

Winged Bean – A Nutritionally Rich Underutilized Legume Crop

Karande P.J.

Ph.D Research Scholar Department of Vegetable Science CCSHAU, Hisar, Haryana

SUMMARY

Winged bean [*Psophocarpus tetragonolobus* (L.) DC] is a protein-rich, underutilised tropical leguminous vegetable. Winged bean thrives in hot, humid equatorial climates. India, Burma, Sri Lanka, Indonesia, Malaysia, Thailand, Philippines, Indo-China, China, and Papua New Guinea are the biggest producing countries in Asia. It has a strong nitrogen fixing capacity due to the presence of numerous nodules in the root system, and the leaves have outstanding protein quality. This neglected crop has the potential to combat malnutrition while also providing nutritious fortification. There is a significant degree of variability in the germplasm lines of winged bean, which allows plant breeders to seek improvements in seed, vegetable, tuber yield, and quality characteristics. This promising crop is resistant to the negative effects of abiotic stressors and can thrive in marginal upland settings. It can be introduced as a source of income in marginal upland areas, particularly for resource-poor communities in these locations. Proteins found in legumes have a low nutritive value, which can be linked to a lack of sulphur-containing amino acids, less digestible proteins, and anti-nutritional components. As a result, winged bean is recommended for commercial cultivation in order to improve soil health and diversity in field settings. When it reaches the plates of hungry people, it improves human health and, as a result, aids in the resolution of malnutrition issues.

INTRODUCTION

Because of its high nutritionally rich green pods, tuberous roots, leaves, immature and mature seeds, the winged bean is often regarded as the 'One Species Supermarket.' The leaves are eaten as spinach, the blossoms as salad, the tubers as raw or processed food, and the seeds in various forms of processed cuisine. Because of its vining tendency and ability to fix nitrogen, it is utilized as a cover crop and is also incorporated into rotation or intercropping systems. As a result, based on sophisticated and more sustainable farming systems, winged bean could be a strong choice for diversifying diets to increase nutritional security. When compared to other important crops, winged bean is a prospective climatic robust crop for adaptability under suboptimal weather circumstances such as drought, flood, heat, and biotic stressors. Growing understanding of the relevance of agro-biodiversity in sustainability, socioeconomic resilience, and human health has resulted in re-diversification of agro-biodiversity through the use of neglected and underutilized crop species. Despite its high quality and international attention, winged bean farming in our country has been limited to non-traditional places. Recognizing the crop's importance in the face of changing climatic circumstances and rising health consciousness in human civilization, winged bean is regarded as one of the future crops that is likely to play a critical role in global food and nutritional security. Recent technology, such as genomics and phenomics tools, as well as precision agriculture approaches, can play a significant role in increasing crop output.



The genus *Psophocarpus* is a member of the legume family Fabaceae and the subfamily Papilionoideae. The plants are herbaceous perennials, but they are typically grown as annuals. It is a climbing vine crop with a wiry stem that can reach a height of 4 m or more if the stacking given is tall enough. The stem is normally green, but some kinds have purple, pink, or brown stems. The leaves are trifoliate and alternating, with an oval to oblong stipule on the whole border. The inflorescence is axillary, raceme-like, and bears a large

number of flowers. The calyx tube is long, the inflorescence is axillary, and the raceme has 4-10 flowers. The vines range in height from 3 to 4 m. The colour of the blossom ranges from white to deep purple, mostly blue, bluish white, and so forth. The best time to see flowers is between 10 a.m. and 12 p.m. The plant produces pods of varying lengths and shapes. Pods are classified into four categories based on their shape: rectangular, semi-flat, flat on sides, and flat on suture. The pods are four-angled, 15-22 cm long, and 2-3 cm wide, with each angle continuing into a crisped and papery wing. Wings on pods can be undulated, dented, or serrate. Each pod contains 5-20 seeds, which are smooth, lustrous, and globular in shape and weigh an average of 250 mg. They burst from ripe pods, and the seed colour changes to brownish as it ripens. The seeds are spherical in shape and have a scent that is comparable to asparagus.

