The Pharma Innovation Journal 2023; 12(3): 3573-3576

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(3): 3573-3576

www.thepharmajournal.com
Received: 07-01-2023
Accepted: 10-02-2023

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Performance of determinate and indeterminate RILs of Indian bean (*Lablab purpureus* L. Sweet)

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DOI: https://doi.org/10.22271/tpi.2023.v12.i3al.19319

Abstract
Growth habit is an important agronomic trait that affects the production and productivity of crop plants including pulses. A preferential shift towards the determinate growth habit types in pulses along with photo-insensitiveness was observed due to their reduced branching, shorter internodes, resistance to lodging, shortened flowering period with synchronized flowering and maturity, and also due to its suitability for mechanical harvesting. In Indian bean, recently few determinate genotypes were released for cultivation nevertheless, most of the wild types and landraces are indeterminate in growth habit. The present study performed the phenotypic evaluation of determinate and indeterminate genotypes in F_7 RILs of determinate x indeterminate crosses, which revealed some of the significant observations on flowering time, plant height, number of racemes produced, and several important yield-related traits in Indian bean. This information could be utilized for selecting the best plant type, optimum plant density, and preferable crop geometry in the cultivation of Indian bean varieties.

Keywords: Determinate (DT), indeterminate (IDT), recombinant inbred lines (RILs), phenotypic and F_7

Introduction
Indian bean (*Lablab purpureus* L. Sweet) is an important minor pulse crop with chromosome number 2n=22, whose draft genome sequence has been recently published, having a genome size of 423 Mb with 20,946 predicted protein-coding genes [1]. It is a short-day pulse crop, predominantly self-fertilizing, and is majorly grown throughout the tropics for food, whose wild plants are found in eastern and southern Africa indicating their center of origin [2–5]. Indian bean is a multipurpose crop and serves as an important protein source, where green pods along with green seeds are used as a vegetable, while dried seeds can be used as split pulse and are also used as a forage and cover crop throughout the tropics and subtropics of Asia and Africa.

There are typically two distinct types of Indian bean grouped based on growth habit i.e. determinate (DT) and indeterminate (IDT) types. The majority of wild types and landraces are characterized by indeterminate growth habit types, which are generally climbing, perennial vines that are trailed in poles or fences. While determinate growth habit is preferable for cultivated types, which have a compact, bushy type plant stature with terminal inflorescence. Moreover, the wild types and landraces are mostly photosensitive and flower only during short day winter conditions. The determinate type growth habit is also considered one of the important domestication syndrome for pulse crops [6], which along with photo-insensitivity facilitates its year-round cultivation along with synchronous flowering and maturity that also improves the ease in harvesting, making mechanical harvesting feasible in pulses. A great amount of variability in morphological and reproductive characters exists among Indian bean landraces grown across the country. The majority of the Indian bean cultivars grown in India are of indeterminate type, but a few determinate varieties have also been released for cultivation. The present study evaluates the phenotypic performance of determinate and indeterminate genotypes in recombinant inbred line (RIL) populations from the following DT x IDT crosses of Indian bean genotypes; GNIB21 x GP1, GNIB21x GP167, GNIB21 x GP189, and GNIB21 x GPKH120, where female parent GNIB21 is determinate and male parents GP1, GP167, GP189, and GPKH120 are indeterminate in growth habit.

Materials and Methods:
The DT x IDT crosses of Indian bean genotypes; GNIB21 x GP1 (cross A), GNIB21x GP167 (cross B), GNIB21 x GP189 (cross C), and GNIB21 x GPKH120 (cross D) with GNIB21 as

the determinate parent was conducted in the Department of Genetics and Plant Breeding, Navsari Agricultural University, Navsari, Gujarat during 2014- 2015. F_1, F_2, and F_3 generations were grown during the short days of winter during subsequent years. Further Single Seed Descent (SSD) method was utilized to generate F_4, F_5, F_6, and F_7 RIL populations. Mean performances of various morphological traits like days to first raceme emergence, plant height (cm), racemes per plant, primary branches per plant, pods per plant, pod weight (g), seeds per pod, and seed yield per plant (g) were evaluated for DT and IDT progenies from F_7 RILs from each cross. All the traits except days to first raceme emergence were recorded at physiological maturity.

