



PLANT FACT SHEET

Psophocarpus tetragonolobus (L.) DC

GENUS *Psophocarpus* FAMILY Fabaceae

COMMON NAMES Winged bean

EDIBLE PARTS AND USES

Edible parts: Seeds, Pods, Leaves, Flowers, Roots, Vegetable

The young pods are edible.

The ripe seeds are edible.

The young leaves are edible.

The flowers are edible.

The root tubers are edible.

The seeds can be used to extract an edible oil.

DESCRIPTION

A climbing perennial bean up to 3 or 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. The leaf stalks are long. The leaflets are 8-15 cm long. The flowers are blue or white. They occur on the ends of branches from within the axils of leaves. Pods have wavy wings or are roughly square in cross section. They are 6-36 cm long with 5-30 seeds. Seeds can be white, yellow, brown or black. They are bedded in the solid tissues of the pod. The seeds are round smooth and brown with a small hilum. Nodules on the roots are many and large.

HABITAT

A tropical plant. The bean grows from sea level up to about 1850 m altitude in the tropics. It normally only produces tubers between 1200 and 1850 m. Because of the effect of daylength it will not produce flowers or pods at places far removed from the equator. Photoperiodism limits pod availability in higher latitudes but this should not be significant in the equatorial latitudes. Winged bean is a short day plant. It needs a daylength less than 12 hours. Winged bean is a plant ideally suited to the tropics including the hot humid lowlands. Papua New Guinea is a centre of diversity for winged beans and they are grown in many areas of the country. They can be seen from sea level up to about 2300 m altitude although they are less common above 1850 metres and normally only produce tubers between 1200 and 1850 m altitude. For maximum seed production winged beans need temperatures between 23°C and 27°C and for tubers the temperatures should be between 18°C and 22°C. This means the main areas of production occur between 20°N and 10°S latitudes. Winged beans can grow on a wide variety of soils. Winged beans have been grown on soils with pH from 3.6 to 8.0. Soils which are very acid have soluble aluminium to which winged beans are sensitive. Soils should not be waterlogged. In Yunnan.

PRODUCTION

Cultivation

Seeds are sown at the beginning of the rainy season. Seeds germinate and grow slowly for the first 3 or 5 weeks. For tubers, vines are pruned off at about 1 m high (or left unstaked) and some flowers are removed.

Winged beans are grown for their edible roots, edible leaves, edible flowers, edible pods and edible seeds. The cultivation procedures vary slightly depending on which product is the preferred goal. The two main types of winged bean are short podded ones which are used for tubers and long podded ones which have poor tubers. Tuber production is not as efficient in tropical lowland conditions.

Production is from seed.

Phases of development:-

1. Germination 5-16 days;
2. Vegetative growth till flower buds 46-92 days;
3. Flowering duration ?
4. Pod development 10-13 weeks after planting;
5. Tuber development 4-5 months after planting.

Winged beans are predominantly self pollinated but limited out-crossing has been reported. Hard seed coats have been reported from dried stored seed. The amount of vegetative growth increased with increasing pH from 4.7 to 5.5. Nitrogen percentage in tissues increased with pH from 4.7 to 6.2. Winged beans have been grown in soils with pH between 3.6 and 8.0. Winged bean is sensitive to aluminium in soil solution. Plants are intolerant of water-logging. Flowering is inhibited by low levels of solar radiation. Shading improves pod length and seed number. Root knot nematode can cause severe damage in some places.

Seeds are planted 2-3 cm deep and about 25-35 cm apart. If seeds have been dried and stored then they can suffer from hard seed coats and this delays the germination of seeds. But normally seeds start to grow in about 15 or 16 days. Plants grow slowly to start with so weeding is important but then they grow rapidly. After 46 to 92 days they are producing flowers. If fattened roots are important some of the leaves and flowers and tips are pruned off at this stage. These can be eaten. Pods develop 10 to 13 weeks after planting and tubers occur 4-5 months after planting.

For tubers production plants are planted seasonally to allow them to mature during the dry season. Winged beans need to be staked for high yields. Winged bean root nodules containing Rhizobia bacteria are very large, inoculation occurs easily and naturally and nitrogen fixation is efficient. This both enables winged beans to grow well and have a high protein content but can also help provide nitrogen in the soil for other plants.

