava inhibit market development and destabilise prices. The kava industry needs to establish kava quality specifications.

National or regional names should be developed and protected to symbolise quality kava from original sources and to protect it from competition from other tropical countries.

Organic certification

A valuable niche market with potential for Pacific Islands kava producers is the organic market. Much of the kava grown in the Pacifi is grown without the use of pesticides and chemical fertilizers. An organic certification system for kava is needed to verify the organic production methods used for the growth of the industry.

Working group of Kava Industry leaders at Regional Kava in meeting, 1998.

Appendix A

Hawaiian kava production

On 11 May 1998 the Association for Hawaiian Awa (AHA) was formed as a non-profit organisation for reserach, education, and preservation of the cultural and medical values associated with the awa (kava) plant.

Hawai‘i has a long tradition of growing and consuming kava that is now being revived. Hawaiian kava growers are applying modern production and propagation technologies to kava. Gowers in other Pacific Islands may be interested in the technical information, which provides a much different approach to kava production. If you are interested in experimenting based on the following information, please do so on a small scale and with caution.

Different soils

There are five basic production systems in Hawai‘i, depending on the type of land where the kava is planted.

Deep soil

These lands, formerly used for sugar or pineapple, are often depleted of nutrients. These soils are deep-ploughed and rotor tilled with compost and /or manure. Calcium and other minerals may be added depending on the soil analysis. The field are then formed into ridges that are as much as 150 cm (5 ft) wide and 75–100 cm (2˚–3˘ ft) high to promote good drainage.

Rocky soil

These soils are often not very deep but ridges are still made in the field. The same procedure as above is followed, with no deep ploughing because of the often shallow soils.

Forested and rocky with limited soil

The trees are left growing on this land. Kava is grown among and under the trees on mounds of cinder, soil, compost and fertiliser mix.

Jerry Konanui in a kava plot that will be used for cuttings.

Rocky with very little or no soil

These lands, where papaya or anthurium may have been grown before fertility depletion or the disease of ring spot virus on papaya or anthurium blight, are cleared of weeds. The kava is grown in mounds of a mixture of cinder, soil, and compost with fertiliser added.

Basket system

The weed mat basket method, though not extensively used, is attractive for smaller farmers including backyard kava growers. This method consists of wire baskets varying from 75 cm (2˚ ft) to 130 cm (4˘ ft) tall made from welded steel wire, hog wire, or wire mesh used for concrete reinforcement. The open wire baskets are lined with weed mats and filled with a mix of cinder, soil, compost and fertiliser. The savings in labour costs and maintenance time, ease of pest and disease control, and the ease of harvesting make this an attractive alternative for small growers wanting to supplement their income.

Kava planted in a large basket.

Fertility management

Many different methods of fertility management are are used, includeing both organic and non-organic approaches. There is very little documented data on kava nutrient requirements. Farmers are experimenting with a wide range of fertiliser application methods such as pre-plant, side dressing and foliar application. The timing of fertiliser application is also an area of experimentation. Ginger farmers use their usual method with some variations. Taro growers are also using their knowledge and experiences in formulating their own adaptation of fertility management.

Here are two examples:

Monthly application of NPK of different formulations:

14-14-14	*time release*	(1–3 months)
14-14-14	*commercial*	(3 months–1 year)
16-16-16	*commercial*	(1–2 years)
10-20-20	*commercial*	(After 2 years)

Monthly application of NPK of these formulations in rotation:

14-14-14
10-20-20
14-14-14 *or* 16-16-16

Fertiliser rates

A small handful of NPK is spread around and over the mound for small plants. A handful for 30 cm (1 ft) tall plants is well broadcast around the plant and two to four handfuls of NPK are applied for plants over 120 cm (4 ft) tall. It is important not to throw handfuls of NPK into piles on the mounds, as it will burn your plant. It is better to have more frequent light applications of fertiliser than less frequent heavy applications.

Height and Yield of Kava

A three year old plant can yield from 8 to 17 kg of green kava. One organic farmer got 16 kg in twelve months; his fertiliser application is not known. The plant height at harvest depends to a great extent on the variety. Plants with short nodes can reach a height of only 1.2 to 1.8 m (4 to 6 ft). Plants with long internodes can reach a height of 3.5 to 5 m (12 to 16˚ ft) in the shade, or a bit shorter in direct sunlight.