Results and Discussion

Initially, the plants in F_7 RILs of each cross were classified as DT or IDT based on shoot apical meristem (SAM) architecture, where in determinate genotypes SAM terminated into reproductive structure giving a compact growth habit, while in indeterminate genotypes they are lateral and the main stem continued its vegetative growth (Figure 1). The mean phenotypic observations for various morphological traits for DT and IDT progenies of F_7 RILs were recorded and tabulated in Table1.

a) b)

Fig 1: Determinate (a) and indeterminate (b) variety of Indian bean, the yellow arrow indicates that terminal inflorescences are produced at SAM in determinate genotypes while vegetative growth continues in indeterminate genotype.

The mean number of days to raceme emergence ranged from 41.6 to 53.6 in DT genotypes while in IDT genotypes it ranged from 64.33 to 83.33 in F_7 RILs (Figure 2). This indicated that the DT genotypes flowered much earlier as compared to IDT genotypes in all four crosses. The average plant height varied from 31.6 cm to 42.37 cm in DT genotypes while it was from 81.3 cm to 115.47 cm in IDT genotypes, which was in confirmation with their growth habit (Figure 3). The mean racemes per plant ranged from 4.7 to 7.5 in DT genotypes, which was comparatively lower than IDT genotypes that produced 10.87 to 18 among all four crosses (Figure 4). The mean number of primary branches per plant was comparatively similar ranging from 5.35 to 5.7 and 5.2 to 5.77 for DT and IDT genotypes, respectively (Figure 5). The mean number of pods per plant was generally higher for IDT genotypes as compared to DT genotypes which ranged from 18.9 to 39.2 and 9.9 to 25.4, respectively (Figure 6). Even though the IDT genotypes had larger pods as compared to DT genotypes with mean pod weight ranging from 1.2 g to 1.83 g and 0.55 g to 0.85 g, respectively (Figure 7). There was no visible difference in the mean number of seeds per pod which ranged from 3.35 to 3.63 in IDT genotypes and 2.8 to 3.67 in DT genotypes (Figure 8). The mean seed yield per plant was comparatively much higher for IDT genotypes which ranged from 13.4 g to 26.8 g than for DT genotypes which ranged from 6.5 g to 10.8 g among all four crosses (Figure 9).

The observations on various morphological traits concluded that the DT genotypes in RILs of all four crosses were early flowering and had short busy type plant stature but had fewer racemes per plant. As a result, the number of pods per plant and seed yield per plant was comparatively lower than that for IDT types. Further DT genotypes had smaller pods which accounted for their lower pod weight but the number of seeds per pod did not vary much between DT and IDT genotypes. The number of primary branches per plant was also comparable between the two genotypes in the RILs of all four crosses. The above results indicated that the determinate genotypes exhibit a low production concerning the yield per plant (g) than indeterminate genotypes. But the compact growth habit trait of determinates types allows the accommodation of more plants per unit area, thus can equalize their production with indeterminate genotypes by modulating the crop geometry [7]. The low grain yield of determinate genotypes could be compensated by high density planting [8, 9].

Table 1: Mean performance of parents, and determinate and indeterminate F_7 RILs in all four crosses

Genotypes	Parents	Plant growth habit	Days to raceme emergence	Plant height (cm)	Racemes per plant	Primary branches per plant	Pods per plant	Pod weight (g)	Seeds per pod	Seed yield per plant (g)
GNIB21		DT	34.5	44.3	5.6	5.8	55.3	0.8	3.8	38.0
GP1		IDT	50.3	65.5	25.5	5.5	58.3	1.6	4.2	61.6
GP167		IDT	50.7	68.3	27.5	5.2	57.1	1.7	4.2	67.9
GP189		IDT	56.3	72.7	30.3	5.7	66.5	1.8	4.1	76.3
GPKH120		IDT	50.7	80.1	26.8	6.1	69.4	1.1	3.7	52.5
RILs (Determinate X Indeterminate crosses)										
DT – Cross A	GNIB21 x GP1	DT	41.6	34.1	4.7	5.35	9.9	0.85	2.8	6.95
DT – Cross B	GNIB21x GP167	DT	53.6	31.6	5.73	5.6	11	0.7	3.1	6.5
DT – Cross C	GNIB21 x GP189	DT	47.73	42.37	6.8	5.63	11.33	0.83	3.67	8.1
DT – Cross D	GNIB21 x GPKH120	DT	52.5	31.6	7.5	5.7	25.4	0.55	3.1	10.8
IDT – Cross A	GNIB21 x GP1	IDT	77.2	83.9	18	5.45	39.2	1.55	3.35	26.8
IDT – Cross B	GNIB21x GP167	IDT	64.33	115.47	10.87	5.23	36.53	1.73	3.63	20.57
IDT – Cross C	GNIB21 x GP189	IDT	83.33	92.4	15	5.77	32.33	1.83	3.43	23.37
IDT – Cross D	GNIB21 x GPKH120	IDT	68.7	81.3	14.2	5.2	18.9	1.2	3.5	13.4

