www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(11): 964-967

www.thepharmajournal.com
Received: 19-08-2021
Accepted: 02-10-2021

Stuti Krishna
Department of Genetics and Plant Breeding, Navsari Agricultural University, Navsari, Gujarat, India

Monika Makwana
Department of Genetics and Plant Breeding, Navsari Agricultural University, Navsari, Gujarat, India

Kaushal Modha
Department of Genetics and Plant Breeding, Navsari Agricultural University, Navsari, Gujarat, India

Ritesh Patel
Department of Genetics and Plant Breeding, Navsari Agricultural University, Navsari, Gujarat, India

Corresponding Author:
Stuti Krishna
Department of Genetics and Plant Breeding, Navsari Agricultural University, Navsari, Gujarat, India

Screening of Indian bean germplasm for photoperiod responsive flowering and growth habit under natural condition

Stuti Krishna, Monika Makwana, Kaushal Modha and Ritesh Patel

Abstract
Domestication of Indian bean has realized the importance of photoperiod responsive flowering and growth habitfor its cultivation. The crop is underutilized and has been outlooked for research despite being immense potential to serve as nutritious like other legumes. In the present study, an attempt has been made to categorize individuals from segregating RIL population for photosensitivity and growth habit by making cross between two extreme phenotypes for this character *viz.,* GNIB-21 (used as female) and GP-189 (used as male). While studying 123 individuals from $F_{3:4}$and $F_{4:5}$ generations, it was observed that there were 58 determinate plants in $F_{3:4}$ generation, out of which, 56 were photo-insensitive while 2 were photosensitive. Sixty five plants were indeterminate, out of which, 39 were photo-insensitive and 26 were photosensitive. For $F_{4:5}$, 63 were determinate (36 photo-insensitive + 27 photosensitive) and 60 were indeterminate where 54 were photosensitive and only 6 were photo-insensitive. This has depicted that most of the photo-insensitive RILs showed more frequency of determinate plants as compared to indeterminate. However, the majority of photosensitive plants were indeterminate in growth. This study could be helpful for breeder to frame research upon this aspect in Indian bean and delineating such important traits for assisting in germplasm conversion.

Keywords: Photosensitivity, photo-insensitive, determinate, indeterminate, growth habit

Introduction
Indian bean (*Lablab purpureus* L. Sweet, Syn. *Dolichos lablab* L.) is a food-grain legume and predominantly a self-pollinated crop with chromosome number 2n=22 (Goldblatt, 1981) [2]. It is a minor pulse crop belonging to the family Fabaceae, sub-family faboidene, tribe phaseoleae and is evidenced to originate in Indian subcontinent (Nene, 2006) [8]. The comprehensive germplasm collection accounts for more than 3000 accessions worldwide with many duplications (Maas *et al.* 2010) [5]. Genome size of *Lablab purpureus*is 367 Mb (Iwata *et al.* 2013) [3]. It is a multi-purpose crop grown as vegetable (immature soft green pods and immature grains) and dried seeds are used as split pulse. Being a legume, it fixes atmospheric nitrogen, hence famous as intercrop to enrich soil fertility. It is used as fodder, forage and cover crop (Magoon *et al.* 1974) [6]. This crop is grown either in pure stands as a sole crop or intercroppedwith finger millet, groundnut, castor, corn, pearl millet orsorghum (Keerthi *et al.* 2014) [4]. Immense genetic variability exists for the morphological and reproductive characters amongst the landraces grown all over the country (Chattopadhyay and Dutta, 2010; Parmar *et al.* 2013) [1, 9]. This crop is highly photoperiod responsive and requires a short day for switching its growth habit from vegetative to reproductive phase (Shivashankar and Kulkarni, 1989) [12]. Most cultivars grown in India are of indeterminate type, however, few determinate varieties have beenreleased. Most of the landraces and cultivars grown among farmers are photoperiod responsive and exhibit indeterminate growth habit, which flowers only during the short day of the winter season making its cultivation difficult across the year. Photoperiod sensitive flowering possesses difficulty in germplasm conversion when a breeder is interested to transfer traits from sensitive to insensitive cultivars. However, few determinate and photoperiod insensitive types are available which flowers within 40-50 days across the year. As photoperiod responsive flowering and growth habit played crucial role in domestication of this crop, it is important to classify and find variability among different germplasm for these traits.
With this view, we have attempted to classify RIL individuals from $F_{3:4}$ and $F_{4:5}$ generation from a cross between GNIB-21 and GP-189 which are phenotypic extremes for photoperiod

responsive flowering and growth habit during *rabi* 2018-19 and 2019-20 under natural field condition.