Weed management

Especially during the period just after transplanting, weeds are a major problem. Farmers transplant large plants from the nursery to help beat the weeds' growth rate. Mulches of cinders, grass clippings, shade tree chips and trimmings, weed mats, and rows of shade and nitrogen fixing windbreaks help keep the weeds down until the kava canopy can provide its own weed control.

In some areas with no irrigation, farmers allow a ground cover of weeds to grow, claiming that this helps maintain moisture during the hot summer months.

Herbicides are not approved for use in kava cultivation. The drift or wind carry of *Roundup*, a systemic herbicide, from road maintenance on non-organic farms can have devastating effects on kava.

Irrigation

Irrigation is a real bonus for those fortunate enough to have it. To get better irrigation coverage, an emitter style head is recommended rather than a drip head.

Farmers who have to rely on rainfall need ways to ensure that the kava plants will have enough moisture throughout the year, especially during the hot summer months.

In high rainfall areas, large, well-drained, high mounds or ridges with a high proportion of moisture-holding materials can help provide the right drainage.

For drier and windy areas, shade-providing, nitrogen-fixing windbreaks are very helpful in preventing the kava from drying out. Nitrogen-fixing windbreak species include *Casuarina equisetifolia*, *Calliandra calothyrsus*, *Gliricidia sepium*, and *Leucaena leucocephala*. Ask forestry or agriculture extension agents for the best trees for windbreaks for your area. In this situation, rocky mounds and hills aid in retaining moisture, so leave the rocks in. Mulch, weed mats, black plastic mulch, and cover crops also help to retain moisture.

Irrigation in a field of young kava plants.

Spacing and shading

Spacing

The initial frenzy of kava planting brought spacing as close as 60 cm (2 ft) between plants within the rows and 120 cm (4 ft) between rows. Experience has now shown that this spacing was too close. Now 180 cm by 180 cm (6 ft by 6 ft) or 240 cm by 240 cm (8 ft by 8 ft) is the recommended spacing.

Shading

Planting out acclimatised young plants calls for shade or at least partial shade. Planting kava between rows of pigeon pea or nitrogen-fixing windbreak trees seems to work well. After one year, or when the kava plants allow it, the shade trees are pruned and chipped on site and added to the top of the mounds or ridges as mulch or later as compost.

Rows of kava plants properly spaced and shaded by windbreak trees.

Pruning

Due to the urgent need for planting material kava crops were pruned drastically. It was then noted that a healthy kava plant can handle drastic pruning twice a year without adverse effect. On the contrary, the plants seem able to not only to recover but to increase in size: more shoots come out; more roots develop from these shoots, the rootstock increases because there are more branches developing. About 10–30% of the stems are removed once or twice a year, depending on how the plants are growing. The woody stem closer to the ground branches is removed, leaving the softer and more succulent stems.

It is believed that Hawaiian ancestors were right when they said that the Awa Kau Laau, a variety of Hawaiian kava, famous for its strength, which grew in the crotch of trees in the district of Puna, Hawai‘i, was strong because the roots coming down the tree were exposed to the sunlight. I feel that pruning is an extension of that idea. It opens up the canopy of the plant and lets the sunlight penetrate to the base of the plant. Testing done on Hawaiian kava in 1998 also supports this.

Advantages of pruning

1) Pruning provides planting material.

2) It promotes an increase in rootstock size.

3) It enhances production of kavalactones.

Fast propagation method

A major constraint to expanding kava production in Hawa‘i is lack of planting materials. There has been a high degree of innovation to get large amounts of vigorous planting material from a small number of plants in a short period of time. In the tipping and pinching approach, the buds are stimulated to grow into shoots while they are still on the plant rather than after planting, with the result that you can have much faster growing plants once they are put in the ground.

Kava stem (primary branch) before tipping.

1. Plant preparation (before taking cuttings)

A. Fertilise plants one or two weeks before tipping.

B. Tipping – the removal of the primary branch tip:

(i) Tip only hard, woody branches (if your thumbnail can penetrate the stem or node, it is too soft).

(ii) The purpose of tipping is to accelerate the growth of the axillary buds into shoots.

(iii) Use only nodes from primary branches. Material from secondary branches will develop into plants with horizontal growth characteristics.

