AgroScience Today

Popular Article

e-ISSN: 2583-0147

Volume 5 Issue 11
Page: 0983 – 0989

Rice Bean - A promising and Resilient Crop with Significant Agricultural Potential

Biswajeet Mishra[1*], Suman Choudhury[1], Suman Dash[1], Ayesha Mohanty[1], Roomesh Kumar Jena[2] and Kaushik Kumar Panigrahi[1*]

[1]Odisha University of Agriculture & Technology, Bhubaneswar, Odisha, India.

[2]ICAR-Indian Institute of Water Management (IIWM), Bhubaneswar, Odisha, India.

Corresponding author's e-mail: *biswajeet1999mishra@gmail.com; kaushikouat@gmail.com*

Published on: November 30, 2024

ABSTRACT

Rice bean (*Vigna umbellate*) is a prospective legume crop grown in many parts of south east Asia. Rice beans are resilient enough to adapt to various environments, from hills to marginal areas, where other crops may not acclimatize themselves easily. Rice beans are tolerant to many abiotic stresses and survive well in warm climates. It can be grown as a sole crop in the field or as a mixed crop with maize or wheat for better produce. Rice bean is a potent food and fodder crop. It serves as a genetic resource for a wide range of genes which are tolerant to biotic and abiotic stress. Rice beans are spread from the Indo-China region to the rest of the world. Being a rich source of albumin and globulin, it is crucially beneficial as a food and fodder crop in the Indian circumstances. Rice bean is now gaining the prevalence due to its adeptness to yield, aversion to various biotic stress, resilience to grow in various conditions and accessible domestication to a new environment with good sustenance potential, which makes rice bean an inexpensive substitute for the common conventional pulses.

INTRODUCTION

Crop diversification provides a new horizon in creating variability in uniform cropping systems, which will help develop new varieties with resistance to biotic and abiotic stress. Rice beans are unexploited compared to other legume crops and are a source of essential vitamins, micronutrients, and protein, which help to attain nutritional manifoldness. Rice bean is a proliferating perennial vine plant with small and edible seeds which are rich in protein. Rice bean, a crop with an important source of nutritional compounds, is suitable for use in regions that deal with protein malnutrition. Due to its nitrogen-fixing ability, it aids in improving soil fertility, thus promising sustainable agricultural practices **(Dhillon & Tanwar, 2018).**

Not only does rice bean have nutritional benefits, but it is also used for fodder, providing feed for livestock. Despite its potential, rice beans remain largely underutilised in mainstream agriculture, though efforts to promote their cultivation are elevating due to their resilience and role in food security. Observing rice bean cultivation in the field **(Figure 1).** Having a good potential to mitigate economic and nutritional inadequacy, rice beans have been neglected due to a lack of scientific research and consumer awareness. This leads to a quest to review contemporary technological knowledge affiliated with the rice bean to extract food and nutritional compounds to ensure nutritional security and extend to crop improvement programs.

Figure1. Rice Bean Crop

ORIGIN AND DISTRIBUTION

Vigna umbellate (Thunb.) Ohwi and Ohashi is usually known by several names such as rice bean, red bean, oriental bean, mambi bean and climbing mountain bean. It originates in Indo-China, Nepal, Burma, Malaysia, Fiji, Mauritius, Philippines, Laos, Vietnam, Indonesia, East Timor, and Bangladesh **(Pattanayak *et al.,* 2018)**. Rice bean is a warm-season perennial legume crop. It is mainly cultivated as an intercrop with many crops like cowpea, maize, and sorghum in India and many other countries. India's major rice bean-growing states are the North-Eastern states, Himachal Pradesh, Chhattisgarh and Madhya Pradesh. It is a perennial legume crop with an average height of 30-100 cm. The leaves are trifoliate with 6-9 cm long leaflets. The flowers are vivid yellow, transforming into pods with small seeds measuring 6 to 8 mm in size. It is not only grown as grain legume by marginal farmers but also as a green manure crop and as nutritious fodder for cattle **(Dahipahle *et al.,* 2017).**

