THE SCIENCE WORLD
A Monthly e Magazine
ISSN:2583-2212
Nov, 2023 3(11), 2958-2963

Popular Article

Winged Bean: An "One Species supermarket

***Rajib Das[1], , Senpon Ngomle[1], Denisha Rajkhowa[2] Ajaykumara K.M[3], Mahesh Kumar[2], Premaradhya N[1]**

[1] Multi Technology Testing Centre and Vocational Training Centre, CAU(I), Pasighat, Arunachal Pradesh
[2] College of Agriculture, CAU(I), Pasighat, Arunachal Pradesh
[3] College of Horticulture and Forestry, CAU(I), Pasighat, Arunachal Pradesh
https://doi.org/10.5281/zenodo.10204797

Introduction

Psophocarpus tetragonolobus (L.) DC., commonly called winged bean, Asparagus pea, or Goa bean, is a self-pollinated tropical legume classified within the phaseoloid clade of Leguminoseae (Fabaceae). It is also referred to as Princess pea, Super market, Goa bean, Four-angled bean, Asparagus pea, Vegetable of 20th century, Manila bean on a stalk. Winged bean has a twining habit, tuberous roots, longitudinally winged pods and both annual and perennial growth forms. It has a diploid genome of 9 pairs of chromosomes (2n = 2× = 18;) and an estimated genome size of 1.22 Gigabase pairs (Vatanparast *et al*,. 2016). It can be grown from sea level up to frost-free altitudes of about 2000 m above sea level, with its main presence found in hot, humid, equatorial countries such as India, Sri Lanka, Bangladesh, Myanmar, Thailand, Laos, Vietnam, Cambodia, Malaysia, Indonesia, Philippines and PNG (Khan, 1976 and Drinkall *et al*,. 1978).

Use

Winged bean has a wide range of uses and most parts of the plant are consumed, depending on where the crop is cultivated. The young pods are a popular edible part across all cultivation areas, eaten raw or as a cooked vegetable (Sastrapradja and Aminah Lubis 1975), and in Indonesia mature seeds are roasted like peanut and boiled. In PNG, immature seeds are consumed due to their pea-like taste (Okezie and Martin 1980). In Myanmar, Thailand, and PNG, boiled, steamed, baked, fried or roasted tubers are also consumed (Eagleton 1999). Leaves and flowers are also consumed (Okezie and Martin 1980), and younger parts are particularly appreciated when infected with the fungus Woroninella psophocarpi in Java, Indonesia (Hymowitz and Boyd 1977). Green

Published: **24.11.2023**

or purple young pods have been reported, with presence or absence of specks (Erskine and Khan 1977). Leaves are eaten like spinach, flowers as salad, tubers as raw or processed food and seeds are used in different forms of processed food (Singh *et al*,. 2022).

Winged bean has been recognized as a crop having much promise for nutritional security in the coming decades. Winged bean tubers are notably rich sources of starch, protein, and B-complex vitamins. Winged beans provide adequate amounts of proteins, minerals and vitamins. In addition, thiamine, pyridoxine (Vitamin B-6), niacin, and riboflavin are some of the B-complex vitamins embedded in these beans. Some of the essential minerals such as iron, copper, manganese, calcium, phosphorus, magnesium is concentrated in them. Manganese is utilized in the human body as a cofactor for the powerful antioxidant enzyme, superoxide dismutase. Winged bean green leaves, are an excellent source of fibre, vitamin A, C and minerals. Hundred grams of fresh leaves provide 45 mg of vitamin C (75% of recommended daily value) and 8090 IU of Vitamin A (270% of RDA) (Singh *et al*,. 2022).

The winged bean is popularly known as 'One Species Supermarket' because of its high nutritionally rich green pods, tuberous roots, leaves, immature and mature seeds. Owing to its vining nature and nitrogen fixation ability, it used as a cover crop and also incorporated into rotation or intercropping systems. As such, winged bean could be a good candidate for diversifying diets to improve nutritional security, based on complex and more sustainable agricultural systems. Besides nutritional qualities, winged bean is a potential climatic resilient crop for adaptation in suboptimal weather conditions, like drought, flood, heat and biotic stresses as compared to other major staple crops (Tanzi *et al*,. 2019 and Singh *et al*,. 2022).

