International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(4): 310-313

Received: 16-05-2019
Accepted: 18-06-2019

Annu Kumari
Department of Vegetable Science, OUAT, Bhubanewsar, Odisha, India

Meenu Kumari
ICAR-IIHR-Central Horticultural Experiment Station, Bhubanewsar, Odisha, India

P Tripathy
Department of Vegetable Science, OUAT, Bhubanewsar, Odisha, India

GS Sahu
Department of Vegetable Science, OUAT, Bhubanewsar, Odisha, India

P Naresh
ICAR-IIHR-Central Horticultural Experiment Station, Bhubanewsar, Odisha, India

GC Acharya
ICAR-IIHR-Central Horticultural Experiment Station, Bhubanewsar, Odisha, India

Correspondence
Annu Kumari
Department of Vegetable Science, OUAT, Bhubanewsar, Odisha, India

Genetic divergence analysis in dolichos bean (*Dolichos lablal* L var. *typicus*)

Annu Kumari, Meenu Kumari, P Tripathy, GS Sahu, P Naresh and GC Acharya

Abstract
The genetic divergence analysis was conducted for thirty genotypes of dolichos bean which consisted local collections of Odisha, Bihar and Jharkhand. All the genotypes were investigated for 23 quantitative traits and grouped into six clusters based on Tocher's clustering approach. Substantial amount of variability was observed among the clusters for studied traits. The cluster I was reported as the largest among the six clusters having 12 genotypes followed by cluster III and cluster II with eight and five genotypes respectively. However, clusters IV and V comprised one genotypes in each and cluster VI had three genotypes. The highest cluster mean was observed in cluster VI for the traits like number of racemes per plant, pod width, number of fresh pods per plant, 100 seed weight, average pod weight and fresh pod yield per plant. Hence, genotypes from this cluster hold promise for transferring the yield and yield attributing characters in breeding programmes. Moreover, Cluster IV recorded minimum number of days for first flowering *i.e.*67 days and can be considered helpful in developing early varieties of dolichos bean. The inter-cluster D^2 value was minimum between cluster I and cluster IV and maximum between cluster IV and VI followed by IV and V. Principal component analysis reported that the first six PCAs contributed to 86% of total variation for the traits. Among the PCAs value of six components, PC1 amounted highest to 37.79%.

Keywords: Dolichos bean, genetic divergence, principal component analysis

Introduction
Dolichos bean (*Dolichos lablab* L. var. *typicus*) is an important bean crop used for vegetable purpose in northern parts of India and for vegetable as well as pulse purpose in southern parts of India. This Indian bean belongs to fabaceae family having chromosome number 2n=2x=22. As originated from India, wide adabtibility and innumerable amount of diversity is available in the dolichos bean. Diversity counts for plant growth habit, pod shape, size, color, photo-insensitivity, phenological traits like days to first flowering, pod set, pod maturity etc. Besides variability and wide adaptation to saline and acidic soil, it also withstands drought condition better than other legumes like cowpea and French bean (Maass *et al*., 2010) [5]. In the changing climate scenario, dolichos bean is also suitable for being a climate resilient vegetable crop by virtue of its universal adabtibility and soil enriching capacity with nitrogen fixation. Therefore, there is requirement of broadening the genetic base of dolichos bean cultivars by indulging diverse genotypes of economic importance. The genetic improvement of any crop is only possible through diverse range of germplasm through traits of objective. Hence, a comprehensive study was carried out in the core set of 30 accessions which were collected from Eastern region of India *i.e.* Odisha, Bihar and Jharkhand.

For the purpose of analysis in genetic divergence of different traits among all dolichos bean germplasms, divergence index could be measured. The index of genetic divergence can help in involving the better genotypes and diverse parents in further breeding programmes. Mahalanobis D^2 is used to quantify the genetic divergence and identification of most diverse parents which can be further utilized in crossing programmes. Besides this, it is found helpful in fixing the clustering pattern among genotypes and to analyse whether the clustering pattern conjugates with the geographical origin or not. The dolichos bean accessions were also studied by Chaitanya *et al*. (2013) [1] and it was found that protein content in the pods contributed to highest extent followed by number of pods per plant and pod length. In addition to this, estimation of genetic variation is important in order to develop a strategy to use the germplasms for breeding purposes through principal component analysis.

Therefore, a study related to clustering of genotypes, genetic divergence and contribution of different traits towards genetic divergence was carried out in this experimental trial.

