

Potentially Important Food Plants of Northern Thailand



**FOOD PLANT
SOLUTIONS
ROTARIAN ACTION GROUP**

*Solutions to Malnutrition
and Food Security*



A Project of the Rotary Club of Devonport North,
District 9830 & Food Plants International

www.foodplantsolutions.org

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Dedication

This book is dedicated to the 3 billion hard working farmers and families around the world who cultivate these, and other, food plants for their own subsistence, and who help conserve them in their rich diversity for other people to enjoy.

Preface

This guide is based on information from the Food Plants International (FPI) database developed by Tasmanian agricultural scientist Bruce French. The source material and guidance for the preparation of the book has been made possible through the support of Food Plants International, the Rotary Clubs of District 9830, particularly the Rotary Club of Devonport North who founded Food Plant Solutions, (previously the Learn ♦ Grow project), and many volunteers who have assisted in various ways.

The selection of plants included in this guide has been developed by Ed Thompson working in a voluntary capacity using the selection criteria developed by Food Plant Solutions. These selection criteria focus on the local plants from each of the main food groups with the highest levels of nutrients important to human nutrition and alleviation of malnutrition. It is intended as a **Draft Guide only** to indicate some important food plants that serve as examples for this purpose. Other important nutritious plants may be equally useful, and it is recommended that the FPI database be used to source information on the full range of plants known to occur in Northern Thailand. This guide has been developed with the best intention to create interest and improve understanding of the important local food plants of Northern Thailand, and on the understanding that it will be further edited and augmented by local specialists with appropriate knowledge and understanding of local food plants.

Food Plant Solutions was initiated by the Rotary Club of Devonport North to assist in creating awareness of the edible plant database developed by Food Plants International, and its potential in addressing malnutrition and food security in any country of the world. In June 2007, Food Plant Solutions was established as a project of Rotary District 9830, the Rotary Club of Devonport North and Food Plants International. The primary objective of the project is to increase awareness and understanding of the vast food resource that exists in the form of local plants, well adapted to the prevailing conditions where they naturally occur, and how this resource may be used to address hunger, malnutrition and food security. For more information, visit the website www.foodplantsolutions.org. More detailed or specific information on plants, including references to material by other authors, is available on DVD on request.

Disclaimer: This Field Guide has been produced using information from the “Edible Plants of the World” database compiled by Bruce French of Food Plants International. Although great care has been taken by Food Plants International and Food Plant Solutions, neither organisation, or the people involved in the compilation of the database or this Field Guide:

- makes any expressed or implied representation as to the accuracy of the information contained in the database or the Field Guide, and cannot be held legally responsible or accept liability for any errors or omissions
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- assume responsibility for sickness, death or other harmful effects resulting from eating or using any plant described in the database or this Field Guide

Always be sure you have the correct plant, and undertake proper preparation methods, by consulting with specialist scientists or local users of the plant. The Food Plants International database, from which the information in this Field Guide is drawn, is a work in progress and is regularly being amended and updated.

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Introduction

This book is designed as a simple introduction to the more common food plants of Northern Thailand. It is hoped people will take greater pride and interest in these plants and become confident and informed about how to grow and use them. Many of the local food plants that occur in every country are very good quality foods. Unfortunately, people often reject traditional food plants and grow more introduced vegetables in preferences. The principle behind Food Plant Solutions is to encourage the use of these local plants.

Local food plants are often very good

People sometimes think that local food plants are not very special and that any food plant that is new or comes from another country must be a lot better. This is often not true. Many of the newer or introduced food plants, such as the round or ballhead cabbages, have very little food value. Many traditional tropical green, leafy vegetables and ferns have 10 times or more food value as ballhead cabbage or lettuce. It is important to find out more information about the food value of different foods if we want to eat well. Citrus fruit, such as lemons and oranges, are often grown for vitamin C that helps keep people healthy. These fruits do not grow well in the tropics - the common guava fruit has three times as much vitamin C and is loved by children. This is just one example showing there are often much better choices of local foods with higher levels of important nutrients.

Growing food

Growing food to feed a family is, without doubt, one of the most important things anyone can do. The more interest you take in your garden and the more you learn about plants and how to grow them well, the more interesting and fun food gardening becomes.

A country with very special plants

The local food plants of most countries have not been promoted and highlighted in the way they deserve. Visiting a local food market will quickly show what a rich variety of food plants can be grown in this country. Good information about these plants is often still in the minds and experience of local farmers, and has not been written down in books. This can make it hard for the next generation of young people to find out how to grow them.

In many countries, some of the traditional food plants are only harvested from the wild and others are only known in small areas. Others have hundreds of varieties and are the main food for people in different regions. Information on these plants, and in many cases, their food value and the pest and diseases that damage them is available in the Food Plants International database.

Getting to know plants

People who spend time in gardens and with their food plants get to know them very well. It is a good idea to learn from someone who grows plants well. Each plant grows best in certain conditions and there are often special techniques in getting it to grow well. For example, sweet potato will not form tubers if the soil is too wet, but it may still grow lots of green leaves. Taro will grow in light shade, but sweet potato will not. Ginger can grow in fairly heavy shade. Pruning the tips of betel leaf or pepper vines will cause more side branches to grow and therefore, produce more fruit. Stored yam tubers need special treatment if you want them to put out shoots early. There are lots of unique things about every plant and learning about these helps a good gardener produce more food.

Naming of plants

Many food plants have local names, as well as a common English name. Every type of plant also has its own scientific name. Although the scientific name might not be widely recognised, this is the link by which people in different countries and with different languages can recognise the same plant. We know that many plants are grown in many different countries, but relying on local or common names, we might not recognise the same plant grown in different places. By using scientific names to accurately identify plants, we can get useful information from people in other countries. Wherever possible, plants in this book are named by their common English name and their scientific name.

AN IMPORTANT NOTE

As noted above, a guiding principle behind Food Plant Solutions is to encourage the use of local plants. It is acknowledged that some of these may be major agricultural crops that are already well known, such as:

- Rice
- Oats
- Mango
- Wheat
- Maize/corn
- Banana

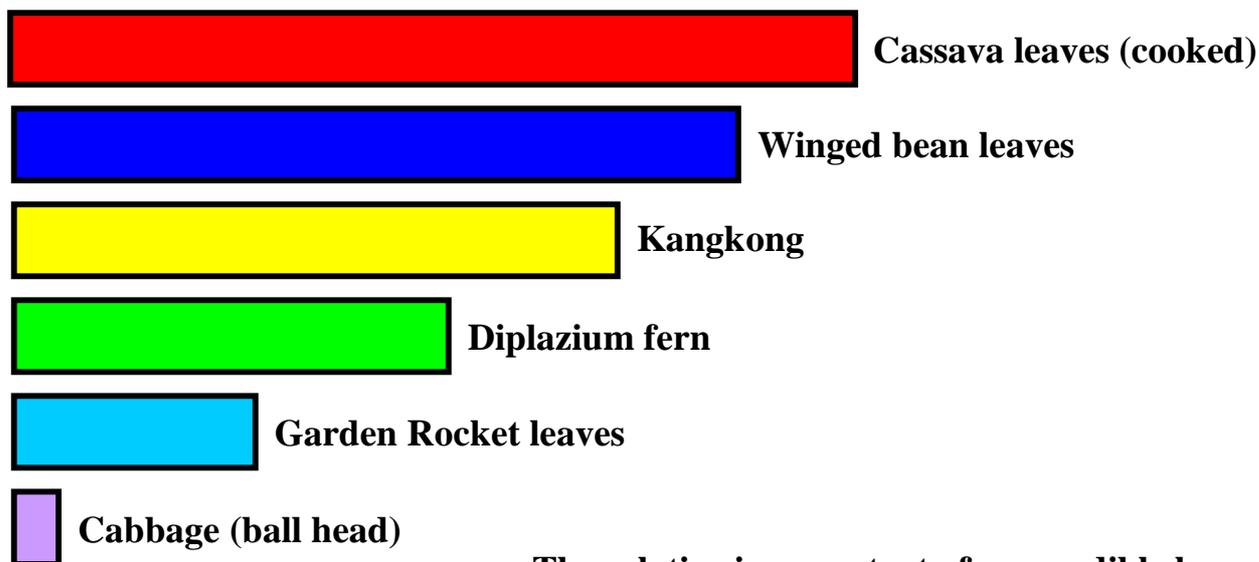
There are others, but these serve as examples.

As a general principle, these types of plants should not be included in a field guide, as they are well known, and in some cases (e.g. corn), are relatively high input crops. The purpose of the Food Plants Solution project is to look beyond these types of crops, and focus on plants that are less well known and, as noted above, often have superior food value and lower input requirements.

It is also important to note that while some plants have extremely high levels of some nutrients, many of these are used as flavouring foods (condiments), and are generally used only in small amounts. Therefore, the nutritional contribution they make to the diet will be relatively small. Typical of these types of plants are coriander, parsley etc. Once again, these should not be considered as major food sources. A few may be included in the *Nuts, Seeds, Herbs and other foods* section of the field guide.

Nutrient Value

Our bodies need a variety of food plants to enable us to grow, stay healthy and have enough energy to work. Different foods are needed to provide energy, protein, vitamins and minerals. The following diagram highlights the iron content value of some traditional edible, tropical plant leaves, compared with cabbage. Iron is a nutrient that is very important for our bodies and especially our blood. People who are short of iron become anaemic and lack energy.



The relative iron content of some edible leaves

A healthy balanced diet

Good nutrition, or eating a healthy balanced diet, is really very simple. If people eat a wide range of food plants, their bodies will normally get a balanced amount of all the different nutrients they require. If a nutrient is lacking in one food plant, then they are likely to get it from another plant if they are eating a range of food plants. For this reason, everybody should eat a range of different food plants every day. The food group that is especially important for young people is the dark green leaves. Everyone should eat a good serving of dark green leaves every day. They have many vitamins and minerals, as well as protein. There are many spices or flavouring plants that can improve the taste of foods, but taste should be considered separately from food value.

Learning to cook well

Even though some nutrients in food can lose some of their value during cooking, it is normally much safer to cook all food plants, at least for a short time. Bacteria, which cause diarrhoea, can occur in gardens and on food plants. These are killed during cooking. Many plants in the tropics develop cyanide, a chemical that makes them bitter and poisonous. This happens often with cassava (tapioca, manioc) and beans, but can also occur in many other plants. Boiling the food for two minutes normally destroys cyanide and makes the food safe to eat. Some of the nutrients our bodies need (such as vitamin A for good eyesight) only become available when food is cooked in oil.

Learning to grow “wild” food plants

Many plants grow wild in the bush and are not cultivated by people. We can normally find someone who has taken an interest in them and has learned to grow them. This may be people from a different language group. It may be that in their area they have found better types than the ones that simply grow wild.

Saving better types of plants

If we simply allow plants to grow from seed, the improvements that have been made in finding sweeter or better types may get lost. Some fruit trees are like this and the fruit produced may not be sweet at all. It is often necessary to take cuttings from a tree to be sure the new plant is exactly the same as the old one. If the plants won't easily grow from cuttings simply by sticking a piece of the branch in the ground, (and keeping it watered), there are other ways of helping these plants to form roots and start to grow. One good way is to make a small cut in the bark of a young branch and then wrap soil around the cut and cover it with plastic. With plants like guava, new roots will start to grow from this cut and grow into the soil wrapped around the branch. It can then be cut off and planted. This is called air-layering. A similar method is used with the roots of breadfruit. A shallow root is uncovered and a small cut made from which a new sucker will start to grow. This can be cut off and replanted.

Growing from cuttings and suckers

Many food plants are grown from cuttings and suckers. This is very important, as it allows all the different kinds of yams, taros, bananas, sweet potato and sugarcane to be continually grown and ensures the varieties are preserved. Each plant has its own special propagation method. It is important to use healthy planting material, as diseases can be spread in planting material. In many cases, small tubers of yams, taro etc. are stored for planting for the next crop. This is not always good practice, as the small tubers could be the result of diseases (such as viruses) in the plant. A good rule is to take cuttings or save tubers from the best plants for re-planting.

Saving seed

Some food plants are grown from seed. Sometimes this is very easy as the seeds are large, store well, grow easily and grow the same as the original plant. It is more difficult with other plants. Many large fleshy seeds, such as breadfruit, need to be planted while still fresh as they do not store easily. Other seeds do not “breed true” or do not grow into new plants that are the same as the original plants. With many of these plants, it may be necessary to find ways of growing them from cuttings or other methods such as grafting. Some plants “inbreed” and get smaller or poorer. This happens when a plant self-pollinates or receives pollen from a close relative. Corn grown in small plots normally does this and the plants grown from seed grown in this situation get smaller and smaller each year. The seed needs to be saved from several different plants with different history and then mixed together before sowing. All the seeds on one cob are related and will inbreed. Some seeds develop a hard seed coat and need to be scratched, soaked in water, or even put into hot water, before they will start to grow. Saving local seeds is often a good idea as they are already adapted to

local conditions. For example, seed saved from pumpkins grown locally will produce plants with less pest and disease damage than those grown from imported seed. *If you can't get seeds or planting material from local gardens – it is probably not a suitable local plant! Once again saving seed from the better plants helps ensure that you have better crops the next time you plant.*

Growing a garden of mixed plants

In nature, one variety of one plant never grows alone. There are always lots of different plants of different kinds and sizes, all growing together. Anyone who has ever walked into a tropical jungle will know this very well. Growing plants in a food garden in a way similar to how they grow in nature, as a mixed group of plants, is very good agriculture. Mixing plants in a garden usually gives more reliable food production, as any disease from one plant will wash off in the rain onto a different plant, where it cannot survive. Small plants fill the gaps and reduce the need for weeding.

Different types of plants for food security

There is another reason for growing a range of food plants in a local garden or around a village. If something goes wrong, like extreme insect damage to plants, some disease occurring in the garden, or a poor growing season, some plants will be more damaged than others. With a variety of plants, there will still be some food to eat until the other plants recover and grow again. Also, a wide variety of plants will mean that different ones will be maturing at different times, which helps ensure a continuous supply of food. There are shrubs that can be planted as edible hedges around houses, and fruit and nut trees that need to be planted as a gift for your children, several years before they will be able to enjoy them. Some nuts can be stored and eaten when other foods are not available. Most yams will store well for a few months.

Looking after the soil

Gardeners in traditional tropical agriculture usually move their gardens often by shifting to a new piece of land. There are usually three reasons for this:

- In the tropical lowlands, weeds can become a very big problem. There are usually a lot fewer weeds in the first year or two after clearing and burning the land, but weeds increase in the following years.
- Some of the nutrients in the soil are used each year and the soil becomes poorer and plants do not grow as well. There are ways of reducing this loss of nutrients.
- Very small worms called nematodes build up in the soil after a few years and get into the roots, especially of annual vegetable plants, and stop their roots working properly. For example, root knot nematode will cause the roots of plants like tomatoes and beans to become twisted resulting in poor growth of the plant.

Building up the soil

When a new garden has been cleared, it has lots of leaf mulch and other old plant material. This provides plant nutrients for new plants to grow. There is a simple rule for growing plants and improving the soil - "If it has lived once, it can live again." Any

old plant material can provide nutrients for new plants to grow, but it must be allowed to rot into mulch or compost for this to happen. If this plant material is burnt, some nutrients, especially phosphorus and potassium (“potash”), get left behind in the ashes for new plants to use, although it also allows these important nutrients to be lost by being washed away by rain. But with burning other important nutrients, such as nitrogen and sulphur, get lost in the smoke and disappear from the garden and soil. These last two plant nutrients are especially important for growing green leaves and when their levels are low, plants grow small or pale green. When nitrogen is lacking, the old leaves of the plant go pale and fall off early, and when sulphur is lacking, the young leaves go pale. Wherever possible, old plant material should be covered with some soil to allow it to rot down and not simply dry out or get burnt. Cutting it into small pieces will help it break down more quickly into usable compost.

Poor soils where crops won't grow

When soils are very acid (or sour), plants cannot get the necessary nutrients. Natural chemicals in the soil that are toxic to plants when present at higher levels become soluble, get into plants, and stop them growing. Adding limestone to these soils can improve them. Using compost will not make them less acid, but will keep the plant nutrients in the soil in a more readily available form that plants can use.

Soil nutrients

Plants need 16 different kinds of plant food or nutrients in different amounts to grow properly. A plant that has already been growing will have these nutrients in them and probably even have them in a balanced amount. That is why composting old plant material is so important. Plants usually show some signs or symptoms if any of these nutrients is running out.

