

Yam Bean: An Underutilized Legume with Potential as a Tuber and Pulse Crop

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SUMMARY

There are three species of *Pachyrhizus* grown commercially and other wild types but *P. erosus* is the species most widely introduced to most tropical areas. Yam bean, grown for its sweet, crisp tuber, is a vegetable that can be eaten raw or cooked. Depending on the selection, a plant can produce one or several tubers. Very young beans can be cooked and eaten but older beans and leaves contain a toxic component. Care and experience in using the beans are necessary to avoid any toxic effects. Seeds, pods, stem and leaves have the insecticidal and fungicidal properties. In India, it is mostly grown in North Bihar, extending parts of West Bengal, Assam, Orissa and eastern Uttar Pradesh.

INTRODUCTION

Humanity relies on a diverse range of cultivated species; which are used for a variety of purposes. It is often stated that only a few staple crops produce the majority of the food supply. This might be correct but the important contribution of many minor species should not be underestimated. Agricultural research has traditionally focused on these staples, while relatively little attention has been given to minor (or underutilized or neglected) crops. Many species have the potential to contribute to food security, nutrition, dietary and culinary diversification, health and income generation. Despite their potential for dietary diversification and the provision of micronutrients such as vitamins and minerals, they remain neglected and attract little research and development attention.

Yam Bean (*Pachyrhizus Erosus* L.)

Among several crops, yam bean (*Pachyrhizus* spp.) is one which is tuberous belonging to family leguminosae. Yam bean is a plant which produces both starch and proteins in quite high level. Thus, yam bean can be used as an alternative source of starch with high protein content. Considering its high climatic and edaphic adaptability and good disease and pest tolerance/resistance is added, the potential of the genus cannot be ignored. Yet, despite its obvious agronomic advantages, the yam bean remains a little-known and underutilized crop.

Taxonomy

Yam bean (*Pachyrhizus erosus* L. Greek words *pachys* = thick ened, and *rhiza* =root) indigenously known as *Mishrikand*. Yam bean is a native of Mexico and Central America. The genus *Pachyrhizus* comprises five species within family Leguminosae and sub family fabaceae. All *Pachyrhizus* spp. species are diploid plants with chromosome number $n = 11$. Cultivated species are *Pachyrhizus erosus*, *P.ahipa*, and *P. tuberosus*. Whereas two wild species are *P.panamensis* and *P.ferrugineus*. Among the species *P. erosus* is most widely cultivated throughout the world.

Nutritional Aspects

Tubers contain more than 82% water, 1.5% protein, 10% starch and 5-6% sugar. (Naskar, 2009) The mature seeds have high content of alkaloids and insecticidal properties; seeds, pods, stems and leaves have the insecticidal and fungicidal properties (Krishnamurti *et al.* 1970.)

Domestic, Industrial and Environmental Uses

The tubers are used in a number of different ways: (i) Fresh tubers (ii) as a vegetable - fresh tuber slices are used in various salad dishes; (iii) cooked tubers are used to prepare a soup, on their own or with other vegetables; (iv) tuber slices may be stir-fried, or (v) sliced or diced tubers may be preserved in vinegar with onion and chilli and used as a snack. (Martínez 1936). Bhag Mal and Kawalkar (1982) reported from India that once the pods are cooked, they may be used as a vegetable in the same way as French beans. Dried hay are used as animal feed. It should be noted that as the cultivated yam bean is reproductively pruned, the rotenone content of the hay does not reach anti-nutritional levels. The highly efficient natural way in which the plant absorbs nitrogen makes it an attractive alternative for cultivation on poorer soils (Castellanos *et al.* 1996). The rotenone can be extracted in economic quantities from the mature seeds, the remaining seed oil is fit for consumption and can be marketed as an alternative to groundnut or cotton seed oil (Jimenez B. 1994;). The rotenone can be sold as a high-value naturally derived chemical or, using simpler extraction methods, be employed locally as a plant protective agent (Halafihi 1994). Once both rotenone and oil have been removed, the remaining seed cake has protein content comparable to that of soybean cakes (Cruz 1950). In spite of the numerous reports on the insecticidal and piscicidal (fishkilling) effect of the rotenone and rotenoids isolated from the seeds, yam bean has yet to be grown on a commercial scale for the production of rotenone.