Materials and Methods

Thirty genotypes including two checks were assessed during the kharif season of 2017-18 in Complete Randomized Block Design (CRBD) with three replications. The experiment site was laid out at Central Horticultural Experiment Station (CHES), ICAR-IIHR, Aiginia, Bhubaneswar, Odisha, India (22 ^{0} 15' N and 85 ^{0} 15' E, 25.5 m above mean sea level). The total plot size was 50 × 50 m^2 with row to row spacing of 2 m and plant to plant spacing of 75 cm. All the recommended cultural practices were carried out to ensure healthy plant growth and an optimum plant population. The mean observations for twenty-three quantitative traits were recorded by taking five plants randomly from each replication per genotype. Further the mean values were analysed for D^2 analysis by following Mahalanobis D^2 method (Mahalanobis, 1936) [4] and principal component analysis was performed for important traits in dolichos bean germplasms.

Results and Discussion

The divergence analysis which has lead to divide the genotypes into six clusters basing upon the important traits. The individual members of each clusters are categorized in Table 1. The dolichos bean genotypes among these six clusters ranges from one to twelve germplasm. The cluster I was the largest one having 12 genotypes followed by cluster III and cluster II with eight and five genotypes respectively. The clusters IV and V comprised of single genotype in each while cluster VI had three genotypes (Figure 1). The inter-cluster D^2 value ranged widely with minimum of 352.66 between cluster I and cluster IV and maximum value of 1799.96 between cluster IV and VI which was followed by IV and V (1488.28). Therefore, the genotypes grouped under cluster IV and VI can be used in breeding programmes to get a wide range of diversity. The selection of genotypes from the diverse clusters is helpful in production of better recombinants in hybridisation programmes. The inter- cluster distances were observed to be higher than intra cluster distances in all cases which significantly shows that potential amount of genetic diversity was present among the genotypes studied under the research trial. The intra and inter-cluster distance is summarized in Table 2. The inter cluster distance has revealed that certain genotypes having higher D^2 value were highly divergent from all other genotypes and may be used as parents in breeding programme or could be used as pureline too. Similarity with present findings was achieved by Ganesh (2005) [2] in field bean. The higher inter-cluster distance than intra-cluster distance was also reported earlier in case of lablab bean (Nandi *et al.*, 2000 and Savitha, 2008) [6-7] and pea (Singh and Mishra, 2008) [8]. This findings strongly supports the presence of significant genetic diversity in the germplasms used under experimental trial.

The cluster means for different characters shows an appreciable amount of variability among them as elaborated in Table 3. The comparative study of cluster means depicts that majority of the genotypes under cluster V showed highest mean value for leaf length, leaf breadth, number of primary branches per plant, plant height, days to first flowering, number of buds per node, number of buds per raceme, bud width, days to fruit set, days to first harvest and days to edible maturity of pods. The cluster VI showed highest cluster mean for traits like days to 50% flowering, number of racemes per plant, pod width, number of fresh pods per plant, 100 seed weight, average pod weight and fresh pod yield per plant while genotypes under cluster III were reported with maximum bud length. Moreover, cluster IV exhibited maximum cluster mean value for number of secondary branches per plant and most of the genotypes took minimum days for first flowering (67 days). At the same time, cluster I and III were observed at par with each other for characters like number of secondary branches, bud length, pod length and number of seeds per pod. Golani *et al*. (2007) [3] also used Mahalanobis D^2 statistics to analyse the genetic diversity present among the accessions of Indian bean (*Lablab purpureus*) for yield and yield attributing parameters and reported significant variation for all the traits under study.

In order to gather information about the dolichos bean genotypes agronomical traits which are highly essential towards providing a good pod yield, minimum maturation period and earliness in the harvesting time, Principal Component Analysis (PCA) was carried out as shown in Table 4. Among the six PCAs the individual contribution amounted to be highest by PC1 (37.79%) followed by PC2 (13.54%), PC3 (12.83%), PC4 (1.48%), PC5 (6.06%) and PC6 (5.16%). The total variance of these six PCAs having eigen values >1 added to 86.00% as a whole. It is registered that traits like plant height, number of buds per node, pod length, 100 seed weight, pod weight and pod yield per plant show higher value of PC1. On the other hand, PC2 is related to number of primary branches per plant, days to first harvest and pod width. The PCA plot shows that components contributing to the yield are fresh pod yield per plant, pod weight, 100 seed weight and plant height (Figure 2).