One of the most common and important nutrients for plant growth is nitrogen, which actually comes from the air, but gets into plants through the soil. When plants are short of nitrogen, their older leaves often become yellow or pale. When grass family plants, like sugarcane and corn, are short of nitrogen, the centre of the oldest (lowest) leaves starts to develop a dry or dead V-shape. The plant cannot find enough nitrogen in the soil so it gets it from an old leaf to grow a new leaf. This causes the old leaf to die, forming a characteristic V-shape in the centre of the leaf. The plant does not get any bigger as an old leaf dies each time a new leaf is produced. Village farmers often walk through grassland before they clear it for gardens, looking to see if the grass leaves are dry and dead, because they know gardens on this soil won't grow well. It is necessary to use compost or legumes (such as beans) to put nitrogen back into the soil. Growing plants from the bean family (legumes) is the most efficient way to increase the level of nitrogen in the soil.

Corn is a good plant for indicating which nutrients are running short in the soil. If the older leaves go dry along the edges, the soil is running out of potash. If leaves that are normally green develop a bluish colour, the soil is short of phosphorus. Generally, leafy crops need lots of nitrogen, and root crops need lots of potash.

Making compost

Compost is old plant material that has been allowed to rot down into a fine, sweet smelling mulch that is full of nutrients that can be put back on the soil to grow new plants. Compost returns nutrients to the soil, improves the soil's ability to retain moisture and also helps improve soils that are acid or saline.

Making good compost is very simple. A simple heap of plant material can be made in the corner of a garden or near a house. Cutting the plant material (especially stems), into small pieces no longer than about the width of a finger, will help it break down quicker. If possible, make layers of plant material, then a small layer of soil, and then scatter fire ash on top. Keep repeating this process to make a heap. A good compost heap should be warm inside. Be careful with diseased plant material. This should be burnt, otherwise the disease may be spread when you use the compost at a later date.

The composting process is carried out by small bacteria that live in the soil and feed on decaying plants. They break down old plant material into compost. These bacteria are living, so they need air, water and food. A good compost heap must have air, so don't cover it with plastic or put it in a container. This makes a foul smelling compost, as different bacteria that don't need air turn it into an acid mixture that preserves it. Good compost must have moisture, so keep the heap damp, but not too wet. The compost bacteria like a balanced diet, which means that both green material and dried material is needed to balance the carbon and nitrogen in the compost pile. If the compost material gets too dry and brown, it will not break down, and if it gets too green, it will go slimy. Using a little bit of compost from an old heap will make sure the right bacteria are there to start the whole process off.

As soon as the plant material is broken down to a fine mulch it can be put onto the garden. It is best if it is dug in, but if it is regularly put onto the surface of the garden, worms will mix it into the soil.

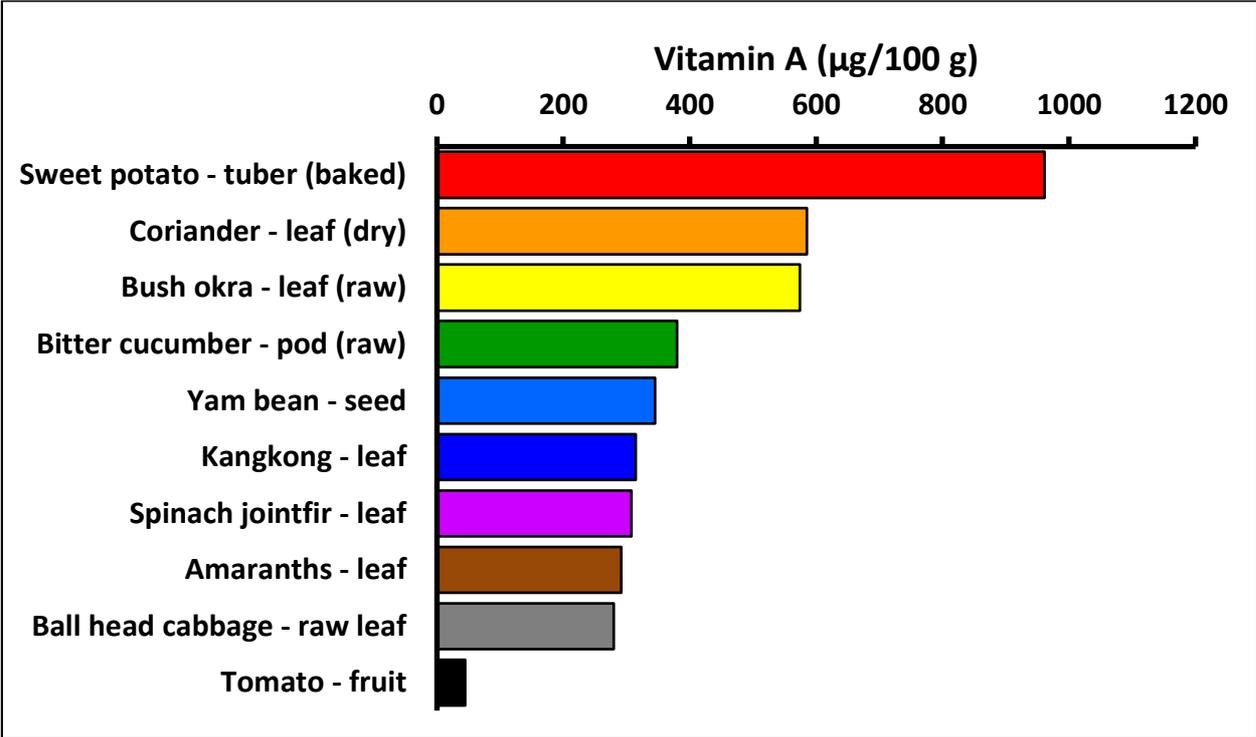
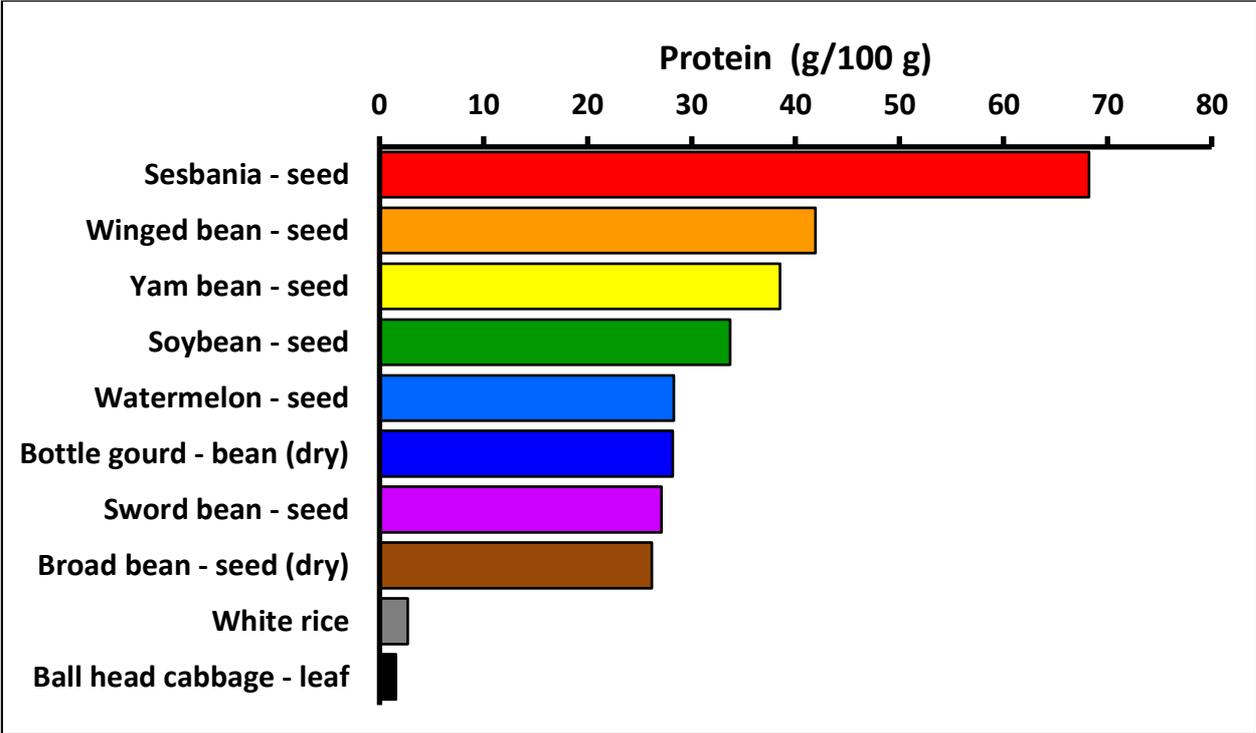
Pests

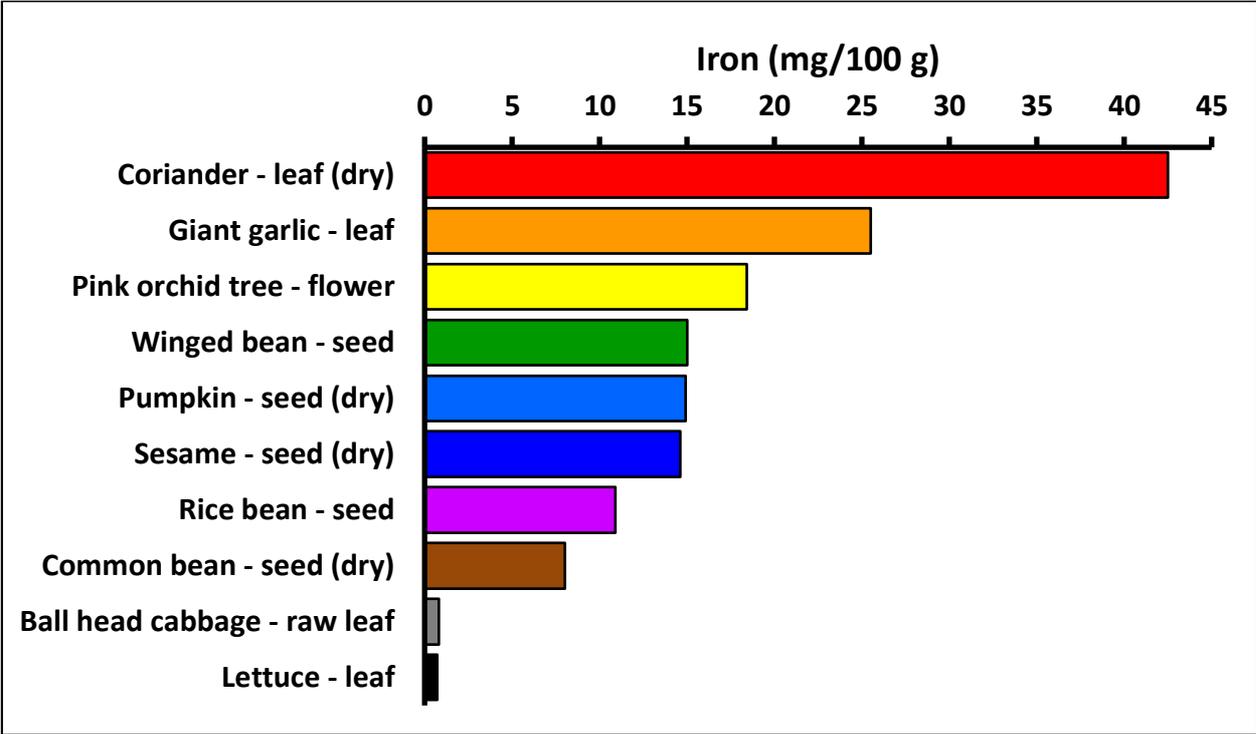
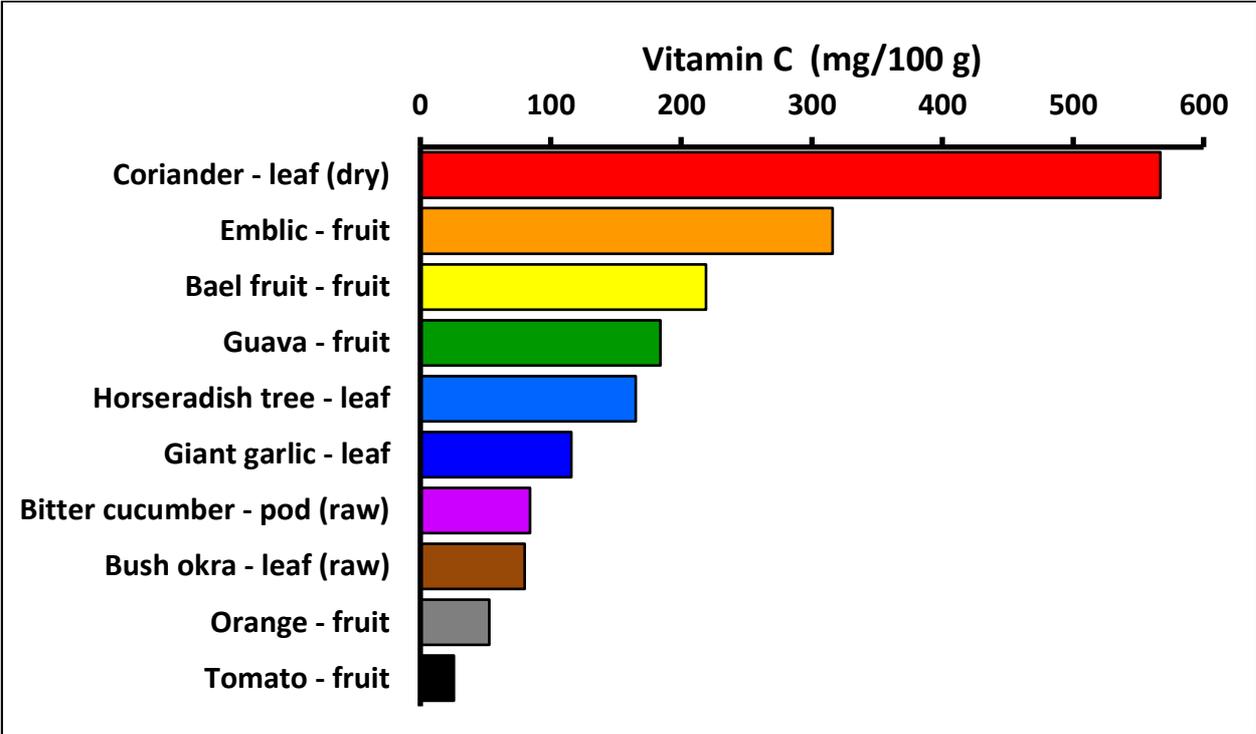
There are a large number of insects that enjoy sharing our food with us! We should not try to kill all these insects as they have an important role to play in keeping everything in nature in balance. What we need to do is to learn to manage these insects so we can all get some food to eat! Some insects are attracted to lights, and if the garden is near village lights some insects can cause a lot of damage. If large areas of one particular crop are planted, insects can breed more quickly and cause a lot of damage. As an example, insects called armyworms can breed up in large numbers on the shade trees of cacao and then move “like an army” into gardens. Some insects are large and breed slowly and can be picked off and removed. The large, green grubs with pointy tips that hide under taro leaves are best controlled by simply picking them off. Some insects, like taro beetles, can be a serious problem, but the young curl grubs of this insect are tasty if you catch and cook them. Some insects do not like sunlight. The very small moth that damages banana fruit is like this. Simply pulling off the leafy bracts over the banana fruit reduces the damage, as this lets sunlight in and the insect flies away. The best rule for reducing pest damage is to grow healthy plants, as they suffer less damage. Spiders, ladybirds, hover flies and many other insects also feed off the insect pests that attack our crops and should be encouraged.