Material and Methods

The present investigation was conducted during 2018-2020 for phenotypic characterization of parents, their $F_{3:4}$ and $F_{4:5}$RIL populations. The parents used in cross were having contrasting phenotypes with GNIB-21 as photo-insensitive (and flowers within 45 days across the year) and determinate growth habit while other parent GP-189 possesses indeterminate growth habit and is photosensitive as it flowers only under short days of winter season irrespective of sowing time. Single seed descent (SSD) method was utilized to generate $F_{3:4}$ and $F_{4:5}$ RIL populations. $F_{3:4}$ and $F_{4:5}$ population were grown and phenotyped for photoperiod responsive flowering and other traits as well in *rabi*, 2018-19 (F_4 population) and 2019-20 (F_5 population) at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat. Parents, $F_{3:4}$, and $F_{4:5}$ populations were screened for photoperiod responsive flowering. GNIB-21 terminates into reproductive phase within 45 days across the year and has a determinate growth habit. Indeterminate parent GP-189 flowers only under short days of winter season irrespective of sowing time. Segregating individuals are classified into photo-insensitive or photosensitive in both trials. Individuals from $F_{3:4}$ and $F_{4:5}$ populations exhibiting flowering within 55 DAS were considered as photo-insensitive as they express flowering similar to GNIB-21 during both long days and short days while those individuals expressing flowering after 55 days to sowing were considered as photosensitive as they flower only during short day like GP-189.

Results and Discussion

Parents, $F_{3:4}$, and $F_{4:5}$ populations were screened for photoperiod responsive flowering. GNIB-21 terminates into reproductive phase within 45 days across the year, photo-insensitive and has a determinate growth habit. Indeterminate parent GP-189 flowers only under short days of winter season irrespective of sowing time and is therefore photosensitive. Segregating individuals are classified into photo sensitive or photo-insensitive in both trials. Individuals from $F_{3:4}$ and $F_{4:5}$ populations exhibiting flowering within 55 DAS were considered as photo-insensitive flowering (like GNIB-21) while those individuals expressing flowering after 55 days to sowing were considered as photosensitive (alike GP-189). Photoperiod-insensitive individuals flower the whole year irrespective of day-length while the individuals flowering only under short days are photoperiod sensitive. The individuals from RILs populations $F_{3:4}$ and $F_{4:5}$ was also classified based on growth habit along with photosensitivity as shown in Figure 1 and 2. There were 58 determinate plants in $F_{3:4}$ generation out of which 56 were photo-insensitive while 2 were photosensitive. 65 plants were indeterminate out of which 39 were photo-insensitive and 26 were photosensitive. For $F_{4:5}$, 63 were determinate (36 photo-insensitive + 27 photosensitive) and 60 were indeterminate where 54 were photosensitive and only 6 were photo-insensitive. which is depicted that most of the photo-insensitive RILs show more frequency of determinate growth plants as compared to indeterminate plants. However, the majority of photosensitive plants were indeterminate in growth. This trend was similar in both trials *i.e.*, 2018 and 2019 representing $F_{3:4}$ and $F_{4:5}$ populations. The individuals with determinate growth and photo-insensitive phenotype and those depicting indeterminate growth and photosensitivity are shown in Figure 3 and 4. Prasanthi (2005) [10] also classified individuals from segregating generations from two crosses in Indian bean into photoperiod sensitive and insensitive and deduced the inheritance of this trait governed by single pair of gene.Assessment of diversity using photosensitivity trait has been carried out by Sanaullah *et al.* (2012) [11] and Keerthi *et al.* (2014) [4]. Segregation of photosensitivity and growth habit in F_2generation for deducing inheritance pattern of these genes was also executed by Modha *et al.* (2019) [7].

Conclusion

Photosensitivity and growth habit are key factors in evolution of Indian bean and are important for its cultivation in wide latitudinal ranges. The study on photo-sensitivity would assist breeder in deciding future breeding programmes and for gene conversion as photo-insensitive types are favoured for year-round cultivation. However, lack of studies in Indian bean has limited its improvement in due course of time apart from other legumes. Study on photo-sensitivity and growth habit in related legumes like soybean, common bean, pea, etc would help breeders to unfold more steps towards breeding for these traits in Indian bean.