The relative contribution of twenty-three quantitative characters towards genetic divergence is shown thoroughly under Table 5. These results illustrated that pod beak length recorded highest contribution to the genetic divergence and has been ranked 115 times first followed by fresh pod length (109 ranked). It is estimated that about 78.16% of divergence was contributed by four major characters *i.e.* leaf length, pod beak length, pod length and average pod weight. Maximum contribution towards divergence was reported in pod length and number of pods per plant which coincides with present findings by Chaitanya *et al*. (2013) [1]. On the other hand remaining nineteen traits altogether contributed to genetic divergence upto 21.84%. Hence a breeder can select the parents from different clusters based upon the inter -cluster distance as well as analysing the percentage contribution done towards genetic divergence.

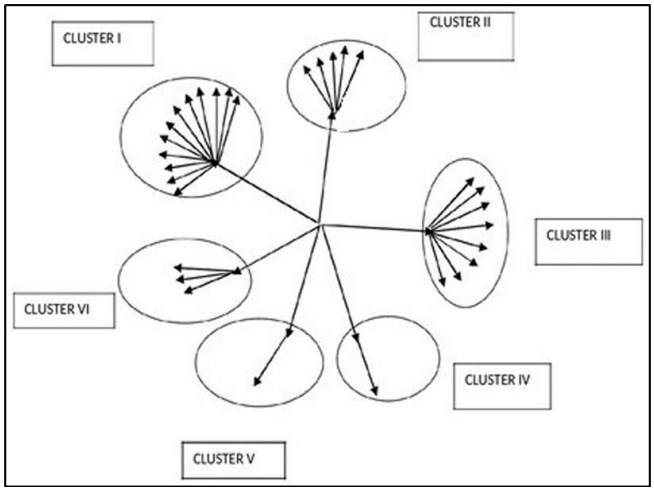

Fig 1: Clustering pattern of dolichos bean genotypes

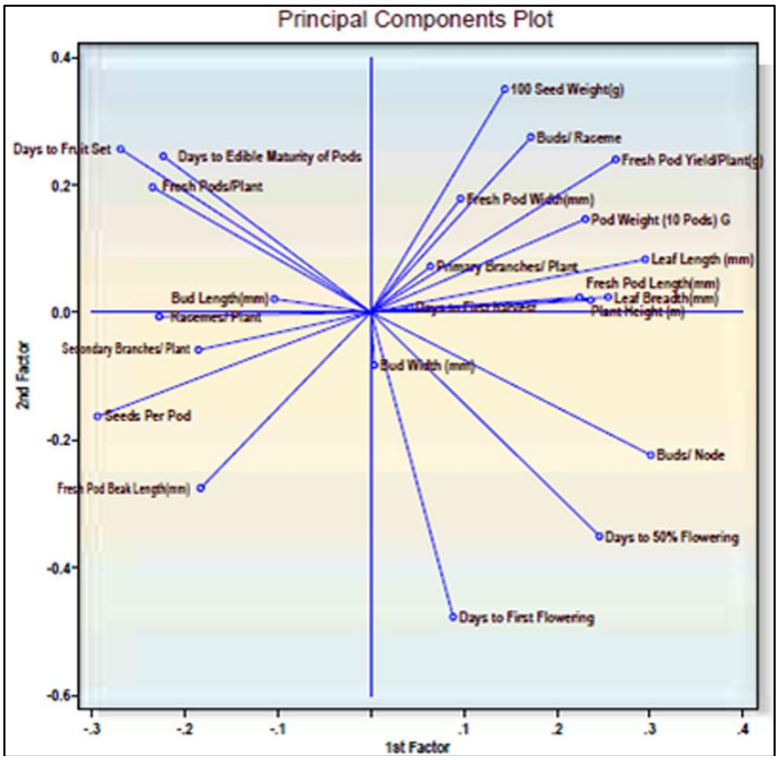

Fig 2: Principal Component Analysis Plot

Table 1: Clustering pattern of dolichos bean genotypes

Cluster	Number of dolichos	Name of genotypes
No.	bean genotypes	
I	12	IIHR-B-DB-25, IIHR-B-DB-29, IIHR-B-DB-30, IIHR-
		B-DB-36, IIHR-B-DB-46, IIHR-B-DB-49, IIHR-B-
		DB-51, IIHR-B-DB-53, IIHR-B-DB-63, IIHR-B-DB-
		65, IIHR-B-DB-112, IIHR-B-DB-115
II	5	IIHR-B-DB-20, IIHR-B-DB-27, IIHR-B-DB-34, IIHR-
		B-DB-40, IIHR-B-DB-58
III	8	IIHR-B-DB-13, IIHR-B-DB-15, IIHR-B-DB-18, IIHR-
		B-DB-28, IIHR-B-DB-31, IIHR-B-DB-109, Arka
		Swagat, Swarna Rituvar
IV	1	IIHR-B-DB-57
V	1	IIHR-B-DB-2
VI	3	IIHR-B-DB-8, IIHR-B-DB-11, IIHR-B-DB-21

