

Yam Bean– an underutilized BeanAmina Shukoor¹, Bhavesh Verma², Shyam Prakash³, Hradesh Shivhare³**Introduction**

Yam bean (*Pachyrhizus erosus* L.) also known as potato bean or mishrikand, is a geotropical legume genus with edible starchy tuberous roots that belongs to the Leguminosae family (Fabaceae). They have 2n=22 diploid chromosomes. It is the only legume that is grown on a small scale in kitchen gardens for its sweet and crisp tubers, as well as on a large scale for export. The genus contains five species, two of which are wild and three of which are domesticated. Mexican yam bean (*Pachyrhizus erosus*), Andean yam bean (*Pachyrhizus ahipa*), and Amazonian yam bean are the cultivated species (*Pachyrhizus tuberosus*). Another species, *Pachyrhizus palmatilobus*, also known as Jicama de leche, has a less pleasant taste. It is commonly grown in India, Mexico, China, Singapore, the Philippines, Hawaii, and Indonesia, among other places. It is indigenous to Mexico and Central America. It was introduced into Indonesia from Manila, Philippines at the end of the 17th century, but it is now found throughout the tropics.

In India, it is widely grown in Odisha, Bihar, Jharkhand, Eastern Uttar Pradesh, West Bengal, and Assam. This crop has a high level of photosynthetic activity as well as a high rate of dry matter production/day/unit area. It is well suited to small and marginal holdings and is resistant to both biotic and abiotic stress. Its root tubers are white and broad spindle-shaped or turbinate, with easily peelable skin. The tubers have a sweet flavour and are eaten raw or used to make sweets. Tender tubers, both raw and cooked, are used in a variety of desserts.



Tubers contain a significant amount of ascorbic acid, 1.5 percent protein, 10% starch, and 5-6 percent sugar. The mature dried roots are used as a cooling agent in cases of high

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fever. The stem is tough and fibrous, and it is used to make fish nets. Rotenone, an alkaloid found in mature seeds, has been shown to be insecticidal. Yam bean seed extract (5%) works as a bio-pesticide against aphids and leaf-eating caterpillars such as the Bihar hairy caterpillar and the tobacco caterpillar. Yam bean contains a high amount of carbohydrates in the form of sugar, starch, and dietary fibre. It has high potassium and vitamin C content, a moderate calcium, iron, niacin, riboflavin, and thiamine content, a trace amount of protein and lipids, and a very low saturated fat, cholesterol, and sodium content.

Uses of yam bean:

Uses In terms of flavour and texture, yam bean tubers are very similar to potato tubers. Its tubers are also used as fodder, and mature tubers yield superior quality starch. Young tubers can be eaten raw, with salt and lemon, boiled, cooked, or pickled, and they make an excellent addition to stir fries, salads, soups, and stews. Tubers can be used in a variety of cuisines and seasonings as cubed, chopped, and sliced fine sticks, as well as in a variety of cuisines and seasonings with other vegetables and fruits. According to Kundu, P. erosus tubers are used in the production of high-quality flour in India (1969). The young immature pods can also be eaten if properly cooked, as the mature pods and seeds are poisonous. The powdered seeds are used as an

insecticide and a fish poison in tropical countries. It is reported to be highly effective against many insects such as aphids, cabbage worms, melon worms, silkworm larvae, beetles, and leaf hoppers, among others.

Medicinal applications:

The high levels of dietary fibre, vitamin C, and other minerals found in yam bean contribute to its health benefits. Its tubers aid in weight loss, immunity building, and the improvement of the digestive, circulatory, and nervous systems.

Climatic and soil requirement:

Yam bean cultivation takes place in tropical and mild subtropical climates with moderate rainfall. It grows well in the tropics up to about 70 m altitude. Its primary climatic requirement is a frost-free environment during vegetative growth. The crop performs better when the temperature is 30°C during the day and 20°C at night. Tuberization is hampered by low temperatures, especially during early vegetative growth, and it is delayed if vegetative growth is prolonged.

Yam bean can be grown successfully in a variety of soil types as long as they are well drained. It grows best in sandy loam, loam, and alluvial soils. In clay or clay loam soil, normal tuber development is limited. The soil should be rich in organic matter, loose and friable, and fertile. The ideal pH range is between 5.5 and 7.0.