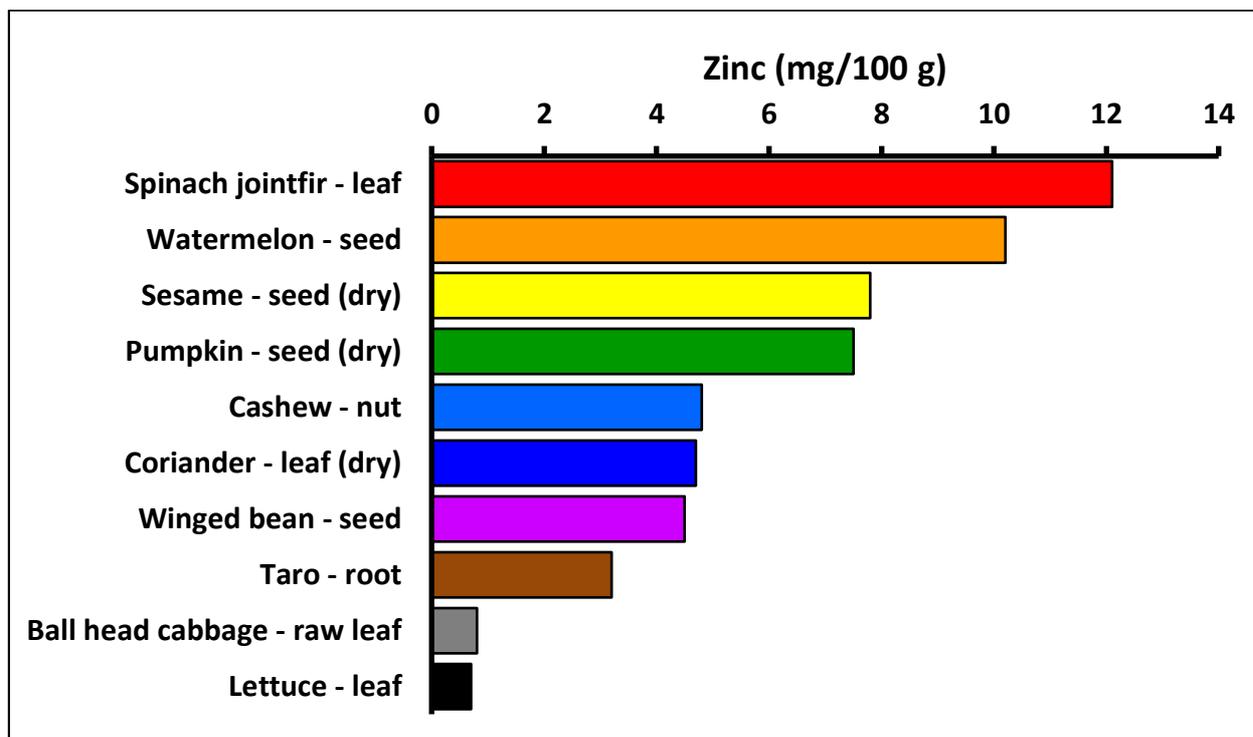
Diseases

The living organisms that cause disease are much smaller than insects. These disease organisms can often only be seen with a microscope. There are three main kinds of disease organisms - fungi, bacteria and viruses. Fungi are like the mushrooms we eat, only very much smaller. They usually make distinct dry spots on leaves and other plant parts. Fungi have spores that often blow in the wind. Bacteria are often smaller and live in damp places. They usually make plants go soft and squashy, and they may cause a smell. Bacteria are mostly spread with rain and in water. Viruses are very, very small and usually make irregular stripes and patterns on leaves and other plant parts. Viruses usually spread in planting material or in the mouths of small sucking insects. Plants infected by viruses are often yellow, and may be stunted, or have curled or unusual shaped leaves. One common fungus disease on sweet potato causes the leaves to become wrinkled and twisted. It usually gets worse in old gardens and where soils are running out of nutrients. It doesn't affect all kinds of sweet potato to the same extent. The answer is not to stop the disease, but to improve the soil. The general rule is that healthy plants that are growing well will suffer less damage from disease.

Food value charts for a selection of plants from Northern Thailand







Note regarding plant selection: In compiling these field guides, we acknowledge that some staple foods and commercial crops which are grown widely in the target country may be omitted. Such foods are often in the starchy staple category (e.g. rice, corn). This does not mean that they are not useful, but merely reflects a desire for the Food Plant Solutions program to concentrate on plants that are less well known and/or underutilised.

Starchy staples

English: Bottle gourd

Northern Thai: มะเดื่อ, น้ำคั้น

Scientific name: *Lagenaria siceraria*

Plant family: CUCURBITACEAE

Description: A pumpkin family plant. It is an annual vine with large leaves. It can grow 3 - 9 m long and spread 3 - 6 m wide. The thick stems have furrows along them. It can climb over logs by attaching the tendrils which grow out of the stem near the leaf. The leaves are large and have soft hairs especially underneath. Flowers of both sexes are borne in the same plant. The plant produces male flowers first and these are on long stalks. Next it produces female flowers on short stalks. Flowers are large and white. They can be 10 cm across. They are mainly pollinated by insects. Fruit vary in shape and can be 8 - 90 cm long. They have brown seeds in a whitish green pulp. There are several varieties.



Distribution: A tropical plant that grows from sea level up to 2,700 m altitude in the tropics. It grows best in a warm humid climate. It is sensitive to frost and prefers full sunlight. It grows best with a night temperature of 17 - 23°C and day temperatures of 28 - 36°C.

Use: The young fruit are boiled as a vegetable. The skin and seeds are removed and can also be steamed, fried or pickled. Young tips and leaves are edible. They are often cooked with milk or coconut milk to improve the flavour. They are also mixed with other edible leaves. The seeds are sometimes eaten and provide an edible oil. Old fruit are used as containers, and the seeds are not normally edible.

Cultivation: To achieve fast and uniform emergence, seed should be soaked overnight. Seeds are best sown in raised beds. Seedlings emerge in 5 - 7 days. Seedlings can be transplanted is required. Because plants cross pollinate, plant and fruit types vary. Removing the young fruit to use as a vegetable will prolong the life of the plant. Large fruit can be obtained by removing some of the small fruit. A spacing of 1 - 2 m is suitable. It prefers a trellis to climb. Because it is shallow rooted, weeding needs to be done carefully.

Production: It is fast growing and flowers 2 months after seeding.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| bean (dry) | 3.2 | 2399 | 28.2 | - | - | 5.3 | - |
| leaf | 83.0 | 180 | 4.4 | 66 | - | 7.4 | - |
| fruit | 93.0 | 88 | 0.5 | 25 | 10 | 2.4 | - |

Starchy staples

English: Taro

Northern Thai: เผือก

Scientific name: *Colocasia esculenta*

Plant family: ARACEAE

Description: This plant has large flat leaves on the end of upright leaf stalks. It grows up to 1 m high. The leaf stalk or petiole joins the leaf towards the centre of the leaf. The leaves are 20 - 50 cm long. Near the ground a thickened rounded corm is produced. Around this plant there is normally a ring of small plants called suckers. Many different varieties occur. If left to maturity, a lily type flower is produced in the centre of the plant. It has a spathe 15 - 30 cm long which is rolled inwards. The flowers are yellow and fused along the stalk. There are many named cultivated varieties. Taro comes in two basic forms. The Dasheen type *Colocasia esculenta* var. *esculenta* and *Colocasia esculenta* var. *antiquorum* or the Eddoe type.



The basic difference is the adaptation of the Eddoe type to storage and survival in seasonally dry places, while the dasheen type needs to be maintained in a more or less continuously growing vegetative stage.

Distribution: It is a tropical plant. Taro grows from sea level up to about 2,300 m altitude in the tropics. It grows well in humid places. It can stand damp soil and grow under light shade. It suits hardiness zones 9 - 12.

Use: The corms, petioles and leaves are all edible after cooking. The leaves are also dried and stored. Fresh leaves can be stored for 4 - 5 days. **Caution:** Some varieties burn the throat due to oxalate crystals.

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

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

For dryland taro, the soil is prepared by digging, unless a fresh bush fallow is used where the natural friability of the soil allows plants to be put into the undug soil in a small hole that is prepared. Plants are put into a hole 5 - 7 cm deep or deeper. Mulching to conserve moisture and reduce weed growth is beneficial. Setts from corms normally give higher yield than that from cormels. The greater leaf area and root production may be responsible for this. Setts of about 150 g are optimum.

The time of planting is primarily determined by the availability of moisture. Planting is done shortly after the rainfall has become regular, if seasonally distinct wet and dry occur. Higher rainfall, higher

temperatures, and higher hours of sunlight, enhance production and determine seasonality of production.

Evapotranspiration for flooded taro averages about 4 mm per day, ranging from 1.5 - 7.2 mm, with a total of about 1,200 mm for the crop. Intermittent moisture can result in irregular shaped corms. Flooding has been found to be more effective than sprinkler irrigation, or furrow irrigation. Increased suckering, giving greater leaf area, seems to be the reason for this.

Taro is sensitive to weed competition throughout most of its growth, but it is more critical during early growth up to 3 - 4 months. About 7 - 9 weedings are required, to keep the crop clean under tropical lowland conditions, where flooding is not used. Due to the decrease in height and leaf area towards the end of the growth cycle when starch accumulation in the corms is maximum, weed competition and weed control are again significant. Mechanical weeding needs to be shallow to avoid damaging the superficial taro roots. A range of herbicides have been recommended in various situations.

Taro produces the highest dry matter yield under full sunlight, but it can still grow under moderate shade. Under shaded conditions it grows more slowly and develops fewer corms. They require good moisture conditions and have little tolerance for drought. Taro residue has an allelopathic factor which can reduce the germination and growth of other plants, for example, beans.

Taro tends to demand high fertility, and is responsive to additional NPK fertiliser. Higher doses of K increases starch content and higher doses of N increases protein content. Both N and K applications increase oxalic acid content of the tubers.

Spacing affects total yield, and marketable, harvestable yield, of corms. Close spacing increases the corm yield per area, and the shoot yield per area, but decreases the corm yield per plant, and the contribution of sucker corms, to the yield. Where spacings of 30 cm x 30 cm are used, giving about 110,000 plants per hectare, a very large amount of planting material is required, which reduces the net return per unit of planting material. A spacing of 60 cm x 60 cm is more common. Wider spacings of 90 cm x 90 cm reduces overall yield.

Production: Crops mature in 6 - 18 months. Yields of 5 - 15 tonnes per hectare are probably average.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|---------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| root | 66.8 | 1231 | 1.96 | 3 | 5 | 0.68 | 3.2 |
| leaf | 85.0 | 210 | 5.0 | 57 | 90 | 0.62 | 0.7 |
| leaf stalk | 93.0 | 101 | 0.5 | 180 | 13 | 0.9 | - |
| leaf (cooked) | 92.2 | 92.2 | 2.7 | 424 | 35.5 | 1.2 | 0.2 |

Starchy staples

English: Foxtail millet

Northern Thai: ข้าวฟ่างทางกระรอก

Scientific name: *Setaria italica*

Plant family: POACEAE

Description: An annual grass. It grows 1 - 1.5 m tall. It can be tinged with purple colour. The stalks are upright and the section between the nodes is hollow. It develops tillers from the base. It has along leaf sheath. The leaf blade is 30 - 45 cm long by 1.2 - 2.5 cm wide. It has a prominent midrib and tapers towards the tip. The flower is a spike-like branching flower 7.5 - 25 cm long by 1.2 - 5 cm wide. The side branches carry 6 - 12 small spikes each with 1 - 3 bristles. The mature grain is 2 mm long. There are many named cultivated varieties.



Distribution: A warm temperate plant. It suits regions of low rainfall. It is grown from sea level to 2000 m altitude. It can tolerate a wide range of soil conditions. It cannot tolerate waterlogging or long periods of drought. It can grow in arid places.

Use: It can be cooked and eaten like rice. The seeds can be parched, popped, added to soups and sauces or made into porridge, cakes, puddings, and dumplings. The sprouted seeds can be used as a vegetable. The seeds can be used for making beer. The seeds can also be made into syrup.

Cultivation: Plants are grown by seed. Seed can be broadcast or drilled. Pure stands require 8-10 kg/ha of seed. Plants are harvested by cutting off the ears.

Production: It grows quickly. Plants mature in 80 - 120 days. Flowering occurs over 10 - 15 days. Plants can be self or cross pollinated. Yields of 800 - 900 kg/ha are common and straw yields for livestock feed can be up to 2500 kg/ha.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| seed | 13.5 | 1425 | 9.5 | - | - | 5.5 | - |

Starchy staples

English: Sesame

Northern Thai: ส๑

Scientific name: *Sesamum indicum*

Plant family: PEDALIACEAE

Description: A small, upright annual plant. It is erect and very branched and grows 1 - 2 m tall. The stem is stout, 4 sided and furrowed along its length. It is densely covered with fine, downy, glandular hairs that vary in shape. The lower leaves have long stalks and are spear shaped, often with lobes or a toothed edge. The leaf stalks are 3 - 11 cm long. The leaf blade is 4 - 20 cm long by 2 - 10 cm wide. Upper leaves are narrow and oblong. They are 0.5 - 2.5 cm wide. The flowers are pink and white. They occur in the axils of upper leaves, either on their own, or in groups of 2 or 3. They can be white, pink, purplish and with yellow spots and stripes. The fruit can be smooth or rough and there are 2 chambers in the capsule. The fruit are brown or purple. They are oblong and deeply grooved. The seeds are small and oval. They are 3 mm by 1.5 mm and vary in colour from white, yellow, grey, red, brown or black. The fully ripe pods burst open.



Distribution: A tropical plant that suits the hot, dry, semi-arid tropics and sub-tropics. It can tolerate short periods of drought once established. It needs a temperature of 20 - 24°C in early growth then 27°C for ripening. It grows from sea level to about 1,200 m in areas with an annual rainfall of 400 - 1000 mm. Soils need to be well drained. It is very intolerant of water-logging. It cannot stand high humidity and needs frost free conditions. It needs a dry period for seed drying. It does not like acid soils. It grows in open sunny places. It can grow in arid places.

Use: The seeds are eaten. They are used in soups or fried or boiled. They are used in tahini and hummus. Seeds are eaten in the form of sweetmeats. Roasted seeds are used in pickles. They are also put on bread. Oil from the seeds is used in cooking and on salads. The refuse from the seed after the oil has been extracted is boiled in water and made into soup.

Cultivation: Plants are grown from seed. Seed will not germinate below 21°C. Seeds are broadcast on well prepared land and then harrowed in using feet or a light harrow. Plants can be thinned or weeded during early growth to produce a better crop. Seeding rates of 9 - 11 kg/ha are used. Plants are spaced 2 - 15 cm apart and in rows placed at 20 - 45 cm apart. Some varieties shatter easily.

Production: Yields of 340 - 500 kg/ha are average. Plants reach maturity in 80 - 180 days. Crops are harvested as the leaves begin to drop. Plants are cut and stooked or dried in racks. The hull is removed by soaking in water overnight, then partly dried and rubbed against a rough surface.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| seed (dry) | 4.7 | 2397 | 17.7 | 1 | 0 | 14.6 | 7.8 |
| leaf (raw) | 85.5 | 188 | 3.4 | - | - | - | - |

Starchy staples

English: Sorghum

Northern Thai: ข้าวฟ่าง

Scientific name: *Sorghum bicolor*

Plant family: POACEAE

Description: Sorghum is a millet grass. A mature sorghum plant resembles maize in its stature. Plants vary in height from 45 cm to 4 m. It is an annual grass with erect solid stems. The stems can be 3 cm across at the base. Prop roots occur at the base of the plant. There are numerous sorghum varieties. Some have one main stem while others produce multiple tillers. More tillers are produced when plants are widely spaced. The nodes on the stem are slightly thickened. Short types have up to 7 leaves while tall late varieties may have up to 24 leaves. The leaf blade can be 30 - 135 cm long. Leaves are bluish green and waxy. They have a prominent midrib. The large flower panicle can be 20 - 40 cm long. The flower occurs at the top of the plant. It can stick upright or bend over. The flower can be open or compact. Over 1,000 cultivated varieties occur in China.



Distribution: Sorghum is a tropical plant. It suits the savannah zones in the tropics and can tolerate heat and drought. It can recover from drought even as a seedling. It can tolerate water-logging. It can be grown on heavy or light soils. Sorghum requires short daylengths to flower. Many kinds are adapted to specific daylength and rainfall patterns. It suits hardiness zones 9 - 12.

Use: Sorghum seeds are eaten as a cereal. Flour can be made from the grain and then used for porridge or other dishes. It is used for dumplings, fried cakes and drinks. It cannot be used for bread as it contains no gluten. The stems of some kinds are sweet and can be chewed. The grains can be popped and eaten. The sprouted seeds can also be eaten.

Cultivation: Sorghum seeds will germinate soon after harvest. The seeds also store well if kept dry and protected from insects.

Production: Grain is ready for harvest 4 - 8 weeks after flowering.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| seed | - | 1459 | 11.1 | 0 | - | - | - |

Starchy staples

English: Rice bean

Northern Thai: ถั่วแดง ถั่วเป็

Scientific name: *Vigna umbellata*

Plant family: FABACEAE

Description: An annual twining, climbing bean plant with a slender hairy vine. It grows from seed each year. It grows to 1.5 - 3 m long. Leaves have 3 leaflets which can vary in shape. They are mostly oval and 3 - 13 cm long by 1.5 - 7 cm wide. They taper towards the tip and are rounded at the base. Usually they are hairy. The leaf stalks are 3 - 16 cm long. Flowers are about 1.5 cm long in dense cone shaped clusters. These flowering stalks can be 3 - 10 cm long. The flowers are yellow. The fruit are straight pods about 10 cm long and 5 mm wide. Seeds are small (5 - 8 mm long) and yellow to brown. The pods split open easily. The seeds can be yellow, green, brown, red, black or mottled.



Distribution: A tropical plant that grows to 1,800 m altitude in the tropics. It suits wet climates. It occasionally becomes self sown in coastal grasslands. It needs a sunny protected position and is drought and frost tender. It can grow in arid places.