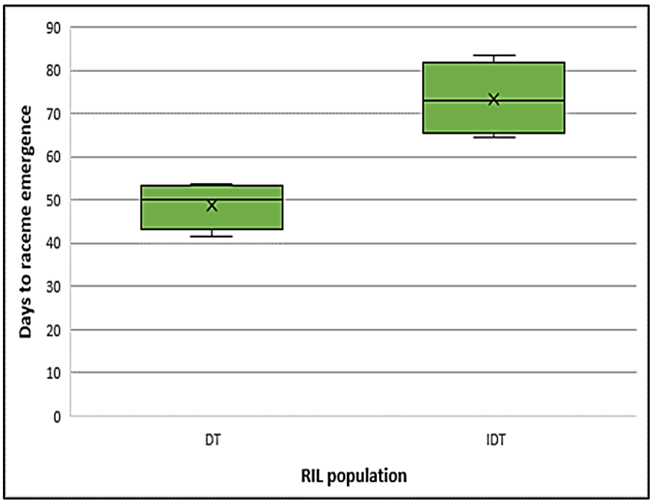

Fig 2: Mean days to raceme emergence among DT and IDT F7 RILs in all four crosses

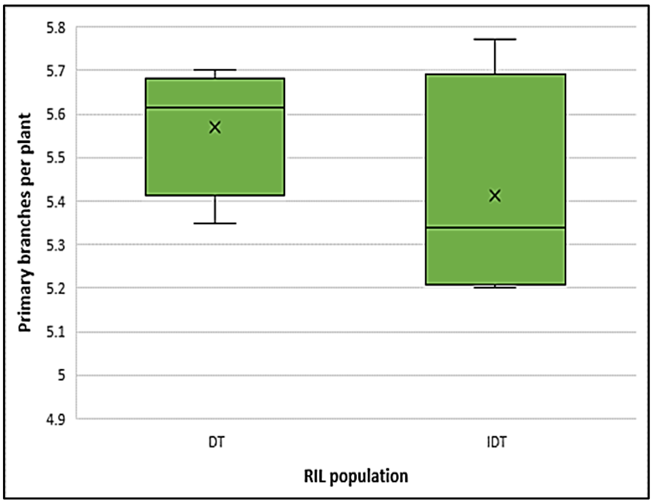

Fig 5: Mean primary branches per plant among DT and IDT F7 RILs in all four crosses

