

Winged bean: A one stop supermarket

Mizoram is blessed with rich agro-biodiversity with favourable climatic conditions. Winged bean is a sporadically distributed crop of Mizoram that has been grown with least management and owns rich diversity. It holds high nutritional value and requires the least management practices. Also, due to its high root nodulating property, it improves soil fertility. As all of its parts can be used for consumption therefore it is called as one stop supermarket and supermarket on a stalk. Greater use of this underutilized crop has the potential to increase crop diversification and improve quality of human diets with sustainable and resilient food production system. However, this crop is grown as rainfed crop without proper agronomic management thus reducing the potential yield of the crop. Therefore, it is important to use scientific cultivation practices with the use of high yielding varieties or local germplasms. This article highlights scientific cultivation practices along with disease and pest management including post-harvest and value addition options for this crop.

WINGED bean [*Psophocarpus tetragonolobus* (L.)] is an underutilized potential crop belonging to family Fabaceae, self-pollinated tropical legume crop popularly known as Goa bean, four-angled bean, and asparagus pea. It is twining crop having tuberous root, longitudinally winged pods and grow generally as annual crop. South-eastern Asia or Papua New Guinea are probable centre of origin for this crop. This plant grows well in hot and humid climatic condition including India, Indonesia, Malaysia, Philippines, Bangladesh, Sri Lanka and Myanmar. In India, it is generally cultivated in southern and north-eastern region, viz. Mizoram, Tripura, and Manipur. In Mizoram, it is locally called as 'Bepuithlanei' and generally consumed as raw, for soup, chutney and vegetable. Almost all the parts of winged bean including green tender pods, immature and mature seeds, leaves and tubers are edible having exceptional nutritional quality and have widespread use in protein supplementation, therefore it has got the nicknames 'One Stop Supermarket', 'Supermarket on a Stalk' and 'One Species Supermarket'. It has higher nodulation and nitrogen fixation capacity than any other tropical legumes crop like cowpea, groundnut, soybean, etc.

Morphology

The winged bean has hypogeal type of germination. It is a climbing twining plant that can reach height of 3–5 m with trifoliolate leaves in ovate to deltoid shape. Its flowers colour ranges from purple, white and blue in colour with 2.5 to 3.5 cm width. It has been observed that flower changes its colour from white at initial to sky blue at later stage. It contains tuberous roots with 8–12 cm length and



Germination of winged bean



(a) Winged bean plant stand



(b) Winged bean flowers



(c) Winged bean root with nodules



(d) Winged bean green pods

Winged bean plant parts

2-4 cm in width. Winged bean fruits are elongated pods with four corners and at each one, the pod bears a wing, hence the name of winged bean. Pod length ranges from 15 to 30 cm; however, in some of the varieties may go upto 40-50 cm in length and 3 cm in width. Each pod contains about 5-20 seeds. Seeds are round in shape and vary in colour from yellow and brown to black or mottled having 100 seed wight of 30-40 g.

Nutritional importance

Winged bean owns all the desirable characteristics of garden pea, green bean, soybean, spinach, mushroom, sprouting bean, and potato. All plant parts, excluding the stalk, are fit for human food. Among all parts, tender winged bean pods are the mainly consumed parts that possess high minerals and vitamins, particularly vitamin A, high fibre and 1-3% protein. It becomes ready to harvest after two to three months of sowing. These tender pods are consumed as salad, soup, curry and pickled forms. While tuberous roots are consumed as roasted, boiled and confectioneries purpose. These tubers are rich in protein ($\approx 20\%$ on dry weight basis) and 1.0-4.0% fat. Mature seeds have crude protein content in the range of 29.0-42.0% and 14-19% oil.

Crop growth stages

Winged bean plants mature between 120-150 days after sowing (DAS). However, its maturity depends on the end products desired by consumers. Brief crop stages are given in figure.

Package of practice for winged bean in Mizoram

In Mizoram, it is generally cultivated in small patches

in Jhum land as mixed farming. Also, it is grown in kitchen garden. However, scientific interventions and screening of suitable high yielding varieties and germplasm that are well suited for Mizoram conditions led to the adoption of winged bean cultivation in a commercial scale.

Climatic and soil requirement

Winged bean can be grown in tropical and sub-tropical condition. It is photosensitive crop and needs short days length (<12 hour day), with day and night temperature of 27°C and 22°C for reproduction, respectively. The optimum temperature for its growth and nodulation is 25°C . The bean is sensitive to frost. For tuber production, the optimum day and night temperature is 24 and 13°C , respectively. It is sensitive to frost. Winged bean can be cultivated at up to 2000 m altitudes from mean sea level and prefers humid and tropical climate. Also, it is well adopted in a region where well distributed annual rainfall ranges from 1500-2500 mm per year. However, it cannot tolerate prolonged dry spell but short dry spells do not affect the crop. But dry spell effect tuber development in crop. It can be grown on sandy to heavy clay soil but grows better on well-drained, loamy and slightly acidic soils with a pH range of 5.5-7.5. However, it does not grow well in wet soils. Under the heavy soil, winged bean tuber remained small. It can be grown well in nitrogen-poor soil because of its exceptional root nodulation ability.

