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## Research Article

### Genetic studies on diversity and variability in dolichos bean (*Lablab purpureus* L.)

K. Geetha\* and S. Divya

Regional Research Station, Paiyur, Krishnagiri district, Tamil Nadu - 635 112

\*E-Mail: geethakreddy@yahoo.com

#### Abstract

The field experiment was carried out by using twenty-six field bean genotypes to study the genetic divergence and genetic variability parameters. The characters studied were days to 50 per cent flowering, days to maturity, plant height, the number of branches per plant, the number of pods per plant, grain yield per plant and green pod yield per plant. On the basis of mean performance, the genotypes, PYR 15-01, Nagavalli local 1 and Nallur local were found to be superior for yield and yield contributing traits. The genotype HA 3 was an early maturing type but possess an optimal green pod yield of 327 g/plant. Twenty-six genotypes were grouped into six clusters and based on the genetic distance, maximum divergence was observed between cluster II (HA4, CO1, CO2, Arka vijay, Arka Swagath & Arka Amogh) and cluster V (Udhuru local & Bannekuppe local), hence parents can be selected from these clusters to exploit better heterosis for hybridization. Maximum intra cluster distance was observed for cluster III (13.88). Among the six clusters, cluster VI (Arka Joy) contributed to wider divergence and promote direct selection of genotypes falling in the respective cluster for plant height, the number of branches per plant, the number of pods per plant and grain yield per plant. The major contribution for divergence was occupied by the characters viz., days to 50 per cent flowering (46.77%), days to maturity (29.85%) and a moderate level of divergence was contributed by the number of pods per plant (12.62%). Therefore, these characters were taken into consideration for selection. With respect to variability studies, all the seven characters viz., days to 50 per cent flowering, days to maturity, plant height, number of branches per plant, number of pod per plant, grain yield per plant and green pod yield per plant recorded high value of PCV, GCV, heritability and genetic advance indicated the involvement of additive genes for the control of these characters and favours selection.

**Key words:** Genetic diversity, PCV, GCV, Dolichos Bean, Lablab purpureus

#### INTRODUCTION

Field bean is mainly known for tender green pods, mature fresh green seeds and is rich in protein. The dry seeds are also utilized for several vegetable preparations and foliage of the crop affords hay, silage and green manures (Bose *et al.*, 1993). Dolichos bean is enriched with a rich source of protein, minerals, vitamins and fibre. The primary centre of origin of Dolichos Bean (*Lablab purpureus* L.) is India. Although this crop has originated in India very minimum research work has been carried out for the genetic enhancement of yield and quality. Genetic diversity

and variability are the basic tools in the development of superior varieties. In general, the available germplasm is filled with sufficient variability which may be better utilized by choosing the right choice of parents with wider divergence to achieve a higher level of heterotic effects in  $F_1$  and a broad range of variability in following segregating generations through genetic diversity studies. In any crop breeding programme for improvement of a specific trait through selection mainly rest on the genetic variability present in the existing germplasm of a particular crop.

In addition, polygenes are responsible for the main plant characters and are highly influenced by the environment. Hence, the improvement of breeding approaches depends on the magnitude, nature and interrelationship of genotypic and non-genotypic variation. This creates a prerequisite to partition the total variability into heritable and non-heritable components. In a breeding programme, heritability and genetic advance for different traits were estimated which help the breeder to apply suitable breeding methodology. Heritability together with genetic advance as per cent of mean is relatively useful in predicting the accurate value of gene action responsible for effective selection. The variability found for various traits is compared with the help of genotypic co-efficient of variation (GCV) and phenotypic co-efficient of variation (PCV). Enhancing the yield is a major thrust area in crop improvement. Being a complex trait, the yield is typically inherited quantitatively. Only scarce information on genetic variability for field beans is available. Hence, an effort was made with a precise objective to estimate the genetic diversity and genetic parameters of variability to identify the foremost characters responsible for obtaining higher yield.

## MATERIALS AND METHODS

The experiment material comprised of twenty-six genotypes viz., Denkanikottai local, Kaveripattinam local, Mecheri local, PYR 15-01, Coll 29, HA 3, HA 4, CO 1, CO 2, Arka Vijay, Arka Swagath, Arka Joy, Arka Amogh, Arka sambhran, Thally local 2, Togarapuramrole local 1, Doddarayapet local 1, Somarpett local 1, Manuganahalli local 1, Agrapharam thally local, Nagavalli local 1, Nagavalli local 2, Nallur local, Hulse local, Udhuru local and Bannekuppe local. These genotypes were raised at the Regional Research Station, Paiyur during *Kharif, 2020* in Randomized Block Design with three replications. The characters studied were days to 50 per cent flowering, days to maturity, plant height, the number of branches per plant, the number of pods per plant, grain yield per plant, green pod yield per plant.

