

Genetic Divergence Analysis in Dolichos Bean (*Lablab purpureus* var. *typicus*)

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Dolichos bean (*Lablab purpureus* var. *typicus*) is a multi-purpose crop which is grown in the tropical and subtropical conditions [1] for food and fodder. Dolichos bean is believed to have originated in India [2]. It is cultivated extensively in Karnataka, Tamil Nadu, Eastern and North-eastern states where it is used as vegetable, pulse and fodder [3]. It is an under exploited crop elsewhere in the country. It is a perennial herbaceous plant often grown as an annual. It is primarily grown for green pods, which are cooked as vegetable like other beans. The dry seeds are also used for various vegetable preparations. The foliage of the crop provides hay, silage and green manure. It is nutritionally rich and is a good source of protein, fibre, calcium and iron [4]. Hence, it can be utilized for achieving nutritional security and eliminating hidden hunger.

Twenty-five dolichos bean accessions were evaluated in randomized block design with two replications at the Department of Vegetable Science, College of Horticulture, Vellanikkara, Kerala, from September (2019) to April (2020). The climate was warm humid tropical and the soil of the area was lateritic and acidic in nature. The spacing adopted was 2.7 m x 1 m. All crop management practices were undertaken as per the Package of Practices Recommendations—Crops, Kerala Agricultural University, (2016). Biometrical observations were recorded taking two plants from each replication. Analysis of variance was performed to assess variability for quantitative characters and expected genetic advance at 5% intensity of selection [5]. The phenotypic and genotypic coefficients of variation were calculated by the formula given by [6].

Genetic divergence analysis was done based on Mahalanobis D² test [7].

Analysis of variance revealed that the accessions exhibited significant differences for all the characters studied. The mean performance of the accessions for growth and

quality characters are presented in (Table 1).

Highest green pod yield per plant was recorded in the accession LP-32 (1.55 kg) followed by LP-28 (1.51 kg) and LP-13 (1.38 kg). Number of pods per plant was highest in LP-28 (612.75) and lowest in LP-22 (36.25). Pod length was highest in LP-19 (15.35 cm) and lowest in LP-27 (5.47 cm). Maximum pod weight was recorded in LP-32 (7.72 g). Highest pod girth was recorded in LP-32 (8.21 g) and lowest pod girth in LP-19 (3.04g). Number of primary branches was maximum in LP-22 (4.25) and minimum in LP-17 (2.25). Minimum number of days to first flowering was recorded in the accession LP-7 (49.50) and maximum number of days to first flowering was recorded in LP-24 (86.50). Days to first fruit set was minimum in LP-2 (61.50) and it was maximum in LP-24 (100.00). Minimum days to first harvest was recorded in LP-7 (74.50) and maximum days to first harvest was recorded in LP-24 (113.50). Number of pods per cluster was maximum in LP-7 (6.85) and minimum in LP-32 (3.50). Maximum number of seeds per pod was recorded in LP-13 (6.74) and minimum number of seeds per pod was recorded in LP-27 (2.30). Maximum number of harvests was observed in LP-28 (8.50) and minimum number of harvests in LP-31 (5.00). Duration of the crop was maximum in LP-29 (206.50) and it was minimum in LP-2 (173.50).

Highest calcium content was recorded in the accession LP-13 (152.66 mg/100g) and lowest content in LP-15 (88.89 mg/100g). Iron content was maximum in LP-11 (18.14 mg/100g) and minimum in LP-27 (11.02 mg/100g). Total phenols recorded was maximum in LP-19 (9.64 mg/100g) and minimum in LP-30 (2.06 mg/100g). Highest crude protein content was recorded in LP-12 (20.65%) and lowest crude protein was recorded in LP-17 (15.82%). Maximum crude fibre was recorded in LP-10 (17.81%) and minimum in LP-17 (8.98%). Phytic acid content was minimum in LP-27 (550.90 mg/100g) and maximum in LP-11 (906.88 mg/100g).

