



RESEARCH ARTICLE

DOLICHOS BEAN: AN UNDERUTILIZED AND UNEXPLORED CROP WITH IMMENSE POTENTIAL

¹*Raghu, B.R., ²Samuel, D.K., ³Mohan N. and ⁴Aghora T. S.

¹PhD (Genetics), Scientist, Division of Vegetable Crops, ICAR-Indian Institute of Horticultural Research, Hessaraghatta Lake Post Bangalore-560089, India

²PhD (Plant Virology), Principal Scientist, Division of Plant Pathology, ICAR-Indian Institute of Horticultural Research, Hessaraghatta Lake Post Bangalore-560089, India

³ PhD (Cytogenetics), Principal Scientist, Division of Vegetable Crops, ICAR-Indian Institute of Horticultural Research, Hessaraghatta Lake Post Bangalore-560089, India

⁴PhD (Vegetable Science), Principal Scientist, Division of Vegetable Crops, ICAR-Indian Institute of Horticultural Research, Hessaraghatta Lake Post Bangalore-560089, India

ARTICLE INFO

Article History:

Received 14th September, 2018

Received in revised form

28th October, 2018

Accepted 18th November, 2018

Published online 26th December, 2018

Keywords:

Dolichos, Climate-change, Genetics-Improvement, Varieties, Vegetable.

ABSTRACT

Dolichos is an oldest leguminous crop known to man. It grows in dry and semi-arid regions of Asia, Africa and America. In India, it is popular in south, east and north-east parts of the country for vegetable, pulse and fodder purpose. It is rich in protein, minerals and vitamins, and is a major source of protein for South Indian diet. It also provides nutritious green fodder to milch animals. Apart from being draught tolerant, it has high adaptability to wide range of production conditions. It also improves soil fertility by fixing atmospheric nitrogen and adding more organic carbon to soil. Despite its multi-utility and multi-benefits, Dolichos is still an underutilized and unexplored crop in terms of area under cultivation and efforts towards its genetic improvement. Adaptation and mitigation strategies against climate change induced threats to global food security; biodiversity and sustainable development require climate resilient crops like Dolichos. It is a potential crop for sustainable agriculture in dry land ecosystems assuring food and income security to small and marginal farmers of this region. Thus, attention should be given for comprehensive genetic improvement and conservation of plant genetic resources of Dolichos.

INTRODUCTION

Dolichos bean or Hyacinth bean or Indian bean [(*Lablab purpureus* L.) Sweet] is a multi-utility and multi-beneficial leguminous crop. It is grown for vegetable, pulse, fodder, green manure, cover crop, medicine and ornamental purpose (Ayyangar and Nambiar, 1935). It is one of the oldest legume crop known to be cultivated dry and semi-arid regions of Asia, Africa and America (Ayyangar and Nambiar, 1935). In India, it is popularly grown in south, east and north east parts of the country. It is the major sources of protein in the South Indian diet. With cultivated area of 0.085 million hectares and production of 0.030 million tones, Karnataka only contributes about 90% of both area and production of Dolichos in India (Laxmi *et al.*, 2015). It is grown either in pure stand or intercropped with cereals like finger millet, pearl millet, corn and sorghum, and with other crops like groundnut, castor in rainfed ecosystems. It prefers comparatively cool season, and moreover majority of traditional cultivars are temperature-and photoperiod-sensitive and requires short days for flowering.

*Corresponding author: Raghu, B.R.,

PhD (Genetics), Scientist, Division of Vegetable Crops, ICAR-Indian Institute of Horticultural Research, Hessaraghatta Lake Post Bangalore-560089, India.

Thus, Dolichos are planted in July-August to synchronize flowering to winter months and harvested in the months of February to April. However, if photo-period neutral varieties are available, then it can be cultivated round the year. Dolichos is an important legume crop with multiple benefits. Its green delicious immature pods and seeds are consumed as vegetable. After maturity, dry seeds are harvested and stored, and consumed as a pulse throughout the year. It is very good source of protein (20-25%), amino acids (like Lysine, usually lack in cereals), vitamins (A, C & Riboflavin) and minerals (Ca, Fe, Mg, S, Na & P) (Deka and Sarkar, 1990). Moreover, immature pods and seeds are rich in dietary fiber, and low carbohydrates and lipids. Due to changing pattern of lifestyle and food habit elsewhere, intake of low calorie and low fat vegetarian food is becoming increasingly popular. Thus, Dolichos is very important from nutritional view point. Besides, Dolichos is endowed with many medicinal and therapeutic properties. The seeds contain kievitone, which is one of the potential breast cancer fighting flavonoid (Hoffman 1995). Tyrosinase present in the seed has greater potential for the treatment of hypertension in human beings (Naeem *et al.* 2009). The beans are used as stomachic, anthelmintic, diuretic, aphrodisiac, anti-spasmodic, digestive, febrifuge, carminative and laxative (Kirtikar & Basu 1995).