This crop's diversity has been seen in Papua, New Guinea, Mauritius, and India, with the greatest variance occurring in Papua and New Guinea. It is mostly farmed as a backyard crop by tribals in eight Indian states, including Assam, Manipur, Mizoram, Kerala, Tamil Nadu, and Karnataka. The good trial findings provide a ray of hope for its effective cultivation in the North Indian plains as well.

Nutritional importance Winged bean has been identified as a crop with great potential for nutritional security in the coming decades. The development of immunity against infections, the maintenance of blood vessel flexibility, and the prevention of cancer.

Table. 1 Nutritive value of winged bean per 100 g

Principle	Nutrient Value	Percent of RDA
Energy	49 Kcal	2.5%
Carbohydrates	4.31 g	3%
Protein	6.95 g	12%
Total Fat	0.87 g	3%
Cholesterol	0 mg	0%
Vitamins		
Folates	66 µg	16.5%
Niacin	0.900 mg	6%
Pantothenic acid	0.059 mg	1%
Pyridoxine	0.113 mg	9%
Riboflavin	0.100 mg	8%
Thiamin	0.140 mg	12%
Vitamin A	128 IU	4%
Vitamin C	18.3 mg	30%
Electrolytes		
Sodium	4 mg	<1%
Potassium	240 mg	5%
Minerals		
Calcium	84 mg	8%
Copper	0.051 µg	5.5%
Iron	1.5 mg	19%
Magnesium	34 mg	8%
Manganese	0.218 mg	9%
Phosphorus	37 mg	5%
Selenium	1.5 µg	3%
Zinc	0.39 mg	3%

(Source: USDA National Nutrient data base)

Adaptation amid changing climatic conditions

Winged bean is more resistant to drought, flood, harsh temperatures, pests, and illnesses than other main staple crops. Diversifying global food systems using this vegetable can be a beneficial tool in

combating extreme weather patterns or the effects of long-term climate change while addressing the problem of nutritional imbalances that the world is currently facing. To deal with the negative effects of climate change and population strain on global food systems, it is anticipated that food supply must be doubled by 2050. Diversification of basic crops and the systems in which they thrive is critical for future agriculture to be sustainable, robust, and appropriate for local ecosystems and soils. A recent study paints a bleak picture of worldwide food consumption trends, urging people to consume a larger range of food sources in order to address malnutrition and global food insecurity, both of which are anticipated to worsen. This indicates that people should eat more of the world's underutilized crops, sometimes known as 'potential' or 'minor' crops.

The ability to eat practically all parts of the plant, including leaves, flowers, tuberous roots, pods, and seeds, is one distinguishing trait of the winged bean, whereas stems and leaves are utilized as fodder. Because of its ability to fix nitrogen, it is also useful in crop rotation. However, as with many neglected crops, there are anti-nutritional components in winged bean (particularly trypsin inhibitors), which necessitate thorough soaking, rinsing, and heating of the dried beans, which may prevent wider acceptance of winged bean in human diet. It also has a high concentration of vitamins A and C, calcium, and iron. Winged bean is a candidate crop that can help diversify human diets and enhance nutrition in regions where protein insufficiency is significant or access to meat protein is limited. The winged bean is mostly a self-pollinated crop, but cross pollination of up to 7.6 percent has been documented. It is a short-day plant, with maximal flower-bud opening between 10 a.m. and 12 p.m. Caging winged bean plants resulted in considerable output reduction and delayed fruit development by excluding pollination agents. This suggested that insect pollination promotes fruit set in winged bean. The stigma is responsive for up to 34 hours after the flower opens. Anther dehiscence happens even before the bloom opens. In light of the foregoing, winged bean is thought to be mostly self-pollinated, with a level of cross pollination ranging from 0 to 7.6 percent. Flowers are hermaphrodite and pale blue in colour.

Varieties

- AKWB-1- It is dual purpose variety used as vegetable and pulse.
- IWB-1- High yielding, medium duration variety and test weight is 36-38 g.
- IWB-2- This variety is amenable for seeds, green pods and fodder.
- Chhattisgarh Pankhiya Sem-2- It is a dual purpose variety performing well under backyard (badi situation) at tribal people of Chhattisgarh

Cultivation

Soil and climatic requirements

The field is ploughed to a depth of 3-4 cm and has a very fine tilth. The goal of land preparation is to create the ideal soil conditions for plant and root growth. Sandy to heavy clay soils, well-drained sandy loam, rich in organic matter, and with a pH of 4.3-7.5 are desirable. A hot and humid atmosphere is perfect for growing winged bean. It can withstand temperatures ranging from 15.4 to 27.5°C and yearly rainfall ranging from 700 to 4100 mm. Flowering occurs from mid-September through October when the days are short. Regardless of the prevalence of short days, temperatures above 32°C or below 18°C limit flowering. The crop thrives well up to 2,000 m in elevation.