Harvesting and Seed 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 to 330 g per plant can be produced depending on variety. Tuber yields of 5500 to 12000 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.

Planting instructions

Winged bean

Scientific name: *Psophocarpus tetragonolobus*

The plant.

The winged bean is a climbing bean which produces pods with four wings along the side. This is why it is called winged bean in English. Under the ground it produces a thickened root or tuber which is eaten. This is where the Tok Pisin name asbin comes from. The seeds are round.

The two main types of winged bean are short podded ones which are used for tubers and long podded ones which have poor tubers. But a very large number of winged bean varieties occur in Papua New Guinea.

What's so special about winged beans?

Winged beans have recently been "discovered" by scientists and other people around the world. They have called it a plant with "exceptional merits"; a "miracle plant"; a "supermarket on a stalk" and many other excited comments. The reasons for these comments are because winged beans:-

1. Grow well in the hot humid tropics;
2. Almost all parts of the plant can be eaten;
3. All parts of the plant have high food value, especially protein;
4. Winged beans generally suffer less from damage of bean insects, pests and diseases than other beans;
5. They are very good at fixing nitrogen for their own growth as well as for other plants.

Where do winged beans grow?

In Papua New Guinea, winged beans are grown in many areas of the country. They can be seen from sea level up to about 2300m altitude although they are less common above 1850 metres and normally only produce tubers between 1200 and 1850m altitude. They are common in Sepik areas in the lowlands and in the mid altitude highland regions especially the Eastern Highlands and Western Highlands.

For maximum seed production winged beans need temperatures between 23o and 27oC and for tubers the temperatures should be between 18o and 22oC.

Winged beans can only be grown in the tropics because flowers and seeds are not formed in countries out of the tropics. But they are grown in a number of other tropical countries particularly in the Asian region.

Winged beans can grow on a wide variety of soils. The acidity of soils is measured on a scale from 0 to 14 and it is called the pH scale. Better soils are near neutral or 7. Winged beans have been grown on soils with pH from 3.6 to 8.0. This is a wide range. When soils become very acid, the aluminium that is common in clays in soil can get into solution and into plants. Aluminium is not a plant nutrient and is not needed by plants. Winged beans are sensitive to aluminium in soil solution.

Soils should not be waterlogged.

Growing winged beans.

Seeds are planted 2-3cm deep and about 25-35cm apart. If seeds have been dried and stored then they can suffer from hard seed coats and this delays the germination of seeds. But normally seeds start to grow in about 15 or 16 days. Plants grow slowly to start with so weeding is important but then they grow rapidly. After 46 to 92 days they are producing flowers. If fattened roots are important some of the leaves and flowers and tips are pruned off at this stage. These can be eaten. Pods develop 10 to 13 weeks after planting and tubers occur 4-5 months after planting.

For tubers, plants are planted at special times to allow them to develop during the dry season.

Winged beans need to be staked for high yields. Stalks from pitpit are sufficient.

All beans have special bacteria (Rhizobia) which attach to the roots and enable beans to take nitrogen out of the air and change it into nutrient nitrogen that plants can use. With winged beans the lumps or nodules that contain these bacteria are very large, they form very easily even in soils where beans haven't been grown before

and they work very efficiently as well. They enable winged beans to grow well, help them have a high protein content and can also help provide nitrogen in the soil for other plants.

How much food is produced?

Winged beans are mostly grown for their tubers, pods and leaves. Dry beans are not used a lot in Papua New Guinea although firm mature beans are eaten fresh from cooked pods.

A single plant can produce up to 75 pods.

Dry bean yields of 45 to 330g per plant can be produced depending on variety.

Tuber yields of 5500 to 12000 kg per hectare have been produced.

Winged beans as food.

Seeds can contain a chemical (trypsin inhibitor) which stops the protein being properly digested by our bodies. This chemical is destroyed if seeds are soaked then boiled well. Tubers can also contain this chemical and need to be well cooked.

One of the main things about winged beans is that they are good at providing protein. The protein content of the different parts varies between varieties but some of the amounts are indicated below.

Protein (g per 100g)

seeds 29.8 - 42.5

fresh tubers 2.27 - 8.05

fresh leaves 4.55 - 11.81

fresh pods 1.31 - 2.73

flowers 1.25 - 2.65

This means all parts of the winged bean plant are very good for providing protein. They are also good sources of vitamins, minerals and energy.