Land preparation

For proper growth and development of winged bean, a well-pulverised soil has to be thoroughly mixed with well-decomposed FYM. It can be grown in raised beds or in ridge with a good drainage facility.



Seeds



Germination
6 to 8 DAS



Seedling
15-30 DAS



Training stage
30-45 DAS



50% flowering
55 to 83 DAS



Pod development
80 to 120 DAS



Maturity
120 to 150 DAS



Mature produce

*DAS- days after sowing

Growth stages of winged bean

Manures and fertilizers

About 10 t/ha of FYM applied at the time of field preparation and application of fertilizer N:P:K (kg/ha) 20:40:20 before planting is recommended or based on the soil testing report. Winged bean seed should be treated with *Rhizobium* sp. (20-30 g/kg seed) prior to planting to improve crop growth and yield.

Sowing time, seed rate and spacing

The optimum sowing time for winged bean in Mizoram is the second fortnight of April-May, however, can be sown up to June. Presence of hard seed coat in winged bean seeds, pre-soaking of seed for 24-48 hours helps in quick and uniform seedling emergence. Seed starts germinating at 6-8 days after sowing. The seed rate varies from 15-20 kg/ha. Depending upon the variety and the climatic factors, spacing of 60-80 cm between row to row and 30-45 cm between plant to plant is optimum with a depth of 2-3 cm.

Suitable varieties/cultivars

Mizoram is blessed with rich winged bean biodiversity. Some of the suitable varieties are AKWB 1, PWB 17-1, Indra Winged bean 1, RMDWB 1, RWB 25, RWB 26, RWB 30, PWB 17-14 and PWB 17-18. Local cultivars like MZWB 1 to 12 are also used.

Training

The winged bean responds to training system. The seedlings show signs of twining few days after germination. The optimum height of trellis is 2 m and can be done through thin bamboo. Normally, the vines are trained either individually or in a row using overhead trellis. This system improves pod yield and quality and seed yield; facilitates intercultural operation and helps to minimize pest and disease.

Irrigation

Winged bean is generally cultivated as a rainfed



Training of winged bean

crop of Mizoram. However, in case of delayed rainfall at the flowering and pod development stage, supplement irrigation is necessary. It has more water requirements for optimum crop growth than other legumes.

Weed management

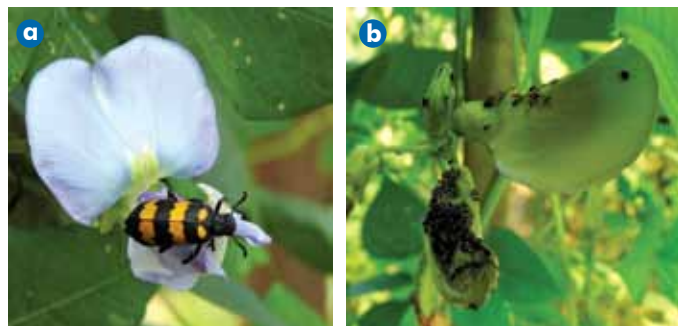
It is important to maintain weed free condition at initial growth stage of winged bean. Initial slow growth of winged bean makes it susceptible to weed competition in the initial 3-6 weeks of development. Two-hand weeding at 20 and 40 DAS is recommended and it should be done before providing support system to its seedling.

Pest and disease management

Winged bean is affected by insect pests, fungal and viral disease. However, infestation of these diseases is not serious in Mizoram. Insects such as pod borer infect pods that can be managed by spraying of cypermethrin @0.008 % at four different stages (flower initiation stage, 50% flowering, 100% flowering and 100% pod setting) were found effective against pod borer. *Bacillus thuringiensis* (Bt), neem seed kernel extract (NSKE), neem seed powder are also effective against the pod borer. Blister beetle damaged flowers can be managed by spraying of lambda-cyhalothrin @ 24 g a.i./ha twice during infestation (blooming stage). Whereas black bean aphid damages flowers, shoots and leaves and can be managed by application of systemic insecticides, viz. imidacloprid 70.00% WG @1 g /10 litre of water or imidacloprid 17.80% SL @ 1 ml/5 litre of water or thiamethoxam 25.00% WG @ 1 g/5 litre of water. Also, yellow sticky traps for @ 4-5 traps/acre is recommended. Whereas, major fungal diseases of winged bean are dark leaf spot and powdery mildew. Dark leaf spot can be managed by proper staking of plant followed by spray of mancozeb (2 g/L) or propiconazole (2 g/L) or copper hydroxide (2 g/L) at fortnight intervals. Powdery mildew can be managed by pruning and thinning for air circulation. Spray neem oil @ 3% or NSKE @ 5% twice at 10 days intervals from initial appearance of disease. Apply carbendazim 500 g/ha or propiconazole 500 ml/ha or wettable sulphur 1500 g/ha at beginning of the disease and 10 days later. Spraying of wettable sulphur @ 4 g/ litre of water is also found helpful.