C. Pinching — the removal of the upper portion of the axillary bud, leaving the base of the node. The purpose of pinching is to prevent damage to the sprouted bud (breaking off of the node). In addition, the pinching stimulates three to four eyes to come out of the base of the axillary bud. This gives you three to four stems from one plant rather than a one-stem plant.

(i) Pinching should be done when axillary shoots are at least 2.5 cm (1 in). The larger the shoots the better.

Pinching — removing the upper portion of axillary bud to stimulate the development of more buds.

Buds (eyes) developing because of pinching.

2. Removing nodes from the stem

A. Cutting individual nodes

(i) Cut with sharp clippers/loppers or a clean cutting saw.

(ii) Cut close to node.

(iii) Place cutting into plastic bucket; damp sphagnum moss is helpful to keep the cutting moist.

(iv) Don't place the bucket in sun or subject it to heat.

(v) Upon completion immediately transport to nursery.

After the top node is removed from the stem, the next node is allowed to sprout and be pinched. This process can continue down the stem. Always leave one node at the bottom of the stem to prevent potential entry of fungi that can cause rotting of the rootstock.

Sprouted node ready to be cut near the node.

3. Preparing Nodes in the Nursery

A. Lay nodes in trays with pinched axillary buds facing up.

B. Dip the tray of nodes in a marinade of fungicide and bactericide to prevent rot (optional but highly recommended).

(i) The length of time to soak the tray depends on the type and strength of fungicide and bactericide used but a few mintues is usually sufficient.

(ii) After soaking, rinse with fresh clean water to prevent burn damage to soft/small buds and shoots.

(iii) Let water drain off until dry.

C. Soak tray of nodes in a marinade of seaweed extract and high phosphate foliar mix (optional).

(i) Soak for five minutes.

(ii) Remove tray from marinade and let drain and dry.

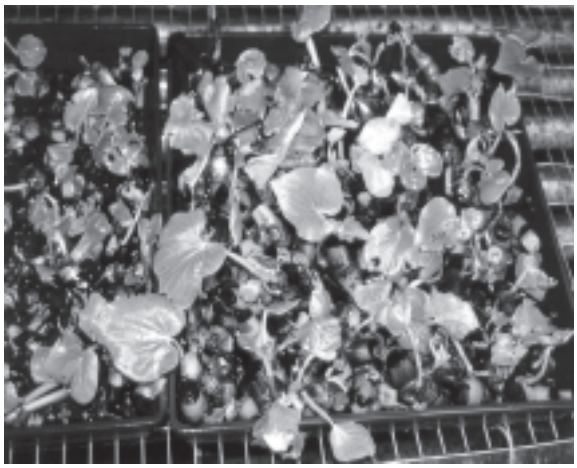
(iii) Paint freshly cut node ends with pruning paint (optional).

D. Place tray on a bench in a mist chamber so that the nodes are kept moist.

(i) Keep in 60% to 80% shade.

(ii) Every day:
   a. Check for drop-off (stubs from secondary cut branch)
   b. Check for and remove rotten nodes
   c. Hose down the nodes to keep them clean
   d. Watch for rooting and when roots appear put the node in a pot of media (see page 50).

(iii) Weekly: spray or soak in high phosphate foliar seaweed extract (optional).



Nodes in trays with buds facing up.

Node with shoots facing up.

4. Potting rooted nodes

A. Use a 4 litre pot or bag.

This is so that you can keep the plant in the same container until transplanting. Smaller pots can be used but transferring to a larger pot will be necessary before transplanting to the field. Using a 4 litre pot also means the plant can be grown even if transplanting is delayed.

B. Media (use sterile media where possible)

(i) 80% cinder/perlite, 20% compost (preferred).

(ii) 100% cinder/perlite (2nd choice).

(iii) Drip or mist irrigation is recommended though watering daily is acceptable once the plants are well established.

C. Start with 60–80% shade in the nursery. Just before transplanting, gradually increase exposure first to 60–70% for a week and then to 30% shade for a week.

D. Fertiliser application can be done in several ways.

(i) Slow release (balanced with minerals) as per directions.

(ii) Foliar spray/soak every other week.

(iii) Manure tea or in the potting mix.

(iv) High phosphate seaweed extract as per instructions.

E. The size of the plant at transplanting depends on field conditions (small plants are under 30 cm (12 in), large plants are over 30 cm).