Winged bean tubers are tied in bundles and sold in markets. They won't keep for very long so need to be treated carefully and eaten quickly. In villages the most popular way to cook them is in a mumu in an earth oven. They are dry and firm and very nice tasting.

The leaves and flowers are mostly boiled.

Although pods are often roasted then the beans just eaten from the pod as it is split open, the beans have more food value if they are soaked then boiled.

What insects damage winged beans?

Bean fly (*Ophiomya phaseoli*)

The bean fly can burrow into the young stems of seedling winged beans. This weakens the plants slowing down growth and causing plants to fall over. They suffer less of this damage than common bean.

Bean pod borer (*Maruca testulalis*)

The caterpillar of this moth is yellow with brown or black spots along the body. They are thin and up to 25mm long. The moth lays eggs singly on the flowers then the larvae bore into the young pods leaving chewed up plant material over the hole where they bored in.

Winged bean blotch miner (*Leucoptera* sp.)

This small leaf miner can cause serious damage in drier areas.

A number of other insects also damage winged beans.

What diseases does winged bean get?

False rust (*Synchytrium psophocarpi*)

This light brown coloured fungus is well known to most village winged bean growers. The fungus can commonly be seen on pods and also grows on the leaves, stems, and flower buds. It makes the pods less attractive to eat. (Because fungi are often too small to see, this fungus disease is often a good one to use to teach people in villages about disease and what fungi are.) The disease spreads with temperatures between 10°C and 25°C and when there is moisture on the plant surface.

Leaf spot (*Pseudocercospora psophocarpi*)

This fungal leaf spot grows on the leaves. It starts as small yellow spots on the top of the leaves and it is grey to black underneath. The whole leaf can become infected and die particularly during the rainy season. All varieties of winged bean get the disease.

Powdery mildew (*Erysiphe cichoracearum*)

This fungus causes a disease that looks like a white powder on the upper surface of the leaves. It grows on older leaves and the leaves become pale then die and fall off. It is most likely that this fungus is the same one that grows on cucumbers.

Collar rot (*Macrophomina phaseolina*, *Rhizoctonia solani* & *Fusarium* spp.)

These fungi cause the roots to die or the stem to die near the ground level. So the young plant (3 to 4 weeks old) is seen to wilt. If you look carefully the stem is more narrow near the ground and black dead spots occur on it. This disease can probably be avoided by planting seeds more shallowly and in well drained soils.

What other pests damage winged bean?

Root knot nematodes (*Meloidogyne* spp.)

These very small worms (too small to see without special equipment) live in the soil and damage the roots of many different plants. They burrow into the roots and the damaged root becomes thick and twisted and no longer works properly to provide nutrients or water for the plant. With winged beans (and other beans) it is important to be able to tell the difference between this root damage, and the good root tuber and the helpful bacteria which attach to the roots and help the plant fix nitrogen.

If you pull up a plant and look at the roots, the bacteria nodules are just on the side of the roots (should be red inside if they are working properly) and can be pulled off the roots without damaging the roots. Root knot nematode is a twisted damaged root and cannot be pulled off. The asbin tuber is the developing fattened central root.

NOTES

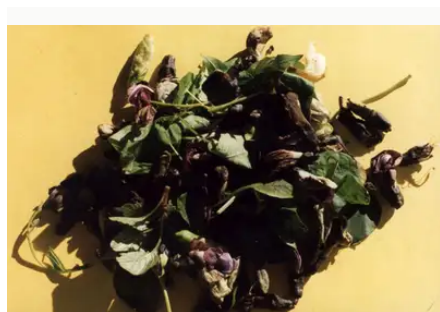
Demo.

Seeds are rich in tocopherol - Vitamin A (126 mg/100 g fresh weight)

PICTURES



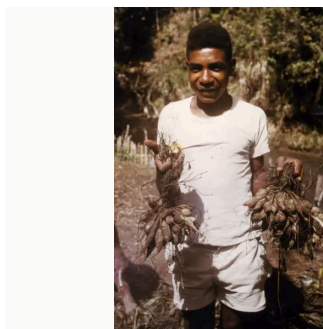
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