Table 1. The distinguishing features of two botanical or cultivated types of Dolichos

Features	<i>Lablab purpureus</i> var. <i>typicus</i>	<i>Lablab purpureus</i> var. <i>lignosus</i>
Common names	Garden bean, Hyacinth bean	Field bean, Indian bean, Lablab bean
Vernacular names	Sem (Hindi), Hittalavare or Nelavare (Kannada), Chikudu (Telugu), Wal (Marathi), Aare (Tamil)	Avare (Kannada), Avarai (Tamil);
Growth type	Indeterminate or semi-indeterminate	Determinate
Growth habit	Perennial twining herb usually trained on a pendal (Pole type)	Perennial bush oftenly grown as annual (Bush type)
Cultivation type	Garden type crop	Field crop type, either as pure crop or intercropped with other cereals
Pigmentation	More pigmentation on stem, leaves and pods	Less pigmentation on stem, leaves and pods
Flowering	Thermo-photoperiod sensitive (short day)	Thermo-photoperiod insensitive
Flowering duration	60-90 days after sowing	40-50 days after sowing
Pod traits	Pods are Longer, flat and tapering. Long axis of seeds is parallel to suture of the pod.	Pods are shorter in length and more abruptly truncated. Long axis of seeds is perpendicular to suture of the pod.
Parchment on pod wall	Pods are relatively less fibrous, soft and whole pod is edible	Pods are firm-walled and fibrous pods not suitable for whole pod consumption
Harvesting stage	Green immature pods and green seeds harvested	Fully matured dry pods are harvested for dry seeds; However, pods are harvested for green seeds
Purpose	Usually cultivated for green immature pods and green seeds and consumed as vegetable	Usually cultivated for dry seeds and consumed as pulse
Other traits	No oily substances and characteristic fragrance	It exude oily substances that emit characteristic fragrance
Yield potential	High	Less
Popular local cultivars	'Kanupu Chikudu'	'Magadi local', 'Shivappu avare', 'Yanaikathu Avarai' and 'Kozhikkal Avari', 'Kadalavare'

Table 2. List of popular varieties of Dolichos developed for vegetable, Pulse and fodder purpose

Institute developed	Varieties	Special features	Purpose
ICAR-IIHR, Bengaluru	Arka Jay, Arka Vijya, Arka Sambhram, Arka Amogh and Arka Soumya	Bush type, Photi-insensitive	Vegetable
	Arka Swagath, Arka Vistar, Arka Krishna, Arka Adarsh, Arka Pradhan, Arka Prasadhi and Arka Bhavani	Pole type, Photi-insensitive	Vegetable
	Pusa Sem 2, Pusa Sem 3 and Pusa Early Prolific	Pole type, Photi-insensitive	Vegetable
ICAR-IARI, New Delhi	Konkan Bhushan (DPLD 1)	Bush type, Photi-insensitive	Vegetable
CSAUA&T, Kanpur	Rajani, KDB 403, KDB 405	Pole type, Photi-insensitive	Vegetable
MPKV, Rahuri	Dasarawal, Deepaliwal	Pole type, Photi-insensitive	Vegetable
JNKV, Jabalpur	JDL 79, JDL 53	Pole type, Photi-insensitive	Vegetable
UAS, Bangalore	Hebbal Avare-1, Hebbal Avare-3, Hebbal Avare-4	Bush type, Photi-insensitive	Pulse
TNAU, Coimbatore	Co-1, Co-2, Co-3, Co-4, Co-5	Pole type, Photi-insensitive	Vegetable
	Co-6, Co-7, Co-8, Co-9, Co-10, Co-11, Co-12, Co-13, Co(Gb)-14	Bush type, Photi-insensitive	Vegetable
ICAR-IGFRI, Jhansi	Bendel Sem-1 (JLP-4)	Biennial growth type, multicut	Fodder