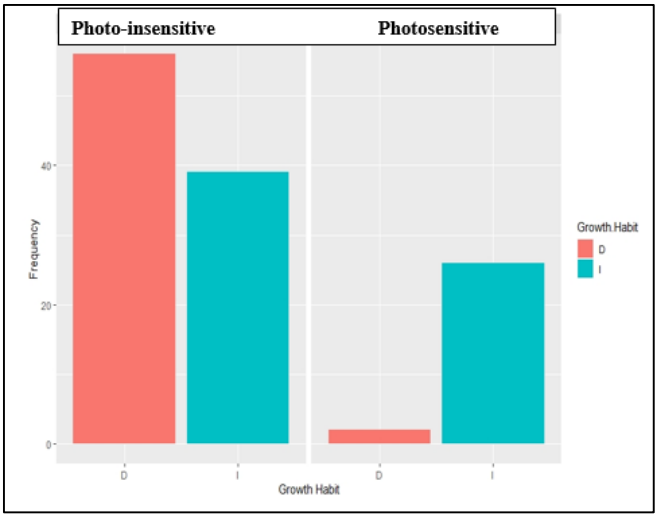

Fig 1: Frequency distribution for growth habit and photo-period responsive flowering for $F_{3:4}$ population (D and I represent determinate and indeterminate growth habit)

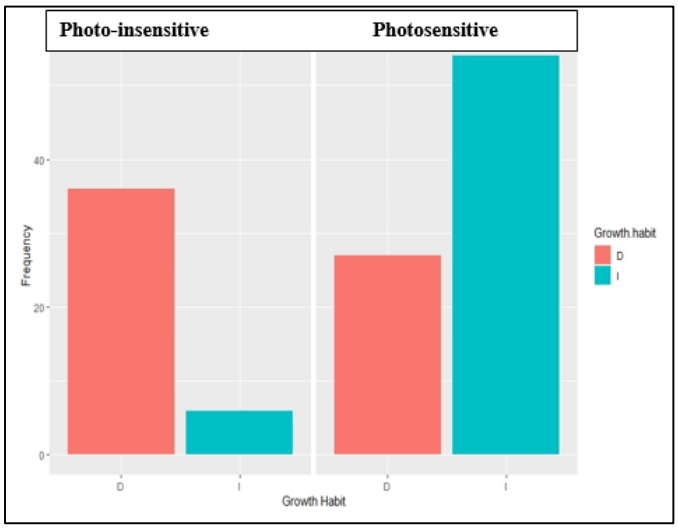

Fig 2: Frequency distribution for growth habit and photo-period responsive flowering for $F_{4:5}$ population (D and I represent determinate and indeterminate growth habit)

Fig 3: $F_{3:4}$ individuals showing determinate growth and photo-insensitive in our study

Fig 4: $F_{3:4}$ individuals showing indeterminate growth and photosensitive in our study

References

1. Chattopadhyay A, Dutta S. Characterization and identification of selection indices of pole type dolichos bean. *Veg. Crops Res*., Bull 2010;73:33-45.
2. Goldblatt P. Cytology and phylogeny of leguminosae. *In Advances in legume systematic* (Polhill RM and Raven eds.), Kew: Royal Botanical Gardens 1981, 427- 463.
3. Iwata A, Greenland CM, Jackson SA. Cytogenetics of legumes in the Phaseoloid Clade. *The Plant Genome*, 2013;6:3.
4. Keerthi CM, Ramesh S, Byregowd, Rao AM, Rajendra Prasad BS, Vaijayanthi PV. Genetics of growth habit and

photoperiodic response to flowering time in dolichos bean (*Lablab purpureus* (L.) Sweet). Journal of genetics 2014;93(1):203-206.
5. Maass BL, Knox MR, Venkatesha SC, Angessa TT, Ramme S, Pengelly BC. *Lablab purpureus*: A crop lost for Africa. *Tropical plant biology* 2010;3(3):123-135.
6. Magoon ML, Singh A, Mehra KL. Improved field been for dryland forage. Indian Farm 1974, 5-7.
7. Modha K, Kale B, Borwal D, Ramtekey, Vinita, Arpit B. Inheritance pattern of photoperiod responsive flowering, growth habit and flower colour in Indian bean [*Lablab purpureus* (L.) Sweet.]. Electorn J Biotechnol 2019;10:297-302.
8. Nene YL. Indian pulses through the millennia. Asian Agri-History 2006;10:179-202.
9. Parmar AM, Singh AP, Dhillon NPS, Jamwal M. Genetic variability of morphological and yield traits in Dolichos bean (*Lablab purpureus* L.). Afr. J. Agril. Res 2013;8:1022-27.
10. Prasanthi L. Inheritance of photosensitivity in lablab bean [*Lablab purpureus* (L.) Sweet]. Legume Res 2005;28(3):233-234.
11. Sanaullah BM, Mohammad Z, Mizanur RM. Assessments of genetic diversity in country bean (*Lablab purpureus* L.) using RAPD marker against photo-insensitivity. Journal of Plant Development 2012;19:65-71.
12. Shivashankar G, Kulkarni RS. Field bean (*Dolichos lablab* L. var. lignosusprain). Indian Hort. 1989;34:24-27.