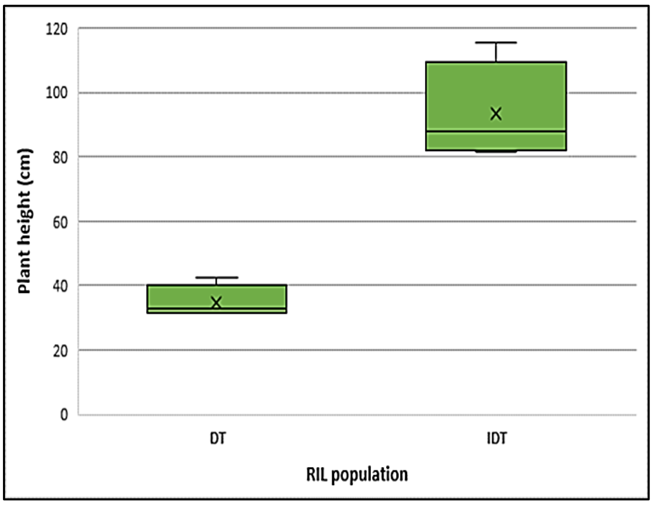

Fig 3: Mean plant height (cm) among DT and IDT F7 RILs in all four crosses

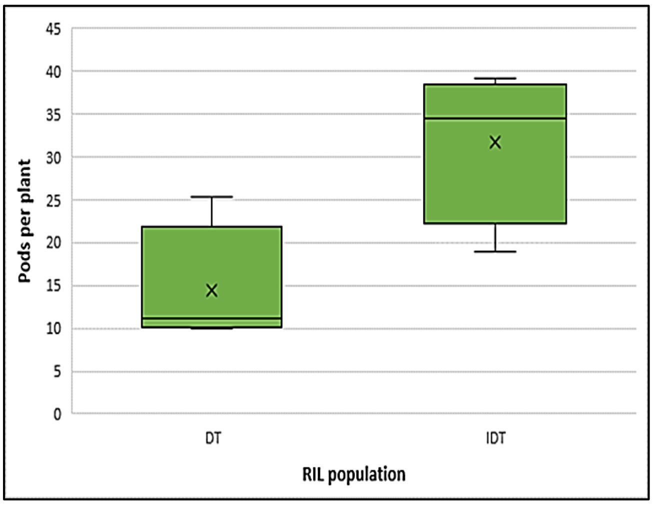

Fig 6: Mean pods per plant among DT and IDT F7 RILs in all four crosses

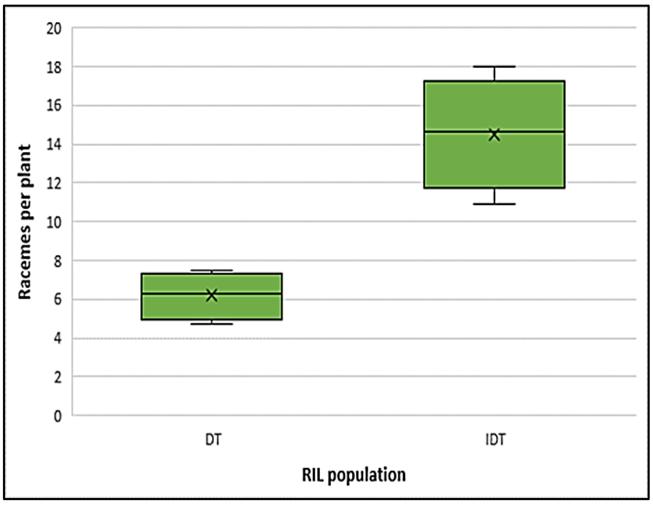

Fig 4: Mean racemes per plant among DT and IDT F7 RILs in all four crosses

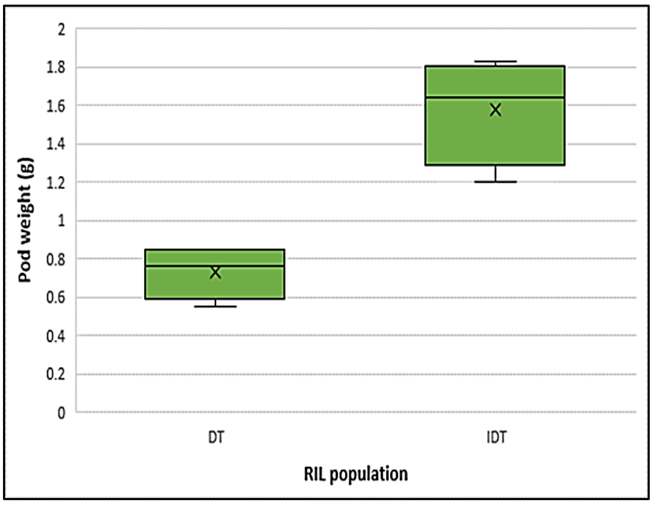

Fig 7: Mean pod weight (g) among DT and IDT F7 RILs in all four crosses

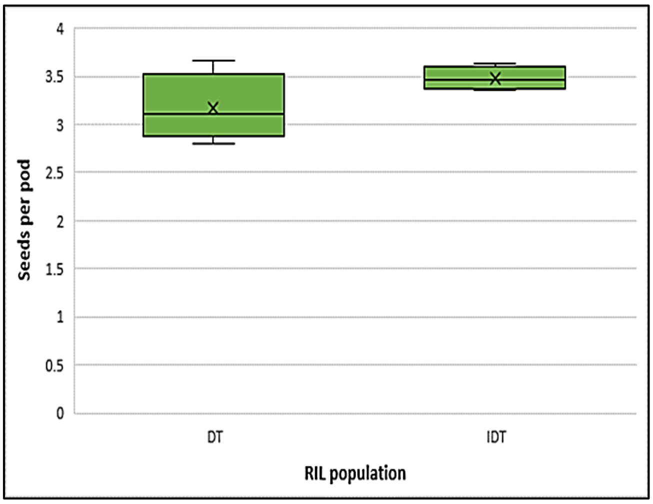

Fig 8: Mean seeds per pod among DT and IDT F_7 RILs in all four crosses

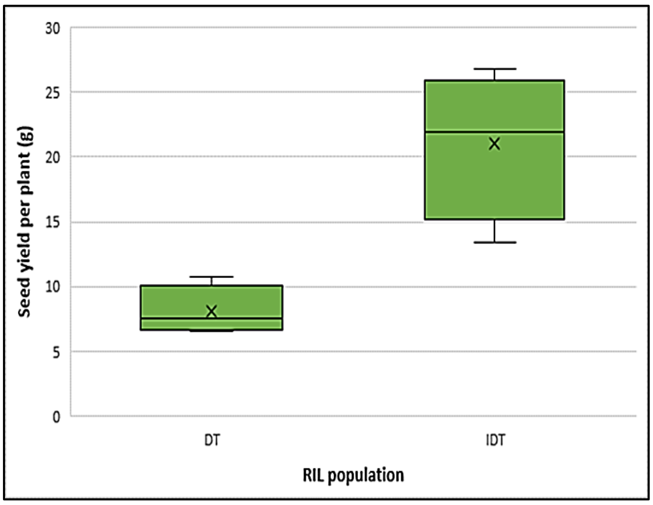

Fig 9: Mean seed yield per plant (g) among DT and IDT F7 RILs in all four crosses

Conclusion:

Growth habit is an economically important trait, which is most often related to plant height, early flowering, yield, resistance to lodging, and suitability for mechanical harvesting [6]. The determinate growth habit trait and synchronous flowering and maturity in pulses enable the mechanization of various agronomic practices and facilitates commercial cultivation. Presently very few such varieties of Indian bean are released for cultivation. The yield per plant for these determinate genotypes is comparatively lower than their indeterminate counterparts but can be equalized by increasing the number of plants per unit area due to their compact growth habit. Hence the determinate varieties of Indian bean have a greater scope for large-scale commercial cultivation as annual crops. While the indeterminate genotypes could still be efficiently maintained as perennial shrubs or climbers in poles or fences at farmsteads or homestead kitchen gardens.

Acknowledgements