Origin

Centre of origin of this crop is still a matter of dispute. Competing theories have been postulated to explain the origin of winged bean. A review by Zeven and De Wet (1982), suggests four areas as probable centres of origin: **(a) Indo-Malayan** - due to a long cultivation history in eastern Assam, India (**b) Asiatic origin** - which suggests winged bean was domesticated there from an unknown and now extinct endemic Asian progenitor **(c) Papua New Guinea** - based on the large genetic variation found there; and **(d) African center** - due to similarities with African species. The African origin hypothesis has received much support due to observations that the morphology of *P. grandiflorus*, an African species, closely resembles winged bean arose on the African side of the Indian Ocean and was carried east as a wild plant and then modified by human cultivation.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published: **24.11.2023**

Crop Botany

Winged bean (*Psophocarpus tetragonolobus*) is a dicotyledonous plant, taxonomically classified under the Fabaceae family, Papilionoideae subfamily. It has a diploid genome (2n = 2x = 18, 14) consisting of a karyotype with three pairs of short and long chromosomes. It is a climbing twinning plant. It has green trifoliate leaves made up from three leaflets of ovate to deltoid shape. It is considered to have a cleistogamous floral system, which would usually imply autogamy, with self-pollination have been observed. The inflorescence of winged bean is Axillary raceme. The flower is Complete, hermaphrodite, zygomorphic, papilionaceous and calyx has 5 Sepal whereas corolla is papilionaceous composed of three types of petals i.e. standard, wing and keel, vexillary aestivation with colour ranging from purple, white and blue, blue to red. Androecium contains 10 monodelphous stamen and Gynoecium- is superior with marginal placentation. Fruit is known as pod and linear oblong in appearance.

Morphology

Winged bean is a climbing twinning plant (climb up to 3–5 m). It has green trifoliate leaves made up from three leaflets of ovate to deltoid shape. It produces 2.5 to 3.5 cm wide flowers with colors ranging from purple, white and blue, blue to red. The pollen grains are spheroidal with a polar axis that measures between 42.3 and 51.6 cm and an equatorial axis that measure between 43.4 and 49.9 cm. Its roots are tuberous; a tuber ranges in size between 8 and 12 cm in length and 2 to 4 cm in width. It produces elongated pods (the fruit) with four corners and at each one the pod bears a wing, hence the name of winged bean. Each pod ranges from 15 to 30 cm in length, and it is about 3 cm in width.

Nutritive Value

Winged bean is particularly well known for nutritious seeds, tubers, pods, foliage and flowers. Crude protein content of winged bean seed (33.82%) is higher than cowpea (22.5%), pigeon pea (22.4%) and lima beans (23.3%), and similar to soybeans (35%).Winged bean produces immense amount of protein in leaves (5–8% by weight), tubers (17–19%) and seeds (32–37%). The amino acid content reported also reveals similar trends. However, as in the case of other leguminous plants, sulphur-containing amino acids are limiting in winged bean. Winged bean seeds are rich in carbohydrates (23–40%). Minerals like K, P, S, Ca, Mg, Na, Fe, Mn, Zn, B, Ba, Sr, Cr and Cu and vitamins including retinol (Vitamin A), thiamine (Vitamin B1), riboflavin (Vitamin B2), niacin (Vitamin B3), pyridoxine (Vitamin B6), folic acid (Vitamin B9), ascorbic acid (Vitamin C) and tocopherol (Vitamin E) are also present in adequate quantity as recommended for the human diet. In general, there is broad similarity between mineral and vitamin

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published: 24.11.2023

contents of winged bean and soybean. However, the content of thiamine, riboflavin and niacin in winged bean exceeds that of soybean and other beans

Anti-Nutritional Factors

With all the positive nutrition offered by winged bean, anti-nutritive factors (ANFs) also exist and have been extensively studied, including trypsin inhibitors, chymotrypsin inhibitors and hemagglutinins. Trypsin inhibitor activity in winged bean ranges from 11,300 IU/g of bean sample to 74,700 IU/g of sample, showing wide variation depending on cultivar. Nonetheless, most trypsin and chymotrypsin inhibitors as well as hemagglutinating agents found in winged bean are heat–labile and are consequently destroyed by the application of moist heat. Phytate is another important anti-nutrient commonly found in legume seeds. Phytates are antioxidants that bind to some dietary minerals, interfering with their availability. Phytate content in winged bean is estimated to be between 6.1–7.5 mg of phytate phosphorus/g of bean, equal to that of soybean. Even with all this, the levels of phytates etc., are not significantly high to cause adverse effects. Considering that most of these ANFs are destroyed by boiling or autoclaving, properly processed winged bean could be safely used as a major plant protein source

Traditional medicinal properties of the crop

Winged bean has several medicinal uses. Its pods are considered to be good for the blood and in diabetes mellitus.

- It also improves immunity as they are rich in vitamin C and vitamin A.
- It reduces inflammation as the considerable amount of manganese in the legumes help in reducing inflammation.
- It improves bone health-The calcium content in the legume has various benefits to your body.
- It helps to generate blood- Known for its high content of iron, winged bean is extremely beneficial

Food Items prepared from the crop

The winged bean is known as “a supermarket on a stalk” because it combines the desirable characteristics of the green bean, garden pea, spinach, mushroom, soybean, bean sprout and potato. Save for the stalk, virtually the entire plant is fit for human consumption- from flowers and leaves to tuberous roots and seeds. Wing beans tubers can be boiled, streamed, baked, fried, roasted and even made into chips. The immature pod, the plants most popular part can be can be eaten raw, pickled or cooked in water, coconut milk or oil. One Indonesian researcher has produced a coffee substitute by roasting and grinding the seeds and has made a tobacco substitute from the dried

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published: 24.11.2023

leaves. Even the dried pod left after the seeds are removed can be used. (Hymowitz and Boyd J,1977. Like the soybean, winged bean seeds or beans, can be pressed to extract an edible, mostly unsaturated oil that is rich in vitamin E, leaving behind a protein rich flour suitable for making bread or cereal. In the north eastern states of India, especially in Mizoram, winged bean is used in side dish preparation.