Though the estimates of PCV were higher than GCV, a close association between PVC and GCV was observed in the traits viz. days to first flowering, days to first fruit set, green pod yield/plant [8], number of seeds / pods, pod length, pod girth, pod weight and number of pods / plants [9]. This indicated that variations in these traits were due to genotype and environment exerted very little effect [10]. High estimates of GCV and PCV were observed for the characters viz. number of pods per plant (66.65, 67.66), green pod yield per plant (49.24, 49.97), total phenols (33.42, 34.10), pod weight

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(31.13, 32.59), pod girth (26.96, 27.17), pod length (25.47, 25.82) and number of seeds per pod (23.04, 23.96) which revealed the existence of high variability for these characters. Considerably wider association was observed between estimates of PCV and GCV of the traits viz. number of

primary branches, number of harvests and number of pods / clusters. This meant a greater degree of environmental effect on the expression of these traits. Hence, selection based on phenotypic values would not be rewarding to improve these characters.

Table 1 Mean performance of dolichos bean accessions for growth and quality characters

Accessions	No. of primary branches	Days to first flowering	Days to first fruit set	Days to first harvest	No. of pods/cluster	No. of seeds/pod	Pod length (cm)	Pod girth (cm)	Pod weight (g)
LP-2	3.00	60.50	71.50	85.50	6.15	4.70	10.50	4.81	4.93
LP-3	2.50	67.00	76.50	90.50	4.90	5.00	12.37	4.82	4.92
LP-4	3.25	71.50	84.00	97.00	5.80	4.40	7.53	3.88	4.77
LP-7	3.50	59.50	72.00	84.50	6.85	3.30	9.35	3.53	5.24
LP-8	4.00	63.00	74.50	85.00	4.35	4.35	10.10	4.10	4.11
LP-10	3.75	67.50	81.00	97.00	5.00	3.40	8.63	3.71	3.04
LP-11	2.50	64.50	77.50	92.50	4.40	3.60	9.54	7.37	4.96
LP-12	2.50	71.00	82.00	94.00	5.25	4.50	10.34	3.54	3.93
LP-13	3.25	68.50	80.00	94.00	4.90	6.79	14.15	4.66	4.41
LP-15	4.00	77.50	90.00	101.00	5.20	3.40	6.79	3.93	2.34
LP-16	3.25	77.00	88.50	102.00	4.75	3.35	10.20	4.22	3.64
LP-17	2.25	77.00	89.50	104.00	4.20	4.90	9.70	3.49	3.33
LP-19	3.25	69.50	83.00	98.00	4.00	5.70	15.35	3.04	3.21
LP-21	2.50	74.50	86.50	101.50	5.00	4.30	7.35	3.84	3.79
LP-22	4.25	75.50	89.00	103.00	5.20	3.00	8.35	6.52	6.79
LP-24	3.25	96.50	110.00	123.50	4.40	3.70	12.30	4.54	4.61
LP-27	2.50	68.00	80.50	93.00	5.35	2.30	5.47	4.18	2.04
LP-28	3.25	64.50	76.50	94.00	5.85	3.10	5.63	4.86	2.45
LP-29	3.75	93.50	107.00	118.50	3.80	4.05	8.49	4.54	3.16
LP-30	2.75	74.50	85.00	100.00	4.35	3.25	8.96	4.75	3.04
LP-31	3.00	63.50	77.50	92.00	4.50	4.50	10.42	5.10	3.79
LP-32	3.00	68.50	83.00	95.00	3.50	3.60	9.98	8.21	7.72
LP-33	3.25	79.50	92.00	104.00	5.60	5.15	9.61	5.76	4.55
Hima	2.75	70.50	82.00	95.00	5.85	4.75	14.56	4.93	4.99
Grace	3.25	67.00	77.50	86.50	5.50	4.45	12.27	3.08	3.24
CD (0.05)	0.92	6.13	7.33	6.22	1.05	0.56	0.84	0.32	0.82
SD	0.44	2.97	3.55	3.01	0.51	0.27	0.41	0.16	0.40