Analysis of variance was performed by following the procedure given by Panse and Sukhatme (1967). The phenotypic and genotypic coefficients of variation (PCV, GCV) were calculated as per the method given by Burton and Devane (1953). Heritability in the broad sense and genetic advance (% of mean) were computed as per the method given by Allard (1960). Genetic diversity was measured using Mahalanobis  $D^2$  by means of the software TNAUSTAT.

## RESULTS AND DISCUSSION

The analysis of variance exhibited a significant difference for most of the characters studied. The mean performances of twenty-six genotypes were presented in **Table 1**. For days to 50 per cent flowering the mean value ranged from 46 days (Arka Amogh, Arka sambhran) to 140 days

(Denkanikottai local, Kaveripattinam local, Mecheri local, PYR 15-01, Thally local 2 and Togarapuramrole local 1). The genotypes Coll 29, HA 3, HA 4, CO 2, Arka Vijay, Arka Swagath, Arka Joy, Arka Amogh, Arka sambhran and Udhuru local recorded lower mean value than the overall mean (103.54 days). For days to maturity, the mean value ranged from 77 days (Arka Amogh, Arka sambhran) to 170 days (Denkanikottai local, Kaveripattinam local, Mecheri local, PYR 15-01, Thally local 2 and Togarapuramrole local 1). The genotypes Coll 29, HA 3, HA 4, CO 2, Arka Vijay, Arka Swagath, Arka Joy, Arka Amogh, Arka sambhran and Udhuru local recorded lower mean value than the overall mean (134.23 days).

The mean value of plant height ranged from 116 cm (Arka joy) to 289.33 cm (Nagavalli local 2). The genotypes Kaveripattinam local, Mecheri local, PYR 15-01, HA 3, HA 4, CO 1, Togarapuramrole local 1, Doddarayapet local 1, Nagavalli local 1 and Nagavalli local 2 recorded higher mean value than the overall mean (181.41 cm). Regarding a number of branches per plant the mean value ranged from 5.33 (Arka sambhran) to 13.33 cm (CO 1). The genotypes Mecheri local, PYR 15-01, Coll 29, HA 4, CO 1, CO 2, Togarapuramrole local 1, Doddarayapet local 1, Somarpett local 1, Agrapharam thally local, Nagavalli local 1, Nagavalli local 2 and Nallur local recorded higher mean value than the overall mean (8.96).

With respect to a number of pods per plant, the mean value ranged from 44.33 (Arka joy) to 166.67 cm (Nagavalli local 1). The genotypes Kaveripattinam local, Mecheri local, PYR 15-01, Coll 29, HA 3, HA 4, CO 1, CO 2, Nagavalli local 1, Nagavalli local 2, Nallur local, Hulse local and Udhuru local recorded higher mean value than the overall mean (108.09).

For grain yield per plant, the mean value ranged from 46.10 g (Arka joy) to 176 g (PYR 15-01). The genotypes Kaveripattinam local, Mecheri local, PYR 15-01, Coll 29, HA 3, HA 4, CO 1, CO 2, Nagavalli local 1, Nagavalli local 2, Nallur local, Hulse local and Udhuru local recorded higher mean value than the overall mean (114.20 g). The trait green pod yield per plant recorded the mean value ranged from 103 g (Arka joy) to 395 g (PYR 15-01). The genotypes Kaveripattinam local, Mecheri local, PYR 15-01, Coll 29, HA 3, HA 4, CO 1, CO 2, Nagavalli local 1, Nagavalli local 2, Nallur local, Hulse local and Udhuru local recorded higher mean value than the overall mean (255.50 g).

The twenty-six genotypes were grouped into six clusters based on Mahalanobis  $D^2$  values. The clustering pattern was presented in **Table 2 and Fig.1**. Cluster I comprised of eight genotypes, forming the major cluster followed by clusters II & III (six genotypes), cluster IV (three genotypes) and cluster V (two genotypes). Cluster VI carries only one genotype which depicts