Pharmacological property

The tender pods are the most widely consumed part of the plant, especially throughout Asia, but the leaves, stems, flowers, seeds and tuberous roots are all nutritionally valuable and are used as food. Winged bean is another of the legumes with elevated seed oil content, varieties typically average 15% oil, with protein levels of 30-37%. The tuberous roots are a good source of energy in the form of starch, and they contain 8-10% protein.

Conclusion

Winged bean is popularly known as "One Species Supermarket" for its nutrient-dense green pods, immature seeds, tubers, leaves, and mature seeds. This underutilised crop has potential beneficial traits related to its biological nitrogen-fixation to support low-input farming. The FAO has noted that availability of legumes in Asian regions is low, and that winged bean is one of several legumes that is under-exploited. Given its previous cultivation history in the tropics, its considerable nutrition quality, and continued development of resources for research, winged bean has the potential to become a global food security crop.

References

Drinkall, M.J. 1978. False rust disease of the winged bean. Trop Pest Manag 24:160–166. https://doi.org/10.1080/096708778094116 05

Eagleton G (1999) Winged bean in Myanmar, revisted. Econ Bot 53:342–352.

Erskine W, Khan TN (1977) Inheritance of pigmentation and pod shape in winged bean. Euphytica 26:829–831. https://doi.org/10.1007/ BF00021714.

Hymowitz T, Boyd J (1977) Origin, ethnobotany and agricultural potential of the winged bean-Psophocarpus tetragonolobus. Econ Bot 31:180–188. https://doi.org/10.1007/BF02866589.

Khan, T.N. 1976. Papua New Guinea: a centre of genetic diversity in winged bean (Psophocarpus tetragonolobus (L.) D c.). Euphytica 25:693–705. https://doi.org/10.1007/BF00041608

NAS (1981) The winged bean: a high-protein crop for the humid tropics, 2nd edn. National Academy of Sciences, Washington, D.C.

NAS. 1975b. The winged bean: a high-protein crop for the humid tropics. National Academy of Sciences, Washington, D.C.

Okelola, F.S., Adebisi, M.A., Kehinde, O.B., and Ajala M.O. Hymowitz T, Boyd J. 1977. Asian Journal of Bio Science, 4 (2): 298-299

Okezie BO, Martin FW (1980) Chemical composition of dry seeds and fresh leaves of winged bean varieties grown in the U.S. and Puerto Rico. J Food Sci 45:1045–1051. https://doi.org/10.1111/j.1365-2621.1980.tb07509.x.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published: 24.11.2023

Sastrapradja S, Aminah Lubis SH (1975) Psophocarpus tetragonolobus as minor garden vegetable in Java. Bogor, Indonesia.

Singh, P.K,. Tiwari, J.K,. Joshi, V,. Lal, S.K,. Selvakumar, R,. Kumar, J,. Kumar, A and Mani, I. 2022. Winged bean – A nutritionally rich underutilized vegetable crop. Indian Horticulture. January–February 2022, pp:16-19.

Sinnadurai S, Nyalemegbe KD (1979) Efect of photoperiod on the nodulation fowering and seed yield of winged bean (Psophocarpus tetragonolobus (L.) DC.). Ghana J Agric Sci 12:27–30.

Stephens, J.M. pProfessor emeritus, Horticultural Sciences Department; UF/IFAS Extension, Gainesville, FL 32611. Website at https://edis.ifas.ufl.edu.

Tanzi, A.s,. Eagleton, G.E,. Ho, W.K,. Wong, Q.N,. Mayes, S and Massawe, F. 2019. Winged bean (Psophocarpus tetragonolobus (L.) DC.) for food and nutritional security: synthesis of past research and future direction. Planta:250, pages911–931.

Vatanparast, M,. Shetty, P and Chopra, R. 2016. Transcriptome sequencing and marker development in winged bean (Psophocarpus tetragonolobus; Leguminosae). Sci Rep 6:1–14. https://doi. org/10.1038/srep29070

Zeven, A.C and Zhukovsky, P.M. 1975. Dictionary of cultivated plants and their centres of diversity. Centre for Agricultural Publishing and Documentation.

Erskine, W and Khan, T.N. 1977. Inheritance of pigmentation and pod shape in winged bean. Euphytica. 26(3):829-83.

Hymowitz T and Boyd J. 1977. Origin, Ethnobotany and Agricultural Potential of the Winged Bean-- Psophocarpus tetragonolobus. Economic Botany: 180-188.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com

Published: **24.11.2023**