Use: The young pods and ripe seeds are eaten cooked. The dried seeds are boiled and served with rice or used in soups and stews. The young leaves can be eaten. The seeds are used in bean sprouts. Seeds should be cooked or crushed if fed to pigs.

Cultivation: It is grown from seeds. Seed collection is easy. Seeds often have a hard skin which must be broken (e.g. by scraping) to help germination.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A μ g | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|------------------|-------------|---------|---------|
| seed | 13.0 | 1373 | 20.9 | - | - | 10.9 | - |

Starchy staples

English: Niger seed

Northern Thai: งาญี่ปุ่น

Scientific name: *Guizotia abyssinica*

Plant family: ASTERACEAE

Description: An erect branched herb. It grows 30-180 cm tall. The stems are soft and hairy. The leaves are usually carried opposite one another. The leaves do not have stalks and they clasp the stem. The leaves have teeth along the edge and the surface is a little rough. The flower head is made up of many small flowers each capable of producing a seed. The fruit (called seeds) are black angled structures. They are up to 12 mm long. The seed inside is 3.5-5 mm long. There are about 250-300 seeds per gram.



Distribution: It is grown in both temperate and tropical zones.

It can compete well with weeds. It has some salt tolerance. The temperatures are between 16°C and 20°C where Niger does best. It cannot tolerate temperatures above 28°C average and must have temperatures above 6°C. In Africa it grows between 300 and 2,300 m altitude but does best at 1800-2000 m altitude in Ethiopia. The rainfall is 100-1,300 mm per year where it grows most. At lower altitudes a lower rainfall is satisfactory if it is spread through the growing season. It grows on a wide range of soils. It can grow on poorly drained soils. It needs short day lengths for flowering. It grows in open places. It can grow in arid places.

Use: The seeds can be fried and used as snacks. They are also used in sauces. The seed cake is mixed with honey to make a sweet bread. The seed oil is edible. It is used in cooking.

Cultivation: It is grown from seed. It is often sown mixed with finger millet. Seeds can be broadcast or planted in rows. 10-15 kg of seed per hectare are used for broadcast crops. When planted in rows 5-8 kg per hectare of seed are used. Fertilisers do not improve seed yield much. As petals drop, seeds are harvested to avoid seed loss. Stems are cut near the ground, then dried for a few days before threshing.

Production: Flowering occurs 3 months after sowing. Seeds are ready for harvest 4-6 weeks later. It can take 5 months at altitudes over 2,000 m. Yields can be 300-700 kg per hectare. Yields of 1,400 kg are possible.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| seed | 6.2 | 2019 | 17.3 | - | - | - | - |

Image sourced from: thebloomingaction.com

Legumes

English: Sesbania

Northern Thai: แคน, ผักบุ้ง

Scientific name: *Sesbania grandiflora*

Plant family: FABACEAE

Description: A shrub or small tree up to 5 - 10 m tall. The trunk has rough bark and the branches often droop. The trunk is thick. The branches are hairy when young. The leaves are made up of 41 - 61 leaflets. These are narrow and oblong. They are 2.5 - 4 cm long by 0.5 - 1.4 cm wide. They have a sharp point at the tip. The flowers are large and white to red. The flower petals can be 5 -10 cm long. They are produced as 2 - 4 flowers on flowering branches 2 - 5 cm long. It has long narrow pods with up to 30 - 50 small brownish seeds. The seeds with their stalk can be 2.5 - 4.5 cm long in pods 20 - 25 cm long by 7 - 9 mm wide.



Distribution: A tropical plant. It grows in tropical and subtropical climates. It grows in places with an average rainfall of 900 - 1,200 mm and a temperature range of 17 - 25°C minimum and 25 - 37°C maximum. It is cultivated in coastal towns. It does well in both dry and moist areas. It probably grows up to about 1,500 m altitude in tropical places. It does best in rich moist soils. It needs a sunny location. It is damaged by frost. It can grow in arid places. It suits hardiness zones 10 - 12.

Use: The leaves and flowers are used as a vegetable. The young pods are also eaten. The young leaves are stripped from the stalks and lightly boiled or steamed or served as a vegetable in curries. The edible flowers of the white variety contain a considerable amount of sugar and iron and are said to taste like mushrooms. Flowers of the red-flowered variety are bitter and hence, are only used as an ornamental. The flowers are boiled, fried or used in curries, soups and stews. **Caution:** The seeds are toxic and need to be fermented before use.

Cultivation: Trees are grown from seed. The seed often need seed treatment to break the hard seed coat. Seeds germinate best with temperatures above 19°C. It can be grown from cuttings.

Production: It is a quick growing, short-lived, tree. Trees flower in their second year. A tree can provide 6 - 9 kg of leaves per year. The leaves can be harvested 120 - 150 days after sowing. Repeat harvests can be made each 30 days.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| leaf | 82.3 | 323 | 8.7 | 66 | 60 | 4.0 | - |
| flower | 89.0 | 92 | 1.8 | 0 | 59 | 0.6 | - |
| seed | 10.4 | - | 68.2 | - | - | - | - |

Legumes

English: Soybean

Northern Thai: ถั่วเหลือง

Scientific name: *Glycine max*

Plant family: FABACEAE

Description: A small erect bean growing up to 60 cm tall. It grows each year from seed. Straggling kinds can occur. Stems, leaves and pods are softly hairy. The leaves have 3 leaflets. The leaflets have stalks. Flowers are small and white or blue. They occur in groups in the axils of leaves. The pods are broad, flat and hairy. Pods have 2 - 4 seeds. The seeds can be yellow to black.



Distribution: It is a temperate plant that suits lowland areas. It can be grown from sea level to 2,000 m altitude. Many varieties will not flower in the tropics (short days). It needs fertile soil. The best soil acidity is pH 5.5 - 7.0. It is damaged by frost.

Use: The young pods and ripe seeds are eaten. They are used for flour. The dried seeds are boiled or baked and used in soups, stews and casseroles. The seeds are used for oil. Toasted seeds are eaten like a snack. Strongly roasted seeds are used for coffee. Soy flour is used for noodles, and confectionary. The beans are fermented and used in a range of foods. Sometimes the young leaves are eaten. The seeds are also used for sprouts and for making cooking oil and soya sauce etc. Because soybean contains a trypsin inhibitor they should be cooked and even the sprouts should be lightly cooked.

Cultivation: It is grown from seed. Seeds need to be inoculated with bacteria before planting. Plants need to be about 20 cm apart.

Production: Plants flower about 8 weeks after sowing and pods mature about 16 weeks after sowing. Often plants are pulled up and hung up before threshing out the seed.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| seed | 9.0 | 1701 | 33.7 | 55 | - | 6.1 | - |

Legumes

English: Sword bean

Northern Thai: ถั่วพ้า

Scientific name: *Canavalia gladiata*

Plant family: FABACEAE

Description: A climbing or sometimes bushy and upright bean plant. Mostly it is a climber that can grow up to 4 m long. The leaves have 3 large leaflets. The leaflets are oval and 7.5 - 20 cm long by 5 - 12 cm wide. The top of the leaf can narrow abruptly to a tip while the base can be rounded or broadly wedge shaped. The leaves are slightly hairy on both surfaces. The leaf stalk is 5 - 12 cm long. The white flowers occur in a cluster 7 - 12 cm long with a stalk 4 - 20 cm long. The individual flower stalks are 2 mm long. The pods are long (20 - 40 cm) and curved. Seeds are coloured red or pink. The hilum is dark brown and almost as long as the seed.



Distribution: A tropical plant. Temperatures of 20 - 30°C suit it well and it grows from sea level to about 1,000 m altitude in equatorial zones. They are drought and salt resistant. They can grow on lowland tropical nutrient depleted soils and on soils with pH from 4.5 - 7.0. They can tolerate some shade.

Use: Young pods are cooked and eaten. Seeds can be cooked and eaten, but the water should be changed and they should be well boiled. They are also fermented. The leaves are blanched and eaten.

Caution: The seeds can be poisonous due to hydrocyanic acid and saponin. Cooking will remove these.

Cultivation: They are grown from seeds. Seeds germinate readily and the plant is relatively fast growing. Seeds can be sown 5 cm deep. Plants should be 60 - 70 cm apart. Climbing types need support. Often natural supports such as trees, walls and fences are used in backyard production. For large scale production 25 - 40 kg/ha of seed are needed.

Production: Green seeds/pods are produced in 3 - 4 months and mature seeds in 5 - 10 months. Seed yields of 700 - 900 kg/ha are possible. Green pods are hand picked when 10 - 15 cm long before they swell and become fibrous.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| seed | 15.0 | 1335 | 27.1 | - | - | - | - |
| pod (fresh) | 89.0 | 142 | 2.8 | - | - | - | - |

Legumes

English: Yam bean

Scientific name: *Pachyrrhizus erosus*

Northern Thai: มะแก้ว, มันละแวก, มะกะตั่ง, มันแก้วลาว

Plant family: FABACEAE

Description: A climbing bean that can grow up to 6 m tall. The hairy stems are woody at the base. It has a white-fleshed tuber with a rough, sandy-coloured skin. The leaves are alternate and made up of 3 leaflets. These leaflets have large teeth. The flowers are violet or white. The pod is 8 - 15 cm long, curved and hairy, and contains 8 - 11 flattened seeds. The seeds are almost black.



Distribution: It grows in warm places, like coastal areas in Papua New Guinea and up to about 70 m altitude in the tropics. A well-drained soil is needed. A light rich sandy soil is suitable. It cannot tolerate frost. Plants need 11 - 13 hours of daylight for tubers to form. It suits hardiness zones 10 - 11.

Use: The young tuber is eaten either raw or cooked. It can also be pickled. The young pods can be eaten, provided they are well cooked. **Caution:** Old pods and mature seeds can be poisonous.

Cultivation: It is grown from seeds and also grows wild. Seed should be pre-soaked for 12 hours in warm water to encourage rapid germination. Seeds germinate (shoot) within 2 weeks. Plants can be grown by dividing the root clump and then growing plants from the thickened roots. Cuttings will grow. A spacing of 50 cm between plants is suitable. Topping the plant by picking out the growing point and removing the flowers is said to help tubers form.

Production: Tubers are ready about 6 months after sowing. Individual tubers can be up to 20 kg in weight.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| tuber | 89.0 | 160 | 1.0 | 2.0 | 20 | 0.6 | 0.2 |
| seed | 8.1 | - | 38.5 | 345 | - | 1.3 | - |
| pod | 86.0 | 189 | 2.6 | 345 | - | 1.3 | - |

Legumes

English: Common bean

Northern Thai: ถั่วแขก

Scientific name: *Phaseolus vulgaris*

Plant family: FABACEAE

Description: There are many bush and climbing varieties of this bean. Climbing forms can be 2 - 3 m tall. Bush types are 20 - 60 cm tall. The leaves have three leaflets, one after another along the stem. The leaf stalk has a groove on the top. The side leaflets are unequal in shape, and can be 8 - 15 cm by 5 - 10 cm. The flowers are in the axils of leaves (where the leaves join the stem) and occur in a loose form. Flowers are white to purple. Pods are smooth, slender and 8 - 20 cm long by 1 - 1.5 cm wide. They are straight or slightly curved with a beak at the end and often have 10 - 12 coloured, kidney-shaped and seeds.



Distribution: It is a temperate plant that grows in many temperate and subtropical countries, including Solomon Islands. It mostly grows from 700 – 2,000 m altitude in the tropics. It suffers from pest and disease damage in the lowlands, but can be grown to sea level. It is not suited to the wet tropics. It is shallow-rooted and damaged by excess moisture near the roots. A crop lifecycle needs about 350 mm of water. It is sensitive to frost and high temperatures. Flowers will not form below 9.5°C. Night temperatures above 37°C cause flowers to drop. The best temperature range is 15 - 21°C. It does not suit very acid soils. It suits hardiness zones 8 - 11.

Use: The young pods, leaves and mature seeds are edible. Dry seeds are soaked in water and boiled until soft.

Cultivation: Plants are grown from seed, preferably sown in raised beds. Seeds remain viable for 2 years. Germination is normally good if seed has been well stored. Climbing types need stakes. Plants are self-fertilised. These beans are intercropped with other plants in many places. If grown on their own, bush types can be spaced at 25 cm x 25 cm. They can be sown closer together in rows wider apart to make weeding and harvesting easier. For dried beans, once the pods are mature and turning yellow, the whole plants are pulled, then dried and threshed. About 50 - 75 kg of seed will sow a hectare. Flowering in most French bean varieties is not affected by day length.

Production:

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|--------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| seed (dry) | 10.0 | 1386 | 25.0 | 10 | 1 | 8.0 | 2.8 |
| seed (young) | 92.0 | 142 | 3.0 | - | 20 | 0.8 | 0.2 |
| pod | 88.0 | 151 | 2.5 | 750 | 27 | 1.4 | 0.2 |
| sprout | 90.7 | 121 | 4.2 | 0 | 38.7 | 0.8 | 0.4 |

Legumes

English: Broad bean

Northern Thai: ถั่วปากอ้า

Scientific name: *Vicia faba*

Plant family: FABACEAE

Description: An upright plant up to 1 m tall. Plants vary in height from 30 - 180 cm. It has a well developed taproot. It has square stems which are hollow and have wings at the angles. There can be 1 - 7 branches from near the base of the plant. The leaves have leaflets along the leaf stalk and end in a short point. There are 2 - 6 leaflets. These are 5 - 10 cm long. Flowers occur in the axils of leaves and there are 1 - 6 flowers on a stalk. The flowers are white with black spots. Pods are large and fat and contain several large beans inside. The pods are 5 - 10 cm long in field varieties and can be 30 cm long in garden varieties. They are fleshy with a white velvety lining. They become tough and hard at maturity. The seeds can vary a lot in shape and size. They can be flat or rounded and white, green, brown, purple or black. They are 1 - 2.6 cm long. The hilum along the seeds is prominent.



Distribution: A temperate plant only suitable for the highlands over about 1,200 m. in the tropics. It mainly occurs from 1,900 - 2,700 m altitude in equatorial zones. It is frost tolerant and is resistant to drought. It can grow with temperatures down to 4°C. In the lowland hot tropics it often flowers but does not set seed. It requires fertile soils. It does best with adequate lime needing a soil pH of 6.4 - 7.2. It can tolerate some salinity.

Use: It is mostly the young beans that are eaten. The ripe beans and leaves are also edible. The dried beans can be boiled, ground into flour and added to soups or used for making tofu. Sprouted seeds are cooked and eaten. The tender pods are eaten as a vegetable. **Caution:** Some people, mainly of Mediterranean origin can get a disease called Favism from these beans. The beans should be well cooked. They can react with some people using some antidepressant drugs.

Cultivation: The crop is grown from seed which are sown at 15 - 40 cm spacing. If the seed pod formation is poor, it can be improved by pinching out the tops of the plants when in flower. Hand pollination also helps. Plants are self pollinated but also cross pollinated by insects.

Production: Time to maturity is 12 - 16 weeks. Yields in the cool tropics vary from 1 - 2 tons per hectare.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|----------------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| seed (dry) | 10.0 | 1448 | 26.2 | 130 | 16 | 6.7 | - |
| seed (fresh, raw) | 76.0 | 315 | 7.1 | 35 | 140 | 1.9 | 0.6 |
| seed (fresh, boiled) | 83.7 | 259 | 4.8 | 27 | 20 | 1.5 | 0.5 |

Legumes

English: Winged bean

Northern Thai: ถั่วฝักยาว

Scientific name: *Psophocarpus tetragonolobus*

Plant family: FABACEAE

Description: A climbing perennial bean up to 4 m tall. It can re-grow each year from the fattened roots. The stems twine around supports or trail over the ground. The leaves have 3 leaflets 8 - 15 cm long with long leaf stalks. The flowers are blue or white and occur on the ends of branches from within the axils of leaves. Pods have wavy wings and are roughly square in cross section. They are 6 - 36 cm long with 5 - 30 seeds. Seeds can be white, yellow, brown or black and are bedded in the solid tissues of the pod. The seeds are round and smooth with a small hilum. The root has large nodules.



Distribution: A tropical plant that grows from sea level up to about 1,850 m altitude in the tropics. It normally only produces tubers at 1,200 - 1,850 m altitude. It is a short day plant and needs a daylength less than 12 hours. It will not produce flowers or pods at places far removed from the equator. The main areas of production are between 20°N and 10°S latitudes. It is ideally suited to the tropics including the hot humid lowlands. For maximum seed production, temperatures of 23 - 27°C are needed, and for tubers the temperatures should be 18 - 22°C. Winged beans can grow on a wide variety of soils and have been grown on soils with pH from 3.6 - 8.0. Soils which are very acid have soluble aluminium to which winged beans are sensitive. Soils should not be waterlogged.