Table 1 Continued

No. of pods/plant	No. of harvests	Duration of the crop	Green pod yield/plant (kg)	Iron (mg/100g)	Calcium (mg/100g)	Total phenols (mg/100g)	Crude protein (%)	Crude fibre (%)	Phytic acid (mg/100g)
241.75	6.75	173.50	1.20	128.02	15.37	2.47	19.55	10.17	768.30
164.75	7.25	184.50	0.83	112.83	13.00	5.29	17.57	12.27	649.90
130.25	6.50	179.00	0.64	117.26	13.92	5.78	17.70	13.45	695.60
49.25	6.00	171.50	0.27	93.28	15.67	9.42	18.28	12.90	783.03
303.00	6.75	163.50	1.20	118.42	15.29	7.30	16.79	11.47	764.38
223.25	7.50	197.00	0.69	124.68	15.07	8.43	19.42	17.81	753.40
52.75	6.25	168.50	0.28	128.37	18.14	9.57	17.21	11.76	906.88
302.75	6.75	182.00	1.18	148.37	16.30	4.58	20.65	14.76	814.60
309.00	7.75	194.00	1.38	152.66	14.52	6.61	19.17	10.83	725.65
468.75	7.00	195.00	1.10	68.89	12.92	6.08	17.64	14.06	645.53
143.25	6.50	196.00	0.54	94.27	16.84	7.08	19.40	11.78	841.90
90.25	5.25	174.00	0.30	99.89	14.73	6.08	15.82	8.98	736.43
210.25	6.75	186.00	0.69	95.93	14.48	9.64	19.25	9.30	723.90
189.50	6.25	183.50	0.74	135.40	12.10	8.49	18.50	15.26	604.58
36.25	5.75	179.00	0.25	117.11	15.75	5.03	20.03	11.87	787.15
129.50	5.25	183.50	0.61	88.55	12.93	5.93	18.78	13.29	646.20
579.00	7.25	187.00	1.18	93.73	11.02	4.12	16.25	15.96	550.90
612.75	8.50	200.00	1.51	119.81	15.96	3.12	19.35	12.99	797.85
175.00	6.50	206.50	0.57	99.58	14.18	6.25	17.97	14.15	708.63
451.00	8.25	206.00	1.38	109.45	12.95	2.06	19.30	17.07	647.30
75.25	5.00	162.50	0.29	85.20	15.91	8.27	18.97	10.74	795.03
195.00	7.50	195.00	1.55	111.94	14.13	4.11	20.11	10.37	706.45
144.00	4.75	168.00	0.66	112.15	14.45	7.61	19.66	14.16	722.40
256.50	7.00	190.50	1.27	121.09	12.37	6.94	20.17	12.04	618.18
396.00	7.25	180.00	1.30	139.85	14.16	6.13	20.29	12.41	707.53
56.78	1.71	16.25	0.15	12.49	1.78	0.88	1.85	2.85	88.83
27.51	0.83	7.87	0.07	6.05	0.86	0.42	0.90	1.38	43.04

