

## Studies on the Inheritance of Bush Habit and Photo Insensitivity in Garden bean (*Lablab purpureus* (*Dolichos lablab*))

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### Abstract

*Dolichos* beans (*Dolichos lablab* var. *typicus*) or garden beans are most liked and nutritious vegetable. They are usually climbers and needs support at huge cost for commercial cultivation. In addition these beans are photosensitive (short day plants) and are available only for a short period in the market. Photo insensitive and bush types are available in its close relative the field bean (*Dolichos lablab* var. *lignuosus*). Research efforts in this direction resulted in photo insensitive bush *Dolichos* varieties However, the nature of inheritance of the traits for bush habit and photo insensitivity have not been reported. Hence, through the present investigation, the inheritances of these traits have been worked out utilizing the backcross generations developed by the NRI Agritech Pvt. Ltd., Guntur. The study revealed that both bush habit and photo insensitivity are independently governed by single recessive genes.

### Keywords

*Dolichos* beans; Garden beans; Inheritance of plant habit; Photoinsensitivity; Photosensitive

### Introduction

Development of photo insensitive and determinate type cultivars is one of the major objectives in *Dolichos* breeding. *Dolichos* beans *Dolichos lablab* var. *typicus* or *Lablab purpureus* are commonly called as garden beans, Indian beans, Hyacinth beans, chikudu (Telugu), Wal (Marathi), Sun (Hindi), Aare (Tamil) and Avarai (Kannada) are the most delicious and nutritious whole pod, belongs to the family Fabaceae and one of most ancient crops among the cultivated plants. In India, *Dolichos* bean is primarily cultivated in Andhra Pradesh, Karnataka adjoining districts

of Tamilnadu, Maharashtra [1] and used as vegetable (immature green soft pods and immature grains) and forage [2]. They are rich in protein and minerals and are liked for its taste. However, by virtue of their climbing habit they are mostly cultivated as backyard crops. Its commercial cultivation requires huge expenditure on support (pendals). These beans are also photosensitive (short day plants) and hence the beans are available for a very short period i.e. during December to March. Botanically, a close relative to garden beans is field beans (*Dolichos lab lab* var. *ligneous*) which is commonly called as anumulu, and is growing in an arid zone. Only cotyledons are used from mature pods as vegetable photo insensitive bush type *Dolichos lablab* var. *lignuosus* are available (such as Hebbal Avarai 3). The garden bean and field beans are cross compatible, Hebbal Avare 3, as donor for bush habit and photo insensitivity, was hybridised with Kanupu Chikudu (Most priced local garden bean) and developed two bush *Dolichos* varieties suitable for round the year cultivation namely Arka Jaya and ArkaVijay at IIHR Bangalore [3]. In order to improve the quality of the vegetable pod further, backcross method of breeding is resorted at NRI Agritech Pvt. Ltd., Guntur. To identify the recombinants and their breeding behaviour, the genetic nature of the above two traits is essential. Hence, utilizing the segregating populations of backcross generations developed the inheritance studies were carried out.

### Materials and Methods

Botanically 2 types of *Dolichos* are cultivated

1. Garden beans (*Dolichos lablab* var. *typicus*)  
Whole pod edible even when the seeds are fully developed, climbers, photosensitive (short day plants) (Kanupu chikudu, the most popular local variety was used as the recurrent parent) (Figure1).
2. Field beans (*Dolichos lablab* var. *lignuosus*)  
Mature seed (cotyledons) are used as delicious vegetable  
Bush and photo insensitive cultivars are available. Hebbal Avare 3 was used as donor.



Figure: 1

In order to improve the pod quality, backcross method of breeding was employed at NRI Agritech Pvt. Ltd., utilizing improved bush type, Arka Jaya as donor and Kanupu chikkudu as recurrent parent [4]. Inheritance studies were carried out utilizing the BC2F1, BC2F2 and BC2F3 generations made available for the current investigation by the NRI Agritech Pvt. Ltd., to understand the nature of inheritance of bush habit and photo insensitivity during 2013-14 and 2014-15. BC2F1 during 2013-14, BC2F2 during Kharif 2014-15 (to identify photo insensitive segregates), BC2F3 during Rabi 2014-15. The studies were carried out at NRI Agritech Pvt. Ltd. R&D Farm, Guntur. Photoperiod sensitivity for flowering time and indeterminate type of most of Dolichos germplasm accessions possess difficulty in evaluating them across seasons and in prediction and synchrony of flowering time [5].