Use: The young leaves, flowers, young pods, ripe seeds and root tubers are edible. The seeds can be used to extract an edible oil.

Cultivation: Seeds are sown at the beginning of the rainy season. Seeds germinate and grow slowly for the first 3 - 5 weeks. For tubers, vines are pruned off at about 1 m high (or left unstaked) and some flowers are removed. Cultivation procedures vary slightly depending on which part of the plant is to be eaten. Short podded winged bean are used for tubers and long podded ones have poor tubers. Tuber production is not as efficient in tropical lowland conditions.

Production: The first green pods are ready about 10 weeks after sowing. Tubers are ready after 4 - 8 months. Seed yields of 1.2 tons/ha and tuber yields of 4 tons/ha are possible. A single plant can produce up to 75 pods. Dry bean yields of 45 - 330 g per plant can be produced depending on variety. Tuber yields of 5,500 - 12,000 kg per hectare have been produced. Seeds can contain a trypsin inhibitor which reduces protein digestibility. This inhibitor is destroyed by soaking seeds then boiling them well. Tubers can also contain this chemical and need to be well cooked.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|--------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| seed | 8.5 | 1764 | 41.9 | - | - | 15.0 | 4.5 |
| pod (fresh) | 92.0 | 105 | 2.1 | - | - | - | - |
| leaf | 95.0 | 197 | 5.0 | 809 | 30 | 6.2 | 1.3 |
| seed (young) | 87.0 | 205 | 7.0 | 13.0 | 18.3 | 1.5 | 0.4 |
| root | 57.4 | 619 | 11.6 | 0 | 0 | 2.0 | 1.4 |

Leafy greens

English: Giant garlic

Northern Thai: หอมแป้น

Scientific name: *Allium ampeloprasum*

Plant family: AMARYLLIDACEAE

Description: An onion family plant with a bulb. It grows to 1.2 m tall and spreads 10 cm wide. The leaves are flat and shaped like a keel. This is a variable species which includes leeks, great headed garlic and kurrat. The bulbs can be 2 - 6 cm wide. The flowers are in a round head and are white, purple or red. The flowers are bell shaped and 4 - 5.5 mm long. The flower heads may have 500 flowers and be 5 - 9 cm across.

Distribution: It prefers a sunny position in a light well drained soil. It tolerates a pH in the range 5.2 - 8.3. It does not suit moist climates. It suits hardiness zones 6 - 9. It can tolerate frosts.

Use: The bulbs and leaves are eaten raw or cooked. The flowers are used raw or to flavour cooked foods. The small bulbs or bulbils can be used for flavouring or pickles.



Cultivation: Plants can be grown from seed or by division of clumps or from bulbils.

Production:

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A μ g | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|------------------|-------------|---------|---------|
| leaf | 79.0 | - | 1.8 | - | 116 | 25.5 | - |

Leafy greens

English: Amaranths

Northern Thai: ผักขม

Scientific name: *Amaranthus tricolor*

Plant family: AMARANTHACEAE

Description: A small, annual, leafy green herb about 1 m high, spreading to 45 cm wide. An upright, much-branched annual with a thin membrane covering the stems. Sometimes the plant lies over. The stems are angular. The plant branches in the upper part of the plant. It does not have thorns and grows from seed each year. Leaves have long leaf stalks which can be 5 - 10 cm long. Leaves vary in shape, size and colour. The leaf blade can be 5 - 25 cm long by 2 - 6 cm wide. Leaves are dull-purplish and the top leaves can be yellow or red. Some types have coloured leaves or patterns on the leaves. It has a clumpy seed head at the top. The flower spike at the top can be 30 cm long. The seeds are 1 - 1.2 mm across and black.



Distribution: It grows in most tropical countries, including the Pacific and Solomon Islands. It will grow in warm, temperate places. Plants grow wild in waste places. Amaranths grow from sea level to 2,400 m altitude in the equatorial tropics. Amaranth seeds need a temperature above 15 - 17°C to germinate. In areas of the equatorial highlands above 1,800 m, average temperatures are probably below this during the cooler months. It may be more difficult to get Amaranths started during these months. It suits hardiness zones 8 - 11.

Use: The young leaves and stems are cooked and eaten as a vegetable. The seeds can be eaten. It is a very important tropical vegetable. It grows quickly, produces well and is nutritious.

Cultivation: The very small seeds of this plant are scattered over ashes or fine soil in fertile ground. The seeds are normally spread by rubbing the dry seed heads between the hands. Some types are self-sown. These plants grow in most tropical countries. The soil must be fertile. If they are put in an old garden, they will grow very poorly. They should either be put in a new garden site, when it is cleared from bush, or in old ground that is had compost added. Small gardens close to a house can often be built up to a good fertility by using food scraps and ashes that are left over near houses. Amaranths need high amounts of two nutrients, nitrogen and potash. The ashes from fires are high in potash, so farmers scatter seeds of Amaranth over areas they have burnt. Normally, the hotter it is, the better they grow. They also like plenty of sunlight and do not suit shaded places. They need to have water most of the time they are growing. This is mostly not an issue in areas with high rainfall.

Production: Plants can be harvested when small by thinning out closely-spaced plants. These can be either transplanted or eaten cooked. Plants can be harvested whole or have top leaves harvested several times. Harvesting begins after 4 - 7 weeks and can continue over the next 2 months.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| leaf | 91.7 | 96 | 2.5 | 292 | 43.3 | 2.3 | 0.9 |

Leafy greens

English: Silver spinach

Northern Thai: ปวยเล้ง?

Scientific name: *Celosia trigyna*

Plant family: AMARANTHACEAE

Description: A branched and straggling herb that grows 25 - 120 cm tall. The lower leaves have long leaf stalks. The plant looks like *Amaranthus hybridus* until it starts to flower. Where the leaf stalk joins the stem there is a pair of small moon-shaped leaflets that lie around the stem. The small white or silvery flowers are crowded together in separate clusters. The fruit is a capsule which is almost round and has several seeds.



Distribution: A tropical plant that grows in tropical lowlands and highlands in Africa. It is often along the coast but grows from sea level to 1,960 m above sea level. It needs an annual rainfall of up to 2,500 mm and an average temperature of 25 - 30°C. It cannot tolerate a temperature below 15°C. It grows best on fertile, well drained soils.

Use: The young shoots and leaves are cooked and eaten. They are finely cut and used in soups, stews and sauces. Because they can be bitter, they need extensive cooking or mixing with other foods.

Cultivation: Plants are grown from seeds which germinate in 4 - 5 days. It grows for 90 - 120 days. Because the seeds are small, they are best mixed with sand to give a more even distribution when sowing.

Production: Plants can be uprooted and harvested or leaves removed. Harvests of 4 - 5 t/ha can be achieved from weekly harvests over 2 months.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| leaf | 89.0 | 139 | 2.7 | 94 | 10 | 5.0 | - |

Image accessed from <http://www.flickr.com/photos/36517976@N06/5063937939>

Leafy greens

English: Kangkong
Northern Thai: ผักบุ้ง

Scientific name: *Ipomoea aquatica*
Plant family: CONVULVACEAE

Description: Kangkong is a creeping sweet potato-like plant. It has hollow stems and can float on water. The leaves are green and are normally not divided like some sweet potato leaves, but the shape and size varies a little between different kinds. The trumpet shaped flower looks like a sweet potato flower and is normally white. The runners develop roots at the nodes and also branch. This branching increases when tips are picked off. Some variation in leaf shape can be observed. Leaf shape is less variable than in the related sweet potato, but narrow and broad leafed kinds occur. White and green stemmed kinds occur. Green stemmed kinds have more cold tolerance than white stemmed.



Distribution: Kangkong is a tropical plant. It grows best in short day, stable high temperature, moist conditions. Temperatures need to be above 25°C for satisfactory growth. In equatorial regions plants probably grow up to 1,000 m altitude. Below 23°C the growth rate is too slow for economic production, so production is mainly in the lowland tropics. Optimum soil pH is between 5.3 - 6.0. It suits damp places and grows well in swamps. It can grow as a partly floating plant in swamps and lagoons behind the beach along the coast. In some countries they grow the dry land form in gardens.

Use: The young tips of shoots are cooked and eaten. They can be boiled, steamed, stir-fried, or added to soups, stews or curries. The young stems can be used in pickles. The young tips can be eaten raw in salads and the roots are occasionally cooked and eaten.

Cultivation: Dryland kangkong is normally grown from seed. Sometimes seed are pre-soaked for 12 - 24 hours prior to sowing. Plants can also be grown from cuttings and establishment is rapid. Top cuttings 25 - 40 cm long can be planted beside a pond.

Production: Young tips can be harvested 30 days after planting, and subsequent harvests every 7 - 10 days. Production of new shoots probably declines at flowering. Yields up to 60,000 kg/ha have been recorded.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|---------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| leaf | 90.3 | 126 | 3.9 | 315 | 60 | 4.5 | - |
| leaf (boiled) | 92.9 | 84 | 2.1 | - | 16 | 1.3 | 0.2 |

Fruit

English: Guava

Northern Thai: มะแก้ว, มะก้วยกำ, มะมัน

Scientific name: *Psidium guajava*

Plant family: MYRTACEAE

Description: A small evergreen tree 8 - 10 m tall with smooth, mottled bark which peels off in smooth flakes. It branches close to the ground and is shallow rooted. The branches are four-angled. The leaves are opposite, dull green, and somewhat hairy. They are oval and somewhat pointed at both ends, 15 cm long by 2 - 5 cm wide with short leaf-stalks. The showy flowers are white and borne in loose, irregular arrangements of 1 - 3 flowers that grow in the axils of leaves on new growth. The petals are 1.5 - 2 cm long. Both self and cross-pollination occurs. The fruit are rounded and 4 - 5 cm long. They are green, turning yellow when ripe. The outer covering is firm and encloses a pink, or nearly white, sweet-smelling, edible pulp with many seeds. In better selected varieties, the skin and the seeds are fully edible. Fruit vary from very acid to very sweet.



Distribution: A native to Central and South America, it grows in most tropical countries. Guava thrives in both humid and dry tropical climates and does best in sunny positions. It grows wild and is also cultivated. It is killed by frost and fruits better where there is a cooler season. Temperatures near 30°C give best production. It is widely distributed in open places and secondary forests throughout the Philippines and Papua New Guinea, and can become weedy under some conditions. It prefers a well-drained soil with good organic matter, but can stand some brief water-logging. A soil pH of 5 - 7 is best, but can tolerate a pH from 4.6 - 8.9. Trees cannot tolerate salty conditions. It suits hardiness zones 9 - 12.

Use: The fruit are eaten raw and can be used for jams and jellies. Half-ripe fruit are added to help the jelly set. The young leaves are eaten raw or cooked. It is an attractive and nutritious fruit.

Cultivation: They are mostly grown from seeds but seedling trees vary in quality. Seeds remain viable for a year or longer. Seeds usually germinate in 2 - 3 weeks, but can take 8 weeks. Selected trees can be propagated by budding or grafting. They can also be propagated by layering, root cuttings or stem cuttings if hormones are used. For stem cuttings, the tips are used and grown under mist at 28 - 30°C with bottom heat. Suckers can also be used. Using vegetative methods of propagation enables better fruit kinds to be preserved. In the lowland tropics, trees are self-sown. As fruit are produced on new season's growth, pruning does not affect greatly fruiting. Trees should be managed to give the maximum number of vigorous, new shoots. Trees can be pruned for shape. Trees can be grown at 2.5 m within rows and 6 m apart between rows.

Production: Seedling trees may begin to bear 2 - 3 years after transplanting. Pruning back the tips slightly increases fruit production. Fruit taste best if ripened on the tree. Ripening after picking can be hastened by placing them in a brown paper bag with a banana or apple. Mature fruit which have not changed colour can be stored 2 - 5 weeks at temperatures of 8 - 10°C and relative humidity of 85 - 95%. Mature fruit ripen in 2 - 3 days at normal temperatures and will keep for 7 days.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| fruit | 77.1 | 238 | 1.1 | 60 | 184 | 1.4 | 0.2 |

Fruit

English: Tamarind

Northern Thai: มะขาม

Scientific name: *Tamarindus indica*

Plant family: FABACEAE

Description: A large spreading tree up to 24 m tall. It has a broad, dense, evergreen crown. The trunk can be 1 m across. The bark is rough and grey with a checkered pattern. The tree can lose its leaves in dry areas. The leaves are carried one after another along the branch. The whole leaf is 6 - 12 cm long and it is divided into 10 - 17 pairs of leaflets. These are oblong and without stalks. The whole leaf has a leaf stalk about 15 cm long. The leaflets are 1 - 2.5 cm long and 4 - 9 mm wide. They are a dull dark green with a rounded tip. The flowers are pale yellow with brown markings. The flowers are about 2.5 cm across and hang on long, many flowered stalks. The fruit is an oblong, thin-skinned, fleshy capsule. The brown seeds are inside this long rough surfaced, sausage-like fruit. This pod is 6 - 8 cm long and about 2 cm wide and contracted between the seeds. The pod cracks when mature. The seeds are shiny and hard. The edible pulp is date like and reddish brown.



Distribution: A tropical legume. The tree is cultivated in a number of coastal towns in the tropics as a street tree. It is probably best grown below 800 m altitude in the tropics. It is drought resistant and cannot stand water-logging. It does well on coastal dunes above high water level. It suits semi-arid areas. It grows in the Sahel and must be in frost free locations. In Kenya it grows from sea level to 1,600 m altitude. It suits hardiness zones 11 - 12.

Use: The pulp of the fruit is edible and is also used for drinks. The seeds are also edible when cooked. They can be roasted and ground into flour. The outer skin is removed. The young leaves, flowers and young pods are also edible and are eaten in curries. They are used to make dishes acid. They are used in sauces and chutneys. The young seedlings are also edible.

Cultivation: It can be grown by seeds or cuttings. It is best to sow seedlings in pots then transplant them, but seed can be sown direct. There are about 1,400 seeds per kg. Seed should be soaked in hot water or the seed coat nicked before sowing. Seed can be stored for 2 years if kept dry, cool and away from insects. Trees can be topped or cut back and allowed to re-grow. Nothing grows under the trees due to the acidity of the leaves. Trees can be grown by air layering or cuttings.

Production: Trees are long-lived and grow very slowly. Fruiting is seasonal from April to June. It takes 8 - 9 months from flowering to ripe fruit. If plants are grown for shoots, they are planted close together.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| fruit | 38.7 | 995 | 2.3 | 20 | 60 | 1.1 | 0.7 |
| flower | 80.0 | 314 | 2.5 | - | - | 1.4 | - |
| leaf | 78.0 | 305 | 3.1 | - | - | 2.0 | - |

Fruit

English: Bael fruit

Northern Thai: มะปิ่น

Scientific name: *Aegle marmelos*

Plant family: RUTACEAE

Description: A medium sized tree that grows 3 - 12 m tall and spreads 2 m across. The stem is erect and thorny. The aromatic leaves are green, with 3 leaflets and generally sword shaped. It loses its leaves. The flowers are yellowish-which have a strong sweet smell. They contain both sexes and occur in clusters. The fruit is large and with a hard shell about 3 mm thick. It is 8 - 10 cm across and is yellow-green when ripe. The edible pulp is reddish or orange. The fruit is made up of small cells (about 15) each with woolly seeds.



Distribution: A tropical plant that prefers rich well drained soils in an open sunny position. It suits tropical or warm places. It appears to do best where there is a distinct dry season. It is drought and frost tender. A hot dry summer is best. It can tolerate some alkalinity and saline soils. It can grow in arid places.

Use: The fruit are eaten raw. They are also used to make drinks. The fruit are often sliced and dried. Marmalade can be made from ripe pulp. They can also be pickled or used in jams and jellies. The young shoots and leaves can be eaten raw in salad. They are also used in chutneys. The flowers are used to make a drink. **Caution:** There are reports that leaves make women sterile or cause abortions.

Cultivation: It is grown from seed. Seed are taken from freshly picked ripe fruit. Seedlings are planted out after one year. It can be grown from root offshoots. They are best grown using patch budding. Trees are spaced 6 - 9 m apart. Trees can be pruned to have 4 - 6 strong branches. Suckers should be removed. It can also be grown from root suckers or air layering.