Cultivated varieties:

Farmers typically grow local cultivars with small sized tubers (200–300 g). Mexican type cultivars with large tubers (500–700 g) are available, but they are not usually preferred because their tubers crack more frequently and are less sweet than the local types. Two improved varieties have been released for commercial cultivation in India. The following is a description of the cultivar's characteristics:

Rajendra Mishrikand-1 (RM-1) and Rajendra Mishrikand-2 (RM-2)

A seedling selection from a germplasm variety developed in 1999 at Rajendra Agricultural University in Dholi, Bihar. RM1 is widely used and recommended for cultivation in North Bihar, West Bengal, and other areas. Its tubers have a brownish white skin and are round and conical in shape. It yields 35 tonnes/ha on average in 120 days, while RM 2 outperforms RM 1 in tuber and seed yield, carbohydrate and sugar content, and tolerance to pod borer infestation.

Time to Plant/Materials: Propagation:

Yam bean is primarily propagated by seeds. Seed pods range in length from 7 to 15 cm and contain 7-9 brownish-yellow to scarlet seeds. The dorsiventral surface of the seeds is flat. Plants for seed crops can also be grown from sprouted tubers from previous crops, though this is uncommon.

Yam bean is typically sown in the north-eastern region of India during June-July, when the rains begin. In tropical areas, planting can be done at any time of year. To improve the tilth of the soil, it is deep ploughed 2-3 times with a mould board plough and then planked. This helps to maintain a consistent moisture regime on the field. Sowing between August and September at 30 cm x 15 cm or even 15 cm x 15 cm spacing is recommended to yield smaller sized delicate tubers

Sowing time and seed rate:

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cracks. The crop is typically grown in flat beds for both tuber and seed production.

The seed rate (20-50 kg/ha) varies depending on the growing season, growing region, spacing, crop purpose, and sowing time. The optimum seed rate, however, is 35–40 kg/ha. The seed crop is sown earlier and with greater spacing (50 cm x 30 cm).

Sowing method:

Commercially, yam bean is propagated by seeds. Soaking seeds in lukewarm water for 12 hours before sowing aids in softening the seed coat and hastening germination. The field is thoroughly prepared by ploughing with a harrow to a fine tilth in order to create smooth seed beds and ensure even germination. Seeds are typically sown at 5 cm depth on 15 cm high ridges 45-60 cm apart, with 15–20 cm spacing between plants.

Nutritional managements:

Yam bean plants prefer soil of moderate fertility because higher nitrogen levels in soil cause excessive vegetative growth, while potassium deficiency in soil negatively affects tuber growth and quality. At the time of land preparation, 10–20 t/ha of well-decomposed farmyard manure should be incorporated into the soil. Furthermore, nitrogen is applied at a rate of 40 kg/ha, phosphorus at a rate of 40 kg/ha, and potash at a rate of 80 kg/ha. The entire dose of phosphorus, potash, and half of the dose of

nitrogen fertiliser should be incorporated into the soil prior to seeding, and the remaining half of the nitrogen should be supplied as a top dressing 40-45 days after sowing.

Irrigation managements:

Irrigation is required because water is one of the essential components required for crop growth and development. The crop's total water requirement varies according to soil type and climatic conditions in the growing region. If the seeds are planted in dry soil, the first irrigation occurs immediately after sowing. Once established, proper soil moisture must be maintained, and care must be taken not to over-irrigate the crop, as this can harm the crop by increasing the risk of fungal diseases.

Intercultural practices: Weeds should be kept out of the yam bean field during the early stages of crop growth because they compete with the crop for nutrients, moisture, space, and sunlight. Manual weeding is done at least twice during the first few months. Mounting soil on both sides of the ridges is also necessary to give the growing tubers enough space and to cover them, as exposed tubers are damaged by rodents and insect-pests. This operation also indirectly aids in weed control in yam bean fields. Removing reproductive shoots, also known as reproductive pruning, is another critical intercultural operation for maximising yam bean yield, as excessive flowering reduces

tuber yield. The outcome of this operation, however, is dependent on cultivar, season, and climate. In some areas, not only are the reproductive branches removed, but the top half of the vegetative component is also removed. In most varieties, two reproductive prunings are usually sufficient to ensure a good yield.

Harvesting: The time it takes to reach maturity varies depending on the cultivar, soil type, growing region climatic conditions, and consumer preference. Harvesting occurs when the tuberous roots reach a marketable size, depending on consumer preferences. Mexican cultivars are harvested 5-7 months after they have been planted. In Thailand, tubers are harvested 4.5–6 months after planting because consumers prefer small tubers, whereas tubers are harvested 3.5–4.5 months after planting in India because early harvested tubers command a higher market price.