## Results and Discussion

The BC2F1 of the cross between photosensitive and climber type variety Kanupu chikkudu and bush photo insensitive variety Arka Jaya was found to be climber and photosensitive indicating that both bush habit and photo insensitivity are governed by recessive genes. BC2F2 generation was raised during rainy season (long day period) 2013-14 to identify photo insensitive segregates (Table 1).

Table 1. Segregation for climber and bush phenotypes in BC2F2 plants

Popula- tion	Phenotype			Chi- square value	P value
	Climb- ers	Bush	Total		
BC2F2	1275	430	1705	0.028	0.5 - 0.7

The segregation ratio fits in 3:1 ratio with a high probability and hence, it is evident that bush habit is governed by a single recessive gene (Table 2).

Table 2. Segregation for photo sensitivity and insensitivity in BC2F2 plants

Popula- tion	Phenotype			Chi- square value	P value
	Photo- sensi- tive	Photo in- sensitive	Total		
BC2F2	1305	400	1705	2.03	0.1 - 0.2

The segregation fits in 3:1 ratio with a probability range of 0.1-0.2 and hence, photo insensitivity is found to be governed by a single recessive gene. In order to understand whether the two traits are independently assorting or linked, the data were recorded for their combined segregation and presented below (Table 3).

Table 3. Co-segregation for plant type and photo sensitivity in BC2F2

The segregation ratio is in good fitness of 9:3:3:1 ratio with a probability range of 0.3-0.5. Indicating independent assortment of the two genes and only 1/16 population at F2 generation are expected to be of Bush habit coupled with photo insensitivity BC2F3 population studies revealed the true breeding. Nature of Bush habit as well as Photo insensitivity as they are governed by recessive genes and the homozygous recessive traits gets fixed once identified.

## Conclusion

Through the present investigation, it is concluded that in Dolichos lab lab, bush habit is governed by a single recessive gene (3:1), Photo insensitivity is also governed by a single recessive gene (3:1) and both the genes assorted independently (9:3:3:1). The present investigation will have tremendous impact in making Dolichos beans available round the year and by cultivating on commercial scale like a field crop without requiring support (Figure 2) using the simple genetic information of two major genes and their transfer from a closely related species.

The present result are in agreement with through their studies on field bean (Dolichos lablab var. lignosus) in respect of monogenic recessive gene controlling photo insensitivity but the present investigation disagrees as far as the plant habit and joint segregation of photo period sensitivity and growth habit [6,7]. This may be due to hybridization between Dolichos lablab var. typicus and Dolichos lablab var. lignosus in the present investigation.

Table 3. Co-segregation for plant type and photo sensitivity in BC2F2

Population	Climber		Bush		Total	Chi-square value	P value
	Photo Sensitive	Photo insensitive	Photo Sensitive	Photo insensitive			
BC2F2	889	288	310	116	1603	3.323	0.3 - 0.5



Figure: 2

Photoperiod insensitiveness to flowering time helps enhance the use of germplasm in Dolichos breeding. Large-scale conversion of photosensitive sorghum germplasm accessions into their photo insensitive counterparts which enabled enhanced use of exotic germplasm, broaden genetic diversity and provide new sources of desirable traits stands testimony to the utility of photo insensitive accessions in breeding crop plants and Dolichos bean is no exception to this [8]. As both photoperiodic response to flowering time and growth habit are easily assayable under field conditions and have monogenic/multigenic control, they serve as diagnostic descriptors of germplasm accessions and hence useful to avoid mistakes in labelling, aid identification and minimize duplication in the germplasm database [9]. They also serve as morphological markers to identify true F1's in Dolichos bean.

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