Production: It is slow growing. Trees produce in 3 - 4 years. Full production is gained after 15 years. Fruit are produced throughout the year. Fruit should be picked and not allowed to drop. There can be 200 - 400 fruit per tree. Fruit ripen in the dry season and can be ripened off the tree. Trees can continue bearing for 50 years. The fruit can be stored for 2 weeks at 30°C and for 4 months at 10°C.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| fruit | 58 | 577 | 2.3 | 0.13 | 219 | 0.55 | - |

Fruit

English: Pomelo

Northern Thai: มะโสด

Scientific name: *Citrus maxima*

Plant family: RUTACEAE

Description: A dome-shaped, spreading, spiny tree that grows up to 15 m tall. The glossy, oval leaves are very large. And are downy underneath. The leaf stalks have broad wings. Young shoots and stems have fine hairs on them. Flowers are large (2 cm) and creamy white. The flowers are produced in bunches from woody shoots. The flowers have a sweet scent. The fruit are oval or pear shaped. The fruit is very large (20 cm) with a thick skin. The skin is dotted with oil glands. The fruit are green but become yellow when ripe. They contain 11 - 14 segments. The flesh can be pale yellow or pink. Each segment of the fruit is covered by a strong membrane. Some kinds have many seeds, while others are almost seedless. There are several named cultivated varieties.



Distribution: A tropical plant that thrives in warm lowland areas. It can grow from sea level up to 900 m. It is tolerant of brackish and salty conditions. It suits humid climates in tropical and subtropical locations.

Use: The fruit can be eaten fresh. It is used for desserts, jams and marmalades. The fruit pulp can be dried and candied. The skin can be eaten as a vegetable. The leaves are used to flavour meat and fish during cooking.

Cultivation: It is mostly grown from seed, and does not breed true. The seed only produce one seedling unlike many citrus. Trees are often produced by aerial layering, but budding or grafting can be used. Air-layered trees give sweeter fruit. Trees start producing after about 9 years. Trees need to be about 9 m apart. Trees grown away from other trees often produce almost seedless fruit.

Production: Fruit is produced almost all the year round. The time from flowering to ripe fruit is about 6 months. Fruit can be stored quite well.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| fruit (raw) | 90.3 | 175 | 0.6 | 20 | 37 | 0.4 | - |

Fruit

English: Emblic

Northern Thai: มะขามป้อม

Scientific name: *Phyllanthus emblica*

Plant family: PHYLLANTHACEAE

Description: A small deciduous tree. It grows 2-20 m tall. The trunk is bent and has many branches. The branches are spreading. The bark is greyish-brown and peels off in flakes. The leaves are pale green and feathery. New leaves are pinkish. The leaves have short stalks. The leaves are 1-1.5 cm long by 0.2-0.3 cm wide. The leaves are arranged on slender branches to appear like feathery compound leaves. They are like tamarind leaves. Male and female flowers occur on different trees. The flowers are small and yellow. They are densely clustered on the branches. The fruit are small and yellow to green. They are 2 cm across and edible. They have 6-8 faint lines along them. They are fleshy and edible. They are sour. Some improved kinds have fruit 8-9 cm across.



Distribution: A tropical plant. It suits the hot humid tropical lowlands. It is native to tropical Asia. It grows in arid bushy savannah. It grows from 10-20 m to 1,400-1,500 m altitude. It often grows on poor shallow soils. It is light demanding and drought tolerant. It can tolerate forest fires. They are common in tropical deciduous forest in India. It suits the subtropics. It needs warm temperatures at time of flower bud formation. Dry times during fruiting cause fruit to drop. It can tolerate low and high temperatures once established. It can tolerate soils with a pH 6-10. Some varieties can tolerate saline soils.

Use: The fruit are cooked and used in preserves. The fruit are acid and can be eaten fresh or used for flavouring. They are also used as a seasoning in cooked food. They are pickled and made into jams, jellies, preserves, tarts and other foods. The dried fruit chips are seasoned with caraway seeds, salt and yoghurt and eaten. Unripe seeds and leaves are edible.

Cultivation: Plants are grown from seed. They are best grown using ring budding or veneer grafting. Trees can be pruned to form 4-6 branches from one trunk. They can be grown from cuttings, grafting or by air layering.

Production: Early growth is fast. Some budded trees produce fruit after 3 years. Seedling trees take 7-8 years. Best yields are produced after 10-12 years and trees can keep bearing for 70-75 years. In India fruit are available October to December.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| fruit | 78.4 | 281 | 0.6 | - | 316 | 0.9 | 0.5 |

Vegetables

English: Sweet potato

Northern Thai: มันแก้ว

Scientific name: *Ipomoea batatas*

Plant family: CONVULVULACEAE

Description: This is a root crop which produces long creeping vines. The leaves are carried singly along the vine. Leaves can vary considerably from divided like fingers on a hand to being entire and rounded or heart shaped. Purple trumpet shaped flowers grow at the end of the vine. Under the ground fattened tubers are produced. There are a large number of varieties which vary in leaf shape and colour, tuber shape, colour, texture and in several other ways.



Distribution: A tropical and subtropical plant. They grow from sea level up to about 2,700 m altitude in the tropics. Plants can grow with a wide range of rainfall patterns and in different soils. Plants are killed by frost and can't stand water-logging. Plants grow well with temperatures between 21 - 26°C. It can grow with a pH between 5.2 - 6.8. Sweet potato are not tolerant to shading. Under shaded conditions, both foliage growth and storage root production are decreased. Some cultivated varieties can be selected for increased production under mild shade but not heavy shade. The survival of cuttings at planting is also reduced under shaded conditions. Under shaded conditions plant become more climbing and with fewer leaves which are however larger. With increasing shade less tubers are produced and these grow more slowly. Sweet potato tends to be responsive to potassium fertiliser. cultivated varieties are often selected for yield under low fertility conditions. Under lowland conditions in the tropics sweet potato tubers undergo active tuber enlargement from 6 - 16 weeks. Weed control is essential especially during early stages of growth. The rate of ground coverage by foliage varies greatly with growing conditions and cultivar but once ground coverage has occurred weed control is less of a problem. Sweet potato tuber initiation is subject to aeration in the soil. Either heavy clay soils, waterlogged conditions or other factors reducing aeration can result in poor tuber production. For this reason sweet potatoes are often grown on mounded beds. It suits hardiness zones 9 - 12.

Use: Tubers are boiled or baked. They can be steamed, fried, mashed or dried. They can be fermented into alcoholic drinks. They can also be used in pies, cakes, puddings and candies and jams. They can be used in noodles. The chopped and dried tubers can be boiled with rice or ground into flour and mixed with wheat flour to make cakes or bread. The young leaves are edible.

Cultivation: Vine cuttings are used for planting. In grassland soils it is grown in mounds, ridges or other raised beds. In bush fallow, it is mostly planted in undug loose soils. It needs a sunny position. Tubers won't form if the ground is waterlogged when tubers start to develop. Sweet potato is grown by cuttings of the vine. About 33,000 cuttings are required per hectare. These weigh about 500 kg. Vine lengths of about 30 cm are optimum. As long as the vine is adequately inserted in the soil, the length of vine inserted does not significantly affect yield. Fresh sweet potato seeds germinate relatively easily and lead to continuous production of new cultivars under tropical conditions. Excess nitrogen restricts storage root initiation and therefore excess leaves are produced without significant tuber yield. Dry matter percentage increases with increasing age of the crop. Higher dry matter tubers are normally preferred.

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Production: The time to maturity ranges from 5 months to 12 months depending on the variety planted and the altitude at which it is being grown. Yields range from 6 - 23 t/ha.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|----------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| tuber (baked) | 72.9 | 431 | 1.7 | 961 | 24.6 | 0.5 | 0.3 |
| tuber (raw) | 70.0 | 387 | 1.2 | 709 | 25 | 0.7 | 0.4 |
| tuber (boiled) | 72.0 | 363 | 1.1 | 787 | 15 | 0.6 | 0.3 |
| leaf | 86.3 | 168 | 3.9 | 105 | 58 | 2.9 | - |

Vegetables

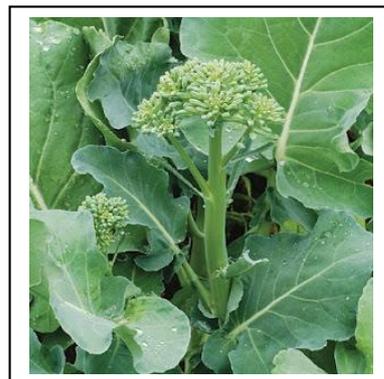
English: Chinese broccoli

Northern Thai: ผักคะน้า

Scientific name: *Brassica oleracea* var. *alboglabra*

Plant family: BRASSICACEAE

Description: A cabbage plant with a single fleshy stem. Although it keeps growing from year to year it is normally grown as an annual. It grows 45 cm high and spreads 40 cm across. The leaves are dark green and rounded on long stems. Plants start to flower when 10 leaves are present. Flowers are white but there are varieties with yellow flowers. There are several named cultivars.



Distribution: It does best in a fertile soil. The soil needs to be well drained. It prefers a soil pH of 6 - 7. Temperatures during the day of 18 - 28°C are best. It can tolerate frost. It grows well in tropical regions but cool temperatures are necessary for flowering.

Use: The flower stalk, flower heads, buds and tender leaves are all eaten. The stems are steamed or braised and often served with oyster sauce. They are also used in soups.

Cultivation: Plants are grown from seed. Seed can be sown direct or put in a nursery then transplanted. Seed is sown about 0.5 cm deep and germinate in 3 - 10 days. A spacing of 15 cm is suitable. Wide spacing causes stems to become thick and tough. Because plants are shallow rooted, they need regular watering.

Production: Chinese broccoli is fast growing. Flower heads are harvested after about 9 weeks. Heads are harvested individually to allow others to form. Harvesting is done before buds start to open.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-----------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| flower (cooked) | 93.5 | 92 | 1.1 | 164 | 28.2 | 0.6 | 0.4 |

Picture sourced from <http://thedahliafarm.blogspot.com.au/2010/06/gai-lohn-or-chinese-broccoli-or-chinese.html>

Vegetables

English: Bush okra

Northern Thai: ผักพริก

Scientific name: *Corchorus olitorius*

Plant family: MALVACEAE

Description: An annual plant. It is upright, branching, and slightly woody. Plants vary in height, shape, leafiness and hairiness. Plants grown for leaves are usually only 30 cm tall. They also have many branches. Leaves are shiny and have leaf stalks. The leaves have teeth along the edge. The tips of the lowest leaves in each side, have long bristle like structures. Small clusters of yellow flowers grow in the axils of the leaves. The fruit are ridged capsules. They can be 7 cm long. These have partitions across them between the seeds. A ripe capsules contains 180 - 230 seeds. The seeds are dull grey and with four faces and one long point. Each seed has one pale line along it.



Distribution: A tropical plant. It is mostly coastal, below 250 m altitude. Temperatures of 22°-35°C are suitable. It can stand both drought (2 - 3 weeks) and water-logging, except when young. A well drained soil is best. They require humus-rich soils. A soil pH of 5.5 - 7.0 is best, but they can grow in soils with pH up to 8.5. They also need adequate moisture for good leaf production. A rainfall of 1,000 mm is suitable. A high relative humidity (80 - 90%) is best. It produces seeds when day lengths are short. It grows in most African and Asian countries.

Use: The young leaves and stem tops are eaten cooked. They are slimy unless fried. They are also used to make a thick soup. Leaves can be sun dried, pounded to flour, then stored for a long time.

Cultivation: Plants grow from seed, and they can be transplanted. Seeds are often broadcast into fine seed beds at the beginning of the wet season. Mixing the small seeds with sand makes it easier to sow them evenly. Often seeds are slow to start growing. This can be overcome by soaking them in hot water. A spacing of 20 - 30 cm between plants is suitable. For vigorous varieties this could be increased to 45 - 50 cm. Seeds are saved from pods for re-sowing.

Production: First leaves can be harvested after 5 - 6 weeks. Tips about 20 - 30 cm long are picked. Production of edible green tips, is not large. 7 - 8 kg of leaf tips can be harvested from 3 - 8 pickings over 3 - 4 months. Seeds can be collected after 13 - 15 weeks. If seeds of a particular variety are desired, it is necessary to grow these plants 16 m away from other plants, to avoid cross pollination. Seeds can be stored for 8 - 12 months in well sealed jars.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|---------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| leaf (raw) | 80.4 | 244 | 4.5 | 574 | 80 | 7.2 | - |
| leaf (cooked) | 87.2 | 155 | 3.4 | 156 | 33.0 | 3.1 | 0.8 |

Vegetables

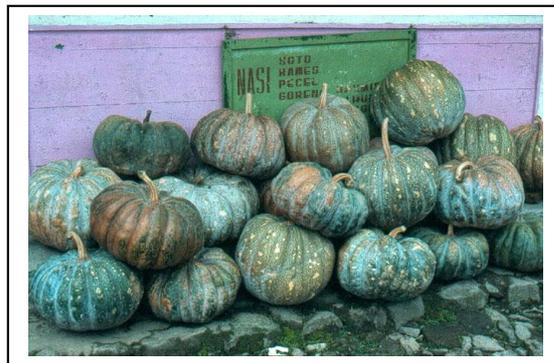
English: Pumpkin

Northern Thai: มะพร้าวแก้ว

Scientific name: *Cucurbita maxima*

Plant family: CUCURBITACEAE

Description: A pumpkin family plant. It is a creeping vine with tendrils. It is an annual plant. The stems are soft and round in cross section. The leaves are large and hang loose. They are dark green and kidney shaped. The edges of the leaves are entire. There are large nodes at the base of the leaf. The tendrils are fairly stout and are divided half way along their length into many branches. Male flowers are carried on long upright stalks. The 5 petals are united into a long yellow tube. The female flowers are larger than the male and are fewer in number and carried on shorter stalks. The fruit varies in size, colour and patterns on the skin. They can be round, oval or flattened, with yellow, orange or green skin. The surface can be smooth and rough and warty. The flesh is yellow and edible. The seeds are in the centre. The seeds are white or brown. They are flattened but plump and have a slanting scar at the top. The seeds are edible. (*C. moschata* does not have hairy stems but has fruit with a thickened stalk near where it joins the fruit.) There are a large number of cultivated varieties.



Distribution: A subtropical plant that grows from sea level to 2,400 m altitude. They need a fertile soil. *C. moschata* is better suited to coastal areas. They are frost sensitive but better suited to cooler areas than *C. moschata*. It can grow in arid places. It suits hardiness zones 8 - 11.

Use: The young leaf tips are eaten cooked. They can also be dried and stored. The fruit can be eaten cooked. They are baked, boiled, fried, steamed or mashed. They are used in pies and cakes. The seeds are edible, raw or roasted. They are also ground into a meal. The male flowers are eaten after removing the stamen and calyx.

Cultivation: They are grown from seed. Usually 2 or 3 seeds are planted together in a mound. The distance apart depends on the cultivar. Some kinds are better for leaf tips. It is good to save seed of adapted varieties.

Production: Fruit are ready for harvest after about 3 - 4 months. Seed can be saved from fruit for re-sowing but as pumpkins cross pollinate different types become mixed.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| seed (dry) | 6.9 | 2264 | 24.5 | 38 | 1.9 | 14.9 | 7.5 |
| fruit | 69.6 | 439 | 1.4 | - | - | - | - |
| leaf | 88.0 | 160 | 4.9 | 260 | 28 | 2.5 | 0.9 |
| flower | 88.7 | 107 | 1.4 | 173 | 14 | 0.8 | 0.1 |

Vegetables

English: Bitter cucumber

Northern Thai: มะระ, มะระขี้เป็ด

Scientific name: *Momordica charantia*

Plant family: CUCURBITACEAE

Description: A pumpkin family plant. It is a slender annual climber with flowers of both sexes on the one plant. It has simple tendrils and vines can be 4 m long. It has bright green lobed leaves 5 - 12 cm long on thin leaf stalks 3 - 10 cm long. The flowers have a sweet smell and 5 small, yellow petals. Fruit are green when young and orange when ripe. The fruit have a lumpy appearance, with ridges along its length and when fully ripe burst open. It has bright red covering on the seeds inside. The seeds are pale brown and 10 - 16 mm long and 7 - 10 mm wide. Considerable variation in the fruit occurs between varieties.



Distribution: A tropical plant that grows from sea level up to about 500 m and will probably grow to 1,000 m altitude in tropical regions. They require a well drained soil preferably rich in organic matter. Seeds do not germinate below 15°C. Plants grow best with temperatures of 18 - 35°C. A soil pH of 6.5 is best. It suits hardiness zones 9 - 12.

Use: The young bitter fruit are cooked and eaten. They are boiled, stuffed, fried or pickled. They are used in soups, stews and stir-fried dishes. The seed mass of the ripe fruit is used as a food flavouring. The leaves are also cooked and eaten as a flavouring. The tender shoots and leaves are sometimes eaten. **Caution:** The leaves are considered to cause diarrhoea and vomiting.