**Table1. Mean performance of twenty-six genotypes for various traits in Dolichos Bean**

Genotypes	Days to 50 % flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Number of pods per plant	Grain yield per plant (g)	Green pod yield per plant (g)
Denkanikottai local	140.00	170.00	172.00	8.33	92.33	96.00	215.00
Kaveripattinam local	140.00	170.00	236.67	7.67	155.33	162.00	361.00
Mecheri local	140.00	170.00	228.33	10.00	131.00	136.00	305.00
PYR 15-01	140.00	170.00	233.67	13.00	146.33	176.00	395.00
Coll 29	51.00	81.00	168.00	10.33	129.67	135.00	302.00
HA 3	54.00	84.00	211.33	8.67	140.33	146.00	327.00
HA 4	54.00	84.00	208.13	9.67	130.67	136.00	304.00
CO 1	110.00	140.00	262.67	13.33	162.33	169.00	378.00
CO 2	75.00	105.00	177.67	9.67	139.67	145.00	325.00
Arka Vijay	54.00	85.00	127.33	6.33	48.33	50.30	112.00
Arka Swagath	56.00	87.00	119.67	7.00	45.00	46.80	105.00
Arka Joy	56.00	87.00	116.00	5.67	44.33	46.10	103.00
Arka Amogh	46.00	77.00	126.33	6.00	49.33	51.30	115.00
Arka sambhran	46.00	77.00	122.00	5.33	47.33	49.20	110.00
Thally local 2	140.00	170.00	172.00	8.67	65.00	67.60	151.00
Togarapuramrole local 1	140.00	170.00	188.67	11.67	78.33	81.50	182.00
Doddarayapet local 1	128.00	160.00	223.33	10.33	87.00	90.50	202.00
Somarpett local 1	128.00	160.00	141.33	9.00	66.33	69.00	154.00
Manuganahalli local 1	128.00	160.00	176.67	8.67	85.67	111.40	249.00
Agraharam thally local	135.00	166.00	146.67	9.67	73.00	75.90	170.00
Nagavalli local 1	135.00	166.00	272.67	10.67	166.67	173.30	388.00
Nagavalli local 2	135.00	166.00	289.33	11.00	165.00	171.60	384.00
Nallur local	135.00	166.00	160.80	9.67	165.67	172.30	386.00
Hulse local	135.00	166.00	147.00	7.67	146.67	152.50	341.00
Udhuru local	56.00	87.00	136.00	7.33	164.67	171.30	383.00
Bannekuppe local	135.00	166.00	152.30	7.67	84.33	87.70	196.00

**Table 2. Clustering of twenty-six genotypes of Dolichos bean**

Clusters	Number of genotypes	Genotypes
I	8	Arka sambhran, Thally local 2, Togarapuramrole local 1, Doddarayapet local 1, Somarpett local 1, Manuganahalli local 1, Agraharam thally local and Nagavalli local 1
II	6	HA4, CO1, CO2, Arka Vijay, Arka Swagath and Arka amogh
III	6	Denkanikottai local, Kaveripattinam local, PYR 15-01, Nagavalli local 2, Nallur local and Hulse local
IV	3	Mecheri local, Coll 29 and HA 3
V	2	Udhuru local and Bannekuppe local
VI	1	Arka Vijay