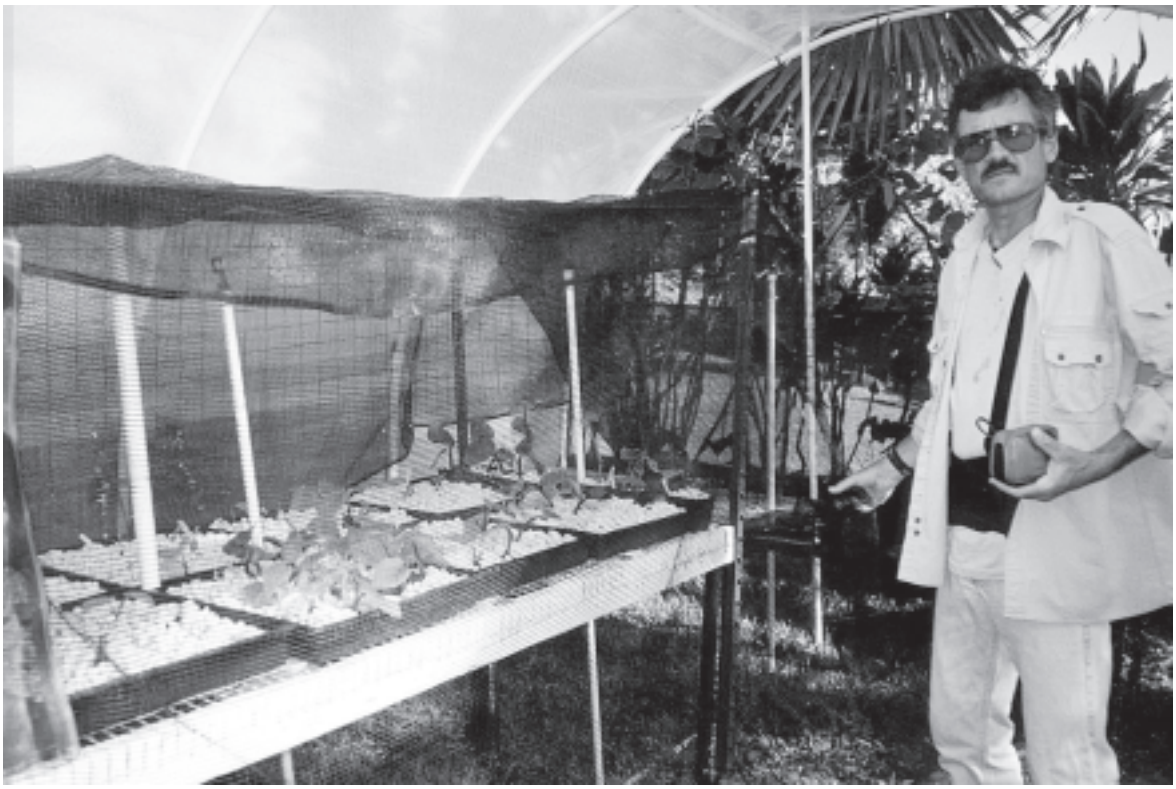
(i) Shaded conditions for small plants and unshaded conditions for large plants.

(ii) Weedy conditions require large plants; small plants need weed-free conditions.

(iii) If pests (insects, slugs and snails) are present, plant large plants; if field is pest-free you can plant small plants.

Nodes after planting in pots.

Hawaiian Pacific Kava Company nursery in Hilo, Hawai‘i.



Small backyard kava nursery in Hilo Hawai‘i with owner Ed Johnston

Organic kava production

Jim Henderson of Pu‘u O Hoku Ranch in Kaunakakai, Hawai‘i, has taken an organic approach to growing kava. Hawaiian soils are low in phosphorous and the pH levels were all well below 6. Much of the fertilisation is based upon what is known of other plants' needs. What kava needs for high kavalactone content and vigorous growth is relatively unknown. It does seem to be a heavy feeder and therefore foliar fertilising is necessary to keep the nitrogen at a high level for maximum growth. So far, the plants are looking quite vigorous, on the whole. There is no yield data yet because the oldest plants are only 16 months old.