Cultivation: Plants are grown from seed. For large scale plantings, 6 - 7 kg of seed are required for planting one hectare. Seeds are planted at 50 cm spacing in the place where the plants are to grow and need a stick to climb up. Often plants are grown on raised beds 2 m apart with 0.5 m between plants. The seed has a hard seed coat and germinates slowly. Soaking seeds for 24 hours before sowing gives a quicker more even germination. Regular watering is required.

Production: Fruit are ready to harvest 45 - 55 days after planting. Fruit should be harvested when young and tender. Once fruit have begun to change colour to yellow they are past maturity for eating. Early removal of young fruit also ensures continuous fruit setting. This can allow 6 - 8 successive pickings of fruit. Fruit on the plant are sometimes wrapped in paper to prevent fruit fly damage. Seed well stored can remain viable for 4 - 5 years. The young bitter fruit are cooked and eaten. The fruit is blanched or soaked in salt water to reduce the bitter taste.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| seed | 8.6 | 2020 | 18.6 | - | - | - | - |
| leaf (raw) | 84.7 | 252 | 5.0 | 44 | 170 | 7.1 | 0.3 |
| leaf tip (boiled) | 88.7 | 146 | 3.6 | 173 | 57 | 1.0 | 0.3 |
| fruit | 93.6 | 105 | 1.2 | - | - | 0.2 | - |
| pod (boiled) | 94.0 | 79 | 0.8 | 11 | 33 | 0.4 | 0.8 |
| pod (raw) | 94.0 | 71 | 1.0 | 380 | 84 | 0.4 | 0.8 |

Vegetables

English: Eggplant

Northern Thai: มะเขือม่วง

Scientific name: *Solanum melongena*

Plant family: SOLANACEAE

Description: A perennial shrubby herb up to 1 m tall. It is often grown as an annual. It has a deep taproot and branched side roots. The stem is thick and covered with many woolly hairs. The plant has many branches. Often the plant is spiny. Leaves can be 20 cm long and wavy along the edge. Leaves are covered with hairs. Flowers are bluish red and 5 cm across. They are either solitary or in small groups opposite the leaves. They have 5 large woolly lobes which continue to surround the base of the fruit. Fruit are white, blue, green or purple. The fruit colour and shape vary. Sometimes the fruit is spiny. Often the fruit are 10 - 20 cm long and 5 - 8 cm wide. Numerous kidney shaped seeds are in the flesh of the berry. There are many cultivated varieties.



Distribution: A tropical plant. Plants grow from sea level up to 2,200 m altitude in the tropics. It suits wet climates but does well in dry climates with irrigation. It needs a long warm growing period. A daily mean temperature of 20 - 30°C is most suitable. They are frost tender. They need a rich, friable, well tilled soil. In the sub-tropics they can be grown as a summer crop.

Use: Fruit are mostly fried then eaten. They can also be grilled, baked, stuffed and stewed. They are used in curries. The fruit are also dried and stored. The leaves, although edible, are hairy and not good flavor.

Cultivation: Plants are grown from seeds. Seeds germinate slowly. At the best temperature, they germinate in 8 - 12 days. Seed are sown in nursery beds. Seedlings can be transplanted when about 8 cm tall or 4 - 6 weeks old. Plants need to be about 60 - 100 cm apart. Because some cross pollination can occur, seed crops need to have varieties planted 400 m apart.

Production: Fruit are ready for harvest after 3 months. They continue to yield for 3 - 4 months.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|---------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| fruit | 91.8 | 117 | 0.83 | 6 | 1.3 | 0.4 | 0.2 |
| fruit (fresh) | 93.4 | 62 | 0.7 | 50 | 5 | 0.4 | 0.3 |

Vegetables

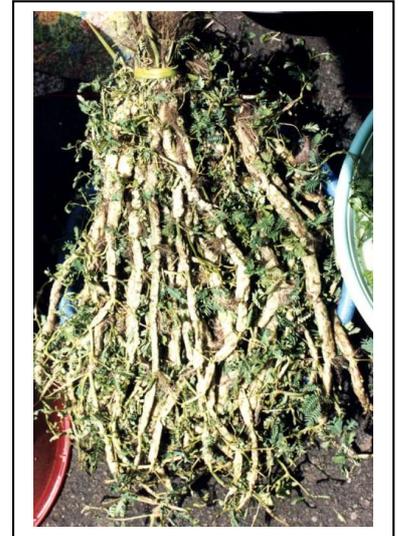
English: Water mimosa

Northern Thai: ผักกะเสด

Scientific name: *Neptunia oleracea*

Plant family: FABACEAE

Description: A plant which grows in water. It has stalks which lie along the ground and also ones which stick upwards. The stems are up to 1.5 m long. The floating parts have spongy white balls around each internode. These only develop when plants grow in water. From each internode roots extend downwards and leaves extend upwards. The leaves are 3.5 - 8 cm long with 2 - 3 pairs of leaflet stalks. Along these are 8 - 18 pairs of leaflets. These are 4 - 10 mm long by 1.2 - 3 mm wide. They are dark green. The flowers are in round heads. They are 1.5 cm long. The flower stalk is 12 - 30 cm long. The fruit is a pod. It is oblong and flat. It is 2 cm long by 1 cm wide. There are 4 - 8 seeds. These are 4 - 5 mm long by 2.5 - 3.5 mm wide.



Distribution: It is a tropical plant. It floats in ditches and ponds.

Use: The young leaves and stalks are eaten as a vegetable. (The white section is removed.) They can be eaten raw but also fried or served with vermicelli and peanut curry. It is also used in sour vegetable salads and hot and sour soup. The young seed pods are cooked and eaten.

Cultivation:

Production: It is grown in tanks.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| leaf | 88.0 | 142 | 5.2 | 114 | - | 3.0 | - |

Nuts, seeds, herbs and other foods

English: Coriander

Northern Thai: ผักชีอม

Scientific name: *Coriandrum sativum*

Plant family: APIACEAE

Description: An annual herb up to 70 cm high. It spreads to 50 cm across. It has a fleshy taproot. The stem is erect and finely grooved. The leaves are compound, and divided along their length. The lower leaves have lobes, while the upper leaves are finely divided. The leaves are bright green, and glossy. Flowers are pink to white. They occur in flat arrangements, with stalks coming from the same point. The plant has an unpleasant smell until the fruit ripens. The fruit are pale brown. The fruit have lines along them. Some lines are wavy and some are straight.



Distribution: A Mediterranean plant. Sometimes it does not set seed in the lowland tropics. It grows up to about 2,200 m altitude in the tropics. It prefers light to medium, well-drained soils. It suits an open sunny position. It is drought and frost tender. In Nepal it grows to 3,000 m altitude. It can grow in arid places. It suits hardiness zones 6 - 9.

Use: The dried fruit are used in curry and flavourings. The young plants and leaves are used in soups, sauces and as flavourings. The root is also crushed and used as a seasoning.

Cultivation: Plants are grown from seed. They are planted where they are to grow.

Production: Plants mature after about 3 months. It is important to dry the fruit before use, to get rid of an unpleasant smell.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| seed | 11.0 | 1218 | 14.0 | 300 | 21 | 18.0 | 4.7 |
| leaf (dry) | 7.3 | 1167 | 21.9 | 585 | 567 | 42.5 | 4.7 |
| leaf | 92.8 | 84 | 2.4 | 48 | 11 | 2.0 | 0.5 |

Nuts, seeds, herbs and other foods

English: Greater galangal

Northern Thai: ฟ้า

Scientific name: *Alpinia galanga*

Plant family: ZINGIBERACEAE

Description: A herb which grows year after year. It grows to 1.6 m high and spreads to 1 m across. The rootstock creeps under the ground. This is round like a cylinder and branches. This thick rhizome can be 10 - 12 cm long by 3 cm wide. It grows as a dense clump. The outside of the root is reddish brown and inside is white. The stems lie along the ground. The leaves are long and narrow and sword shaped. The leaf blade is 25 - 35 cm long by 6 - 10 cm wide. They taper to the tip. They have a sweet scent. The flower spike is at the end of the shoot. It is hairy and 15 - 30 cm long. The flower bracts are oval and 2 - 8 mm long. The flowers are white. They occur in clusters at the ends of stalks. Each bract surrounds 4 - 5 flowers. The flowers are 1.5 cm long and white with purple lines. The fruit is a round capsule. It is 1 cm across. It is orange-red.



Distribution: A tropical plant. It does best in rich moist soils. It prefers a protected shady position. It is drought and frost tender. The soil needs to be well-drained. It can be grown in sheltered sites in cooler climates but needs a heated glasshouse in cold places. In southern China, it grows in grasslands from 100 - 1,300 m altitude. It suits hardiness zones 9 - 12.

Use: The root is used for flavouring curries. They are often sliced then removed before serving the dish. They can be pounded to a paste then added to dishes. They are also pickled. The young shoots and leaves are also eaten. Flower buds and flowers can also be cooked and eaten. They are also pickled. The red fruit are edible.

Cultivation: It is grown by dividing the rootstock. A piece about 5 - 10 cm long with at least 2 undamaged buds is used. Rhizomes are planted just below the surface and 60 cm apart.

Production: Young rhizomes have more flavour than older ones.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| leaf | | - | 0.5 | - | - | - | - |
| rhizome | 85.9 | 213.5 | 1.0 | - | - | 2.1 | - |

Nuts, seeds, herbs and other foods

English: Cashew

Northern Thai: มะม่วงหิมพานต์

Scientific name: *Anacardium occidentale*

Plant family: ANACARDIACEAE

Description: An evergreen tree, with spreading branches, growing 7 - 14 m tall. The canopy can spread to 12 m. The roots grow deeply and spread widely. The shiny leaves are pale green and large. They are 10 - 15 cm long by 6 - 8 cm wide. They have fine veins. The flowers are produced on the ends of the branches. They are red in colour. The kidney-shaped nut is about 3 cm long and is borne below the "apple" which is really a fleshy stalk.



Distribution: It is a tropical plant that suits the lowland tropics but will grow up to about 1,200 m altitude. It only bears well in dry areas because of blight of the flowers. It grows with temperatures between 22 - 26°C. A rainfall of 1,750 mm per year is considered suitable but good yields have been obtained with rainfall of 750 mm. It can grow on poor soils but needs good drainage.

Use: The fleshy "apple" is edible but acid until very ripe. It is used for jams and drinks. It is also candied, made into chutney and pickles. The nut is eaten after roasting. The young shoots and leaves are edible. They are picked during the rainy season and eaten fresh with hot and spicy dishes.

Caution: The oil of the nut can blister the skin until roasted. The apple is used to make spirits.

Cultivation: It is usually grown from seeds. Seeds germinate poorly and slowly. Only nuts which sink in water (or a solution of 150 g of sugar in a litre of water) should be planted. Seeds are sun dried for 2 - 3 days to improve germination. Seeds can be sown in a nursery then transplanted, or more commonly, are sown directly. Trees are spaced 7 - 10 m apart. The crop is cross pollinated mostly by insects. For good production, complete fertiliser or appropriate organic material should be applied. Pruning to shape the tree is often undertaken in the first 2 - 3 years. Cashews are often planted scattered in gardens or amongst other trees. Clearing under the tree prevents fire and makes finding nuts easier. Allowing nuts to fall before harvesting ensures only ripe nuts are collected. Resin in the cashew nut shell can damage hands and discolour the nuts. Roasting the nuts before removing the kernel avoids this.

Production: Trees commence bearing after 3 years. Fruit production is seasonal, normally October - January. Mature nuts are produced in 2 - 3 months. Yields of 80 - 200 kg of nuts per hectare are normal. Trees reach maximum production after 10 years and trees last for about 100 years.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| nut | 4.0 | 2478 | 17.5 | - | - | 2.8 | 4.8 |
| leaf | 69.9 | 418 | 5.2 | - | - | - | - |
| fruit | 84.7 | 213 | 0.8 | 0.12 | 265 | 1.0 | 0.2 |

Nuts, seeds, herbs and other foods

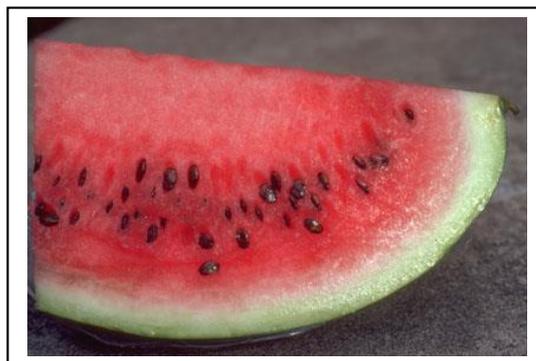
English: Watermelon

Northern Thai: มะแต้

Scientific name: *Citrullus lanatus*

Plant family: CUCURBITACEAE

Description: An annual climber, with deeply divided leaves and tendrils along the vine. It trails over the ground and has hairy, angular stems. The leaves are on long leaf stalks. The leaves are deeply divided along their length. These leaf lobes are rounded and can themselves be divided. The leaves are 5 - 20 cm long by 2 - 12 cm across. The tendrils are divided. The plant has separate male and female flowers on the same plant. The flowers are pale yellow and smaller than pumpkin flowers. The flowers occur in the axils of leaves. The male flowers appear first. Fruit are large and round or oval. They can be 60 cm long. Fruit have a hard smooth skin. Several fruit colours and shapes occur. They often have a dark green mottle, or blotches. The fruit has reddish, juicy flesh and black or red seeds. The seeds are oval-shaped and smooth.



Distribution: It grows in most tropical and subtropical countries. It grows best on the coast in the tropics, but will grow up to about 1000 m altitude. It will not stand water-logging and does well on sandy soils. Plants are frost-sensitive. Seed will not germinate below 21°C. Temperatures between 24 - 30°C are suitable. Fruit are sweeter in arid warm areas. It suits hardiness zones 10 - 12.

Use: The fruit is eaten raw when ripe. Small, unripe fruit can be cooked as a vegetable. The skin is sometimes candied in vinegar and eaten with fish. Seeds are also eaten. They are dried, soaked in salt water, then roasted. Oil is extracted from the seeds. Very young leaves are occasionally eaten. It is a popular fruit.

Cultivation: They are suitable mainly for the dry season. A spacing of 1.5 - 2 m is suitable. They grow easily from seed. They do best when fully exposed to the sun. Seed can be dried and stored. If too much vegetative growth occurs, picking out the tip to produce side branches will produce more fruit.

Production: Harvesting commences after 4 - 5 months. The main fruit season is November to January. The ripeness can be determined by tapping the fruit to get a dull sound. The part of the fruit on the ground changes from green to light yellow and the tendril near the base of the fruit becomes dry when ripe. Fruit yield can be 45 - 60 t/ha.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| fruit | 94.0 | 92 | 0.4 | 20 | 5 | 0.3 | 0.1 |
| seed | 5.1 | 2330 | 28.3 | 0 | 0 | 7.3 | 10.2 |

Nuts, seeds, herbs and other foods

English: Spinach jointfir

Northern Thai:

Scientific name: *Gnetum gnemon*

Plant family: GNETACEAE

Description: A shrub or small tree about 10 m high. It can grow to 20 m high. It normally has a cone-shaped crown. The bark is greyish-brown. The small branches are slender and like a vine. The leaves are produced in pairs opposite each other. They are dark green and shiny, oval and pointed at both ends. The leaves are 7.5 - 12.5 cm long by 2.5 - 7.5 cm wide. Trees are either male or female. Male spikes are 3 - 6 cm long. They consist of 50 - 80 very small flowers in rings along the stalk. Flowers are produced as cones made up of rings of scales along stalks that can be up to 12 cm long. There are 5 - 8 flowers at each node. Fruits are oval and green when young, but red when ripe. Fruit are 2 - 3 cm long and contain one seed.



Distribution: It grows in Asia in Burma, Cambodia, China, India, Indochina, Indonesia, Malaysia, Myanmar, Northern Thailand, and Vietnam, and in the Pacific in Fiji, Palau, Papua New Guinea, Philippines, Solomon Islands and Vanuatu. Trees occur in tropical rainforest from sea level to about 1,200 metres altitude. It can grow on a range of soils but does best on deep well-drained soils. It suits hardiness zones 10 - 12.

Use: Young leaf tips, young flowers, and young fruit are eaten cooked. Ripe fruit are eaten raw or cooked. Fruit should be crushed before cooking or they can explode. Young flowers and fruit need cooking to get rid of irritating substances. The seeds are dried and flattened and then deep fried in hot oil and salt added. It is a popular snack food and an important vegetable.

Cultivation: Trees are grown from seed. When using the seed for growing, a fully-ripe, red fruit is needed. Seeds exhibit a natural dormancy due to a very hard (impermeable) seed coat. Breaking this seed coat can normally hasten germination, or shooting. This is done by boring a hole into the seed. Propagation, or starting new plants, can occur naturally from seeds distributed by birds, or by planting seeds or by cuttings. A spacing of 6 m is suitable, although in rows, they are often sown closer together. Trees appear to establish in the forest understorey, indicating some shade tolerance. Trees recover readily from pruning. Coppicing, or chopping back and letting the plant regrow, can produce a rapid flush of new leaves. Flushes of new leaves tend to occur seasonally. Trees can be topped to keep them shorter. If plants are grown by air-layering, they are shorter and more compact.