We acknowledge the Department of Genetics and Plant Breeding, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat for providing the necessary facilities and funds for carrying out the present experiment.

References

1. Chang Y, Liu H, Liu M, Liao X, Sahu SK, Fu Y *et al*. The Draft Genomes of Five Agriculturally Important African Orphan Crops. Gigascience. 2019;8(3):1-16.
2. Verdcourt B. Lablab In: A Manual of New Guinea Legumes. Bot. Bull. 1979;11:537.
3. Verdcourt B. Studies in the Leguminosae-Papilionoïdeae for the Flora of Tropical East Africa: III. Kew Bull. 1970;24(3):379-447.
4. Maass BL, Jamnadass RH, Hanson J, Pengelly BC. Determining Sources of Diversity in Cultivated and Wild *Lablab purpureus* Related to Provenance of Germplasm by Using Amplified Fragment Length Polymorphism. Genet. Resour. Crop Evol. 2005;52:683-695.
5. Maass BL, Usongo MF. Changes in Seed Characteristics during the Domestication of the Lablab Bean (*Lablab purpureus* (L.) Sweet : Papilionoideae). Aust. J. Agric. Res. 2007;58:9-19.
6. Krylova EA, Khlestkina EK, Burlyaeva MO, Vishnyakova MA. Determinate Growth Habit of Grain Legumes : Role in Domestication and Selection, Genetic Control. Ecol. Genet. 2020;18(1)43-58.
7. Modha K, Kale B, Borwal D, Ramtekey V, Bhuriya A. Inheritance Pattern of Photoperiod Responsive Flowering, Growth Habit and Flower Colour in Indian Bean [*Lablab purpureus* (L.) Sweet.]. Electron. J. Plant Breed. 2019;10(1):297-302.
8. Ashwini KVR, Ramesh S, Sunitha NC. Comparative BLUP, YREM-Based Performance and AMMI Model-Based Stability of Horse Gram [*Macrotyloma uniflorum* (Lam.) Verdc.] Genotypes Differing in Growth Habit. Genet. Resour. Crop Evol. 2021;68(2):457-467.
9. Chandana BR, Ramesh S, Basanagouda G, Kirankumar R, Ashwini KVR. Genetics of Growth Habit in Horse Gram [*Macrotyloma uniflorum* (Lam.) Verdc.]. Genet. Resour. Crop Evol. 2021;68(7):2743-2748.