CULTIVATION

Rice bean is predominantly grown in marginal areas of land by farmers in northeastern India, northern parts of Nepal and some parts of Southeast Asia **(Gayacharan *et al.*, 2024; Pattanayak *et al.,* 2019).** Rice bean is well adapted to humid tropical climates. Rice beans require a fine seedbed to ensure good seed germination. Rice beans can be cultivated in a diverse range of soils, varying from loamy to sandy loam, facilitated by a drainage system. Poor to light, fertile

soils can lead to moderate yields. Saline-alkaline soil, as well as sandy or waterlogged soils, should be averted. Root-knot nematode infestation may occur when rice beans are grown on light soils. Even though weeds are generally not a problem, 2 or 3 weeding at six weeks after sowing and before flowering is required for good crop establishment. Rice beans help fix the soil's atmospheric nitrogen through rhizobium symbiosis**.** In the early period, the rice bean was grown in the lowlands using the soil after the harvest of the long-season rice. However, later on, it shifted to lands where rice varieties were cultivated for a shorter duration. Some recent findings suggest that the crop can be established at a faster rate and, hence, can be cultivated effectively on diverse quality soils under elevated temperature and scanty rainfall conditions **(Kaur *et al*., 2013; Katoch, 2013).** Rice beans can yield fine-quality grain with higher produce.

Rice bean is mainly a kharif season crop, and the seed sowing is usually done in the first or third week of July. The seed rate used is 25-30kg/ha. The method of sowing is different according to the need it varies from broadcasting to dibbling to line sowing. In most cases, the dry seeds are sown in the field. Promising results are shown if the seed undergoes priming with water or phosphorous and improved yield is reported. While cultivating, a row-to-row distance of 30 cm and a plant-to-plant distance of 10 to 12 cm is advised. Weeding is not required for the sole crop, but a single weeding after 30 days of sowing is advised. The harvesting of the rice bean crop is done when the change in the pods colour from green to brown is observed. As the rice bean crop is relatively indeterminate, harvesting is practised in 2 to 3 pickings in the morning to evade pod shattering, and yield loss can be minimized. The mature rice beans can then be separated from the mature pods by manual handling by beating them after sun drying them. The crop duration is 120-150 days.

PLANT MORPHOLOGY

Rice bean is a short-lived, fast-growing perennial legume crop cultivated annually. A short-day crop, it has a very diverse growing habit as it is erect as well as semi-erect. It usually grows up to a height of 30 to 100 cm but sometimes can reach up to a height of 200 cm. The crop has a deep taproot system ranging from 100 to 150 cm. The stem is branchy with trichomes. Leaves are trifoliate, with 6 to 9 cm long leaflets. The inflorescence is axillary raceme, which is 5to10 cm long, showing vexillary aestivation and is vivid yellow in colour as shown (**Figure 2 & 3)**. The fruits are cylindrical, with 7.5 to 12.5 cm long pods, and they contain 6 to 10 oblong-shaped seeds, which are 6 to 8 mm in size, with a concave hilum. The colour of the seeds ranges from light greenish-yellow to black. The Yellow-brownish types are high in nutrition content. Rice bean is grown on a wide range of soil, including little shallow, less fertile, cracked or degraded soil. High soil fertility may hinder pod formation by promoting more vegetative growth, which may lead to more accumulation of photosynthates in the plant's vegetative structures, leading to poor seed yield of the plant. Rice bean is a photosensitive plant that grows well in an area where the temperatures range from 18 to 30^0C on average. It can tolerate 10-40^0C but can’t resist frost.

Figure 2

Figure 3

PEST AND DISEASE MANAGEMENT

The rice bean is a robust crop with ample resilience towards disease and pest attacks **(Oraon *et al.*, 2023)**. The major diseases and insect pests and their management are given below.

Rust: It is caused by *Uromyces appendiculatus. The* pathogen has a wide host range, and the typical symptom on the rice bean plant is minute, slightly raised pustules with a whitish colour on the leaves. Maneb at 3g/L can be applied to the rice bean plant to control the disease.

Powdery mildew: It is caused by *Oidiopsis taurica*. The symptom appears as a powdery coat on the rice bean's leaves, stems and pods, which turn yellow later. The application of carbendazim 0.5g/L can help in controlling the disease.