Table 2 Variability in dolichos bean accessions for yield and quality characters

Characters	Range	Mean	GV	PV	GCV	PCV	h ²	GA	GAM
No. of primary branches	2.25-4.25	3.14	0.19	0.39	13.82	19.77	48.87	0.63	19.90
Days to first flowering	59.50-96.50	71.60	74.52	83.35	12.06	12.75	89.41	16.82	23.49
Days to first fruit set	71.50-110.00	83.86	82.21	94.81	10.65	11.46	86.35	17.09	20.38
Days to first harvest	84.50-123.50	97.24	80.86	89.94	9.25	9.75	89.90	17.56	18.06
No. of pods/cluster	3.50-6.85	4.99	0.49	0.75	14.09	17.38	65.72	1.17	23.53
Green pod yield/plant (kg)	0.25-1.55	0.86	0.18	0.19	49.24	49.97	97.09	0.86	99.94
No. of seeds/pod	3.00-6.79	4.14	0.91	0.98	23.04	23.96	92.46	1.89	45.63
Pod length (cm)	5.47-15.35	9.92	6.38	6.54	25.47	25.80	97.47	5.14	51.80
Pod girth (cm)	3.04-8.21	4.61	1.55	1.57	26.96	27.17	98.48	2.54	55.12
Pod weight (g)	2.04-7.72	4.11	1.64	1.80	31.13	32.59	91.27	2.52	61.27
No. of pods/plant	36.25-612.75	237.16	24987.47	25744.13	66.65	67.66	97.06	320.81	135.27
No. of harvests	5.25-8.50	6.65	0.57	1.25	11.36	16.83	45.54	1.05	15.79
Duration of the crop	162.50-206.5	184.24	126.13	188.12	6.10	7.44	67.05	18.94	10.28
Ca (mg/100g)	68.89-152.66	112.67	394.38	430.98	17.63	18.43	91.51	39.14	34.74
Iron (mg/100g)	11.02-18.14	14.48	2.28	3.02	10.42	11.99	75.44	2.70	18.64
Total phenols (mg/100g)	2.06-9.35	6.25	4.37	4.55	33.42	34.10	96.05	4.22	67.47
Crude protein (%)	15.82-20.65	18.71	1.29	2.09	6.07	7.73	61.58	1.84	9.81
Crude fibre (%)	8.98-17.07	12.79	4.16	6.04	15.94	19.25	68.58	3.48	27.20
Phytic acid (mg/100g)	550.90-906.88	724.07	5689.25	7541.66	10.42	11.99	75.44	134.96	18.64

Table 3 Cluster wise distribution of accessions

Cluster No.	No. of accessions in each cluster	Accessions
1	4	LP-15, LP-27, LP-28, LP-30
2	4	LP-11, LP-22, LP-31, LP-33
3	6	LP-10, LP-13, LP-16, LP-24, LP-29, LP-34
4	2	LP-7, LP-19
5	1	LP-32
6	8	LP-2, LP-3, LP-4, LP-8, LP-12, LP-17, LP-21, LP-35

Table 4 Intra and inter cluster D² values in clusters

	I	II	III	IV	V	VI
I	391.34 (19.78)					
II	3125.14 (55.90)	586.25 (24.21)				
III	1632.14 (40.40)	1297.15 (36.02)	586.99 (24.23)			
IV	2792.72 (52.85)	1698.19 (41.21)	1165.76 (34.14)	1185.51 (34.43)		
V	2971.30 (54.51)	1546.13 (39.32)	2213.43 (47.05)	3929.71 (62.69)	0.00	
VI	1128.02 (33.59)	1689.33 (41.10)	871.83 (29.53)	1276.48 (35.73)	2602.51 (51.01)	529.63 (23.01)

Intra cluster distance : Diagonal values
 Inter cluster distance : Off-diagonal values
 D values : Value in parenthesis

Table 5 Cluster wise mean performance of characters

Character	Cluster					
	I	II	III	IV	V	VI
No. of primary branches	3.13	3.25	3.33	3.38	3.00	2.91
Days to first flowering	71.13	70.75	78.92	64.50	68.50	68.94
Days to first fruit set	83.00	84.00	91.42	77.50	83.00	80.25
Days to first harvest	97.00	97.88	105.00	91.25	95.00	93.00
No. of pods/cluster	5.19	4.93	4.78	5.43	3.50	5.14
No. of seeds per pod	3.01	4.06	4.34	4.50	3.60	4.58
Pod length (cm)	6.71	9.48	11.39	12.35	9.98	10.02
Pod girth (cm)	4.43	6.19	4.43	3.28	8.21	3.94
Pod weight (g)	2.46	5.02	3.97	4.22	7.72	4.13
No. of pods per plant	527.88	77.06	206.08	129.75	195.00	227.28
No. of harvests	7.75	5.44	6.75	6.38	7.50	6.59
Duration of the crop	197.00	169.50	194.58	178.75	195.00	177.50
Green pod yield per plant (kg)	1.29	0.37	0.84	0.48	1.55	0.92
Calcium (mg/100g)	97.97	110.71	113.47	94.60	111.94	125.00
Iron (mg/100g)	13.21	16.06	14.32	15.07	14.13	14.36
Total phenols (mg/100g)	3.84	7.62	6.98	9.53	4.11	5.76
Crude protein (%)	18.13	19.07	19.15	18.76	20.11	18.36
Crude fibre (%)	15.02	12.13	13.31	11.10	10.37	12.34
Phytic acid (mg/100g)	660.39	802.86	715.66	753.46	706.45	717.66