Table 2: Average intra cluster and inter cluster (D^2) values in dolichos bean genotypes

	I	II	III	IV	V	VI
I	168.15	454.01	509.09	352.66	1282.55	1469.36
II		232.32	649.67	466.76	543.94	998.93
III			423.49	609.54	1174.44	1191.02
IV				0.00	1488.28	1799.96
V					0.00	555.81
VI						539.77

Table 3: Mean cluster values for twenty-three quantitative characters of genotypes in dolichos bean

	LL (mm)	LB (mm)	NPB	NSP	PH (m)	DFF	DPF	NRP	NBN	NBR	BW (mm)	BL (mm)	DFS	DFH	DEM	PBL (mm)	PL (mm)	PW (mm)	NSP	NPP	SW (g)	APW (g)	PYP (g)
I	75.87	74.77	2.92	3.75	5.49	107.14	135.47	12.81	3.92	32.58	0.56	1.53	137.53	165.61	165.64	5.07	87.32	15.96	4.86	50.08	31.33	39.99	220.61
II	97.96	94.31	3.20	4.20	5.56	106.67	137.40	12.67	4.20	34.93	0.67	1.42	134.40	159.33	159.53	4.86	115.51	17.97	5.40	55.00	35.47	44.57	271.73
III	81.21	80.14	3.25	3.75	5.77	88.58	114.58	13.21	4.17	35.17	0.76	1.63	119.83	147.96	148.33	2.05	86.91	19.97	4.96	72.04	37.72	49.28	463.96
IV	80.09	81.55	3.00	4.67	4.60	67.00	84.33	13.33	3.00	30.67	0.50	1.27	93.33	122.00	122.00	5.25	113.78	13.26	5.67	40.00	30.59	58.46	295.00
V	127.17	110.74	4.00	4.00	11.53	132.00	156.33	13.33	6.67	66.67	0.78	1.39	163.00	190.33	190.33	3.29	110.97	19.00	5.33	77.33	24.50	41.78	396.67
VI	107.20	94.61	3.89	4.11	7.46	121.67	162.67	15.22	5.22	51.33	0.63	1.52	149.11	178.00	178.00	2.13	101.74	32.60	5.33	79.67	44.89	96.18	763.56

Note: LL: Leaf length, **LB:** Leaf breadth, **NPB:** Number of primary branches, **NSB:** Number of secondary branches, **PH:** Plant height, **DFF:** Days to first flowering, **DPF:** Days to 50% flowering, **NRP:** Number of racemes per plant, **NBN:** Number of buds per node, **NBR:** Number of buds per raceme, **BW:** Bud width, **BL:** Bud length**, DFS:** Days to fruit set, **DFH:** Days to first harvest, **DEM:** Days to edible maturity, **PBL:** Pod beak length, **PL:** Pod length, **PW:** Pod width, **NSP:** Number of seeds per pod, **NPP:** Number of pods per pod, **SW:** 100 seed weight, **APW:** Average pod weight of 10 pods, **PYP:** Pod yield per plant

Table 4: The first six principal components of 23 quantitative traits, Eigen value, % variance and cumulative% variance:

Characters	PC1	PC2	PC3	PC4	PC5	PC6
LL (mm)	0.295	0.083	0.097	0.085	0.232	0.056
LB(mm)	0.255	0.024	0.169	0.341	-0.042	-0.033
NPB	0.064	0.072	-0.388	-0.302	0.199	0.087
NSB	-0.185	-0.059	-0.044	-0.145	0.245	0.411
PH (m)	0.236	0.019	-0.147	0.175	0.280	-0.206
DFF	0.089	-0.478	-0.192	-0.035	-0.217	0.041
DPF	0.246	-0.351	-0.133	-0.050	-0.049	0.067
NRP	-0.228	-0.007	-0.185	-0.349	-0.198	-0.003
NBN	0.301	-0.224	-0.079	0.051	0.042	0.016
NBR	0.172	0.274	0.078	-0.208	0.441	0.017
BW(mm)	0.004	-0.083	-0.232	0.449	-0.154	0.434
BL(mm)	-0.104	0.021	-0.428	0.073	0.233	0.121
DFS	-0.223	0.245	-0.015	0.283	0.135	-0.194
DFH	0.042	0.007	-0.428	0.272	0.269	0.067
DEM	-0.269	0.256	-0.039	0.240	-0.031	0.085
PBL(mm)	-0.183	-0.276	0.261	0.019	0.342	-0.031
PL(mm)	0.224	0.024	0.245	-0.086	0.145	0.392
PW(mm)	0.097	0.178	-0.340	-0.028	-0.141	-0.437
NSP	-0.294	-0.163	0.044	0.113	0.031	0.071
NPP	-0.235	0.196	-0.078	-0.163	-0.044	0.257
SW(g)	0.144	0.350	0.026	0.143	-0.332	0.241
APW(g)	0.231	0.146	-0.112	-0.260	-0.088	0.054
PYP(g)	0.264	0.240	0.001	-0.085	-0.181	0.201
Eigen Value (Root)	8.692	3.114	2.950	2.411	1.395	1.186
% Variance	37.793	13.539	12.826	10.483	6.064	5.156
Cumulative Variance%	37.793	51.332	64.158	74.641	80.705	85.861

Note: Abbreviations as per given under Table 3

Table 5: Relative contribution of different characters to genetic divergence of genotypes in dolichos bean

Character	Times ranked 1st	% contribution
LL(mm)	67	15.40%
LB(mm)	9	2.07%
NBP	0	0.00%
NSB	0	0.00%
PH(m)	1	0.23%
DFF	17	3.91%
DPF	14	3.22%
NRP	0	0.00%
NBN	0	0.00%
NBR	0	0.00%
BW(mm)	1	0.23%
BL(mm)	3	0.69%
DFS	0	0.00%
DFH	0	0.00%
DEM	0	0.00%
PBL(mm)	115	26.44%
PL(mm)	109	25.06%
PW(mm)	14	3.22%
NSP	0	0.00%
NPP	26	5.98%
SW(g)	1	0.23%
APW(g)	49	11.26%
PYP(g)	9	2.07%

Note: Abbreviations as per given under Table 3

Conclusion

The genotypes of dolichos bean exhibited an immense range of variability among the widely categorised traits investigated under the trial. The genotypes among most diversed clusters can be utilized to create variations under crop improvement programme. In the present study, fresh pod yield per plant, average pod weight and 100 seed weight were the main components of yield pod beak length and pod length contributed highest towards the divergence study in dolichos bean.

References

1. Chaitanya V, Reddy RVSK, Kumar Arun P. Variability, heritability and genetic advance in indigenous dolichos bean (*Dolichos lablab* L.var *typicus*) genotypes. Plant Archives. 2013; 14(1):503-506.
2. Ganesh BN. Genetic variability and divergence studies by D^2 statistics and RAPD analysis in field bean (*Lablab purpureus* L. Sweet). M. Sc. (Agri.) Thesis, Acharya N. G. Ranga Agricultural University, (A.P.), 2005.
3. Golani IJ, Mehta DR, Naliyandhara P, Kanzariya MV. Genetic variability, correlation and path analysis for green pod yield and its characters in Hyacinth bean. Orissa journal of Horticulture. 2007; 35(1):71-75.
4. Mahalanobis PC. On the need for standardisation in measurements on the living. *Biometrika*. 1936; 20:1-31.
5. Maass BL, Knox MR, Venkatesh SC, Angessa TT, Ramme S, Pengelly BC. *Lablab purpureus* – A crop lost for Africa. Tropical Plant Biology. 2010; 3:123-135.
6. Nandi A, Tripathi P, Lenka D. Genetic divergence in hyacinth bean (*Dolichos lablab*). Indian Journal of Agricultural Science. 2000; 70(7)**:**450-451.
7. Savitha BN. Characterisation of avare (*Lablab pupureus* L. Sweet) local collections for genetic variability. M.Sc. (Agri.) Thesis, University of Agricultural Science, Bangalore (India), 2008.
8. Singh D, Mishra AK. Studies on genetic divergence in pea (*Pisum sativum* L.). Agricultural Science Digest. 2008; 28(1):77-78.