Yield: Yield varies depending on cultivar, soil type, climatic conditions in the growing region, and cultural management. The average yield of yam bean ranges between 400 and 600 q/ha.

Post-harvest management:

Washing, trimming (removal of the non-tuberous part of the root and the basal part of the stem), and dipping in a high-concentration chlorine solution, which has sterilising and bleaching effects, are the post-

harvest operations used in yam bean. Tubers are packed in jute sacks after being cleaned of adhered soil particles and curing in the shade. Tubers can be stored for 1–2 months at temperatures ranging from 12 to 160 degrees Celsius. Colder temperatures will cause tuber damage, so they should not be refrigerated. The starch-to-sugar ratio shifts over time, with the starch content decreasing and the sugar content increasing.

Insect pests:

A variety of insect pests have been identified as causing damage to various parts of the yam bean.

1. spotted pod borer (*Maruca vitrata*)

Symptoms: This is a serious pest of vegetable legumes in the tropics. Its larvae attack blooms, buds, and early pods with webbing. They feed on the immature young seeds that they bore into the pods. Small holes on flower buds, flowers, and pods characterise the symptoms. The yield loss caused by this insect's attack has been reported to range between 20% and 80%.

Control:

- a) Collect and destroy the damaged pods and larvae.
- b) To reduce borer populations, spray the crop with dimethoate 0.05 percent, tobacco decoction 3%, or neem oil 3%.

2. hairy caterpillars (*Ascotis imparata* and *Spilosoma oblique*)

Symptoms: The adult female lays eggs in clusters on the leaves' surface. During the early gregarious stage, the caterpillars feed on the green portion of the leaves, leaving them skeletonised. In severe cases, it causes defoliation, which has a negative impact on plant growth.

Control:

- a) Collect and destroy larvae during the early stages of crop growth.
- b) Spray the crop every 10–12 days with Quinolphos 0.05 percent, Endosulfan 0.2 percent, Monocrotophos 0.15 percent, or Fenvalerate 0.05 percent.

3. Nematode of the root knot (*Meloidogyne arenaria*):

Root knot nematodes are polyphagous and widespread throughout the country. Infected tubers develop warts and have a bitter taste. It reduces tuber yield and quality, which in turn reduces marketable yield. Aboveground symptoms include foliage discoloration to a paler shade than normal, plant dwarfing, and wilting.

Control:

- a) Adhere to a strict long crop rotation with non-host crop species.
- b) Use neem cake in conjunction with the recommended fertilizers.
- c) Apply nematicides to the soil, such as Furadon 20 kg/ha or Cadusafos 1 percent.

Diseases:

1. Rust (*Phakopsora pachyrhizi*):

Symptoms: It is the deadliest disease spread by wind. The disease symptoms are mostly visible on the plant's leaves and other above-ground parts. Rust pustules appear as small, spherical, reddish brown bumps on the lower surface of the leaves, shrivel, and fall off.

Control:

- a) Cropping non-host crops for at least three to four years is recommended.
- b) Plant early maturing cultivars to avoid rust until harvest.
- c) Keep the field clean by removing diseased debris and weeds.
- d) At 10–12 day intervals, spray the crop with Dithane M-45 0.2 percent and Bayleton 0.05 percent.

2. Sincama mosaic virus:

Symptoms: This is the most serious viral disease of yam beans. Due to low pollen fertility, the disease causes irregular chlorosis on the leaves, brittle young shoots, and impaired seed set. Tuber yield and quality are both adversely affected. Only mechanical wounds and insect bites are allowed. Appear to be a mode of transmission Aphids and possibly spider mites spread the disease.

Control:

- a) Clear the field of all infected plants and weeds.

- b) Apply Disulfotan or Phorate 10G granules at a rate of 1.5 kg/ha when seeding.
- c) To control vectors, spray the crop with Monocrotophos 0.05 percent or Dimethoate 0.05 percent at 10–12 day intervals.
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3. The disease of witches' brooms:

Symptoms: This disease is most likely caused by mycoplasma-like organisms. Excessive branching, dwarfed leaves, and flower deformation are symptoms. It is not thought to be spread by sap inoculations, but there are some indications that sucking insects such as whiteflies (*Orosius argentatus*), aphids, and mealy bugs may.

Control:

- a) Apply 1.5 kg a.i/ha Carbofuran, Fensulfothion, or Disulfotan to the soil at the time of sowing.
- b) Remove infected plants as soon as they are discovered.
- c) Spray the crop every 10–12 days with Monocrotophos 0.05 percent or Dimethoate 0.05 percent.

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