1. Soil evaluation: soil nutrient levels vary greatly. A soil test is important to know what to add to the soil. Based on the soil analysis Jim has developed a soil fertility management plan.
2. Preplant application of one tonne/hectare of calcium (oyster shell lime) and one tonne/hectare of phosphorous (soft rock phosphate).
3. When possible he plants the field with either Sudan grass or crotalaria before it is prepared for planting kava. Both are known to kill nematodes. Crotalaria is a legume that fixes nitrogen thereby adding soil nutrients. Crotalaria can and should be inoculated with rhizobium bacteria for maximum nitrogen production. There are also other good tropical cover crops that can be used. This crop is allowed to grow to crowd out the weeds and enrich the soil. It is then cut and plowed into the soil.
4. The kava is grown on raised beds 30 cm (12 in) tall and 1.8 m (6 ft) across that are made with a tractor and a ridging attachment. The three-month-old kava seedlings are planted 1.6 m (5˘ ft) apart in the row. At planting Jim adds 450 g each of lime, phosphorous, Norwegian kelp (algit), fish or blood meal, and diatomaceous earth. Compost is added at a rate of 28 kg per bed of 65 m. A mulch cover of chipped trees is overlaid on beds to a depth of 10 cm (4 in).
5. There are windbreaks every 150 m (500 ft) and rows of pigeon pea, gliricidia and sesbania at closer intervals. Shading is not considered necessary.
6. There is not much pruning of the kava. Exceptions are for propagation and culling out poor stems at fertilisation and weeding.
7. A foliar fertiliser spraying schedule begins after planting, using Maxicrop (commercial brand) foliar fertiliser and Mermaids (commercial brand) fish powder, applied with a small tractor and sprayer at a rate of 9 kg of formulation per 400 litres of water per 0.45 hectare. This is ideally done every three weeks. The process can be improved upon with the use of spreader stickers (yucca extract) and oxygen and pH modifiers (hydrogen peroxide or vinegar).
8. At six months of age the kava is side dressed with 500 kg phosphorus, 500 kg lime and 125 kg blood meal per hectare. At 1–1˚ years we side dress with 500 kg algit and 500 kg fishmeal (potassium and nitrogen) per hectare.

Appendix B

False kava — a threat to the South Pacific kava industry

The development of the kava industry has brought with it new producers and buyers. In the rush to produce and sell kava, a problem has appeared in the form of false kava. The false kava is sold to unsuspecting buyers here in the Pacific or shipped directly to overseas buyers, usually mixed in with true kava. The result is that the shipment will be rejected when the kavalactone content is tested.

False kava is a threat to quality kava produced in the region. It gives kava producers and exporters a bad name in the international kava market.

In Samoa and Fiji Islands false kava is referred to as 'Tongan kava' or 'yaqona ni onolulu', and in Tonga 'Hawaiian kava'. What are these other kinds of kava? The scientific name of kava is *Piper methysticum.* False kavas are other species within the *Piper* genus but they do not contain kavalactones.

Piper aduncum. This species is a tree up to 5–6m (15–20 ft) tall with leaves up to 15 cm (6 in) long and flowers borne on cream coloured drooping spikes about 12 cm (5 in) long. The leaves are bigger and lighter green than kava. This species apparently was introduced in the 1920s and now is a widespread weed in the wet and intermediate zones of Viti Levu, Fiji Islands.

Piper auritum. This species causes the most confusion in Hawai'i. The distinguishing characteristic are:

Vein pattern: there is a central vein with smaller veins branching off it. This contrasts with the distinctive vein pattern of kava, which has 9 to 13 veins all spreading from the base of the leaf.

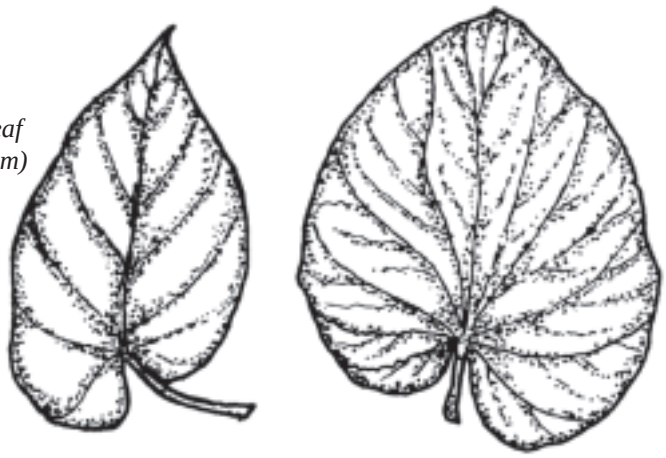
Smell: crushed leaves smell strongly of safrole (similar to sassafras or root beer). Safrole found in the leaves and stems is considered a carcinogen by the FDA.