Production: Trees produce flushes of young, reddish leaves. Flowers are produced throughout the year. Trees grown from seed take 5 - 8 years to bear fruit. Air-layered trees produce fruit in 2 - 3 years. Leaves are harvested when fully expanded, but still soft and succulent. The fruit are harvested when the skin turns red. Trees can produce 20,000 pieces of fruit per year, each weighing 6 - 7 g.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| leaf | 66.0 | 378 | 5.9 | 308 | 1.5 | 2.7 | 12.1 |
| seed | 13 | 1442 | 12.0 | - | - | 5.0 | - |

Nuts, seeds, herbs and other foods

English: Pink orchid tree

Northern Thai: ตักเสี้ยว

Scientific name: *Bauhinia variegata*

Plant family: FABACEAE

Description: A tree that loses its leaves during the dry season of the year. It grows to a height of 8 - 12 m and spreads to 5 m across. The stem is erect and straight. The leaves are entire to the midpoint, then divided into 2 lobes. The leaves are 10 - 20 cm long and 10 - 15 cm across. The base of the leaves is heart shaped. They are dull blue-green. The veins radiate from the base of the leaf. The leaf stalk is 2 - 3 cm long. The flowers are pink to purple with 5 club-shaped petals. One petal is a different shape and colour. They are produced on stalks around a flowering stalk at the end of branches. The flowers are 8 - 12 cm across. The fruit are pods. They are 20 - 30 cm long and 1.5 - 2.5 cm wide. They are flat and brown and twist as they open. There are 10 - 15 seeds. The seeds are round and flat and 1 cm across.



Distribution: A tropical plant. The minimum temperature is 7°C. They cannot tolerate salt spray. It grows naturally in deciduous forest between 500 and 1,500 m altitude. It can grow in arid places. It suits hardiness zones 9 - 10.

Use: The flowers are used in pickles. They are edible when fried. The young leaves, flowers and fruit (pods) are boiled and cooked as a vegetable. They are also used in relish and chutney. The seeds are eaten after roasting.

Cultivation: Plants can be grown from treated seed. Fresh seeds do not need to be treated, but stored seed do. They are put into hot water then left overnight before planting. (There are 4,200 - 5,700 seed per kg.) Seeds germinate in about 3 weeks.

Production: Trees are fairly fast growing. Trees produce flowers when 3 years old.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|-------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| pod (young) | 70.5 | 468 | 4.4 | - | - | - | - |
| leaf | 78.9 | 291 | 1.8 | - | - | - | - |
| flower | 79.0 | - | 1.8 | - | - | 18.4 | - |

Nuts, seeds, herbs and other foods

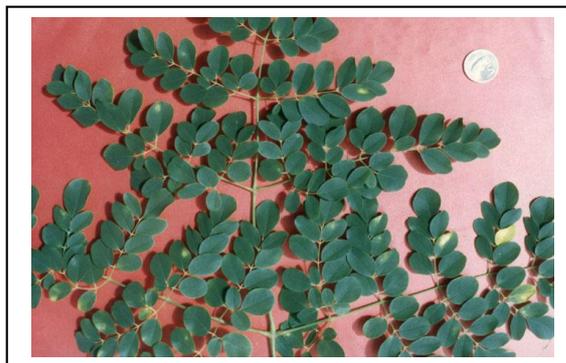
English: Horseradish tree

Northern Thai: มะค้อนก้อม, ผักอี๋ม

Scientific name: *Moringa oleifera*

Plant family: MORINGACEAE

Description: A small, soft-wooded tree that grows 9 - 12 m tall. The tree loses its leaves during the year. The bark is grey, thick, corky and peels off in patches. The leaves are pale green and the leaf is divided 3 times. The whole leaf is 30 - 60 cm long and the leaflets are usually oval and 1 - 2 cm long. The leaflets are jointed with a gland near the joint. The flowers are pale yellow. They occur in long sprays 30 cm long. Each flower has 5 petals and of these one is erect and 4 are bent backwards. The fruit is a long capsule 30 - 100 cm long by 2 cm wide. The seed capsules are up to 45 cm long. They are roughly triangular in shape. The seeds have 3 wings. Often the fruiting kinds are grown as annual plants.



Distribution: A tropical and subtropical plant. They suit the dry lowland areas and grow up to 1,350 m altitude in the tropics. They are not hardy to frost. They cannot tolerate water-logging. A pH of 6 - 7.5 is suitable. It can grow in arid places. It suits hardiness zones 9 - 12.

Use: The young tops and leaves are eaten cooked. They are eaten as potherbs or used in soups and curries. They can be dried and stored for later use. The very young long pods are eaten cooked, especially in curries and soup. They are also pickled. The young seeds are eaten roasted or fried. Sometimes the roots are used as a horseradish substitute. A gum from the bark is used as seasoning. The bark is used for tea. The roots, leaves, flowers and fruits are eaten cooked in water and mixed with salt and chili peppers. The oil expressed from the seeds is used in salads.

Cultivation: It is best to grow plants from 1 metre long cuttings but they can be grown from seed. They can be used as a hedge and pruned regularly to produce more leaves. Properly dried seed can be stored for a long time in sealed containers in a cool place. Normally perennial types are grown from cuttings and annual types are grown from seed.

Production: Trees are fast growing. They can be pruned or topped. With one variety the tree flowers and fruits continuously while with the other variety there are flowers and fruit once per year. The fruit ripens 3 months after flowering. Annual types produce fruit 6 months after planting. Leaves are best dried in the shade to retain more of their Vitamin A.

Food Value: Per 100 g edible portion

| Edible part | Moisture % | Energy kJ | Protein g | proVit A µg | proVit C mg | Iron mg | Zinc mg |
|---------------|------------|-----------|-----------|-------------|-------------|---------|---------|
| leaf | 76.4 | 302 | 5.0 | 197 | 165 | 3.6 | - |
| flower | 84.2 | 205 | 3.3 | - | - | 5.2 | - |
| leaf (boiled) | 87 | 189 | 4.7 | 40 | 31.0 | 2.0 | 0.2 |
| pod (raw) | 88.2 | 155 | 2.1 | 4 | 141 | 0.4 | 0.5 |
| seed | 6.5 | - | 46.6 | - | - | - | - |

Nutritional values of food plants by plant Family

| Plant Family | Scientific name | Common name - English | Central Thai name | Phonetic Central Thai | Northern Thai Name | Edible part | Moisture % | Energy kJ | Protein g | Vit A µg | Vit C mg | Iron mg | Zinc mg | Page |
|----------------|--|-----------------------|-------------------|-----------------------|--|-----------------|------------|-----------|-----------|----------|----------|---------|---------|------|
| AMARANTHACEAE | <i>Amaranthus tricolor</i> | Amaranths | ผักขม | pækħɔ̃əm | ผักขม | leaf | 91.7 | 96 | 2.5 | 292 | 43.3 | 2.3 | 0.9 | 32 |
| AMARANTHACEAE | <i>Celosia trigyna</i> | Silver spinach | ปวยเล้ง? | | ปวยเล้ง? | leaf | 89.0 | 139 | 2.7 | 94 | 10 | 5.0 | - | 33 |
| AMARYLLIDACEAE | <i>Allium ampeloprasum</i> | Giant garlic | กระเทียมต้น | krætɛəm 'tɔ̃n | หอมเป็น | leaf | 79.0 | - | 1.8 | - | 116 | 25.5 | - | 31 |
| ANACARDIACEAE | <i>Anacardium occidentale</i> | Cashew | มะม่วงหิมพานต์ | mæ'mɔːŋħim pɛə̃n | มะม่วงหิมพานต์ | nut | 4.0 | 2478 | 17.5 | - | - | 2.8 | 4.8 | 50 |
| APIACEAE | <i>Coriandrum sativum</i> | Coriander | ผักหอมป้อม | pækħæm'pɔ̃m | ผักป้อม | leaf (dry) | 7.3 | 1167 | 21.9 | 585 | 567 | 42.5 | 4.7 | 48 |
| ARACEAE | <i>Colocasia esculenta</i> | Taro | เผือก | pɜːæk | เผือก | root | 66.8 | 1231 | 1.96 | 3 | 5 | 0.68 | 3.2 | 17 |
| ASTERACEAE | <i>Guizotia abyssinica</i> | Niger seed | งาญี่ปุ่น | | งาญี่ปุ่น | seed | 6.2 | 2019 | 17.3 | - | - | - | - | 23 |
| BRASSICACEAE | <i>Brassica oleracea var. alboglabra</i> | Chinese broccoli | ผักคะน้า | pa?kə̃nəːə | ผักคะน้า | flower (cooked) | 93.5 | 92 | 1.1 | 164 | 28.2 | 0.6 | 0.4 | 42 |
| CONVOLVULACEAE | <i>Ipomoea Aquatica</i> | Kangkong | ผักบุ้งไทย | pæk' bə̃ŋtəi | ผักบุ้ง | leaf | 90.3 | 126 | 3.9 | 315 | 60 | 4.5 | - | 34 |
| CONVOLVULACEAE | <i>Ipomoea batatas</i> | Sweet potato | มันเทศ | mən'teə? | มันแกว | tuber (baked) | 72.9 | 431 | 1.7 | 961 | 24.6 | 0.5 | 0.3 | 40 |
| CUCURBITACEAE | <i>Citrullus lanatus</i> | Watermelon | แตงโม | tæŋmɔ | มะเดื่อ | seed | 5.1 | 2330 | 28.3 | 0 | 0 | 7.3 | 10.2 | 51 |
| CUCURBITACEAE | <i>Cucurbita maxima</i> | Pumpkin | ฟักทอง | fækħɔ̃ŋ | มะพร้าวแก้ว | seed (dry) | 6.9 | 2264 | 24.5 | 38 | 1.9 | 14.9 | 7.5 | 44 |
| CUCURBITACEAE | <i>Lagenaria siceraria</i> | Bottle gourd | น้ำเต้า | næm'dtəu | มะเดื่อ, น้ำเต้า | bean (dry) | 3.2 | 2399 | 28.2 | - | - | 5.3 | - | 16 |
| CUCURBITACEAE | <i>Momordica charantia</i> | Bitter cucumber | มะระขม | mæɾæ'khɔ̃əm | มะระ, มะข่อย | pod (raw) | 94.0 | 71 | 1.0 | 380 | 84 | 0.4 | 0.8 | 45 |
| FABACEAE | <i>Bauhinia variegata</i> | Pink orchid tree | ชงโค | ʃɔ̃ŋ'kɔ | ผักเสี้ยว | flower | 79.0 | - | 1.8 | - | - | 18.4 | - | 53 |
| FABACEAE | <i>Canavalia gladiata</i> | Sword bean | ถั่วพริ้ว | tɔ̃əpɾiːə | ถั่วพริ้ว | seed | 15.0 | 1335 | 27.1 | - | - | - | - | 26 |
| FABACEAE | <i>Glycine max</i> | Soybean | ถั่วเหลือง | tɔ̃əʔːəŋ | ถั่วเหลือง | seed | 9.0 | 1701 | 33.7 | 55 | - | 6.1 | - | 25 |
| FABACEAE | <i>Neptunia oleracea</i> | Water mimosa | ผักกระเจ็ด | pækɾæ'ʃɛd | ผักกระเจ็ด | leaf | 88.0 | 142 | 5.2 | 114 | - | 3.0 | - | 47 |
| FABACEAE | <i>Pachyrhizus erosus</i> | Yam bean | มันแกว | mənkeəw | มะเดื่อ, มันสะเวก, มะกะตู่, มันแก้วลาว | seed | 8.1 | - | 38.5 | 345 | - | 1.3 | - | 27 |
| FABACEAE | <i>Phaseolus vulgaris</i> | Common bean | ถั่วแขก | 'tɔ̃əkæk | ถั่วแขก | seed (dry) | 10 | 1386 | 25 | 10 | 1 | 8 | 2.8 | 28 |
| FABACEAE | <i>Psophocarpus tetragonolobus</i> | Winged bean | ถั่วพู | tɔ̃əpu | ถั่วพู | seed | 8.5 | 1764 | 41.9 | 0 | - | 15 | 4.5 | 30 |
| FABACEAE | <i>Sesbania grandiflora</i> | Sesbania | แคร์ | keə | แค, ผักบุ้งลิง | seed | 10.4 | - | 68.2 | - | - | - | - | 24 |
| FABACEAE | <i>Tamarindus indica</i> | Tamarind | มะขาม | 'mækħæəm | มะขาม | fruit | 38.7 | 995 | 2.3 | 20 | 60 | 1.1 | 0.7 | 36 |
| FABACEAE | <i>Vicia faba</i> | Broad bean | ถั่วปากอ้า | tɔ̃əpækə | ถั่วปากอ้า | seed (dry) | 10 | 1448 | 26.2 | 130 | 16 | 6.7 | - | 29 |
| FABACEAE | <i>Vigna umbellata</i> | Rice bean | ถั่วแดง ถั่วแป็ | | ถั่วแดง ถั่วแป็ | seed | 13.0 | 1373 | 20.9 | - | - | 10.9 | - | 22 |
| GNETACEAE | <i>Gnetum gnemon</i> | Spinach jointfir | ผักเหมียง | pæk' miːŋ | | leaf | 66.0 | 378 | 5.9 | 308 | 1.5 | 2.7 | 12.1 | 52 |
| MALVACEAE | <i>Corchorus olerius</i> | Bush okra | ขบถ | pɔːkrə'ɔ̃tɕəu | พื้อม่าน | leaf (raw) | 80.4 | 244 | 4.5 | 574 | 80 | 7.2 | - | 43 |
| MORINGACEAE | <i>Moringa oleifera</i> | Horseradish tree | มะรุม | mæɾɔ̃m | มะค้อนก้อม, ผักอีเอ็ม | leaf | 76.4 | 302 | 5.0 | 197 | 165 | 3.6 | - | 54 |
| MYRTACEAE | <i>Psidium guajava</i> | Guava | ฝรั่ง | fə' ræŋ | มะเดื่อ, มะกั่วแก้ว, มะมัน | fruit | 77.1 | 238 | 1.1 | 60 | 184 | 1.4 | 0.2 | 35 |
| PEDALIACEAE | <i>Sesamum indicum</i> | Sesame | งา | | งา | seed (dry) | 4.7 | 2397 | 17.7 | 1 | 0 | 14.6 | 7.8 | 20 |
| PHYLLANTHACEAE | <i>Phyllanthus emblica</i> | Emblic | มะขามป้อม | mækħæm'pɔ̃m | มะขามป้อม | fruit | 78.4 | 281 | 0.6 | - | 316 | 0.9 | 0.5 | 39 |
| POACEAE | <i>Setaria italica</i> | Foxtail Millet | ข้าวฟ่างหางกระรอก | | ข้าวฟ่างหางกระรอก | seed | 13.5 | 1425 | 9.5 | - | - | 5.5 | - | 19 |
| POACEAE | <i>Sorghum bicolor</i> | Sorghum | ข้าวฟ่าง | | ข้าวฟ่าง | seed | - | 1459 | 11.1 | 0 | - | - | - | 21 |
| RUTACEAE | <i>Aegle marmelos</i> | Bael fruit | มะขุม | mætəm | มะปิ่น | fruit | 58 | 577 | 2.3 | 0.13 | 219 | 0.55 | - | 37 |
| RUTACEAE | <i>Citrus maxima</i> | Pomelo | ส้มโอ | səmɔ | มะโอ | fruit | 90.3 | 175 | 0.6 | 20 | 37 | 0.4 | - | 38 |

| Plant Family | Scientific name | Common name - English | Central Thai name | Phonetic Central Thai | Northern Thai Name | Edible part | Moisture % | Energy kJ | Protein g | Vit A µg | Vit C mg | Iron mg | Zinc mg | Page |
|---------------|--------------------------|-----------------------|-------------------|-----------------------|--------------------|-------------|------------|-----------|-----------|----------|----------|---------|---------|------|
| SOLANACEAE | <i>Solanum melongena</i> | Eggplant | มะเขือม่วง | mæk3:ə'mɔ:w Λη | มะเขือม่วง | fruit | 91.8 | 117 | 0.83 | 6 | 1.3 | 0.4 | 0.2 | 46 |
| ZINGIBERACEAE | <i>Alpinia galanga</i> | Greater galangal | ข่า | ka | ข่า | rhizome | 85.9 | 213.5 | 1.0 | - | - | 2.1 | - | 49 |



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