Method of sowing and seed rate

Seeds are the most common way to grow winged bean, however stem cuttings can also be employed in some circumstances. The optimum seed rate per hectare is 15-20 kg/ha. Seeds, on the other hand, have a hard seed coat and should be pre-soaked for 1 - 2 days. The seeds are sown at a depth of 3 - 4 cm, and they germinate in 5-7 days. The optimal mean temperature for crop growth is 25°C, and the North-South orientation of the trellis is preferable for proper sunshine exposure. The ideal spacing for commercial crops is 90 cm 90 cm and 45 cm 45 cm for seed crops. In the event of dwarf kinds, a spacing of 30 cm 20 cm might be used.

Time of sowing

Normally, the winged beans are sown in June-July, with the arrival of the monsoon. Because early seeding results in profuse vegetative growth and may impair tubulisation, tuber crops should be sown in August-September.

Integrated nutrient management

As a leguminous crop, winged bean has a high nodulation rate. This legume crop does not require inoculation with nitrogen-fixing bacteria for vigorous growth because it grows swiftly and fills the soil with nitrogen, especially when ploughed. Tropical soils are often nitrogen deficient, yet winged bean survives even in poor soils, owing to its ability to fix atmospheric nitrogen. Winged bean, like other legumes, exhibits indications of aluminium poisoning in acidic soils. The crop requires 20 tonnes/ha FYM and a N:P:K fertiliser dosage of 50:80:50 kg/ha. The full P and K doses, as well as a split dose of nitrogen, are applied at the time of sowing, with the remaining dose of nitrogen top dressed at 40 to 60 DAS. Weed management Winged bean grows quickly and offers plant cover within one month of seeding. To manage weeds during the early development period, however, one-handed weeding at 15-20 DAS is essential. Due to unpredictable stem growth, staking is a critical strategy for obtaining a good and quality yield in winged bean. Several staking tactics are in use, depending on agricultural use and resource availability. Plants produced for tuber output, for example, are permitted to trail across the ground, however if the legume is grown just for the pods, short stalks are employed for continual plucking of green tender pods. Vine assistance is also required for increased seed output.

Plant protection

In India, there have been no substantial reports of insect-pest and disease incidence on winged bean. The most serious fungal infections are false rust (*Synchytrium psophocarpi*) and leaf spot (*Pseudocercospora psophocarpi*). Similarly, the crop may be harmed by *Maruca testulalis* and *Hermoceplachna signatipennis*, as well as root knot nematodes. As a result, appropriate plant protection measures can be implemented to reduce crop losses.

Harvesting and Post-harvest management

The shoots and leaves are harvested while they are still tender. Green pods can be collected approximately 10 weeks after planting. Fresh pod and tuberous root yield 5-10 t/ha, respectively, whereas seed output ranges from 1-1.5 t/ha. To keep the winged bean fresh, store it in plastic bags that are tightly wrapped at the neck. Under storage conditions of 10°C and 90% relative humidity, the shelf life of the pods can be extended to 4 weeks.

Future thrust and Prospects

Winged bean is a viable option for growing in tropical areas of the world due to its outstanding nutritional quality and tropical adaptation. Previous research attempts were impeded by a paucity of genetic resources and information on which to create the key foundation that can fuel research activities. More importantly, efforts must be undertaken to gather, conserve, and utilise the largely eroding genetic resources, as well as raise knowledge of their existence among the local people, particularly the young generation, thereby increasing their consumption. Establishing an enabling policy, as well as financial aid from government agencies and the backing of non-governmental groups, will be crucial to advancing research and development initiatives. Nonetheless, the nutritious value of this bean necessitates such efforts. There is no question that increased research efforts will propel winged bean forward and turn this orphan legume crop into a global player.

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