***Piper* spp**. There are other members of the *Piper* genus, such as *Piper wichmannii* in Vanuatu, that may be confused with kava. If you are an experienced kava producer you will notice the differences on close examination of the plant: leaves, stem, flowers, and plant form. If the plant is already dried, the roots will not have the characteristic smell of kava and will sometimes be a different colour. The roots are more woody and contain less starch, and are not slender and flexible.

These other members of the *Piper* genus are widespread in the Pacific and they do not contain kavalactones.

Do not let the false kava destroy the reputation of kava from the Pacific.

False kava leaf (Piper auritum)



Kava leaf.

False kava being removed in Fiji Islands. (Piper aduncum)

False kava.

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Kava drying shed in Vanuatu.

Glossary

Adulteration	is the term used when the product for sale has other foreign material mixed with it so that it doesn't conform to the specification agreed on, e.g., the kava is dirty; is mixed with false kava, or has other plant materials mixed in.
Adventitious roots	roots which develop spontaneously from the stem when it is placed in a moist environment. In the case of kava these roots develop quite easily. In other species it can be quite difficult for the roots to develop.
Bacterium	very small (microscopic) organisms that can cause diseases in plants.
Basal stem	the stem, 20 cm (8 in) above the rootstock.
Bud scar	small rough scar on the nodes (stem joints) where shoots will emerge when the conditions are right.
Competition	plant and root competition occurs when two or more compete with one another for light, water, nutrients etc. One plant may grow well and the other dies or grows sickly.
Compost	a mixture of dried plant material, animal manure and other organic materials such as sea weed or saw dust that is combined and goes though a microbiological breakdown that turns it into a compound that looks like soil. It is then used to fertilise the soil.
Cortical layer	the part between the bark (epidermis) and the central core of the stem.
Cover crop	a crop, often of the legume family, planted to fully cover the soil between stands of trees and between other crops. Cover crops are useful because they protect and also enrich the soil. Yams and sweet potatoes are often used as a cover crop.
Crop rotation	refers to planting a sequence of different crops on a plot of land. The practice help maintain soil fertility and break the life cycle of many pests and diseases that may only survive on one crop and thereby reduce pest and disease attack.
Cropping system	pattern of growing crops over time as well as the mixture of plants grown together at the same time.
Cultivar	any variety and selected plant that is produced or grown by farmers and is not found naturally in the wild.
Cultivation	shallow digging of the soil to allow water to soak into the soil and also to remove weeds.
Cutting	plant stem cut into pieces and planted to start a new plant.
Dieback	a disease in which a plant starts to die from the ends of its branches. See kava dieback.
Direct planting	making a hole and planting a cutting without first growing the seedlings in a nursery.

Disease	any condition that is not normal in a plant. Diseases usually produce signs and symptoms.
Epidemiology	the study of diseases.
Extraneous matter	any material which is not in the specification, e.g. foreign matter — dirt, stones, false kava, etc.
Farming system	different methods used to grow crops, including shifting cultivation, continuous cropping, mixed cropping, monocropping etc.
Foliar fertiliser	a fertiliser which is applied to the leaves of a plant.
Genetic vulnerability	A species of plant such as kava that has only a limited number of cultivars which means that it has a narrow genetic base and limited variability. These plants are generally more susceptible to environmental stress, pest, and diseases.
Germinating	the first stages in growth of a cutting or seed.
Green kava/ green weight	not dried.
Intercropping	planting together more than one type of crop, in lines and with a definite spacing.
Internode	space between two nodes.
Lateral branches	side branches.
Maceration	breaking up the kava plant bits to release the chemicals or kavalactones.
Markets	domestic/local: within a community, district or country. export: outside the country where the kava was grown. nutriceutical: health food, nutritional and diet supplements. pharmaceutical: medicines and drugs.
Mealy bugs	Small insects of not more than 5 mm in length that suck the juice from plants. Usually on the underside of leaves. Mealy bugs get their name from the white material that covers their bodies as protection and comes off when touched. Mealy bugs produce honeydew that is visible as black stain on the leaves.
Micro-organism	any organism that can only be seen with a microscope. Bacteria, viruses and fungi are all microorganisms.
Mixed cropping	method of planting crops in which more than one type of crop is planted in the same garden, at the same time, without any definite spacing and without any rows or lines.
Moisture	soil moisture is the medium in which plant food is carried from the soil into the plant.
Monocropping	planting only one crop throughout the plantation.
Mulch	dried leaves and grasses placed around the base of a plant to reduce water loss, control weeds and add plant food to the soil. Plastic mulch does all of this except add plant food to the soil.