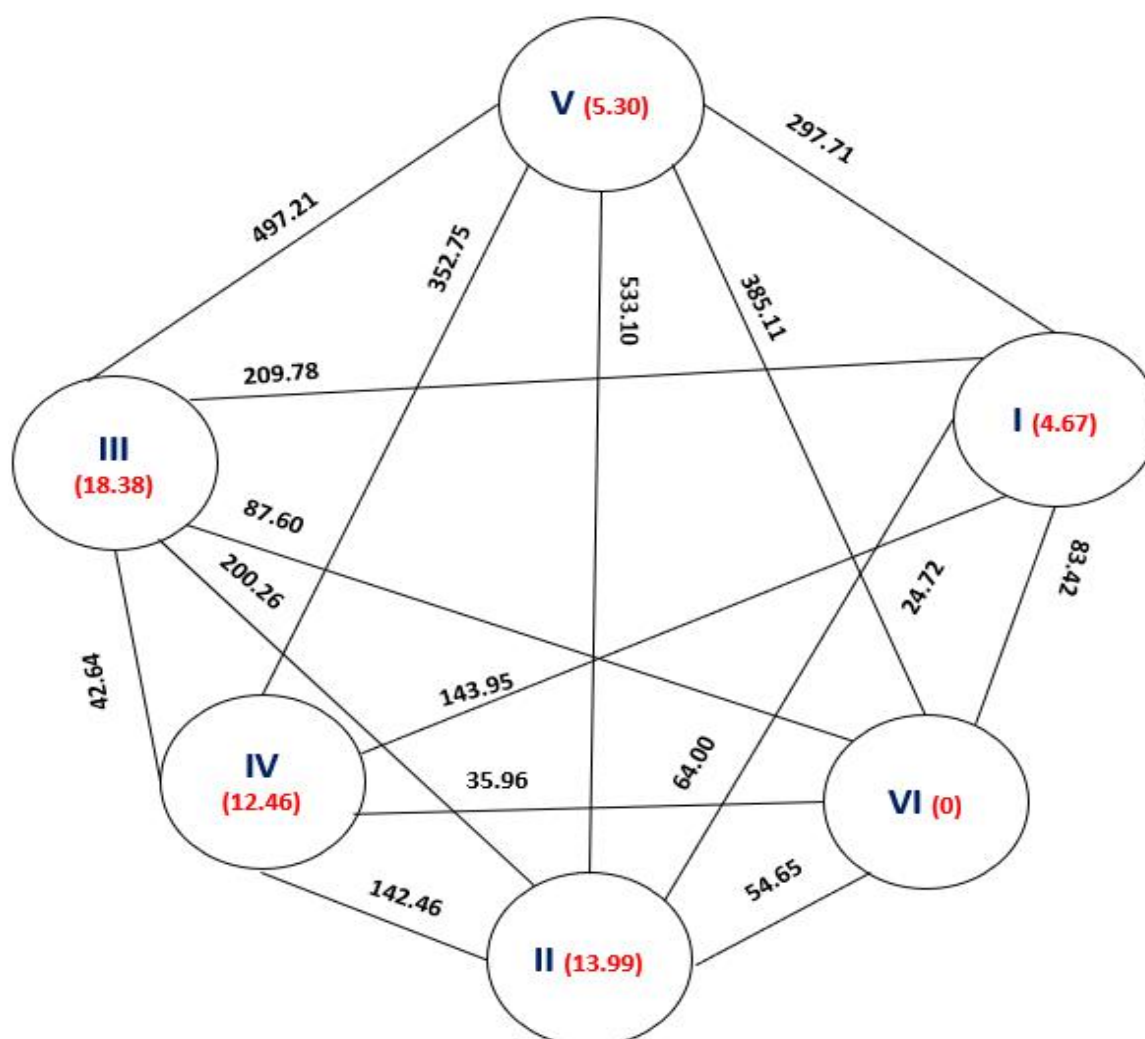


Fig. 1. Intra and inter cluster distances among six clusters in twenty-six Dolichos bean genotypes

its uniqueness. The intra and inter cluster distance among the six clusters were estimated and presented in **Table 3**. The maximum inter cluster distance was observed between cluster II and V (533.60), followed by cluster III and V (497.21) and cluster V and VI (385.11). In order to achieve higher heterotic effects and high variability, the parents should be selected from most divergent clusters. The clusters IV and VI recorded a minimum inter cluster distance of 35.96 which represents the close association between these clusters. With regard to intra cluster distance cluster III recorded a higher value of 18.38 followed by cluster II (13.99) and cluster IV (12.46). Clustering of Dolichos bean into different clusters was reported by Upadhyay *et al.* (2011).

Wide ranges of variations were observed for the cluster mean values for various characters studied. Cluster III and IV recorded higher mean values for days to 50

per cent flowering and days to maturity (**Table 4**). Cluster VI recorded a higher mean value for plant height. The mean value was found high in cluster VI for the number of branches per plant, the number of pods per plant and grain yield per plant. Cluster IV recorded a higher mean value for green pod yield per plant. The contribution of characters towards divergence helps in the selection of parents for the hybridization programme. The greater contribution in an index of genetic divergence was displayed by days to 50 per cent flowering (46.77%), followed by days to maturity (29.85%) and a moderate level of divergence was contributed by the number of pods per plant (12.62%) (**Table 4**). Regarding the genetic distance towards total divergence, the results of the present study indicated that parental lines were selected from cluster II (HA4, CO1, CO2, Arka vijay, Arka Swagath & Arka Amogh) and cluster V (Udhuru local & Bannekuppe local) for hybridization.

**Table 3. Average intra and inter-cluster D<sup>2</sup> values for six clusters in twenty-six Dolichos bean genotypes**

Clusters	I	II	III	IV	V	VI
I	<b>4.67</b>	64.00	209.78	143.95	297.71	83.42
II		<b>13.99</b>	200.26	142.46	533.10	54.65
III			<b>18.38</b>	42.64	497.21	87.60
IV				<b>12.46</b>	352.75	35.96
V					<b>5.30</b>	385.11
VI						<b>0</b>

\*Bold diagonal values depicts the intra cluster distance while the other values show the inter cluster distances.