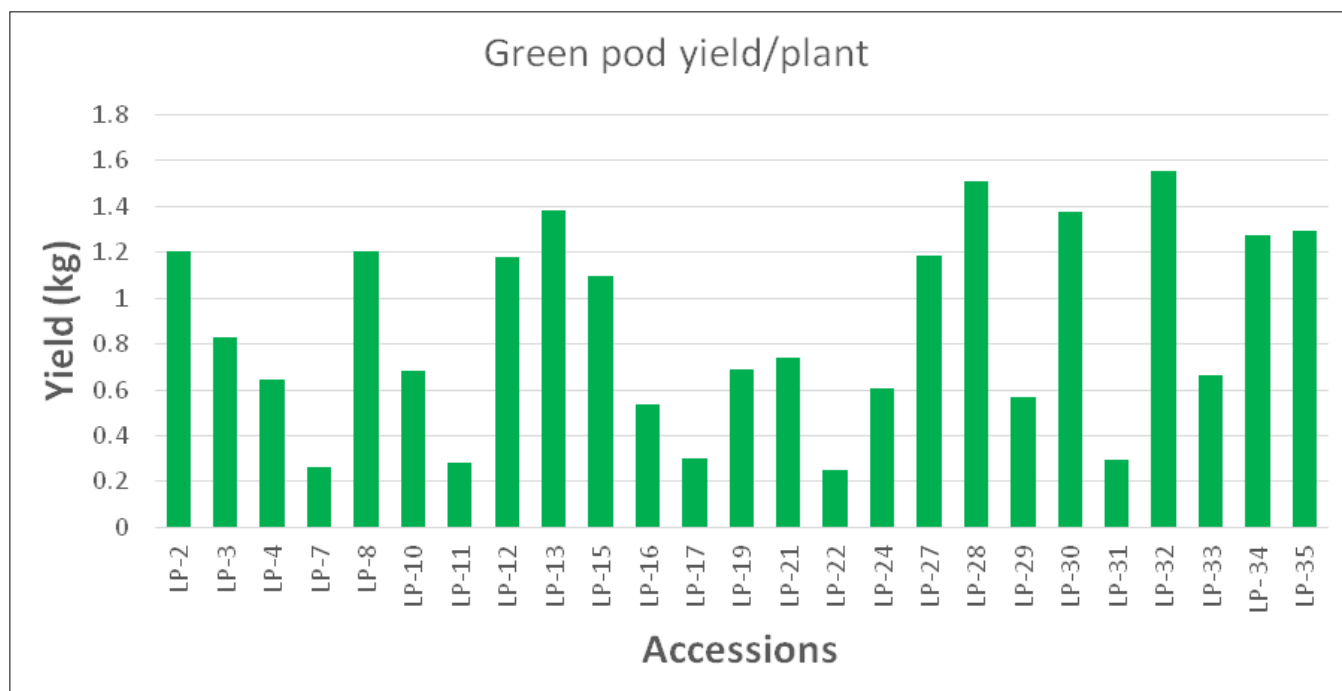


Fig 1 Green pod yield/plant in dolichos bean accessions

Heritability estimates are useful in predicting the response of the traits to selection. High heritability coupled with high genetic advance is an indication of additive gene action and hence improvement is possible through selection [11]. High heritability coupled with high genetic advance as percentage of mean (GAM) was exhibited by days to first flowering, days to first fruit set, number of pods per cluster, green pod yield per plant, number of seeds per pod, pod length, pod girth, pod weight, number of pods per plant [12],

calcium, total phenols and crude fibre indicating the possibility of improvement through selection [13].