Rhizoctonia blight: It is caused by *Rhizoctonia solani*, a soil-borne pathogen that causes small pale green spots on rice bean pods and leaves. Applying Bavistin 1g/kg of seeds helps control the incidence of this disease.

Cercospora leaf spot: It is caused by *Cercospora spp*. (Deuteromycetes group) and is characterized by small, dry spots on the leaves of rice beans. This disease can be effectively managed by spraying Maneb at 3g/L of water as a prophylactic measure to control the disease incidence.

Root-knot nematode: *Meloidogyne incognita*, a common pest that attacks rice beans. It can be treated by application of *Purpureocillium lilacinum* @ 2.5 kg/ha in the rice bean.

Blister beetle: *Mylabris pustulata* damages the flower and thereby stops the pod formation in rice bean. The Spraying of insecticides deltamethrin 2.8 EC at 200ml or indoxacarb 14.5 SC at 200ml or acephate 75 SP at 800g/acre in 80-100 L of water is applied to the plant for blister beetle incidence. A photograph **(Figure 4)** is shown, which depicts the pest attack on rice beans.

Figure 4. Blister beetle infestation (field condition)

Hairy caterpillar: *Spilarctia casignata* or *S. obliqua* damages the leaves of rice bean by scrapping the chlorophyll and turns it into papery brownish yellow in colour. Spraying of quinalphos 25 EC at 200ml/acre in 80-100 L of water is generally used for hairy caterpillars.

Pod borer: *Helicoverpa armigera* and *Lampides boeticus* are the major pod borers. It causes damage to the pod by feeding on the young seeds of rice beans or by moving from one pod to another by making holes. Application of insecticides by spraying indoxacarb 14.5 SC at 200 ml or acephate 75 SP at 800 g or spinosad 45 SC at 60 ml in 100 litres of water per acre is applied for the treatment of pod borer.

Green bugs and Pod bugs: *Nezara spp*. and *Anoplocnemis spp* are the pests which attacks the rice bean plant and suck the sap from the immature seeds formed inside the pod. The rice beans get affected due to the deformation in the seed. The pest attack leads to wrinkled and black spots in the seed, resulting in the seeds' inability to germinate and being regarded as unfit for food and fodder. Chemicals like Imidacloprid and Thiamethoxam are considered effective in managing this insect.

Leaf folder: *Hedylepta indicata* is a pest which affects the rice bean plant by removing the content of chlorophyll from the leaves of the rice bean, resulting in defoliation and reduction in yield. This pest is destructive in nature as it deforms the young leaves of the rice bean plant. It attacks the leaves by folding them, resulting in a web-like structure. Chemicals like Indoxacarb 4.5 SC in combination with novaluron 5.25 or spinosad 45 SC can be applied in the rice bean crop to manage this pest.

HARVESTING

Rice beans can be harvested manually by identifying and differentiating the pods' colour as mature pods turn brown. Other harvesting methods can be followed, such as drying the rice bean plants in the sun for 4-8 days. After that, the dried pods can be threshed with bamboo sticks or trampled by draft animals. Seeds must be allowed to dry for 1-2 days before storing them.

UTILISATION

Rice bean is not as prominent as commonly cultivated legume crops, but it has a high potential to be used both as food and fodder if cultivated well and developed according to need. Rice bean is an underutilized legume with various uses, from food to fodder, as all plant parts contribute to overall nutrition.

The beans can be steamed or boiled and used in making curry which can be taken with chapatti or rice. Rice beans are not easily processed into dal due to the fibrous mucilage present in the bean seeds that hampers the hulling process preventing the cotyledons to separate. The pods, after attaining vegetative growth, can be boiled and used for culinary purposes. The seeds of the rice bean plant are considered to be rich in protein content but poorer as compared to pea or cowpea as the seeds are deficient of fats and fibre content. The rice bean seeds are comparatively rich in lysine but poor in sulphur-containing amino acids. Rice bean seeds are reported to be rich in starch (52 to 57 %) **(Chavan et al., 2009).**

Rice beans are an excellent livestock feed crop as the vegetative parts of the rice bean plant can be used as green fodder for ruminants. The stem, leaves, empty pods, and other foliage parts can be used as straws or fodder for cattle, especially in hilly areas (Khanal et al., 2009). Besides food and fodder, rice beans can also be used for green manuring, as a cover crop, or as a biological barrier as a living fence.