Arka Jay



Arka Vijay

Figure 1. Bush type photo-insensitive Dolichos varieties developed at ICAR-IIHR, Bengaluru, for vegetable purpose for round the year cultivation

Besides, Dolichos provides very nutritious and palatable green fodder for milch animals. The green leaves contain 21-38% of crude protein. In addition, Dolichos is used in silage making by mixing it with other cereals (like Sorghum) in 2: 1 proportion to improve quality and protein content of silage (FAO, 2012). Besides, Dolichos produces more biomass per unit area and time, and thus act as very good natural mulch and reducing soil erosion due to runoff water. Moreover, it adds more biomass to soil and improves soil health by enriching soil carbon content. The extensive root system of Dolichos improves physical properties and structure of the soil. Further, it fixes atmospheric Nitrogen symbiotically with beneficial microorganism and improves the soil fertility. Moreover, it can withstand drought better than other legumes like common bean and cowpea, and well adapted to acidic and saline soils. Thus, it is an important crop when considering food, nutritional and economic security to poor and marginal farmers, ecosystem stability, climate change resilience, and cultural diversity for local food habits.

Types of Dolichos: Dolichos belonging to the family *Fabaceae*, is predominantly a self-pollinated crop and native to India (Nene, 2006). The cultivated Dolichos is broadly identified as two botanical types, namely *Lablab purpureus* var. *typicus* and *Lablab purpureus* var. *lignosus* (Sasthry, 1952). Both types are cross compatible and produce fertile progenies upon hybridization. The differentiating features of both types are given the table 1.

Genetic improvement of Dolichos: Despite its multi-utility and multi-benefits, Dolichos is still an underutilized and unexplored crop. It is evident from limited area of cultivation under this crop and efforts towards its genetic enhancement (Vaijayanthi *et al.*, 2018). Though, few efforts are underway to improve the genetic potential of Dolichos for pod yield, grain yield and its attributes elsewhere. More often, they are isolated programmes, characterized by limited use of plant genetic resources (PGR), relies on narrow genetic base. In most cases, breeding methods involves hybridization followed by selection for recombinants in segregating generations, which is more time consuming, more land and resource demanding and less efficient. Whereas, more efficient and enhanced pace of breeding programme in Dolichos require adoption of a well-conceived strategy that hinges on increased use of available plant genetic resources, identification of trait based genotypes, identification and introgression of key genes/ Quantitative Trait Loci (QTLs). Further, it should be supported by comprehensive survey and exploration of wide range of germplasm resources, understanding the extent of genetic wealth, followed by characterization and documentation and regular exchange of germplasm between institutes involved in Dolichos improvement. Development and increasing use of different robust genomic resources such as SSR (Simple sequence repeats) markers, SNPs (Single Nucleotide Polymorphism), DArT (Diversity Arrays Technology) *ect.* and their efficient use in identification of elite genotypes and traits discovery. In past, efforts were made to improve Dolichos for vegetable purpose, grain yield and fodder purpose. Many Indian Council of Agricultural Research (ICAR) institutes, State Agricultural Universities (SAU) and few international institutes are actively involved in genetic improvement of Dolichos. The ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru, is a pioneer institute to successfully introgress photo-insensitivity and determinate traits from *Lablab purpureus* var. *lignosus* (Hebbal Avarai 3, a pulse type

Dolichos as a donor) into genetic background of *Lablab purpureus* var. *typicus* (Kanupu Chikudu, a most priced local garden bean), and developed two bush type vegetable Dolichos varieties namely, Arka Jay and Arka Vijay suitable for round the year cultivation (Fig. 1) (Satyanarayana, 1985). Besides, ICAR-IIHR, has developed six varieties of photo-insensitive pole type Dolichos and three more photo-insensitive bush type Dolichos varieties for vegetable purpose. The list of popular varieties of Dolichos released for vegetable, pulse and fodder purpose is given in the table 2.