Multicrop garden	growing several different plants in the same garden.
Mutation	is a change in the hereditary materials of a plant. Mutations may happen spontaneously or because of specific factors in the environment.
Nitrogen-fixing legume	a legume which can change the free element nitrogen in the soil to plant food substances called nitrates. Examples are peanuts, pigeon pea, and mucuna.
Node	point of a stem from which stems or leaves grows. The internode is the part between the nodes.
Nursery	place where cuttings or seeds are planted and tended to grow into young plants.
Nutrient	element or other substance that can be used as a source of plant food. Some nutrients can move in water. The water in the soil transports the nutrient to the plant. Other nutrients are not mobile in the soil and when the soil is exhausted the plant needs to grow more roots to reach the nutrients in fertile soil, or the farmer needs to fertilise the soil with mulch and animal manure.
Organic matter	decomposed material from living or once living things.
Organic farming/ organic production	growing crops with the use of compost, manure and other natural plant food, and without the use of any chemical pesticides or man-made plant food.
Physiological effect	the effect on the body's normal functions.
Potting soil	a special blend of organic matter and soil which is prepared for nursery and potted planting.
Pathogen	any living thing that can cause disease, e.g. bacteria, fungi, viruses, parasites.
Propagate	to increase the number of plants by natural means, e.g. cuttings or seeds.
Relative humidity	the moisture in the air at any temperature compared to the maximum amount of moisture the air can contain at that temperature — high levels of relative humidity are favorable for the the outbreak and spread of plant disease. High relative humidity is unfavorable for storage of kava.
Representative sample	a small sample of a larger quantity of kava product that is obtained in such a way that it will provide an accurate sample of the larger quantity for analysis.
Ridging	mounding up soil around the plants either individually or in a long continuous seedbed or plantbed.
Rot	the plant or plant material is attacked by micro-organisms and is decomposed.
Rotation	*see* crop rotation.

Scale insects	Small insects of not more than 5 mm in length that suck the juice from plants. Usually on the underside of leaves. They get their name from the round shell that covers their bodies as protection and looks similar to scales on fish. Scales produce honeydew that is visible as black stain on the leaves.
Shade	protection from the sun. Kava needs shade if the roots and young plants are to grow quickly and easily.
Shade cloth	manufactured cloth designed in several different thicknesses, used to shield nursery plants from exposure to too much sun.
Seedling	a young plant grown from a cutting or from seed.
Soil fertility	ability of the soil to provide essential nutrients in the correct amounts and proportions for plant growth.
Sterile	does not produce seeds that will grow. Kava plants are sterile.
Stress	when a plant suffers stress it does not grow well or easily. Stress can be due to a variety of causes, including lack of moisture or lack of nutrients in the soil.
Systemic herbicide	a chemical which will kill the plant by being absorbed by the plant and transported through the plant's own systems.
Transplant	to transfer a young plant from where it was first grown and looked after, to a permanent place in the garden.
Variety	is a grouping below the species (*Piper methysticum*). A type of kava differs from other types e.g. Vanuatu variety and Papua New Guinea variety.
Vegetative propagation	propagation by planting part of the plant and not by seed. Each generation is identical to the parent. The danger is that the plants are genetically vulnerable.
Vigorous	strong and healthy.
Virus	small infectious agent that causes disease that passes on from one sick plant to a healthy one. Insects sometimes pass the virus from infected plants to healthy plants. A virus can produce a variety of symptoms in a plant and reduce yield. Diseases caused by viruses are difficult to control. The disease kava dieback is thought to be caused by the cucumber mosaic virus (CMV).