Rice beans at the vegetative stage can generate a good amount of green fodder before the flowering stage, which can be used as feed to sheep due to their palatability. It was observed in an experiment in which the rice bean hay was fed to the bullocks for some days. The bullocks ate the fodder hesitantly, but within a few days of regular feeding, the animals got accustomed to it, and the consumption of rice bean hay increased.

When the rice bean straw was used as feed for bullocks on a trial basis, it showed that the rice bean straw had less digestibility in the ruminants (31- 47%). It was then recommended that the rice bean straw be used to supplement a rice straw-based feed with cereal grains or bran, which are energy-rich feed materials. In some areas in India, the rice bean seeds are used as feed for young calves of buffalo and sheep as an energy-rich fodder.

CONCLUSION

It can be concluded that rice beans, which have yet to be exploited to their full potential, can be used as a potential crop for food and fodder. Rice beans have immense potential for enhancing quality, leading to an increase in productivity. Rice beans are a multipurpose budding legume crop and can be used to combat climate change.

REFERENCES

Chavan, U. D., Momin, A., Chavan, J. K., Amarowicz, R. (2009). CHARACTERISTICS OF STARCH FROM RICE BEAN (VIGNA UMBELLATA L.) SEEDS – A SHORT REPORT. Polish Journal of Food and Nutrition Sciences, 59(1), 25-27.

Dahipahle, A., Kumar, S., Sharma, N., Singh, H., Kashyap, S., & Meena, H. (2017). Rice Bean - A Multipurpose, Underutilized, Potential Nutritive Fodder Legume - A Review. *Journal of Pure and Applied Microbiology*, *11*(1), 433–439. https://doi.org/10.22207/jpam.11.1.57

Dhillon, P. K., & Tanwar, B. (2018). Rice bean: A healthy and cost-effective alternative for crop and food diversity. *Food Security*, ***10*(3)**, 525–535. https://doi.org/10.1007/s12571-018-0803-6

Gayacharan, N., Parida, S. K., Singh, A. K., Chattopadhyay, D., Joshi, D., & Katna, G. (2024). Rice Bean (*Vigna umbellata* (Thunb.) Ohwi & Ohashi). In *CABI eBooks* (pp. 100–115). https://doi.org/10.1079/9781800624658.0006

Katoch R. (2013). Nutritional potential of rice bean (*Vigna umbellata*): an underutilized legume. *Journal of food science*, ***78*(1)**, C8–C16. https://doi.org/10.1111/j.1750-3841.2012.02989.x

Kaur, A., Kaur, P., Singh, N., Virdi, A. S., Singh, P., & Rana, J. C. (2013). Grains, starch and protein characteristics of rice bean (*Vigna umbellata*) grown in Indian Himalaya regions. *Food Research International*, ***54*(1)**, 102–110. https://doi.org/10.1016/j.foodres.2013.05.019

Kaur, D., & Kapoor, A. C. (1990). Some antinutritional factors in rice bean (*Vigna umbellata*): Effects of domestic processing and cooking methods. *Food Chemistry, **37*(3),** 171–179.

Oraon, S. *et al.* (2023). Biotic Stresses in Multipurpose Legume: Rice Bean. In: Jha, U.C., Nayyar, H., Sharma, K.D., von Wettberg, E.J.B., Singh, P., Siddique, K.H. (eds) Diseases in Legume Crops. Springer, Singapore. https://doi.org/10.1007/978-981-99-3358-7_12

Pattanayak, A., Iangrai, B., Khongwir, D. E. A., Gatphoh, E. M., Das, A., & Chrungoo, N. (2018). Diversity analysis of rice bean (Vigna umbellata (Thunb.) Ohwi and Ohashi) collections from North Eastern India using morpho-agronomic traits. Scientia Horticulturae, **242**, 170–180. https://doi.org/10.1016/j.scienta.2018.08.003

Pattanayak, A., Roy, S., Sood, S., Iangrai, B., Banerjee, A., Gupta, S., & Joshi, D. C. (2019). Rice bean: a lesser-known pulse with well-recognized potential. *Planta*, ***250*(3)**, 873–890.https://www.jstor.org/stable/48702272