Future thrust:

- **Area expansion under Dolichos:** In India, about 60% of cultivable area is under rainfed situation. More than 90% of area under Dolichos is in Karnataka. However, Dolichos can easily fit to existing cropping systems of other dry land parts of the country. Besides, it assures nutritional and income security to small and marginal farmers and improves soil fertility in rainfed ecosystems. Thus, there is a huge scope to expand Dolichos cultivation to non-conventional arid and semi-arid regions of central, western and north-east parts of the country.
- **Conservation of PGR in Dolichos:** Dolichos is native to India. Thus tremendous diversity exists for this crop. In order to understand the extant of variability for important economic traits and identification of trait specific genotypes requires comprehensive exploration of PGR, characterization and documentation. There should be a system of regular exchange of germplasm among the breeders.
- **Development of DUS guidelines and protection of farmer's varieties:** In various parts of India, the farmers are popularly growing their own bred varieties of Dolichos passed from many generations known by different vernacular names, collectively called farmers varieties. They known to possess unique traits and have economic importance. However, there is no internationally or nationally accepted DUS test guidelines available in Dolichos; which is a mandatory requirement to register and protect farmer's varieties under PPV&FRA, New Delhi. Thus there is a urgent need to develop internationally or nationally accepted DUS test guidelines in Dolichos.
- **Comprehensive research efforts in Dolichos:** A breeding programme inclusive of increased use of genomic resources in PGR management, identification of trait specific genotypes and trait discovery, successful introgression into elite genetic background is need of the hour. Further, much intensive efforts towards ideotype breeding in Dolichos are required for development of bush and semi-determinate growth habit with early flowering and superior pod quality suitable for vegetable purpose and do way with cost intensive trailing.
- **International Cooperation:** Particularly, with African and Asian countries for exchange of expertise and experiences, human resources and germplasm resources to accelerate the research activities in Dolichos.

Conclusion

Climate change is inflicting serious threat to global food security, biodiversity and sustainable development. One of the

strategies to adapt and mitigate climate change effects involves adaption of climate resilient crops. Though, Dolichos considered as underutilized and unexplored crop in terms of cultivated area and efforts to genetic improvement. However, it has a huge potential to play a crucial role in sustainable agriculture, nutritional and income security of small and marginal farmers in dry and semi-arid regions of tropic and subtropics in the near future.

Conflict of Interest statement: No conflict of interest

Funding statement: Not applicable

REFERENCES

- Ayyangar GNR and Nambiar KKK. 1935. Studies in Dolichos lablab (Roxb) and (L.). The Indian field and garden bean. In: The First Proceedings of Indian Academy of Science 1 (12): 57-867
- Deka RK and Sarker CR. 1990. Nutritional composition and antinutritional factors of *Dolichos lablab* L. seeds. *Food Chemistry*, 38: 239-246.
- FAO, 2012. Grassland species index. *Lablab purpureus*. <http://www.fao.org/ag/AGP/doc/Gbase/DATA/Pf00047.HMT> (accessed 6 June 2012).
- Kirtikar KR. and Basu BD. 1995. Indian Medicinal Plants. Vol. I. 3rd Edn., Sri Satguru Publications, New Delhi.
- Hoffman R. 1995. Potent inhibition of breast cancer cell lines by the iso-flavonoid Kievitone: Comparison with genistein. *Biochemical and Biophysical Research Communications*, 211: 600-606.
- Laxmi K., Vijayanthi PV., Keerthi CM., Shivakumar MS., Ramesh S. and Mohan Rao A. 2015. Genotype-dependent photoperiod-induced sensitivity to flowering time in Dolichos bean (*Lablab purpureus* L.) sweet var. lignosus. *Bangladesh Journal of Botany*, 45(3): 471-476.
- Naeem M., Khan MMA., Moinuddin Siddiqui MH. 2009. Triacetonol stimulates nitrogen-fixation, enzyme activities, photosynthesis, crop productivity and quality of hyacinth bean (*Lablab purpureus* L.). *Scientia Horticulturae*, 121(4): 389-396.
- Nene, Y.L. 2006. Indian pulses through Millennia. *Asian Agri-History*, 10(3):179-202.
- Sasthry, B.N. 1952. *Dolichos lablab* L. The wealth of India-raw materials. Council of Scientific and Industrial Research 3: 104-106.
- Satyanarayana A. 1985 Annual Report, IIHR, Hessuraghatta, Bangalore.
- Vijayanthi PV., Ramesh S., Mohan Rao A., Mangala N. and Ashwini M. 2018. Identification and characterization of contrasting genotypes for productivity traits from a core set of dolichos bean germplasm. *International Journal of Chemical Studies*, 6(2): 2946-2949.