**Table 4. Cluster mean values of six clusters for different quantitative characters in Dolichos bean and their contribution to total divergence**

Clusters	I	II	III	IV	V	VI	Contribution %
Days to 50% flowering	53.06	61.42	140.00	140.00	128.00	110.00	46.77
Days to maturity	84.00	91.42	170.00	170.00	160.00	140.00	29.85
Plant height	125.69	199.75	191.50	232.67	201.00	255.00	4.62
Number of branches /plant	6.31	9.92	9.42	10.83	9.75	13.00	4.31
Number of pod/plant	52.69	137.67	93.00	148.17	80.25	158.00	12.62
Grain yield /plant	55.06	140.00	97.26	165.00	83.45	181.50	0.62
Green pod yield/plant	123.69	318.50	213.42	378.00	186.75	372.00	1.23

PCV was relatively high in all the traits studied viz., days to 50% per cent flowering (38.68%), days to maturity (29.86%), plant height (28%), the number of branches per plant (25.09%), the number of pod per plant (42.19%), grain yield per plant (42.71%) and green pod yield per plant (42.35%). The high estimate of GCV was recorded for days to 50 per cent flowering (38.68%), days to maturity (29.86%), plant height (27.61%), the number of branches per plant (22.27%), the number of pods per plant (41.63%), grain yield per plant (41.44%) and green pod yield per plant (41.60%). High heritability was recorded for days to 50 per cent flowering (100%), days to maturity (100%), plant height (97.22%), the number of branches per plant (78.75%), the number of pods per plant (97.36%), grain yield per plant (94.16%), green pod yield per plant (96.48%). Similar results were reported by Peer *et al.* (2018) and Sahu and Bahadur (2018). The high estimate of genetic advance as per cent of mean was observed for days to 50 per cent flowering (79.67%), days to maturity (61.51%), plant height (56.07%), the number of branches per plant (40.71%), the number of pod per plant (84.63%), grain yield per plant (82.84%), green pod yield per plant (84.17%). Similar results were reported by Peer *et al.* (2018). With regard to variability studies all the characters viz., days to 50 per cent flowering, days to maturity, plant height, the number of branches per plant, the number of pod per plant, grain yield per plant and green pod yield per plant showed high value

of PCV, GCV, heritability and genetic advance indicated the involvement of additive genes for the control of these characters. The results were in line with the findings of Mohan *et al.* (2014). Days to 50 per cent flowering and days to maturity indicated the same value of PCV and GCV, suggesting that the environment has no role on the days to 50 per cent flowering and days to maturity for their expression. The relationship between PCV and GCV indicates that PCV values were slightly higher than GCV signifying the very least influence of environment for the trait expression. The results are similar with the findings of Upadhyay and Mehta (2010) and Verma *et al.* (2014). High heritability accompanying with high genetic advance is recorded in all the biometrical traits observed as in the order of Number of pods per plant > Green pod yield per plant > Grain yield per plant > Days to fifty per cent flowering > Days to maturity > Plant height > Number of branches per plant. High heritability associated with high genetic advance was observed in all the seven traits studied indicating that the heritability is due to the consequence of additive gene and these traits were least affected by environmental effects and selection based on all these characters would be rewarding.

It is concluded from the diversity studies that cluster VI has recorded desirable mean value for several yields contributing traits and the desirable genotypes within this cluster may be subjected to direct selection for use as

**Table 5. Range, variability parameter, heritability and genetic advance as per cent mean for seven characters in Dolichos Bean**

Characters	Range	Minimum	Maximum	PCV (%)	GCV(%)	h <sup>2</sup> (%)	GA	GAM (%)	Mean
Days to 50% flowering	94.00	46.00	140.00	38.68	38.68	100.00	82.49	79.67	103.54
Days to maturity	93.00	77.00	170.00	29.86	29.86	100.00	82.56	61.51	134.23
Plant height (cm)	173.33	116.00	289.33	28.00	27.61	97.22	101.72	56.07	181.41
Number of branches / plants	8.00	5.33	13.33	25.09	22.27	78.75	3.65	40.71	8.96
Number of pod/plant	122.33	44.33	166.67	42.19	41.63	97.36	91.47	84.63	108.09
Grain yield /plant (g)	129.90	46.10	176.00	42.71	41.44	94.16	94.60	82.84	114.20
Green pod yield/plant (g)	292.00	103.00	395.00	42.35	41.60	96.48	215.13	84.17	255.50

parents based on giving importance to the traits such as plant height, number of branches per plant, number of pod per plant and grain yield per plant which are contributing more to the total divergence. The results of various studies indicated that high heritability with high genetic advance was recorded for all the traits studied and made clear that the additive gene action is responsible for the inheritance of all the traits studied.

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