Harvesting

Harvesting of winged bean depends on products aimed to harvest. The details are given here.



Pest incidence on winged bean: (a) Blister beetle and (b) Aphid



Green tender pods

Green tender pods: The pods become ready to harvest after 20-35 days of flowering or 2-3 weeks after fruit set. Usually, 2-3 picking are required for complete harvesting. It should be flexible to bend without breaking and have less fibre content. The green tender pods are harvested after 75-100 days of sowing depending upon the variety. Average yield of green tender pods is 6-10 t/ha that depends upon variety, environment and management practices.

Seed: Seeds mature within 2.0-2.5 months after flowering. At full maturity, pods turn to brown or black with hard seeds inside pods. Mature seeds are bright with round in shape, brown or black with average yield of 1.5 to 3.0 t/ha.

Tuber: The yield of tuber is 5-10 t/ha.

Post-harvest and Value-addition

The different parts of winged bean, viz. seeds, immature pods, leaves, flowers and tubers are edible and are rich sources of carbohydrates, proteins, vitamins, minerals and fats. Crop after harvest should be sorted by removing diseased and pest-infested leaves/pods/seeds/



Boiled winged bean tubers

tubers. Proper drying of seeds up to 10-12% moisture for storage and seed purposes (sowing and consumption) is required. Soil debris should be removed from tubers of winged bean by cleaning and washing in water before processing. The seeds can be used for making flour, weaning foods, protein supplement and seed oil. Mature seeds are reported to contain 29 to 37% proteins and 15 to 18% oil. The immature pods and flowers can be used for making pickles. The immature dry leaves can be stored and used as boiled vegetable. Fresh tubers of winged bean contain up to 11% crude protein. So, the tubers can also be processed as protein supplements and used in boiled form.

Economics

Based on the prevailing market price of 2021, cost of inputs, cost of cultivation and gross return was calculated. It has been observed that the cost of cultivation for winged bean in Mizoram is ₹ 60,000-65,000/ha. While gross return from dry winged bean seed yield (considering average yield of 2 t/ha) has been ₹1,40,000/ha (considering ₹ 70/

kg of seed price). The resulting benefit-cost ratio is 2.15-2.30. However, if returns from dry seed and tuber are combined, its B:C ratio would be 2.8-3.0.

SUMMARY

Winged bean is high-yielding underutilized potential legume crop. It possesses high nutritious value and requires the least management practices. Apart from these benefits, the climatic condition of Mizoram are very well suitable for winged bean cultivation and blessed with rich diversity. In order to boost its production and alleviate the malnutrition problem of the state, it is important to go for scientific cultivation practices with selection of high yielding variety or local germplasm.

For further interaction, please write to:

Jeetendra Kumar Soni (Scientist), ICAR-RC NEH Region, Mizoram Centre, Kolasib, Mizoram 796 081. *Corresponding author's email: jeetendra.soni@icar.gov.in

Varieties of vegetable crops for release and notification



Cowpea (Bush): VRCP 12 is a bush type variety with erect growth habit and photo-insensitivity. Suitable for sowing in rainy and spring-summer seasons. It flowers in 40–45 days after sowing. Pods are 32–35 cm long, dark green, tender and free from parchment layer. Yield potential 140–160 q/ha. Identified for cultivation in Zone IV (Punjab, Uttar Pradesh, Bihar and Jharkhand).

Dolichos bean (Bush): VRBSEM 3-Days to first picking: 80–85 days, Peak fruiting period: December to March. DYMV disease free in cropping period with temperature tolerance up to 35°C. Yield: 360 q/ha in five pickings. Identified for cultivation in Zone VI (Rajasthan, Gujarat, Haryana and Delhi), Zone VII (Madhya Pradesh, Maharashtra and Goa) and Zone VIII (Karnataka, Tamil Nadu, Kerala and Puducherry).



Indian (Dolichos) bean/Sem: Arka Neelachal Pushti, is high yielding, pole type, round podded variety. The pods are rich in protein (4.61 g/100 g) and micronutrients (iron: 15 ppm, zinc 37 ppm). Duration of crop is 95 days from sowing to green harvest. Rabi season is ideal for its cultivation in Eastern India. Average yield is 24 tonnes/ha in 120 days.

French bean (Bush): VRFBB 91 is bush-type, early, short duration, flowers at 32–35 days after sowing. Pods are green and bright, fleshy, tender, straight, cylindrical and free from parchment. Bears about 20–25 pods/plant. Resistant to sclerotinia rot (*Sclerotinia sclerotiorum*). Tender pod yield potential is 125–150 q/ha. Recommended for Zone I: Humid Western Himalayan Region (Jammu and Kashmir, Himachal Pradesh and Uttarakhand).



Source: ICAR Annual Report 2021-22