Based on genetic divergence analysis using Mahalanobis D^2 method, the accessions were grouped into six clusters (Table 2). Cluster VI had highest number of accessions (8) followed by cluster III (6). Cluster I and II had four accessions each. There were two accessions in cluster IV and one accession in cluster V. Cluster diagram showing average inter and intra cluster values is given in (Fig 3).



Fig 2 Variability in pods of dolichos bean accessions

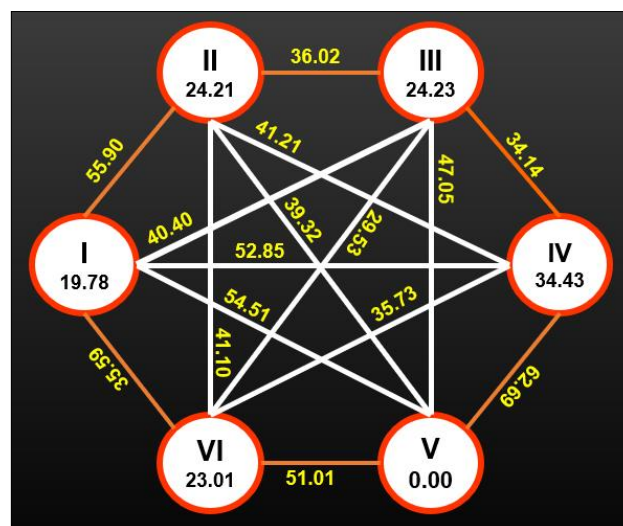


Fig 3 Cluster diagram showing intra and inter cluster distances

Highest mean value for green pod yield per plant was in cluster V. Pod girth, pod weight and crude protein were also highest in this cluster. Calcium content was highest in cluster VI whereas, iron and phytic acid was highest in cluster II. Total phenols were highest in cluster IV whereas, fibre was highest in cluster I. Intra cluster distance was maximum in cluster IV (1185.51). Hence, greater heterogeneity existed among the accessions in this cluster. Intra cluster distance was minimum in cluster I (391.31). Hence, maximum homogeneity existed among the accessions in this cluster. As the distance

between the clusters increases the divergence between them also increases and vice versa. Inter cluster distance was maximum between cluster IV and cluster V (3929.71). Hence, superior hybrids could be obtained by hybridization among the accessions present in these clusters [13]. Minimum inter cluster distance was between cluster III and cluster VI which suggested that low genetic divergence existed among the accessions present in these two clusters [14].

SUMMARY

Twenty-five dolichos bean accessions (*Lablab purpureus* var. *typicus*) were evaluated for variability, heritability and genetic divergence under Kerala conditions. GCV and PCV were highest for number of pods per plant (66.65, 67.66) followed by green pod yield per plant (49.24, 49.97). High heritability coupled with high genetic advance as per cent of mean was noted for the characters pod girth (98.48, 55.12), pod length (97.47, 51.80), green pod yield per plant (97.09, 99.94), number of pods per plant (97.06, 135.27), number of seeds per pod (92.46, 45.63), pod weight (91.27, 61.27), days to first flowering (89.41, 23.49), days to first fruit set (86.35, 20.38), number of pods per cluster (65.72, 23.53),

total phenols (96.05, 67.47), calcium (91.51, 39.74) and crude fibre (68.58, 27.20). Based on Mahalanobis D^2 analysis the accessions were grouped into six clusters. The highest inter cluster distance was exhibited between the clusters IV and V (3929.71) which indicated that maximum variability existed between the accessions present in these clusters and hence they can be used as parents in a hybridization programme.

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