Reproductive Biology

Yam bean vines are semi-erect herbaceous to somewhat lignified perennial plants with one or more tuberous roots; trifoliolate leaves, inflorescence is a complex to simple raceme and the flowers have a tubular calyx and a papilionaceous corolla. The floral biology of *P. erosus* was studied in some detail by Prasad and Prakash (1973). The flowering in the three cultivars examined commenced 58-68 days after sowing, and lasted 92-103 days. The vine reaches a height of 4 to 5 m when given suitable support. Its root can attain lengths of up to 2 m and weight up to 20 kg. The heaviest yam bean root ever recorded weighed 23 kg and was found in 2010 in the Philippines. (Anon. 2010).

Yam Bean Production in India

It is commonly called *Misrikand*, *Kesaru*, *Shankalu* or *Sankeshalu* in different parts of India. In India, it is mostly grown in North Bihar, extending parts of West Bengal, Assam, Orissa and eastern Uttar Pradesh. Large area under yam bean is in Bihar state of India from where it is marketed all over the country. It is also a popular crop in the Gangetic alluvial tract of West Bengal (Naskar, 2009). Yam bean will thrive best in light, rich, sandy-loam or alluvial soils in zones with a moderate precipitation rate, i.e. approximately 1500 mm m.a.p.r.(mean annual precipitation rate) Srivastava *et al.* (1973).

Yam Bean Production in Konkan Region of Maharashtra

Hot and humid Konkan agro-climatic conditions are ideal for cultivation. In Konkan it can be grown during Kharif as well as rabi season. Considering its taste and acceptability as salad, the crop is having tremendous potential for commercial cultivation in Konkan. Yam bean tubers may be well marketed as an attractive product to be used in various dishes, and also as a snack (Mudahar and Jen 1991). According to Kundu (1969), *P. erosus* tubers are used in the

production of a high grade Flour. The proximity of the Konkan region to metropolitan market like Mumbai, Pune and Panaji is an added advantage for marketing of these tubers especially in hotel and tourism industry which is flourishing at an accelerated rate in Konkan region also.

Production Practices

Yam bean is frost susceptible and requires nine months without frost for a good harvest of large tubers. It grows well in tropical areas. The plants are rambling vines that can be let run along the ground or up on trellis. This crop is propagated by seeds. Being a tuber crop, sowing should be done on ridges and furrow method. In India Rajendra Misrikand-1(RM-1) and Rajendra Misrikand-2 (RM-2) are two varieties of yam bean which are released by All India Coordinated Research Project on Tuber Crops (AICRPTC), Rajendra Agricultural University, Dholi, Muzaffarpur, Bihar. Excessive flowering will reduce tuber size. Yam bean is generally free of pests and disease. Young plants need to be kept weed free. Harvest takes place once the tuberous roots have attained marketable size, i.e. depending on whether small, medium sized or large tubers are preferred by the consumers. In *P. erosus* this means that the Mexican cultivars are harvested from 5 to 7 months after planting, as there are both early and late-maturing cultivars available. The yield of yam bean ranges from 35-60 t/ha (fresh tubers).



a) Yam bean plant at initial growth stage



b) Yam bean plants at flowering stage



c) Harvested yam bean tubers



d) White yam bean tuber



e) Sliced yam bean tuber

CONCLUSION

Yam bean share a unique combination of the general qualities present in most cultivated legumes, which makes them attractive to the producer, the consumer, the processor and the environment, respectively: good adaptability to a wide climatic and edaphic range, yield reliability of the root/tuber well-balanced and nutritious composition of their protein/starch

contents agreeable taste good post-harvest/storage characteristics biological nitrogen fixation (sustainability). Yam bean can be used as an alternative source of starch with high protein content. Despite the potential of yam bean tubers, they are neglected and attract little research and development attention. The systematic research on agronomical aspects is also neglected..

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